1 - 1969 *R. Ruffini and S. Bonazzola.*

Systems of Self-Gravitating Particles in General Relativity and the Concept of an Equation of

A method of self--consistent fields is used to study the equilibrium configurations of a system of self--gravitating scalar bosons of spin--1/2 fermions in the grounds state without using the traditional perfect-fluid approximation or equation of state. The many--particle system is described by a second--quantized free field, which in the boson case satisfies the Lein--Gordon equation in general relativity, $\nabla_\alpha \nabla^\alpha\phi =\mu^2\phi$, and in the fermion case the Dirac equation in general relativity $\Upsilon_\alpha \nabla^\alpha \psi = \mu \psi $(where $\mu = mc/h$). The coe~cients of the metric $\delta \alpha \beta$ are determined by the Einstein equations with a source term given by the mean value $\langle \phi \vert\tau_\mu\nu\vert \phi \langle$ of the energy--momentum tensor operator constructed from the scalar or the spinor field. The state vector $\langle \phi\vert$ corresponds to the ground state of the system of many particles. In both cases, for completeness, a nonrelativistic Newtonian approximation is developed, and the corrections due to special and general relativity explicitly are pointed out. For N bosons, both in the region of validity of the Newtonian treatment (density from 10^-80 to 10^54gcm^-3, and number of particles from 10 to 10^40) as well as in the relativistic region (density $\sim 10^54gcm^-3$, number of particles $\sim 10^40$, we obtain results completely different from those of a traditional fluid analysis. The energy--momentum tensor is anisotropic. A critical mass is found for s system of $N \sim $[(Planck mass)/m]$^2\sim 10^40$ (for $m \sim 10^-25$) self--gravitating bosons in the ground state, above which mass gravitational collapse occurs. For N fermions, the binding energy of typical particles is $G^2m^5N^4/3 \hbar^-2$ and reaches a value $\sim mc^2$ for $N \sim N_crit \sim$ [(Planckmass)/m]$^3 \sim 10^57$ for $m \sim 10^-24$ g, implying mass $\sim 10^33$ g, radius $\sim 10^6$ cm, density $\sim 10^19g/cm^3$. For densities of this order of magnitude and greater, we have given the full self--consistent relativistic treatment. It shows that the concept of an equation of state makes sense only up to $10^42 g/cm^3$, and it confirms the Oppenheimer--Volkoff treatment in extremely good approximation. There exists a gravitational spin--orbit coupling, but its magnitude is generany negligible. The problem of an elementary scalar particle held together only by its gravitational field is meaningless in this context. $$N_crit \sim [Planck mass/m]^2$$ while for N fermions: $$N_crit \sim [Planck mass/m]^3.$$

Reference ***Physical Review 187,1767-1783 (1969).***

2 - 1969 *A. Ferrari and R. Ruffini.*

Theoretical Implications of the Second Time Derivative of the Pulsar NP0532

Even in the early days of Pulsar Astrophysics it became clear that much information could be gained on the nature of these objects by analysing the change of their period. In particular, quite apart from sudden changes in the pulsar period ("glitches"), an analysis of the second derivative with respect to time of the pulsar period could give important information on the breaking mechanism of the rotating neutron star. In this work, which uses techniques of a low velocity approximation of relativistic theories, an analysis is made of the emission of gravitational radiation from rotating neutron star as being the possible consequence of asymmetries in the equatorial plane. The results from breaking are due to gravitational radiation and from breaking due to electromagnetic radiation from an offaxis magnetic field are compared and contrasted. Suggestions are also made for estimating the possibk lifetime of the Pulsar. We were able to confront these theoretical predictions with the results of Pulsar Timing. These results have allowed us to impose limits on the eccentricities of neutron stars in pulsars.

Reference ***Astrophys. J. Letters158, L71(1969)***

3 - 1970 *R. B. Partridge and R. Ruffini.*

Gravitational Waves and a Search for the Associated Microwave Radiation.

We discuss astronomical sources which might produce the pulses of gravitational waves reported by Weber (3). A fraction of the energy emitted by such sources may emerge as electromagnetic pulses associated with the reported gravitational events. We observe the galactic center at a favorable microwave frequency, 19 GHz. The directional sensitivity of Weber's detector (given below) is a maximum during our observing period, allowing a direct comparison between our data and his. If positive correlations are found, the propagation velocity of gravitational waves can be determined to one part in 10^11.

Reference ***Gravity Research Foundation. Third Award. 12pp. 1970.***

4 - 1970 *R. Ruffini.*

Gravitational Waves.

In this section, following an invited talk by J. Weber, Ruffini critically analyzed the energy problem connected with the explanation of Weber's events as being due to gravitational radiation bursts. This talk was based mainly on the theoretical work of Ruffini and Wheeler, leading for the first time to a rigorous analysis of gravitational wave detectors and their estimated cross--section.

Reference ***Invited talk, 30 minutes, Particle and Field Section of the American Physical Society, Austin, Tx. 5.XI. 1970.***

5 - 1971 *Remo Ruffini*

Relativistic Cosmology and Space Platforms.

Einstein's standard 1915 general relativity or geometrodynamics introduces a new dynamic participant on the scene of physics: geometry. Nowhere did the dynamics of geometry originally show up more impressively than in the expansion of the Universe. Today the role of curved space geometry, both static and dynamic, lends itself to investigation from space platforms or from the ground. or both, in many other contexts. Among those discussed here are: properties of a superdense or neutron star; pulsar physics; collapse of a star with big dense core to a superdense star in a supernova event or complete collapse to a black hole; physics of the black hole; galactic centers, jets, and quasi--stellar sources; gravitational radiation; Misner's mixmaster model of the universe; the primordial fireball radiation; the time--scale of the expansion of the Universe; the Universe as a lens, magnifying the apparent diameter of a far--away galaxy; the mystery of the missing matter; the formation of galaxies; reaching out via radiation receivers for more information on the physics of these phenomena; and finally the solar system itself as a testing ground for relativity including the traditional three tests of relativity; the retardation of light as it passes close to the Sun on its way to Venus and back; relativistic effects in planetary motion and searches via corner reflectors on the Moon for relativistic effects in the motion of the Moon, as predicted by Baierlein.

Reference ***Institute for Advanced Study, Princeton, New Jersey and John--Archibald Wheeler--Joseph Henry Laboratories, Princeton University, Princeton, New Jersey. ESRO Pub., A.F. Moore and V. Hardy. 1971.***

6 - 1971 *R. Ruffini.*

Sources of Gravitational Radiation.

This was the first invited talk given by R. Ruffini, and was presented at a meeting of the American Physical Society. During this meeting, W.O. Hamilton of Louisiana State University and W.M. Fairbank of Stanford University presented the research program for the super--cooled gravitational waves antenna. In his talk, Ruffini presented the first evidence for the possibility of detecting a large amount of gravitational radiation from material accelerated in the field of collapsed objects. This research program was developed and presented by him and his students and collaborators in further papers.

Reference ***Invited talk, 30 minutes. New Orleans meeting of the American Physical Society.***

7 - 1971 *C.E. Rhoades, Jr. and R. Ruffini.*

Hagedorn Equation of State in Neutron Stars.

At a density of 5 x 10 gr/cm neutron star matter can be described by a system of three non--interacting degenerate gasses: electrons, protons, and neutrons. At densities 10 gr/cm and greater, strong interactions between particles can make significant contributions. At densities of 10 gr/cm, the production of new particles and resonances has to be taken into account. Under these conditions the equation of state proposed by Hagedorn, applies. In this work Rhoades (a graduate student of Ruffini's) and Ruffini have analyzed the effects of this equation of state in the computation of the equilibrium configuration of a neutron star. The authors, were able for the first time, to point out both the new effects of the "softening" of the equation of state towards high densities and the "saturation" of the value of the mass of the neutron star as a function of its central density, and as a consequence of the generation of the particles and resonances. A critical analysis of these results together with a study of the physical reasons originating from these results were presented by C. Rhoades in his doctoral thesis at Princeton University (advisor was R. Ruffini) and by R. Ruffini in his Les Houches lectures (see further).

Reference ***Astrophysical Journal Letters, 163, L83 . 1971***

8 - 1971 *R. Ruffini.*

Emission of Gravitational Waves from the Pulsar. In the Crab Nebula.

In this talk, given at the International Astronomical Union meeting held in Manchester in 1971, the author pointed out the relevance of the classical analysis of McLaurin, Poincare, Darwin, Jacobi and Jeans on the configuration of rotating fluid masses for the emission of gravitational radiation. Together with numerical estimates of the strength of the emitted radiation, the author presented evidence for the possibility of obtaining information on the internal structure of the neutron star from the existence of a large emission of gravitational radiation. The "signature" of the gravitational radiation emitted in these processes was also examined.

Reference ***Davies and Smith eds. H. Reidel. 1971***

9 - 1971 *R. Ruffini.*

Gravitational Collapse and Gravitational Radiation.

In this talk theoretical arguments were presented, which lead to the conclusion that the process of gravitational collapse is the only realistic source of conceivably detectable signals of gravitational radiation.

Reference ***Invited talk, 40 minutes delivered at the International Astronomical Union general assembly in Brighton, England. 1971.***

10 - 1971 *R. Ruffini and J.A. Wheeler.*

Introducing the Black Hole.

This article proved to be popular and was written with the intention of communicating some of the major processes made in understanding the final configurations of collapsed stars to the largest possible audience. In this article, the authors summarized the results of their students' work with particular emphasis on the work of D. Christodoulou (graduate student of R. Ruffini's at that time) together with some of their most significant new results (see 3). Moreover, it was emphasized that of all the procedures for identifying a collapsed object in space at a great distance, the most promising consisted of analyzing a close binary system in which one member is a normal star and the other a black hole. The X--ray emission associated with the transfer of material from the normal star to the collapsed object would then be of greatest importance in determining the properties of the collapsed object. This article has been reprinted many times and has been translated into many languages (Japanese, Russian, and Greek, among others). It has created much interest in the final configuration of stars after the endpoint of their thermonuclear evolution. The analysis of the possible processes leading to the formation of a black hole, via either a one--step process of a multistep process, was also presented for the first time in this article.

Reference ***Physics Today, p. 30039. 1971.***

11 - 1971 *R. Ruffini and J.A. Wheeler.*

Gravitational Radiation.

In this paper, presented by J.A. Wheeler at the conference held by the Accademia dei Lincei in Cortona, the first detailed analysis of two separate processes of emission of gravitational radiation was given. The first process, which studied the radiation emitted by a particle "flying by" a black hole, from which "splash" radiation originates, was mainly carried out by J.A. Wheeler and was based on the corresponding work of Bohr and Fermi in the electromagnetic field. The second process, which studied the radiation emitted by a particle plunging radially into a black hole, was mainly carried out by R. Ruffini. His results were obtained by Fourier analysis with numerical techniques which are the standard equations of linearized low velocity approximation. As it was later shown, both results came within a few percent of those obtained by a fully relativistic analysis of the process. Also in this paper, the classical formula of the cross--section of a gravitational wave detector was obtained by using a formula structurall-- identical to that of Breit and Wigner. Although very compact (21 pages), this paper contains many results which became important in estimating and understanding the physical mechanisms generating gravitational radiation.

Reference ***In Atti del Convegno: The Astrophysical Aspects of the Weak Interactions. Quaderno No. 157. Accademia Nazionale dei Lincei. 1971.***

12 - 1971 *D. Christodoulou, R. Ruffini.*

Reversible Transformations of a Charged Black Hole.

A formula is derived for the mass of a black hole as a function of its "irreducible mass", its angular momentum and its charge. It is shown that 50\% of the mass of an extreme charged black hole can be converted into energy as contrasted with 29\% for an extreme rotating black hole.

Reference ***Physical Review D 4, 3552-3555. 1971.***

13 - 1971 *D. Christodoulou, R. Ruffini.*

Black Holes: The Strongest Energy Storehouse in the Universe.

Recent theoretical advances have clearly put in evidence that black holes are not only the only astrophysical objects that are fully describable by general relativity alone, but also to be the strongest storage of energy in the Universe. In this paper we give a new formula establishing for the first time the energetics limit of a black hole (50\% of the total mass energy can be extracted from a black hole!); we also give two new mechanisms of extraction of energy of unprecedented efficiency. We finally, shortly discuss the singularity problem in a realistic Black Hole.

Reference ***Essay submitted to the Gravity Research Foundation. Third prize. 1971.***

14 - 1971 *M. Davis, R. Ruffini, W.H. Press and R.H. Price.*

Gravitational Radiation from a Particle Falling Radially into a Schwarzschild Black Hole.

We have comuted the spectrum and energy of gravitational radiation from a "point test particle" of mass m falling radially into a Schwarzschild black hole of mass $M \gg m$. The total energy radiated is about 0.0104 $mc^2(m/M)$, 4 to 6 times larger than previous estimates; the energy is distributed among multipoles according to the empirical law $E_21- pole \sim (0.44m^2c^2/M)e^-21$ and the total spectrum peaks at an angular frequency $\omega = 0 .32c^3 / GM.$

Reference ***Physical Review Letters. 27, 1466-1469. 1971.***

15 - 1972 *R. Ruffini, J. Tiomno, and V.C. Vishweshvara.*

Electromagnetic Field of a Particle Moving in a Spherically Symmetric Black Hole Background.

This work gives the theoretical framework in which any electromagnetic perturbation F in a background field fixed by a Schwarzschild geometry can be expanded. The covariant maxwell equations are reduced to two linearly independent Schrodinger--like equations in the radial coordinate r. The angular dependence of the vector potential A is taken into account by expanding it in vector harmonics. The source term J is also expanded in vector harmonics and the final equations governing the evolution of this perturbation are analyzed. This work is analogous to the Regge--Wheeler--Zerilli gravitational perturbation analysis regarding electromagnetic perturbations, and gives the complete set of eigenfunctions in which an arbitrary ekctromagnetic field in the fixed Schwarzschild background can be expanded. This has generated further research and many new results, in particular, making it possible to compute the electromagnetic radiation emitted by a particle faning in a gravitational field (see further work by Ruffini). This work also represents the starting point for systematic inquires into an electromagnetic field situated in strong gravitational fields. It lead, above an, to further analyses by Zerilli, and a continued collaboration between Ruffini and Zerilli on the coupling of electromagnetic and gravitational radiation.

Reference ***Nuovo Cimento Letters, 3, 211. 1972.***

16 - 1972 *M. Davis, R. Ruffini, J. Tiomno, and F. Zerilli.*

Can Synchrotron Gravitational Radiation Exist?

A complete relativistic analysis for gravitational radiation emitted by a particle in circular orbit around a Schwarzschild black hole is presented in the Regge--Wheeler formalism. For completeness and contrast we also analyze the electropmagnetic and scalar radiation emitted by a suitably charged particle. The three radiation spectra are drastically different. We stress some important consequences and astrophysical implications.

Reference ***Physical Review Letters, 28,1352-1355. 1972.***

17 - 1972 *M. Davis, R. Ruffini, and J. Tiomno.*

Gravitational Radiation from a Particle Circling a Schwarzschild Black Hole.

Reference

18 - 1972 *J. Tiomno and R. Ruffini.*

Electromagnetic Radiation from a Particle Moving in a Spherical Symmetric Background

Reference

19 - 1972 *D. Wilkins, R. Ruffini, and L. Parker.*

Coalescence of Many Black Holes

This set of works was presented at the April 1972 meeting of the American Physical Society. It summarized much of the work completed by Ruffini together with his students (M. Davis and D. Wilkins) and collaborators (L. Parker and J. Tiomno) during the academic year 1971--1972.

Reference ***Bulletin American Physical Society, 17, 449. 1972.***

20 - 1972 *M. Davis and R. Ruffini.*

Gravitational Radiation in the Presence of a Schwarzchild Black Hole - A Boundary Value

This work is the first in a series of works completed by Ruffini together with his students (M. Davies and W. Haxton) and collaborators (F. Zerilli and J. Tiomno). Its aim is to analyze the processes of gravitational and electromagnetic radiation in extremely relativistic regimes by means of a fully relativistic analysis, starting with the Regge--Wheeler formalism. In this first work a direct integration of the Schrodinger -- like equation governing the emission of gravitational radiation was attempted, with a simultaneous search for two eigen values (phase and amplitude of the wave) in order to match the required bouindary conditions of purely outgoing waves at infinity and those at the horizon of the black hole. This work pointed out the the computations previously done by Ruffini and Wheeler in the slow motion approximation underestimated the total amouint of gravitational radiation emitted and in viewing the "global" approach followed in the solution of the problem it was possible to conclude that the amount of gravitational radiation falling inside the black hole was in fact larger that the outgoing quantity at infinity. This work clearly indicated the possiblity of reaching the explicit numerical estimate of radiation processes by means of the Regge--Wheeler--Zerilli formalism and of leading to the development of powerful computational techniques for the solution of this type of problem (see following references) .

Reference ***Nuovo Cimento Letters, Vol. 2,1165. 1972.***

21 - 1972 *M. Davis, R. Ruffini. J. Tiomno.*

Pulses of Gravitational Radiation of a Particle Falling Radially into a Schwarzschild Black Hole.

Using the Regge--Wheeler-Zerilli formalism of fully relativistic linear perturbation in the Schwarzschild metric. we analyze the radiation of a particle of mass m falling into a Schwarzschild black hole of mass $M \gg m$. The detailed shape of the pulse of the tideproducing components of the Riemann tensor at large distances from the source are given as well as the angular distribution of the radiation. Finally, the analysis of the energy going down the hole indicated the existence of a divergence; implications of this divergence as a testing ground of the approximation used are examined.

Reference ***Physical Review D 5, 2932-2935. 1972.***

22 - 1972 *R. Ruffini.*

Fully Relativistic Treatment of the Brehmstrahlung Radiation from a Charge Falling in a Strong Gravitational Field.

The details of the spectral distribution of the radiation emitted by a particle freely falling in gravitational field are given in the case of the most general static asympototically flat solution with regular horizon. No contradiction exists with the principle of equivalence. A clear enhancement of high multipoles is shown to exist.

Reference ***Physics Letters, 41B, 334. 1972.***

23 - 1973 *D. Christodoulou, R. Ruffini*

On the Electrodynamics of Collapsed Objects.

The details of the magnetic and electric field to be expected in a collapsed object nonradiative at ∞ ("Black Hole") are here given. Also given are the formulae determining the maximum total energy extractable from a collapsed object and the definition of its angular velocity as seen from infinity. Physical meaning is given to the expression of the surface area. Typical order of magnitude of the preceding quantities for collapsed objects of different masses are here estimated.

Reference ***Bulletin of the American Physical Society. Series II. 16, No. 4 612, 1971. Also reprinted (10 pages) in Black Holes, B. De Witt and C. De Witt. Eds. Gordon and Breach. 1973.***

24 - 1973 *L. Parker, R. Ruffini, and D. Wilkins.*

Metric of Two Spinning Charged Sources in Equilibrium.

Using the approach of Israel, Wilson and Perjes we give the explicit form of the metric corresponding to two identical Kerr--Newman sources in equilibrium under their mutual electromagnetic and gravitational forces, with their spins oppositely oriented along a given axis. Symmetries, the complete analytic extension, the limit of infinite separation of the sources, and the two types of solution with vanishing separation are discussed.

Reference ***Physical Review D, 7, 2874-2879,1973.***

25 - 1973 *R. Ruffini and A. Treves.*

On a Magnetized Rotating Sphere.

In this paper, the case of the most stable electromagnetic structure--associated with a rotation sphere, which has a magnetic axis aligned to the rotation axis is discussed. Using a classical (non--relativistic) model it can be shown that the configuration that minimizes the total electromagnetic energy of the system is endowed with a non zero net charge. The importance of some of the implications regarding the physics of black holes is stressed, in particular, it is suggested that the fixed value of the magnetic ratio of a Kerr black hole is a direct consequence of a minimum energy condition. This last result is of the greatest relevance, since it stresses the possibility that black holes can be found in a binary system X--ray source and that they can be endowed with an electromagnetic structure. Much research is currently being carried out by J. Wilson in conaboration with R. Ruffini at Livermore, California using a direct numerical integration of a three dimensional hydrodynamical code.

Reference ***Astrophysical Letters. 13, 109. 1973.***

26 - 1973 *R. Leach and R. Ruffini*

X-ray Sources: A Transient State from Neutron Stars to Black Holes.

The latest theoretical results are here analyzed and in the light of recent experimental discoveries the evidence is shown presented that X--ray sources and pulsars are different aspects of the same evolutionary process: gravitational collapse of a star at the endpoint of thermo--nuclear evolution. Estimates and detailed predictions for further experimental observations are given. The case is made that X--ray sources are the key objects that will (for the first time!) discriminate between a neutron star and a black hole. The importance of the X--ray sources as sources of gravitational radiation is presented.

Reference ***Gravity Research Foundation. Essay. 1973.***

27 - 1973 *R. Leach and R. Ruffini.*

On the Masses of X-ray Sources.

An analysis of X--ray sources based on the Roche model is here presented. On this basis we can conclude that pulsating sources appear to have systematically smaner masses than nonpulsating sources. We suggest identifying the first objects as neutron stars and the second as totany collapsed objects or black holes. Detailed predictions are presented. Discriminating features between neutron stars and black holes are also given.

Reference ***Astrophysical Journal Letter, 180, L15. 1973.***

28 - 1973 *M. Rees, R. Ruffini and J.A. Wheeler.*

Black Holes, Gravitational Waves and Cosmology

This book, with 329 pages of text and 80 pages of appendices, is considered tobe introduction to the field of relativistic astrophysics. It is mainly directed towards final year undergraduate and first year graduate students. The material ranges from an updated version of R. Ruffini's and J.A. Wheeler's "Cosmology from Space Platforms" to a detailed analysis of cosmology covering topics such as the expansion of the Universe, the formation of the galaxies, the cosmological black body radiation, the missing mass, the large numbers and a final run down on the current knowledge (this final section is written by J.A. Wheeler).

Reference ***ed. Gordon and Breach, London, New York, 1973. Translated into Russian by Minkievitch, ed. M. I. R. Moscow. 1973.***

29 - 1973 *G. Denardo and R. Ruffini.*

On the Energetics of Reissner-Nordstom Geometries.

We point out the existence of a generalized ergosphere in the Reissner Nortstrom geometry and we give an explicit formula to determine its range. These results are compared and contrasted with the ones obtained in the case of the Kerr solution. An explicit process of energy extraction from a Reissner Nordstrom black hole is given.

Reference ***Physics Letters B, 45, 259. 1973.***

30 - 1973 *Richard Squier Hanni, R. Ruffini.*

Lines of Force of a Point Charge Near a Schwarzschild Black Hole.

The electric field generated by a charged particle at rest near a Scwarzschild black hole is analyzed using Maxwell's equations for curved space. After genralizing the definition of the hnes of force to our curved background, we compute them numerically and graph them with the charge at $r = 4M, 3M,$ and $2.2M.$ Particular attention is paid to the behavior of the lines of force near the event horizon and the smooth transition of the electric field to that of a Reissner Nordstrom black hole.

Reference ***Physical Review D, 8, 3259-3265. 1973.***

31 - 1973 *R. Ruffini.*

Gravitational Radiation from a Mass Projected into a Schwarzschild Black Hole.

Gravitational radiation emitted by a particle projected with nonzero kinetic energy from infinite distance into a Schwarzschild black hole is examined. Direct comparison between a semirelativistic approach and the fully relativistic approach in the Regge--Wheeler--Zerilli formalism gives an insight into the nature of the results. Detailed spectral distributions are given. Contrary to the case in which the particle falls in with zero kinetic energy, the spectrum does not vanish any more at low frequencies and a considerably larger amount of radiation is emitted.

Reference ***Phvsical Review D 7, 972-976. 1973.***

32 - 1973 *R. Ruffini.*

On the Energetics of Black Holes.

This was the nrst time such a large effort had been made to present a complete set of lectures on some of the basic aspects controlling the energetics of black hole physics. The lectures comprise four chapters and eighteen appendices. In chapter one, a full survey on the physics of neutron stars is made, with a detailed analysis of the physical reasons leading to inevitable gravitational collapse. In chapter two, the electromagnetic perturbation in a fixed background is presented, together with details of the numerical techniques used in the numerical integration of the Schrodinger--like equations governing the radiation processes. In chapter three, the gravitational perturbations and processes of emission of gravitational radiation are described, including all technical details. A special mention is made of the analysis of the distinguishing features of gravitational radiation signals (polarization and spectrum). Finally, chapter four presents the energetics of black holes, mentioning in particular the mass formula of black holes and the energy extraction processes.

Reference ***Lectures delivered at the Les Houches Summer School.In "Black Holes". Carter, Hawking, Bardeen, Throne, Novikov, Ruffini. Editors B. De Witt and C. De Witt. Gordon and Breach, 1973.***

33 - 1973 *P.L. Bernacca, G. Canton, F. Ciatti, S. D'Odorico, R. Stagni, S. Leschiutta, R. Ruffini, G. Sedmak and A. Treves.*

High Time-Resolution Optical Monitoring of Periodic and Transient-like Phenomena. A Research Project.

The only reason for inserting this work in the publication list is that it represents the accomplishment of a large organizational effort, started by Bernacca and Ruffini, that was directed towards the application of a system for observing pulsar--like phenomena in the optical, using the Astronomical Observatory of Asiago. This program has been started and is currently making important contributions to optical observations of binary X--ray sources .

Reference ***Nota interna dell'Osservatorio di Asiago.***

34 - 1973 *R. Ruffini.*

Neutron Stars and Black Holes in our Galaxy.

This paper is based on the invited 1972 Joseph Henry Lecture of the Philosophical Society of Washington, which was delivered by Ruffini at the Cosmos Club on the 12th of May 19,2. It received the Annual Cressy Morrison Award in Natural Science for 1972 from the New York Academy of Sciences.

Reference ***Transactions of the New York Academy of Science Series II. Volume 35, No. 3, pp. 196-226. Marche, 1973.***

35 - 1973 *R. Ruffini.*

Relatività Generale e Fisica della Galassia.

This paper was written for the Italian Encyclopedia of Science in order to explain to a large number of readers the great progress made in both the theoretical and experimental field of relativistic Astrophysics. A systematic survey of the major progress made in the classical testa for general relativity, as well as in the new test for leme thining effects in space technology, is presented. A section on the fundamental theoretical aspects of the physical of neutron stars and black holes is followed by a revies of the results of X--ray observations from the Uhuru satellite. Finally, the prospects for detecting gravitational radiation are discussed. A complete bibliography is also given.

Reference ***Enciclopedia della Scienza e della Tecnica Mondadori. Milano, 1973, 25 pages.***

36 - 1973 *R. Ruffini.*

Neutron Stars and Black Holes in our Galaxy.

This invited talk was delivered at a meeting in New York of the American Physical Society, and it is estimated that about 6,000 physicists attended. The evidence for identifying Cygnus XI as a black hole was summarized and the experimental evidence supporting the classification of binary X--ray sources advanced by Leach and Ruffini was discussed. Some of the major electromagnetic and energy properties of black holes discovered through the work of Ruffini and his students and conaborators were presented. Ruffini stated that:"since the discovery by Hubble of the expansion of the Universe, the observation of X-ray sources can be considered the greatest and most dramatic breakthrough in experimental relativity.

Reference ***Invited talk delivered at the New York meeting of the American Physical Society (40 minutes). Bulletin of the American Physical Society, 18,109,. 1973.***

37 - 1973 *R.A. Breuer, R. Ruffini, J. Tiomno, C.V. Vishveshwara.*

Vector and Tensor Radiation from Schwarzschild Relativistic Circular Geodesics.

For the case of high multiples we give an analytic form of the spectrum of gravitational and electromagnetic radiation produced by a particle in a highly relativistic orbit $r_0 =(3 + \delta) M $ around a Schwarzschild blacck hole of mass M. The general dependence of the power spectrum on the frequency in an three spin cases (s=O) for scalar, s=l for vector, and s=2 for tensor fields) are summarized by power $P \propto \omega^1-s \exp ("2\omega/\omega_crit)$. Although they havo the common feature of an exponential cutoff above a certain frequency $\omega_crit = (4/\pi\delta) \omega_)$, where ω_0 is the frequency of the orbit, the tensor case has a much broader frequency spectrurn than scalar or vector radiation.

Reference ***Physical Review D, 7,1002-1007. 1973.***

38 - 1973 *M. Johnston, R. Ruffini, F. Zerilli.*

Gravitationally Induced Electromagnetic Radiation.

A fully relativistic treatment is given to analyze the electromagnetic radiation induced by gravitational perturbations in extreme relativistic regions. For the sake of clarity, results are presented here for the simplest possible example: an uncharged mass m faning radiany into a field of a Reissner--Nordstrom solution. Explicit results governing the energetics of the process are found. The amount of the electromagnetic radiation radiated can be of the order of magnitude of the gravitational one.

Reference ***Physical Review Letters, 31, 1317-1319, 1973.***

39 - 1973 *R. Ruffini, J. Wilson.*

Possibility of Neutrino Emission from Matter Accreting into a Neutron Star.

We analyze the possiblility of neutrino enlission from matter accreting into a neutronstar member of a binary X--ray source. Estimates of the expected fluxes and neutrino energy are given for selected values of the accretion rate under the asumption that the neutrino production is mainly due to the reaction $\gamma \leftrightarrow e^- + e^+ \rightarrow v_e + \bar v_e$.

Reference ***Physical Review Letters, 31, 1362-1364. 1973.***

40 - 1974 *C. Rhoades, Jr. and R. Ruffini.*

Maximum Mass of a Neutron Star.

On the basis of Einstein's theory of relativity, the principle of causality, and Le Chatelier's principle, it is here extablished that the maximum mass of the equilibrium configuration of a neutron star cannot be larger than 3.2$M_\odot$. The extremal principle given here applies as well when theequation of state of matter is unknown in a limited range of densities. The absolute maximum mass of a neutron star provides a decisive method of observationally distinguishing neutron stars from black holes.

Reference ***Physical Review Letters, 32, 324-327 (1974)***

41 - 1974 *M. Johnston, R. Ruffini, M. Peterson.*

On the Solution of the Equations Governing the Coupled Emission of Gravitational and Electromagnetic Radiation.

In this paper, some of the mathematical question encountered in solving the coupled system of equations governing the interaction between electromagnetic and gravitational radiation are examined. Iteration procedures, based on a generalization of Green's function technique, which Ruffini and his students used, is applied to this more colplex case, in which the presence of "feed--back" terms is essential for interpreting the results. The numencal method presented in this paper can be applied to each and aL of the systems of equations of the kind considered here, and has remarkable properties of fast convergence.

Reference ***Nuovo Cimento Letters. 9, 217. 1974.***

42 - 1974 *G. Denardo, L. Hively, and R. Ruffini.*

On the Generalized Ergosphere of the Kerr-Newman Geometry

The formula for the size at the generalized ergosphere given by Denardo and Ruffini for the Reissner--Nordstrom metric is shown to apply in complete generality to the case of any black hole. The structure of the ergosurface is discussed and analytic formulae are given for various asympototic limits.

Reference ***Physics Letters B, 50, 270, 1974.***

43 - 1974 *M. Johnston, R. Ruffini, and F. Zerilli.*

Electromagnetically Induced Gravitational Radiation.

Using a general relativistic treatment we have analyzed the coupled emission of gravitational and electromagnetic radiation in tile simplest possiible radiation process: a massive charged particle falling radially into a Reissner--Nordstrom geometry. Particular attention is given to a detailed analysis of the "feedback": terms between gravitational and electromagnetic radiation.

Reference ***Physics Letters B, 49, 185. 1974.***

44 - 1974 *R. Ruffini*

Neutron Stars, Black Holes and Binary X-ray Sources.

In this detailed report of 75 printed pages, the theoretical aspects of gravitationany collapsed objects relecant to the physics of binary X-ray sources are reviewed with particular emphasis on the physical processes occurring in the field of black holes. This article summarizes much of the theoretical work on conapsed objects carried out by Ruffini and his students during the acadmeic year 1972--1973 at both Princeton University and Stanford University, while on leave. In both this talk and one given later at a meeting in San Francisco of the American Association for the Advancement of Science, the main issues concerning neutron stars and black holes and the latest prospects for experimental detection of gravitational radiation were discussed, and further clarification by future theoretical and experimental analysis was recommended.

Reference ***Talk given at the 19/3 Solvay Meeting on "Astrophysics and Gravitation". Proceeding of the Sixteenth Solvay Conference on Physics at the University of Bruxelles, September, 1973. Editions de l'Universite' de Bruxelles. pp. 394-424. 1974.***

45 - 1974 *M. Johnston and R. Ruffini.*

Generalized Wilkins Effect and Selected Orbits in a Kerr-Newman Geometry.

Wilkins has pointed out that, in addition to the periodicities associated with circular orbits in the equatorial plane of a Kerr geometry, there exist periodicities connected with the longitudinal motion of particles. We extend this result ot spherical orbits of charged particles in a Kerr-Newman geometry. We give explicit examples of nonspherical orbits, illustrating dragging of inertial frames and these longitudinal periodicities. The relevance of these results for the physics of collapsed objects is discussed.

Reference ***Physical Review D, 10, 2324-2329. 1974.***

46 - 1974 *H. Ohanian and R. Ruffini.*

Quantum-Mechanical Uncertainties in the Measurement of Mass, Charge, Spin, and Multipole Moments of a Black Hole.

By considering a set of gedanken experiments we show how quantum mechanics imposes uncertainties of the mass, charge, spin, and multipole moments of a black hole. In the case of mass and charge the only limitations on the precision of the measurement arises from the size of the universe. However, in the case of the spin the limitations on the measurability arises from the intrinsic properties (horizon) of the black hole. The uncertainty in the spin is always larger than $\hbar/2$. It is shown how the mass, charge and spin of the black hole have to be considered as purely classical parameters deprived of any quantum property.

Reference ***Physical Review D, 10, 3903-3905. 1974.***

47 - 1974 *R. Ruffini.*

What are We Learning from X-ray Sources.

This talk was given at the annual meeting in Chicago in one of the most highly attended sections, namely, "New Physics in Galaxies". The abstract of Ruffini's talk was entitled "The Impact of X--ray Astronomy", an area of research unprecedented in the field of Astrophysics, which has enabled us, in a few years, to gain a deep knowledge of the latest stages in the evolution of stars in our galaxy. Moreover, information on the X-ray background gives new and important information on the structure and clusters of galaxies. From a purely theoretical view, the physics of collapsed objects has become one of the leading and most important topics of experimental Astrophysics. The experimental results obtained from objects ranging from neutron stars to black holes agree with some of the most advanced theoretical predictions. It also seems that in the near future we shan be able to detect "the moment of gravitational collapse". In this talk great emphasis was placed on the study and analysis of short time variations in the X--ray signals, and on time scales to the order of a millisecond, such as with Cygnus XI.

Reference ***Invited talk (30 minutes) given at the annual meeting of the American Physical Society, Chicago, February 4. 1974. American Physical Society Bulletin, 19, 28. 1974.***

48 - 1974 *R. Ruffini.*

On the Coupling of Electromagnetic and Gravitational Radiation

Reference

49 - 1974 *M. Johnston and R. Ruffini.*

Emission of Gravitational and Electromagnetic Radiation from Ultrardativistic Circular Orbits

Reference

50 - 1974 *W. Haxton and R. Ruffini.*

On Some Absorption and Defocusing Effects of Schwarzschild Black Holes

Reference

51 - 1974 *M. Peterson and R. Ruffini.*

On the Solution of the Equation Governing General Perturbation in Stationary Geometry

Reference

52 - 1974 *N. DerueLe and R. Ruffini.*

Gravitational Bounded States of the Klein Gordon Equation in Stationary Geometries

Reference

53 - 1974 *H.C. Ohanian and R. Ruffini.*

Uncertainties in the Measurement of Quantum Numbers of Black Holes

Reference

54 - 1974 *L. Pietronero and R. Ruffini.*

On Some Inequalities Governing the Critical Masses of Neutron Stars

Reference

55 - 1974 *R. Leach and R. Ruffini.*

Collapsed Objects in Binary X-ray Sources

Reference

56 - 1974 *K. Baker and R. Ruffini.*

Theoretical Implications of the First Derivative of the Periods in Binary X-ray Sources

Reference

57 - 1974 *R. Jantzen, M. Jolmston, and R. Ruffini.*

Spatially Homogeneous World Models with Rotation

This section of the A.P.S. chaired by S. Chandrasekhar, concentrated on the work of Ruffini's students cnd collaborators. It summarizes much of the work during the acadmeic year 1973--1974, bGth at Princeton and Stanford Universities.

Reference ***In the Bulletin of the American Physical Society. 19, 94. 1974***

58 - 1974 *R. Ruffini.*

The Physics of Collapsed Objects.

At the annual meeting of the A.A.A.S. an entire section was organized by R. Ruffini and H. Gursky, entitled "Neutron Stars and Black Holes in the Universe". The experimental aspects were presented by H. Gursky and the theoretical by R. Ruffini. In the final written version (150 typewritten pages) Ruffini traces the essential physical principles governing the late evolution of stars. Emphasis is placed on the fact that knowledge can still be gained from directly observing the process of gravitational collapse. This article, with a bibliography of more than one hundred references, completely reviews this field of research and indicates possible future developments.

Reference ***Invited talk (30 minutes) delivered at the 140th annual meeting of the American Association for the Advancement of Science in San Francisco, March, 1974.***

59 - 1974 *N. Deruelle and R. Ruffini.*

Quantum and Classical Relativistic Energy States in Stationary Geometries.

The positive and negative root states ($E^+, E^- $) for a particle moving along a geodesic in a stationary background, introduced by Christodoulou and Ruffini, are here interpreted in the framework of a relativistic quantum field theory. It is shown how E^+ and E^- have to be considered as the classical correspondent of the postive energy states of a quantized field. It is explicitely shown that crossing between the states E^+ and E^- can occur and consequently the necessary condition for particle creation as given by Klein,Sauter, Heisenberg, and Euler can be encountered.

Reference ***Physics Letters, 52B, 437. 1974.***

60 - 1974 *T. Damour and R. Ruffini*

Sur Certains Verifications Nouvenes de la Relativite' Generale Rendues Possibiles par la Decouvert d'un Pulsar Membre d'un Systeme Binaire.

This article followed shortly after the discovery by J.H. Taylor of a binary pulsar, and offered some new possibilities for testing Einstein's theory of general relativity. An explicit evaluation is given of the Doppler and gravitational shifts to be expected in the pulsar period, as well as the magnitude of the periastron precession. A detailed explanation of how this system provides favorable conditions for measuring the gravitational spin--orbit coupling of the neutron star is given. The observation of this effect is not only a crucial test for general relativity, but also offers the possibilty of analyzing many properties of neutron stars and their beaming, which is due to the precession induced by the spin-orbit coupling.

Reference ***Comptes rendues de l'Academie des Sciences de Paris. Series A 917, 1974, 2e Semestre.***

61 - 1974 *R. Ruffini.*

Astrophysics and Elementary Particle Physics.

Recent developments of relativistic astrophysics allow the observation of regimes in which all existing field theories have never been tested. In the description of these regimes, unreachable in any experiment performed in a laboratory on the Earch, our current knowledge of electrodynamics or elementary particle physics has to be extrapolated by many orders of magnitude. For the first time, we are able to observe phenomena in which fully relativistic treatment of gravitational interactions is mandatory.

Reference ***Invited taLk delivered at the International Accelerator Conference, Stanford Linear Accelerator, 1974.***

62 - 1974 *R. Ruffini*

Neutron Stars, Black Holes and Binary X-ray Sources.

In this detailed report of 75 printed pages, the theoretical aspects of gravitationany collapsed objects relecant to the physics of binary X-ray sources are reviewed with particular emphasis on the physical processes occurring in the field of black holes. This article summarizes much of the theoretical work on conapsed objects carried out by Ruffini and his students during the acadmeic year 1972--1973 at both Princeton University and Stanford University, while on leave. In both this talk and one given later at a meeting in San Francisco of the American Association for the Advancement of Science, the main issues concerning neutron stars and black holes and the latest prospects for experimental detection of gravitational radiation were discussed, and further clarification by future theoretical and experimental analysis was recommended.

Reference ***Astrophysics and Gravitation, 349, 1974***

63 - 1974 *M. Rees, R. Ruffini and J.A. Wheeler.*

Black Holes, Gravitational Waves and Cosmology: an introduction to current research

Reference ***Astrophysics and Space Physics, Vol. 10, 182, 1974***

64 - 1975 *P. Mc Guire and R. Ruffini.*

Metric of Two Spinning Charged Sources with Taub-Newman-Unit-Tamburino Parameter

Following the approach of Israel and Wilson and Perjés we give the explicit from of the metric corresponding to two Kerr-Newman sources in equilibrium endowed with opposite values of the Taub-Newman-Tamburino-Unti parameters. The two solutions have equally and oppositely directed spin vectors. The explicit structure of the electromagnetic fields is given for the case where the two sources are separate, and in the limit their separation goes to zero (coalescence). The asymptotic form of the metric is regular for r-->+ [infinity] ; and when the separation of the two solutions is not zero the electromagnetic field asymptotically approaches an electric monopole and a magnetic dipole field.

Reference ***Physical Review D 12, 3026-3029 (1975)***

65 - 1975 *P. McGuire and R. Ruffini*

Some Magnetic and Electric Monopole One-Body Solutions of the Maxwen-E-instein Equations.

We examine the electromagnetic structure of a one--body solution of the coupled Einstein--Maxwell equations endowed with mass m, charge Q, specific angular momentum a and a parameter l. It is shown how the paramerter l introduced by Newman, Tamburino and Unti is realted to thee magnetic monopole charge distribution of the solution. A relation is presented between the total mass energy of the system and its irreducible mass. The total mass energy can be much smaller that the irreducible mass. A general solution characrterized by the four parameters m, Q, a and l is here introduced.

Reference ***Physical Review D, 12, 3019-3025 (1975) .***

66 - 1975 *P. Mc Guire and R. Ruffini.*

Metric of Two Spinning Charged Sources Endowed with the Newman-Tamburino-Unti Parameter.

Following the approach of Israel and Wilson and Perjes we give the explicit form of the metric corresponding to two Kerr--Newman sources in equilibrium endowed with opposite values of the Taub--Newman--Tamburino--Unti parameters. The two solutions have equally and oppositely directed spin vectors. The explicit structure of the electromagnetic fields is given for the case where the two sources are separate, and in the limit their separation goes to zero (coalescence). The asymptoic form of the metric is regular for $r \rightarrow \infty$; and when the separation of the two solutions is not zero the electromagnetic field asympototically approaches an electric monopole and a magnetic dipole field.

Reference ***Physical Review, 12, 3026. 1975.***

67 - 1975 *R. Ruffini.*

Radiation Gravitationelle.

In this article a detailed analysis is made of the present status of theoretical and experimental work on the search for gravitational radiation. After an introduction, which details the theoretical framework and cross--section of gravitational radiation detectors, and analyzes the directivity and sensitivity to polarization of existing detectors, experimentally established upper limits of gravitational radiation fluxes are analyzed. The author then emphasizes the fact that the discovery of collapsed objects in our galaxy has changed every previous estimate and expectation in this field, and that now viable processes exist for creating gravitational wave detectors fall about 10 below the theoretically required sensitivity. The author summarizes the progress made in constructing a new family of super--cooled detectors.

Reference ***La Recherche. 61, 908. 1975.***

68 - 1975 *R. Ruffini.*

Black Holes

This talk was given to an audience consisting mainly of elementary particle theorists and experimentalists. After presenting the recent progress on the observation and theory of binary X--ray sources, the talk was mainly directed towards recent progress on quantum ndd theories in curved space. After reviewing the results obtained by Deruene and Ruffini in their interpretation of the positive and negative root solutions arrived at by Christodoulou and Ruffini, the importance of the application of these results in interpreting the Klein paradox within the framework of general ralativistic treatment was mentioned. It was also explained that the main ideas in this talk were derived from the application of the classical works of Sauter, Euler, and Eeisenberg. In fact, an effective potential can be introduced which can at once account for the relativistic and centrifugal effects and those of the Coloumb interaction. The introduction of this effective potential anows us to treat the system as a purely classical system and then to apply the wen known procedures for evaluating the coefflcients of transmission. The importance of this analysis lies mainly in the procedure for obtaining an effective potential from a fully relativistic treatment rather than from a phenomenological point of view.

Reference ***Invited talk delivered at the 1974 Summer School "Ettore Maiorana" on Subnuclear Physics. A. Zichichi Ed., 889-914. Academic Press. 1975.***

69 - 1975 *H. Gursky and R. Ruffini, H. Reidel*

Neutron Stars, Black Holes and Binary X-ray Sources

Articles based on a session of the Annual Meeting of the American Association for the Advancement of Science, held in San Francisco in February 1974.
Index
Neutron stars Congresses.
Black holes (Astronomy) Congresses.
X-ray astronomy Congresses.
X-ray sources, Galactic Congresses.

Reference ***Editors H. Gursky and R. Ruffini. H. Reidel, 1975.***
ISBN: 9027705410, Publisher Kluwer Academic Publishers Group, Imprint Kluwer Academic Publishers,

70 - 1975 *W. Haxton and R. Ruffini.*

Absorption and Defocussing of Electromagnetic Radiation by a Schwarzschild Black Hole.

A comparison of electromagnetic radiation absorbed by a black hole and that emitted at infinity is made for selected circular orbits of a charged particle in a Schwarzschild geometry. Radiation intensity and beaming prjocesses for geodesic as well as ultrarelativistic unbound orbits are compared and contrasted with the special relativistic results of classical electrodynamics.

Reference ***Annals of Physics, 93, 1. 1975.***

71 - 1975 *T. Damour and R. Ruffini*

Quantum Electrodynamical Effects in Kerr-Newman Geometries.

Following the classical approach of Sauter, of Heisenberg and Euler and of Schwinger, the process of vacuum polarization in the field of the "bare" Kerr--Newman geometry is studied. The value of the critical strength of the electromagnetic fields is given together with an analysis of the feedback of the discharge on the geometry. The relevance of this analysis for this analysis for current astrophysical observations is mentioned.

Reference ***Physical Review Letters, 35, 463-466. 1975.***

72 - 1975 *R. Ruffini.*

On Black Eoles Attrition.

In this talk the necessity of using a fully relativistic magneto-hydrodynamics in order to attack the problem of accretion into a black hole has been presented with the basic equation to be solved and a few examples of explicit solutions of greatest interest. In this talk the main idea presented was that the newly discovered gamma rays burst should be associated with the processes of accretion into black holes and due to processes of *ischarge a working in the magnetosphere of a black hole as a consequence of vacuum polarization (see pub. No. 57). A new program of theoretical research dealing with accretion into black holes and possible observational consequences has been outlined.

Reference ***Invited talk delivered at the Seventh Texas Symposium on Relativistic Astrophysics December 1974. - In Proceedings published by the New York Academy of Sciences. 13 pages. New York. 1975.***

73 - 1975 *Nathalie Deruelle and Remo Ruffini.*

Klein Paradox in a Kerr Geometry.

The crossing of the classical positive and negative energy states E+ and E-- introduced by Christodoulu--Ruffini and interpreted within the framework of a relativistic quantum field theory by Deruelle and Ruffini, leads to a Klein paradox. It has been shown bv Euler and Eisenberg that when the transmission coefficient T2 through the barrier between the E+ E-- states is small it is proportional to the probability of pair creation. Numerical computations show that, in the case of a small Kerr black hole ($GM/c^2 \leq \hbar/ \mu c$), the probability of pair creation of particles of mass μ is maximum when E h, where E is the energy of the created particles and M the angular velocity and the mass of the black hole.

Reference ***Physics Letters, 57B, 248. 1975.***

74 - 1975 *Remo Ruffini and James R. Wilson.*

Relativistic Magnetohydrodynamical Effects of Plasma Accreting into a Black Hole.

By an explicit analytic solution, it is shown how in the accretion of a poloidally magnetized plasma into a kerr hole, a torque is exerted on the impalling gas, implying the extraction of rotational energy from the black hole. The torque arises from the twisting of magnetic field lines by the frame dragging effect. It is also shown how under suitable conditions, a sizeable charge separation can be found in the magnetosphere of accreting black holes and hence, an electric charge is expected to be induced on the black hole.

Reference ***Physical Review, D12, 2959-2962. 1975.***

75 - 1975 *R. Ruffini and R.B. Partridge.*

Modern Astrophysics

A textbook covering such fields as: pulsars, gravitational radiation, black holes, cosmology. This book will differ from the previous one by M. Rees, R. Ruffini and J.A. Wheeler, "Black Holes Gravitational Waves and Cosmology" in the sense that it will treat the arguments more thoroughly and in great detail so as to make the book readable by a larger number of students (senior, undergraduate, first year graduat students). It will also differ from the Les Houches notes by R. Ruffini, "On the Energetics of Black Holes", being a much more broad and extensive analysis without technical analytic details. The book is going to be pubilshed by Freeman of San Francisco and translation rights have alerady been assured by other European Companies.

Reference ***W.H. Freeman, S. Francisco Pub. 1975. In preparation.***

76 - 1975 *R. Ruffini and A. Treves.*

Fisica ed astrofisica del campo gravitazionale

A book an in depth introduction to general relativity, the physics of neutron star and black holes and observational effects of general relativity.

Reference ***A book in Italian published by Mondadori covering***

77 - 1975 *Gursky H., Ruffini R.*

Neutron Stars, Black Holes and Binary X-Ray Sources

Reference ***D. Reidel Publishing Company, 1975***

78 - 1976 *R. Hanni and R. Ruffini.*

Schwarzschild Black Hole in an Asymptoically Uniform Magnetic Field.

In this paper the influence of a Schwarzschild black hole on a uniformly magnetic field is analyzed. The solution of Maxwell equations in a curved background offers explicit analytical expressions for the electromagnetic field tensor. The importance of this analytical solution arises from the way in which it renders possible an analysis of the structure of the lines of force near the event--horizon of the black hole. This problem is of the greatest interest for physics since in the physics of binary X--ray sources we expect to find a large amount of magnetic field carried by the accreting plasma. It is also clear that this work should only be considered a preliminary investigation of the highly complex problem of treating plasma accretion in relativistic magneto--hydrodynamics. This last program is currently being pursued by Ruffini and Wilson.

Reference ***Nuovo Cimento Letters. 15, 189. 1976.***

79 - 1976 *T. Damour, N. Deruelle and R. Ruffini*

On Quantum Resonances in Station Geometries

By analyzing a relativistic quantized field in a classical background Kerr geometry resonance states with $\Gamma < 0$ (grouping with time) are found. The interpretation of these states is made in the framework of the effective potential approach previously introduced by Deruene and Ruffini. It is shown to be consequence of the interplay of the two processes of pair creation and resonance states in the field of a collapsed object.

Reference ***Lettere Nuovo Cimento, 15, n.8, 257. 1976.***

80 - 1976 *T. Damour and R. Ruffini*

Black Hole Evaporation in the Klein-Sauter-Heisenbergg-Euler Formalism.

A generalization of the classical approach of barrier penetration introduced by Klein, Santer, Heisenberg, and Euler to curved spaces endowed with future horizons is given. This technique allows one to recover most directly results obtained recently by Eawking. The treatment here presented encompasses, as special cases, the work of Deruene and Ruffini, of Damour and Ruffini, and of Nakamura and Sato.

Reference ***Physical Review D 14, 332-334 (1976)***

81 - 1976 *E. Sato and R. Ruffini.*

Black Holes: Ultimate State of Stars and General Relativity.

Introduction: General Relativity and Black Holes.
Chap. 1: Cosmology and Physical Law -- "Specification" and "generalization".
Chap. 2: Einstein's Relativity -- "Special" and "General".
Chap. 3: Gravitational Equilibrium Limit of a Star and Compact Stars.
Chap. 4: Neutron Stars. Black Holes. and Binary X--ray Stars.
Chap. 5: Evaporation of Black Holes, Naked Singularities and others.

Reference ***Book in Japanese, September 1976.***

82 - 1977 *R. Ruffini.*

Processes in the Fields of Black Holes.

Some experimental results giving evidence for the observations both of neutron stars and black holes in our galaxy and some classical theoretical results in black hole physics are summarized. Recent advances in relativistic magnetohydrodynamics are then reviewed with special emphasis on the analysis of simple models leading to a better understanding of the properties of the magnetosphere of a black hole. The stability of the magnetosphere against processes of vacuum polarization is discussed as well as its relevance for possible sources of detectable signals of gravitational radiation.

Reference ***In proceedings of the First Marcel Grossmann Meeting, Ed. by R. Ruffini, North Honand Pub. Co. Amsterdam. 1977.***

83 - 1977 *R. Ruffini*

Physics outside the Horizon of a Black Hole.

The observation of binary X--ray sources have given new and important information about masses, the magnetospheres, and the energetics of gravitationally conapsed objects. We review some results on the energetics of black holes, on their stability, on their magnetosphere, and on process of vacuum polarization occurring in their strong gravitational fields. The theoretical interpretation of the many observations of neutron stars and black holes point to the possibility of probing, for the first time, the physics of extreme relativistic gravitational fields.

Reference ***In proceedings of the LXXV, Ed. R. Ruffini and R. Giacconi. "E. Fermi" Summer School, North Honand Pub. Co. Amsterdam. 1977.***

84 - 1977 *M.A. Peterson and R. Ruffini.*

Perturbations of an Analytic Background Metric.

An analysis of perturbations in a curved background is developped fonowing the construction of Green's functions by the Hadamard's principal solution. Applications to numerical techniques are discussed.

Reference ***In proceedings of First Marcel Grossmann Meeting, 321, North Holland Pub. Co. Amsterdam. 1977.***

85 - 1977 *R. Ruffini.*

On Relativistic Magnetohydrodynamics Processes in the fields of Black Holes.

Some experimental results giving evidence for the observations both of neutron stars and black holes in our galaxy and some classical theoretical results in black hole physics are summarized. Recent advances in relativistic magnetohydrodynamics are then reviewed with special emphasis on the analysis of simple models leading to a better understanding of the properties Or the magnetosphere of a black hole. The stability of the magnetosphere against processes of vacuum polarization is discussed as well as its relevance for possible sources of detectable signals of gravitational radiation.

Reference ***In Proceedings of the First Marcel Grossmann Meeting, 349, North Holland Pub. Co. Amsterdam. 1977.***

86 - 1977 *Edit. Ruffini R.*

Proceedings of the "1st Marcel Grossmann Meeting on General Relativity" July 7-12, 1975

Reference ***North-Holland Publishing Company, 1977***

87 - 1978 *L. Pietronero and R. Ruffini.*

Numerical Criteria in the Determination of an Upper Limit of the Critical Mass of a Neutron Star.

After reviewing the Rhoades--Ruffini treatment for the determination of an upper limit to the numerical value of the critical mass of a neutron star, their numerical analysis of the equation obtained from the variational principle are criticany reexamined. Counter example are given for the application of the variational techniques. The absolute upper limit of 3.2 M to the critical mass of a neutron star is confirmed.

Reference ***Proc. of the LXXV E. Fermi Summer School, North Holland Pub. Co. Amsterdam. 1978.***

88 - 1978 *R. Ruffini*

Physics Outside the Horizon of a Black Hole.

An extensive general review of the physical processes occurring outside the horizon of a black hole and their astrophysical relevance is presented. The major results of black hoks energetics, stability, vacuum polarization processes are reviewed in light of recent observation of X and Gamma Ray astronomy.

Reference ***Proc. of the LYXV E. Fermi Summer School, North Holland Pub. Co. Amsterdam. 1978.***

89 - 1978 *T. Damour, R.S. Hanni, R. Ruffini and J.R. Wilson*

Regions of Magnetic Support of a Plasma around a Black Hole.

The necessary conditions for the trapping of charged particles by an electromagnetic field in the magnetosphere of a black hole are established. Three different regions are defined according to the rdative importance of electric and magnetic fields: regions of magnetic dominance, plasma horizons, lines of constant flux. Idealized models are used to illustrate the application of these criteria.

Reference ***Physical Review D 17, n. 6, 1518-1523 (1978)***

90 - 1978 *R. Giacconi and R. Ruffini*

Proceedings of the LXXV Enrico Fermi Summer School on the Physics and Astrophysics of Neutron Stars and Black Holes.

Reference ***North Eolland Pub. Co. Approximately 900 pages. Amsterdam. 1978., R. Giacconi and R. Ruffini Editors***

91 - 1978 *P.L. Bernacca and R. Ruffini*

Astrophysics from Spacelab.

A book reviewing the technical capabilities of the spacelab -- Shuttle program and a set of authoritative reviews on the Astrophysics to be performed from spacelab.

Reference ***Reidel Dordrecht 1978 - 450 pages. P.L. Bernacca and R. Ruffini Editors***

92 - 1978 *R. Ruffini*

Bianchi Universes and Relativistic Cosmology.

A book reviewing the mathematical aspects of the Bianchi classification and application to Astrophysics in the framework of Einstein theory of gravitation. The observational consequency of Bianchi Universes are presented together with a new and in depth analysis of their singularity structure.

Reference ***Princeton University. Approximately 500 pages, 1978 (in press). R. Ruffini Elitor***

93 - 1979 *R. Ruffini*

On Subcriticany Accreting Black Holes.

A model is presented analyzing accretion disks around black holes. Special attention is given to possible models with application suggested to SS433 and Bursters.

Reference ***Nuovo Cimento Letters, 26, 239. 1979.***

94 - 1979 *Fang Li Zhi and R. Ruffini .*

On the Doppler SS433.

A new family of X--ray sources has recently been proposed including SS433. The general relativistic formula to fit the frequency dependence of the H/alpha lines in SS433 as a function of the phase is presented here. Particularly relevant for the verification of the model are the observations at the phase of minimum shift.

Reference ***Physics Letters, 86B, 193, 1979.***

95 - 1980 *J. Ferreirinho, R. Ruffini, L. Stella*

On the Relativistic Thomas-Fermi Atom

A relativistic equation, generalizing the Thomas Fermi Equation is given. A critical number of is found which is the electromagnetic analogue to the critical number against gravitational conapse.

Reference ***Physics Letters, 91B, 314,1980.***

96 - 1980 *A. Qadir, R. Ruffini, G. Violini.*

On the Rotational Energy Loss of Pulsars

The role of higher multipole (2) structures in the magnetosphere of puLsars is pointed out and explicit effects on the showing doux index are studied.

Reference ***Nuovo Cimento Letters, 27, 381. 1980.***

97 - 1980 *R. Ruffini, L. Stella.*

On the Emission Regions of the Doppler SS433

Some phenomenological consequences of the model presented in ref. 72 and 73 are developed and directly confronted with experiments.

Reference ***Nuovo Cimento Letters, 27, 529. 1980.***

98 - 1980 *R. Ruffini, L. Stella.*

On Stimulated Emission Processes in Gravitational Fields

We here introduce necessary conditions to be fulfilled in order to have stimulated emission processes in a gravitational field. We also define "regions of constant shift" with respect to an asymptotic observer.

Reference ***Physics Letters, 93B, 107. 1980.***

99 - 1980 *R. Ruffini.*

On a System of Self Gravitating Fermi Degenerate Neutrinos

It is pointed out that degenerate massive neutrinos could from halos comparable in size and larger in masses than galactic structures.

Reference ***Nuovo Cimento Letters, 29, 161. 1980.***

100 - 1980 *Gao Jian Gong, R. Ruffini.*

Relativistic Limits on the Masses of Self-gravitating Systems of Degenerate Neutrinos

The existence of a nonzero rest mass for neutrinos implies the possible existence of galactic size masses of degenerate self--gravitating neutrinos. We discuss some limits imposed on the masses of such systems by special relativity and cosmology.

Reference ***Physics Letters, 97B, 388. 1980.***

101 - 1980 *R. Ruffini.*

On the Magnetosphere of Collapsed Stars

Much progress has been made inrecent years on the knowledge of gravitationany collapsed objects thanks to a deeper understanding of relativistic field theories and to a large amount of experimental information obtained from x and gamma ray -- radio and optical astronomy [1]. Nevertheless, basic issues on the structure both of neutron stars and black holes remam unanswered.

Reference ***International Meeting on Astrophysics and Elementary Particles, Common Problems, Accademia dei Lincei di Roma, N.53. 1980.***

102 - 1980 *V. Belinski, R.Ruffini*

On Axially Symmetric Solitonic Solutions of the Coupled Scalar-Vector Equations in General Relativity

The inverse scattering theory used by Belinsky and Zakharov for obtaining solitonic solutions of the Einstein equations is here applied to the case of a 5--dimensional space and interpreted in the framework of the Jordan--Kaluza--Nein theory. For two solitons exact, stationary, axiany symmetric and asymptoticany flat solutions are obtained.

Reference ***Physics Letters, 89B, 195. 1980***

103 - 1981 *I. Ciufolini, R. Ruffini.*

On the Value of the Masses of Neutron Stars in the Parametrized Post Newtonian Formalism

In light of the current experimental tests of gravitational theories we have computed the masses of the equilibrium configurations of neutron stars within the parametrized post Newtonian formalism. It is also shown how general requirements like the conservation of, the energy and momentum of an isolated system do impose severe constraints on the P.P.N. parameters. Our results are at variance with those previously reported by Wagoner and Malone. An computations do also confirm the existence of a critical mass against gravitational collapse.

Reference ***Astronomy and Astrophysics, 97, 12. 1981.***

104 - 1981 *Gao Jian Gong, R. Ruffini,*

On the Formation of Self--gravitating Svstems of Degenerate Neutrinos in an Expanding Universe are Studied within the Framework of a Gamow Cosmology

The possible formation of self-gravitating systems of degenerate neutrinos in an expanding universe are studied within the framework of a Gamow cosmology.

Reference ***Physics Letters, B, Vol. 100, Iusse1, 47-49, 1981.***

105 - 1981 *V. Ferrari, R. Ruffini.*

On the Structure of Gravitational Waves Bursts: Implosion with Finite Kinetic Energy

The structure of a gravitational wave burst emitted by a particle radiany imploding into a Schwarzschild black hole with a finite kinetic energy at infinity is analyzed in the framework of the Zerilli--Regge--Wheeler formalism. The three components of the burst a) precursor b) main burst c) ringing tail are analyzed and the results compared and contrasted with those obtained for a particle initially at rest at infinity. The ringing tail of the burst is studied in terms of the normal modes of a black hole.

Reference ***Physics Letters, 98B, n.5, 381. 1981.***

106 - 1981 *Fang Li Zhi, R. Ruffini, L. Stella.*

SS433: Background for a Relativistic Model

A detailed review is presented of the theoretical models of the source of SS433 with special attention to ring models and processes of stimulated emission.

Reference ***Vistas in Astronomy, 25,185. 1981.***

107 - 1981 *R. Ruffini, Song Doo Jong, L. Stella.*

On Some Possible Additional Relativistic Effects in SS433

The 163.8 days period observed in the shifted lines of SS433 if due to Lense Thirring precession, should change with time as a consequence of matter accreting into the black hole and changing its singular momentum. The propagation of light signals within a few Schwarzschild radii of the black hole surface, in the ring models, may lead to the observation of further relativistic effects.

Reference ***Astronomy and Astrophysics, (in press). 1981.***

108 - 1981 *R. Jantzen, R. Ruffini.*

Particles in Friedmann and Einstein-Strauss Universes

Expressions are given for the energy and momentum of a free particle in a Friedmann Universe and in an Einstein--Strauss Universe. Special attention is given to the determination of the conserved quantities for the particle motion. The necessary conditions are given for a particle injected into a Schwarzschild geometry from expanding open, closed or fiat dust--filled Friedmann Universe, matched to that geometry, to find itself in a bound orbit.

Reference ***Physics Letters, 104B,, Issue 5, 373-376, 1981.***

109 - 1981 *R. Ruffini, L. Stella.*

Some Comments on the Relativistic Thomas--Fermi Model and the Vallarta Rosen Equation

It is argued that the treatment of Muner and Rafelski on the relativistic Thomas--Fermi model is well known from the literature. Some basic differences between the screening of the nuclear charge due to a relativistic cloud of electrons in a neutral atom and the one due to vacuum polarization effects induced by a superheavy ion are discussed.

Reference ***Physics Letters B, 102, 442, 1981***

110 - 1981 *M. Sasaki, R. Ruffini.*

On a Semi Relativistic Treatment of the Gravitational Radiation from a Mass Thrusted into a Black Hole

A Semi--relativistic treatment estimating the gravitational radiation emitted by a particle thrusted into a Schwarzschild black hole with a finite kinetic energy at infinity is presented making two extreme assumptions: (a) that the particle moves along a geodesic in a curved space and (b) that the particle radiates as if it were in flat space--time. The structure of the burst and beaming process of grantational radiation are studied. The merit of this approach lies in its simplicity and in providing a direct and complementary understanding of the results obtained by a fully relativistic treatment.

Reference ***Progress of Theoretical Physics, 66, 1627, 198l.***

111 - 1981 *R. Ruffini, L. Stella.*

ON SS433

Reference ***Proceedings of the 5th General Conference of the European Physical Society - Istanbul. Ed. Dorobautu: Bucharest: Central Institute of Physics. Sept. 1981***

112 - 1981 *A. Crollalanza, Gao Jian Gong, R.Ruffini.*

On Massive-Neutrino Halos and Galactic Structures

Galactic halos of massive degenerate neutrinos are analyzed for selected equilibrium configurations in which the central density of neutrinos is smaller than the density of galactic visible matter. On the ground of a simplified model some general conclusions are reached about the rotation curves of galaxies. These conclusions may be subjected to a direct experimental verification. The local neutrinos density in our galaxy may be as large as 10^7 neutrinos cm^-3 .

Reference ***Lettere al Nuovo Cimento 32, 411. 1981.***

113 - 1981 *J.G. Gao, R. Ruffini*

On the formation of massive neutrino halos in a Gamow cosmology

Reference ***Physics Letters B, 100, 47, 1981***

114 - 1982 *R. Ruffini, Z.Kopal, J. Rahe (eds.)*

Bynary and Multiple Stars as Tracers of Stellar Evolution

Some of the most unique experimental features of the source SS433 are outlined as well as some implications of the theoretical models of this source.

Reference ***373-388 - Reidel Publ. Company 1982.***

115 - 1982 *R. Ruffini.*

Gravitationally Collapsed Objects

The observations of the binary pulsar carried out by J. Taylor (1) have given the first evidence of the eYistence of grfavitaitonally radiation and further verifications of relativistic effects are likely to be performed on this astrophysical system (2). These considerations make this object one of the most interesting in the entire field of relativistic astrophysics.

Reference ***Proceedings of the Second Marcel Grossmann Meeting on General Relativity, R.Ruffini (editor), North Holland Pub. Co. Amsterdam. 1982.***

116 - 1982 *R. Fabbri, R. Ruffini,*

Galactic Halos, Globular Clusters and Massive Neutrinos

Within the framework of a Gamow cosmology with massive neutrinos a scenario is proposed in which both galactic halos and globular clusters are formed due to the existence of a critical injection mass. Galactic halos are formed at red shift z 10-100 by self-gravitating neutrinos, and globular clusters at z 10 by a critical injection mass of primordial plasma (Gamow's Ylem).

Reference ***Astrophys. And Space Science 82, 249, 1982.***

117 - 1982 *R. Fabbri, R.T. Jantzen, R. Ruffini.*

Massive Neutrino Halos in an Expanding Universe

The growth of massive neutrino halos around a mass condensation in an expanding universe is considered using the simplified model of an Einstein-Straus universe. This model illustrates the possibility of capturing freely moving particles in a homogeneous and isotropic cosmological gas by the local gravitational field of a mass condensation. This capture process is particularly relevant to the neutrino background in a neutrino dominated universe and explicit formulas are given relating the maximum capture rate by a neutrino condensation to the cosmological redshift and the mass of the condensation. Analogies between self--gravitating systems of neutrinos in an asymptotically flat spacetime and the condensations which maximize the capture rate are noted and observational consequences are considered.

Reference ***Astronomy Astrophysics, 114, 219-232. 1982.***

118 - 1982 *Edit. Ruffini R.*

Proceedings of the "Second Marcel Grossmann Meeting on General Relativity" July 5-11, 1979

Reference ***North-Holland Publishing Company, 1982***

119 - 1983 *Fang Li Zhi, R. Ruffini*

Basic Concepts in Relativistic Astrophysics

Reference ***World Scientific Publishing Co., Singapore, 1983.***

120 - 1983 *R. Ruffini, L. Stella.*

On Semi-degenerate Equilibrium Configurations of a conisionless Self-gravitating Fermi gas

We derive a self--consistent solution to the problem of the gravitational equilibrium of a collisionless semi--degenerate Fermi gas. The treatment is applied to model massive halos observed on scales ranging from galaxies to clusters of galaxies, by means of nonzero mass neutrinos. A self consistent lower limit to the neutrino mass is derived for neutrinos to provide the dark mass on various scales in a lepton symmetric universe.

Reference ***Astronomy and Astrophysics, 119, 35. 1983***

121 - 1983 *R. Ruffini, Song Doo Jong.*

Nutational Effects in SS 433

The nutation effects of an accreting disk around SS433 are analyzed within the framework of the fully relativistic mod of Fang and Ruffini.

Reference ***Astrophys. And Space Science, 97, 1, 1983.***

122 - 1983 *R. Ruffini.*

Some Topics in Relativistic Astrophysics: Galaxies, SS433

Two topics are discussed. The first one concerns the size, shape and stability of galaxies. Particularly, the massive neutrino halo theory is discussed to account for the missing mass of the galaxies. The second topic concerns SS433. An Attempt to analyze the peculiar characteristics of SS433 using a ring model is explained.

Reference ***The Journal of Basic Sciences, Seoul, 2. 1983.***

123 - 1983 *M.R. Baldeschi, G.B. Gelmini, R. Ruffini.*

On Massive Fermions and Bosons in Galactic Halos

Galactic halos of massive fermions, of arbitrary half integer spin, or of massive bosons are considered. To give results of astrophysical interest, the fermions with spin s should have a mass $m \simeq 10eV/c^2/(2s + 1)^l/4$, while the bosons a mass in the range from $10eV/c^2$ to $10^-24eV/c^2$. We also consider galactic halos of more than one fermion species.

Reference ***Physics Letters B, 122, 221, 1983***

124 - 1983 *R.Ruffini, D.J. Song, L. Stella.*

On the Statistical Distribution of Massive Fermions and Bosons in a Friedmann Universe

The distribution function of massive Fermi and Bose particles in an expanding Universe is considered as well as some associated thermodynamic quantities, pressure and energy density. These considerations are then applied to cosmological neutrinos. A new limit is derived for the degeneracy of a cosmological gas of massive neutrinos.

Reference ***Astronomy and Astrophysics, 125, 265, 1983.***

125 - 1983 *R. Ruffini, L. Stella.*

On the Structure of Semidegenerate Massive Neutrino Halos

Reference ***Proceedings of the Third Marcel Grossmann Meeting on General Relativity, 545-559, Hu Ning (editor) Science Press & North Holland Pub. Co. Amsterdam. 1983.***

126 - 1983 *I. Ciufolini, R. Ruffini.*

Equilibrium Configurations of Neutron Stars and the Parametrized Post--Newtonian Metric Theories on Gravitation

The values of the masses of the equilibrium configurations of neutron stars are analyzed within the framework of the standard nine--parameter post-Newtonian (PPN) theories of gravitation. The traditional approach imposes constraints on the PPN parameters via experimental tests. In this paper, further constraints on the numerical values of these parameters are imposed by basic conservation laws, such as the conservation of each component of the four--momentnm of an isolated system. As a consequence we are able to establish in the PPN formalism the existence of a critical mass for the equilibrium config- urations of neutron stars.

Reference ***Astrophysical Journal, 275, 867. 1983.***

127 - 1984 *R.Ruffini, Doo Jong Song.*

Nutational Effects in SS433

The nutation effects of an accreting disk around SS433 are analyzed within the framework of the fully relativistic mod of Fang and Ruffini.

Reference ***Astrophysics and Space Science, 99, 319. 1984.***

128 - 1984 *A. Malagoli, R. Ruffini.*

On the Gravitational Red-Shift of Galactic Halos

Limits are established for the gravitational red--shift to be expected for galactic halos. The possibility that collapsed galactic halos have relevance in astrophysical systems is also advanced.

Reference ***Lettere al Nuovo Cimento 39, 177. 1984.***

129 - 1984 *S. Filippi, I.D. Novikov, R. Ruffini.*

The Capture of Particles in an Einstein-Straus Universe. A Newtonian approach

A Newtonian approach to the problem of the capture of particles by a gravitational condensation in a Friedmann universe is considered. Explicit formulae are given for the value of the momenta and injection angles leading to the capture, and a comparison is made with analogous fully relativistic results.

Reference ***Lettere al Nuovo Cimento Vol. 39, n.8, 165-170, 1984.***

130 - 1984 *R. Fabbri, G. Pucacco, R. Ruffini.*

The Angular Distribution of the Background Radiation in Homogeneous Cosmological Models

A method is presented to calculate the most general effects of the global anisotropy of homogeneous cosmological models of the angular distribution of the cosmic background radiation. Using a spherical harmonic expansion. Bianchi types I. V and IX are explicitly considered.

Reference ***Astronomy and Astrophysics, 135, 53. 1984.***

131 - 1984 *L.Z. Fang, R. Ruffini, editors.*

Cosmology of the Early Universe

Reference ***Advanced Series in Astrophysics and Cosmology, World Scientific, Singapore, Volume 1. 1984.***

132 - 1985 *L.Z. Fang, R.Ruffini, editors.*

Galaxies, Quasars and Cosmology

Reference ***Advanced Series in Astrophysics and Cosmology, World Scientific, Singapore, Volume 2. 1985.***

133 - 1985 *A. Malagoli, R. Ruffini.*

Theoretical Considerations on the rotation Curves of Galactic Halos

The influence of the visible matter of the galaxy on the galactic halo is examined in the two limiting configurations of a classical isothermal sphere and a fully degenerate configuration. We infer the masses of the particles composing the galactic halos. The possible role of dwarf spheroidal galaxies in probing the structure of the galactic halos at large galactic distance is considered.

Reference ***In Advanced Series in Astrophysics and Cosmology, World Scientific, Singapore, Volume 2. 1985.***

134 - 1985 *J.A. de Freitas Pacheco, G. Pucacco, R. Ruffini*

Rotation and Vorticity in Galactic Models

Reference ***In Advanced Series in Astrophysics and Cosmology, World Scientinc, Singapore, Volume 2. 1985.***

135 - 1985 *R. Ruffini, Song Doo Jong.*

De Media Aequinoctiorum Praecessione Atque de Nutatione Stellae SS433

On the basis of Bessel's classical papers De Media Aequinoctiorum Praecessione and De Nutatione compact formulae are given to interpret the observed vanations in the shifted lines of SS433 in terms of nutational and precessional effects of a disk in a binary system.

Reference ***Astrophysics and Space Science, 110, 89. 1985.***

136 - 1985 *R. Cogotti, R. Ruffini, Song Doo Jong.*

Theoretical interpretation of the Nutational Effects in SS433

The nutational effects induced by a companion star on the emitting regions of SS433 are anlysed within the framework of the ring model. Analytic expressions are derived for the variations of the shifted lines due to the nutation of the disk; the amplitudes and periodicities of these variations are given. Constraints on the inclination angles and masses of the system are derived. These results are compared and contrasted with those of the "twin-jet" model.

Reference ***Astronomy and Astrophysics, 142, 124. 1985.***

137 - 1986 *A. Malagoli, R. Ruffini.*

Theoretical Considerations on the Rotation Curves of Galactic Halos

The influence of the visible matter of the galaxy on the galactic halo is examined in the two limiting configurations of a classical isothermal sphere and a fully degenerate configuration. We infer the masses of the particles composing the glactic halos. The possible role of dwarf spheroidal galaxies in probing the structure of the galactic halos at large galactic distance is considered.

Reference ***Astronomy and Astrophysics, 157, 293. 1986.***

138 - 1986 *J.A. de Freitas Pacheco, G. Pucacco, R. Ruffini*

The Equilibrium and Stability of Inhomogeneous Riemann Ellipsoids with Anisotropic Pressure

Extending the tensor virial equations analysis we obtain new equilibrium solutions for inhomogeneous Riemann ellipsoids. It is shown that, taking into account anisotropic velocity dispersion and a confocal ellipsoidal density distribution, it is possible to find stable ellipsoidal figures of equilibrium, for which the existence of a massive galactic halo as a means of stabilizing the structure against bar--like modes of oscillation is not required. At the same time the arnount of velocity dispersion necessary in the model is not far from that actually observed in our galaxy. These results, obtained for specific values of the angular velocity, the vorticity and the axial ratios, naturally lead to triaxial galaxy configurations.

Reference ***Astronomy and Astrophysics, 161, 39. 1986.***

139 - 1986 *R. Ruffini, D.J. Song, S. Taraglio.*

The Neutrino Mass and the Cellular Large Scale Structure of the Universe

We show how within the theoretical framework of a Gamow cosmology with massive neutrinos, the observed correlation functions between galaxies and between clusters of galaxies, naturany lead to a "cellular" structure of the Universe. From the size of "elementary cells" we derive constraints on the value of the masses and chemical potentials of the cosmological "inos". We outline a procedure to estimate the "effective" average mass density of the Universe. We predict also the angular size of the inhomogeneities to be expected in the cosmological black body radiation as remnants of this cellular structure. A possible relation of our modd to a fractal structure is indicated.

Reference ***Proceedings of the 124th IAU Symposium held in Beijing, August 1986.***

140 - 1986 *M. Li, R. Ruffini.*

Radiation of New Particles of the Fifth Interaction

The fact that the radiation of new particles of the fifth interaction from the binaries is much smaller than that of gravitation is shown by calculations. The radiation from a particle system with collision is also given.

Reference ***Physics Letters A, 116, 20. 1986.***

141 - 1986 *G. Ingrosso, R. Ruffini.*

On Systems of Self-gravitating Bosons and Fermions Undergoing Ouantum Condensation

The transition to the ground state for a system of self--gravitating bosons or fermions is examined. In the case of bosons, a phase transition of the first kind occurs, going from a classical to a fully condensed configuration.

Reference ***Proceedings of the Fourth Marcel Grossmann Meeting on General Relativity, R.Ruffini (editor), part B, 14. North Holland Pub. Co. Amsterdam. 1986 .***

142 - 1986 *M. Merafina, R. Ruffini.*

On Self-gravitating Classical Systems with a Phase Space Cutoff

We have derived a self--consistent solution to the problem of the stability of self--gravitating classical systems and applied the model to globular clusters and galactic halos. Our results, moreover, allow us to explain the existence of binary systems in globular clusters and fix an upper bound for the particle rest mass for galactic halos in the context of the massive neutrino hypothesis for the solution of the "missing mass" problem.

Reference ***Proceedings of the Fourth Marcel Grossmann Meeting on General Relativity, R.Ruffini(ed.), Part B, 1501, North Holland Pub. Co. Amsterdam. 1986.***

143 - 1986 *J.A. de Freitas Pacheco, G. Pucacco, R.Ruffini*

The Stability of Inhomogeneous Spheroids with Anisotropic Pressure

Reference ***Proceedings of the Fourth Marcel Grossmann Meeting on General Relativity, R.Ruffini (ed.) Part.B, 1511-1522, North Holland Pub. Co. Amsterdam. 1986.***

144 - 1986 *L.Z. Fang, R. Ruffini, editors.*

World Scientific Series in Astrophysics and Cosmology

This volume presents a detailed survey on the theory of the creation of the Universe. It comprises reprints on subjects related to the development of quantum cosmology. As an introduction to the subject, an overview of quantum cosmology is included in the first chapter of this volume.

Reference ***World Scientific Series in Astrophysics and Cosmology, Volume 3. 1986.***

145 - 1986 *R. Ruffini*

Editor. Proceedings of the Fourth "Marcel Grossman Meeting on General Relativity

Reference ***Part A and Part B, North Holland Pub. Co. Amsterdam. 1986.***

146 - 1986 *Edit. Ruffini R.*

Proceedings of the "Fourth Marcel Grossmann Meeting on General Relativity" June 17-21, 1985

Reference ***North-Holland Pub., Amsterdam 1986***

147 - 1986 *Eds. Fang L.Z., Ruffini R.*

Galaxies, quasars and cosmology
June 17-21, 1985

Reference ***Singapore, World Scientific, 1986***

148 - 1986 *Eds. Melchiorri F., Ruffini R.*

Gamow cosmology
Proceedings of the international school of physics "E. Fermi"

Reference ***Amsterdam, North Holland, 1986***

149 - 1986 *Fang L.Z., Ruffini R.*

Basic concepts in relativistic astrophysics
Chinese version

Reference ***Taiwan, Eastern Asian Pu., 1986***

150 - 1987 *R.Ruffini, D.J. Song.*

Cosmological Constraints of the "INOS" Composing Galactic Halos

We introduce a general theoretical framework which imposes constraints upon the spin, masses, and phase space densities of the cosmological "inos" forming the dark matter component of the Universe. The novelty of the approach is in using largely model--independent features of both galactic halos and cosmological thermodynamical equilibrium. Uncondensed bosons are excluded as a component of the galactic halos, while fermions are confirmed as best candidates. Explicit limits on the masses and occupation numbers of "inos" fermions are established in terms of the masses and radii of galactic halos and of their cosmological abundances. Consequences on the associated cosmological background radiation are given.

Reference ***Astronomy and Astrophysics, 179, 3. 1987.***

151 - 1987 *F. Melchiorri, R. Ruffini.*

Gamow Cosmology

Proceedings of the International School of Physics "Enrico Fermi", course LXXXVI, 13–23 July 1982, Enrico Fermi International Summer School of Physics

Reference ***North-Holland Physics Publishing, Amsterdam, 1987, vol. 86, 548 pp, F. Melchiorri, R. Ruffini. edit.,***

152 - 1987 *R.Ruffini, D.J. Song.*

On the Jeans Mass of Weakly Interacting, Neutral Massive Leptons

Reference ***In proceedings of the LXXXVI Course, International School of Varenna. 1987.***

153 - 1987 *H.C. Ohanian, R. Ruffini, D.J. Song.*

Properties of a Cosmological Gas of Bosons

On the basis of red--shifted statistics of collisionless gas, the properties of decoupled cosmological boson are derived. The equations of states are considered for the various decoupling epochs and they are different from classical Bose gas, particularly, in the case of bosons which decoupled at their relativistic regime. The cosmological limits on the mass of boson are also considered.

Reference ***Il Nuovo Cimento, 99B. 1987.***

154 - 1987 *R. Ruffini, D.J. Song and W. Stoeger.*

Detachment of Superclusters from the Hubble Flow and their Fragmentation into Galaxies

We consider the possibility that galactic structures be formed bv successive fragmentations in the still expanding phase of the Universe. This point of view in contrast with the traditional approach of "pancake" theory. We here study the initial density contrast for fragmentation as well as the development of successive fragmentation process within a given fragment.

Reference ***World Scientific, 1st Italian-Korean Symposium on Relativistic Astrophysics. 1987.***

155 - 1987 *D. Calzetti, M. Giavalisco, L. Pietronero, R. Ruffini.*

On the Amplitudes of Galxy Correlation Functions

Within the framework of a self--similar observer--homogeneous model, a Mandelbrot's fractal, the observed amplitudes of the correlation functions for galaxies, clusters and superclusters are expressed by a simple analytic formula as function of the fractal dimension and a simple size. The various discrepancies among the observed correlation functions are naturally resolved in terms of appropriate normalizations.

Reference ***Submitted for publication to Physical Review Letters. 1987.***

156 - 1987 *D. Calzetti, J. Einasto, M. Giavalisco, R.Ruffini, J.Saar.*

On the Correlation Function of Galaxies in the Direction of the Coma Cluster

The observational data on the amplitude of the correlation function of galaxies in the direction of the Coma cluster are confronted with analytic formula derived for a self--similar observer--homogeneous structure.

Reference ***Astrophysics and Space Science, 137,101. 1987.***

157 - 1987 *M.V. Arbolino, R. Ruffini.*

Effects of Semidegeneracy on the Structure of Galactic Dark Halos

This is the sixth of a series of papers that examines the possible role of massive and weakly interacting fermions as constituents of galactic dark halos. In paper III of this series we have studied the possibility that the observed flat rotation curves of spiral galaxies are due to the presence of an halo composed by fully degenerate fermions. In two other papers of this series (papers IV and V) the structure and the stability of self gravitating isothermal conngurations composed of classical or semidegenerate fermions have been investigated. A cutoff in the phase--space distribution of the particles has been introduced in order to avoid the problems that arise from the unfiniteness of isothermal configurations as usually described. In this paper we have considered the implications of the same semidegenerate configurations with a phase--space cutoff in presence of a visible matter component. The comparison of these theoretical analisys with the observed data on the rotation curves of spiral galaxies allows us to impose upper and lower limits on the mass of the particles that compose the dark halos and to obtain informations on the ratio between the masses of the dark and visible matter. We have also given the analytical dependence of the above limits on the degeneracy parameters of the halo special in the limit of classical configurations. We compare and contrast the results with the ones obtained in paper III for fully degenerate configurations.

Reference ***Submitted to Astronomy and Astrophysics. 1987.***

158 - 1987 *Eds. Fang L.Z., Ruffini R.*

Quantum cosmology

Reference ***Singapore, World Scientific, 1987***

159 - 1988 *M.V. Arbolino, R. Ruffini.*

On the Ratio Between the Halo and Visible Masses in Spiral Galaxies and Limits on the Neutrino Mass

Observed rotation curves for galaxies with values of the visiblc mass ranging over three decades together with considerations involving equilibrium configurations of massive neutrinos impose constraints on the ratio between the masses of visible and dark halo components in spiral galaxies. Upper and lower limits on the mass of the constituents of the dark matter are derived.

Reference ***Astronomy and Astrophysics, 192, 107. 1988.***

160 - 1988 *R. Ruffini*

Dark matter and the fractal large-scale structure of the universe

Reference ***XXVII. International Univ. fur Kernphysik, Schladming, steiermark, 22.2 -- 3.3. 1988.***

161 - 1988 *R.Ruffini, D.J. Song,, S. Taraglio.*

The "Ino" Mass and the Cellular Large Scale Structure of the Universe

Within the theoretical framework of a Gamow cosmology with massive "inos", we show how the observed correlation functions between galaxies and between clusters of galaxies naturany lead to a "cellular" structure for the Universe. From the size of the "elementary cells" we derive constraints on the value of the masses and chemical potentials of the cosmological "inos". We outline a procedure to estimate the "effective" average mass density of the Universe. We also predict the angular size of the inhomogeneities to be expected in the cosmological black body radiation as remnants of this cenular structure. A possible relationship between our model and a fractal structure as indicated.

Reference ***Astronomy and Astrophysics, 190,1. 1988.***

162 - 1988 *D. Calzetti, M. Giavalisco, R. Ruffini.*

On the Normalization of the Correlation Functions for Extragalactic Structures

It is shown that the spatial two--point correlation functions for galaxies, clusters and superclusters depend explicitly on the spatial volume of the statistical sample considered. Rules for the normalization of the correlation functions are given and the traditional classification of galaxies into field galaxies, clusters and superclusters is replaced by the introduction of a singe fractal structure, with a lower cut--off at galactic scales. The roles played by random and stochastic components in the galaxy distributon are discussed in detail.

Reference ***Astronomy and Astrophysics, 198,1. 1988.***

163 - 1988 *D. Calzetti, M. Giavalisco, R. Ruffini.*

On the Scaling of Fractal Structures

We discuss some inconsistencies in a recent letter by Vicsek and Szalay.

Reference

164 - 1988 *G. Busarello, S. Filippi, R. Ruffini.*

Anisotropic Tensor Virial Models for Elliptical Galaxies with Rotation or Vorticity

We present a new class of anisotropic inhomogeneous models of elliptical galaxies based on the McLaurin and Jacobi--Dedekind sequences of `Papuru' ellipsoids. These models are mantained in equilibrium either by the rotation of the figure (i.e. of the potential), or, alternatively, by stellar streaming with respect to the figure, which is fixed in space. The only hypothesis on the density distribution is that the equidensity surfaces are similar concentric ellipsoids. Both triaxial and spheroidal equilibrium solutions are found, with a varietv of geometrical and dynamical configurations. The stability of equilibrium systems against global oscillations is tested under particular assumptions on the behaviour of the velocity fields. We find that the triaxial configurations are in general energetically favoured with respect to the spheroidal ones, giving a new argument in favour of the triaxiality of elliptical galaxies. From the observational limits on the ellipticities of galaxies, we deduce rather strict limits on the anisotropies of real systems, and, consequently, on the main physical properties involved. We also show that, if triaxiality is a common characteristic of elliptical galaxies, the compresence of figure rotation and stellar streaming is a dynamical condition necessary for the equilibrium of galactic structures characterized by the observed V/σ values.

Reference ***Astronomy and Astrophysics, 197, 91-104. 1988.***

165 - 1988 *J.A. de Freitas Pacheco, G. Pucacco, R. Ruffini, G. Sebastiani.*

Odd Modes Stability Analysis of Papuru Ellipsoids

The odd modes stability analysis of S--type Riemann ellipsoids generalized to an autosimilar density distribution law and an anisotropic pressure tensor is performed in the framewwork of the tensor virial theorem.

Reference ***Submitted to Astronomy and Astrophysics. 1988.***

166 - 1988 *G. Busarello, S. Filippi, R. Ruffini.*

Anisotropic and Inhomogeneous Tensor Virial Models for Elliptical Galaxies with Figure Rotation and I nternal Streaming

We apply the tensor viral theorem to the analysis of a new class of anisotropic inhomogeneous models for elliptical galaxies. The models are characterized by simultaneous rotation of the figure (potential) and internal streaming motion. A very general density distribution is assumed, with concentric similar (generally triaxial) ellipsoids as equidensity surfaces. The anisotropy is parametrized by the ratio of the mean velocity dispersion in the plane of rotation to the component along the rotation axis. We give detailed analysis of the relevant physical properties of the models, as the total kinetic energy, the angular momentum, and the total energy. We show that, one one axial ratio is fixed, the minimum energy configuration is triaxial one. The equilibrium shape turns out to be determined by the ratio of the internal streaming to the figure rotation X, together with the anisotropy . By plotting our equilibrium sequences on the ($\epsilon, V/\sigma$) plane, we try an interpretation of the observed positions of eniptical galaxies on this plane in terms of X and ,β. Our main conclusions are: i) the anisotropy in elliptical galaxies is restricted in a relatively narrow range around the isotropic value; ii) triaxial ellipticals must be characterized by the simultaneous presence of figure rotation and internal streaming motion, in the opposite sense. As an example of application of the models, we analyze the gross properties of a particular object (NGC 5266,, finding a remarkable agreement with a previous, more detailed, study.

Reference ***Astronomy and Astrophysics, 213 , 80-88, 1989.***

167 - 1988 *R. Ruffini, D.J. Song, W.R. Stoeger:*

Detachment of Superclusters from the Hubble Flow and their Fragmentation into Galaxies

We consider the possibility that galactic structures be formed bv successive fragmentations in the still expanding phase of the Universe. This point of view in contrast with the traditional approach of "pancake" theory. We here study the initial density contrast for fragmentation as well as the development of successive fragmentation process within a given fragment.

Reference ***Il Nuovo Cimento B, 102, 159 (1988).***

168 - 1988 *M. Merafina, R. Ruffini*

Some Remarks on the Selfgravitating Classical Particle

We compare and contrast recent results we have published on a finite system of isothermal selfgravitating particles with the one obtained by Zel'dovich and Podurets.

Reference ***Submitted to Europhysics Letters. 1988.***

169 - 1988 *M. Merafina, R. Ruffini*

On Systems of Self-gravitating Classical Particles with a Cutoff in their Distribution Function

We examine the relativistic and Newtonian configurations of a system of classical particles with a distribution function with a cutoff in the momentum space. These distributions are obtained as classical limit of more general quantum statistics. The characteristic physical quantities of astrophysical interest of the equilibrium configurations are given, assuming selected values of the parameters. The stability of these configurations is treated both from a global point of view of the mass--central density and mass--radius relation as well as by introducing the concept of an effective polytropic exponent. The results are compared and contrasted with the existing ones in literature.

Reference ***Accepted in Astronomy and Astrophysics. 1988.***

170 - 1988 *Mo Houjun and R. Ruffini*

Cenular Structure and Redshift Space

The distortions in Hubble ratio by density inhomogeneity in the universe are calculated for different models within an elennentary cell. The extrapolation procedure for global Hubble constant and other quantities are discussed. It is shown that such distortions have great theorethical and observational significances in density distribution, clustering prperty, large scale peculiar velocity field, and the estimation of the mean density parameter.

Reference ***Preprint 1988.***

171 - 1988 *R. Ruffini and D.J. Song*

The Jeans Instability and the Formation of Structure of the Universe

For the dominant component of the dark matter which dominates the matter of the Universe, the weakly interacting neutyral leptons are discussed. The cosmological rate equation for leptions with non--zero chemical potentials are solved and new cosmological constraints on the mass and degeneracy paramter are obtained. For light leptons, the formation of large scale structure of the Universe were discussed in the framework of the fractal set.

Reference ***World Scientific, 1st Italian--Korean Symposium on Relativistic Astrophysics. 1987-- World Scientific, Singapore. 1988.***

172 - 1988 *G. Ingrosso, M. Merafina, R. Ruffini*

On Systems of self-gravitating Fermions with a Cutoff in their Distribution Function

We analyze with a general relativistic treatment the configuration of a quantum system of fermions with a distribution function with a cutoffin momentum space. This distribution function also introduces a spatial cutoff in selfgravitating systems otherwise unlimited. The quantities of astrophysical interest of the equilibrium configurations are given for selected values of the parameters from the classical nondegenerate limit to the quantum fully degenerate limit.

Reference ***Proceedings of the Fifth Marcen Grossmann Meeting, Perth, West Australia. 1988. World Scientific Singapore. 1988.***

173 - 1988 *G. Ingrosso, R. Ruffini*

On System of Self-gravitating Bosons and Fermions undergoing Quantum Condensation. Newtonian Approach.

A system of N self--gravitating bosons or fermions can, by loss a total energy, concentrate, gain gravitational energy, and heat up. If the particle number N is smaller than a critical number $N^F_crit \sim (Planckmass/m)^3$ for fermions and $N^B_crit \sim(Planckmass/m)^2$ for bosons, the system can heat up to temperatures and concentrate to densities such that some particles win reach a quantum ground state, functional of the total particle number. By further cooling of the system, the N particles approach well--known fully condensed or fully degenerate configurations. For bosons the apperance of a quantum condensed state leads to a phase transition of the first kind. For $N > N^F_crit$ fermions $N > N^B_crit$ bosons, the system increase their temperature and condense to configurations for which a general relativistic treatment is mandatory. The concept of maximum temperature for a self-gravitating Bose and Fermi system is introduced.

Reference ***Nuovo Cimento, IOIB. Aprile 1988.***

174 - 1988 *M. Giavalisco, D. Calzetti and R. Ruffini*

The Fractal Distribution of Matter in the Universe: The Spatial Two-point Correlation Function and the de Vaucoleurs Density Versus Radius Relation

A lot of observational evidences on the distribution of matter in the Universe at its various hierarchical levels--galaxies, clusters of galaxies, superclusters --seem to suggest strongly that it may be succesfully described by using a fractal approximation in the range of sistances from some fractions of Megaparsec to some hundreds of Megaparsec. One evidence is based on the spatial two--point correlation functions for the various galactic structures. Once the appropriate self--similar scaling relation is taken into account, it is easy to recognize that an the hierarchical levels of distribution of matter are in fact part of the same fractal structure. In this context we give some rules for the correlation analysis $^3,7)$. Another kinc: of proof for the fractal interpretation is the work by de Vaucouleurs $^14,15)$ where it is shown how the density versus radius relation for the matter in the Universe scales as an inverse power law form with an exponent very similar to the one satisfied by the correlation function. Once an appropriate value for the galactic mass is considered$^18)$ it is easy to see how the de Vaucouleurs results agree with the correlation function analysis in a neutrino dominated fractal cell model for the Universe $^19)$.

Reference ***Proceedings of the Fifth Marcel Grossmann Meeting on General Relativity, Perth, West Australia. 1988.***

175 - 1988 *J.A. de Freitas Pacheco, G. Pucacco, R. Ruffini, G. Sebastiani,*

Equilibrium Figures of An-iso-tropic Heterogeneous S--type Riemann Ellipsoids

The triaxial equilibrium figures of rotating inhomogeneous ellipsoidal configurations with a density distribution stratified on similar ellipsoids, a mean streaming motion linear in the coordinates and an anisotropic pressure tensor (here referred to as "anisotropic S--Type Riemann ellipsoids") are analyzed in the framework of the tensor virial theorem. The equilibrium solutions are first represented by the values of the anisotropic pressure parameters consistent with a given ellipsoidal figure. The analogous of the classical Riemann equilibrium sequences are defined and the Dedekind's theorem is generalized to this contest. The equilibrium figures are then depicted given the axial ratios compatible with a given value of the anisotropy. A stability analysis of the equilibrium is performed against odd mode second harmonical pertubations in the configuration space. Merits and limits of this approach to modelling eniptical galaxies are discussed.

Reference ***Accepted by Astron. Astrophys. 1988.***

176 - 1988 *R. Ruffini, D. Calzetti, M. Giavalisco*

The Large-Scale Structure of the Universe: Fractality and Homogeneity

It is shown the highly inhomogeneous self--similar distribution of extragalactic objects, put in evidence bv observations on spatial and angular correlation functions of galaxies, clusters and superclusters up to scales of about 100 Mpc, have been conciliated with the dominant homogeneity and isotropy of the Large--Scale Universe.

Reference ***Annales de Physique, Colloque N. 3, Supplement au N.6, 13. 1988.***

177 - 1988 *F. Melchiorri, R. Ruffini.*

Gamow Cosmology

Reference ***eds., Proceedings of the International School of Physics "Enrico Fermi", course LXXXVI, 13–23 July 1982, Nuclear Physics B, Volume 297, Issue 4, 22 February 1988, Page 839***

178 - 1988 *Edit. Kim Y.D., Lee C.H., Ruffini R.*

Proceedings of the "1st Italian-Korean Symposium on Relativistic Astrophysics" 3-8 September, 1987

Reference ***World Scientific Pub., Singapore, 1988***

179 - 1989 *D. Calzetti, M. Giavalisco, R. Ruffini*

Angular Correlation Functions of Galaxies and Fractal Cen Model for the Universe: Comparison with Observations

An alternative interpretation of Peebles and co--workers' results on the angular two--point correlation amplitude of galaxies in the Zwicky and Shane-Wirtanen catalogs is here presented, supporting the idea of a large--scale structure of the Universe consisting of 110--200 Mpc fract.31 cells.

Reference ***Proceedings of the Fifth Marcell Grossmann Meeting on General Relativity, Perth, West Australia, 1988. World Scientific, Singapore. 1989***

180 - 1989 *D. Calzetti, M. Giavalisco, R. Ruffini*

The Angular Two-Point Correlaction Function and the Cenular Fractal Structure of the Universe

An alternative interpretation of the observational results on the angular two-point correlation functions is here presented. They are used for determining the upper cutoff R_co of a cellular structure for the Universe, each cell being a fractal, but randomly distributed with respect to the others. The values obtained seem to support the above scenario, even if further analyses are needed.

Reference ***Astron. Astrophys. 226, 1-8, 1989.***

181 - 1989 *D. Calzetti, M. Giavalisco, R. Ruffini*

The de Vaucouleurs Density-Radius Relation and the Fractal Structure of the Universe

The de Vaucouleurs astrophysical desnity--radius relation in reinterpreted in the framework of the fractal structure of the Universe in presence of a lower and upper cut--off size.

Reference ***Submitted to Astronomy and Astrophysics.***

182 - 1989 *P. Carini, R. Ruffini*

Rotovibrational Modes of Neutron Stars

Reference ***Submitted.***

183 - 1989 *S. Cosentino, V.G. Gurzadyan, A.A. Kocharyan, R. Ruffini.*

The Instability of Plasma Type Configurations from the Concept of Ergodic Theory

The problem of statistical properties of neutral plasma type configurations (systems of N charged particles) is considered. The criterion of relative instability of many--dimensional dynarnical systems proposed in [5] and based on the calculation of the Ricci curvature in the direction of the velocity of geodesics in the configurational space is used. Two kinds of numerical experiments are performed in order to investigate: a) relative instability of different static configurations; b) variation of instability properties during the evolution of a given system. The results of calculations enable us to understand the dependence of instability properties of systems on their physical characterics. The method used here can be applied to more complicated systems -- plasma configurations of physical and astrophysical interest.

Reference ***Submitted to Il Nuovo Cimento 1989.***

184 - 1989 *L.L. Feng, M. Li, R. Ruffini*

Optical Activity in a Rotating Frame of Reference

We present here an investigation of phase factor that photon may receive in a rotating frame of reference. The resulting pjhase include the three part, the Berry phase, the Sagnac factor and a new term unknown before. The new phase factor is due to the coupling of intrinsic spin of photon with rotation, an must became significant in a strong gravitational field produced by a rapidly rotating object. The experimental justification of the new effect is suggested.

Reference ***Nuclear Physics B 6, 314. 1989.***

185 - 1989 *S. Filippi G. Busarello and R. Ruffini*

Equilibrium of triaxial self-gravitating ellipsoids with rotation, vorticity and anisotropic pressure

Reference ***Proc. Fifth Marcel Grossmann Meeting, World Scientific 1989.***

186 - 1989 *G. Busarello, S. Filippi and R. Ruffini*

Observable properties of generalized Riemann ellipsoids and their application to elliptical galaxies

Reference ***Proc. Fifth Marcel Grossmann Meeting, World Scientific 1989.***

187 - 1989 *Eds. Bernacca P.L., Ruffini R.*

Physics and astrophysics in the space station era
First scientific meeting of the international forum on the scientific uses of the space station.

Reference ***Bologna, Italian Physical Society, 1989***

188 - 1989 *Editors Blair D.G., Buckingham M.J.*
Series Editor Ruffini R.

Proceedings of the "Fifth Marcel Grossmann Meeting on General Relativity"
University of Western Australia, August 8-13, 1988

Reference ***World Scientific Publishing Co. Pte. Ltd., 1989***

189 - 1990 *R. Fabbri and R. Ruffini*

Anisotropies of the Cosmic Background Radiation in a Cellular-Structured Universe

We study the anisotropies of the cosmic background radiation within the framework of a recent model which considers a fractal distribution of cosmic matter up to characteristic cells of size 100-300 Mpc. This model, while it meets no diffculty with anisotropy data at angular scales $\gamma < 1^\circ$, is usefully constrained by data at $1^\circ < \gamma < 90^\circ$. We impose limits on the rms perturbation amplitude at thermal decoupling, which depend on γ^*, the angular size of the fractal cell. A recently claimed detection of anisotropy at the scale of 8° is also discussed in the light of the model.

Reference ***Astronomy and Astrophysics 228, 1-5, 1990.***

190 - 1990 *G. Fanari, R. Ruffini and D.J. Song*

Cosmological Limits on the Inos Masses in a Universe with Net Leptonic Number

We examine the case of Lee and Weinberg leptons with a non--vanishing chemical potential and, correspondingly, we establish the cosmological limits on the relative lepton number β and the masses of the inos. In order to have a flat universe the relative lepton number is bounded to the $\beta_crit \leq 1.6 \cdot 10^-9$.

Reference ***Submitted. 1990***

191 - 1990 *Long Long Feng, Miao Li and R. Ruffini*

Berry Phase of Photon and Sagnac Effect.

We give a naive derivation of Berry of photon travelling along opticalifibre and its Sagnac facto, which differs from the original treatment of Chiao and Wu. In addition a new factor unknown before appears, it must become significant in a strong gravitational field suc as one surrounding the Kerr black hole.

Reference ***Submitted. 1990***

192 - 1990 *R. Ruffini, D.J. Song and S. Taraglio*

The Fragmentation of Supercluster and Large scale structure of the Universe.

We examine the spectrum of cosmological perturbations which may give origin to a cellular observer--homogeneous self similar structure in the Universe, which we have recently proposed. We assume that this structure originates by successive fragmentations in the dark matter "ino" component, due to a process of Jeans instability. The fragmentation is characterized by the number of fragments (N) occurring at each step and by a characteristic "lagging time factor" (τ) at each successive fragmentation. In order to fulfil the observed spectrum of perturbations, at the present epoch, suitable values r are defined, the process is quite independent on the value of N. The initial spectrum of perturbations is found to have a flat Zel'dovich spectrum with an upper and lower cutoff. The initial amplitudes of the perturbations, as well as the ones to be found at the era of decoupling between matter and radiation, are discussed.

Reference ***Astronomy and Astrophysics, 232, 7--15, 1990***

193 - 1990 *R. Ruffini*

On the de Vaucouleurs Density Radius Relation and the Cellular Intermediate Large Scale Structure of the Universe.

The de Vaucouleurs mass density relation is interpreted in term of a fractal and cellular structure and the usually adopted cosmological conditions of homogenity and isotropy, on the three dimensional space, are critically discussed.

Reference ***A book in honour of de Vaucouleurs. 1990***

194 - 1990 *R. Ruffini*

Effects of Rotation in Newtonian and Relativistic Regime

Reference ***Paper VI.4. 1990***

195 - 1990 *G. Busarello, S. Filippi and R. Ruffini*

On "b-type" Spheroids

In t\his paper we analyze the equilibrium, the stability and some physical properties of a class of spheridal configurations discovered in the framework of previous studies on anisotropic and inhomogeneous ellipsoidal system. The systems studied here are oblate spheroids which rotate perpendicularly to the symmetry axis. We take into account the inhomogeneity of the density distribution, the anisotropy in the velocity distribution as well as two types of global motions: figure rotation and internal streaming. The method of analysis is the solution of the tensor virial equations and their second order perturbations.The requirements of equilibrium and expecially of stability put strict limits on the possible range of ellipticities and anisotropies of these systems. Such systems can in fact exist only if other components and only if the axial ratio is greater than $\sim$ 0.1.We find also that there is a maximum and minimum angular velocity, at which the potential (figure) can rotate.

Reference ***Astronomy Astrophys. 227, 30-32, 1990***

196 - 1990 *S. Cosentino, G. Pucacco, R. Ruffini*

Relaxation Times in Systems with Long-Range Interactions.

Reference ***Submitted to Europhysic Letters. 1990***

197 - 1990 *G. Pucacco, R. Ruffini*

Astrophysical implications of inertial properties of Riemann ellipsoids

We indicate some possible astrophysical of the Riemann ellipsoids (S--type and I--type, according to the classification made by Chandrasekhar) in two very different regimes: (a) in the dynamics of an isolated elliptical galaxy and (b) in the phases of a newly formed neutron star.

Reference ***Accepted in Astronomy and Astrophysics 1990.***

198 - 1990 *S. Filippi, R. Ruffini and A. Sepulveda*

Generalized Riemann configurations and Dedekind's theorem: the case of non-linear internal velocities

The S--type Riemann configurations are generalized to a non--linear form of the velocity field, given by a polynomial expression in odd powers of the coordinates. The velocity field with a cylindrical structure and the equilibrium equations are given. The adjoint solutions, in the Dedekind sense, have been found and discusses. Finally the equations for the stability against odd and even modes of perturbations are presented and the general algoritms for the solution of the characteristic equations are given.

Reference ***Astron. Astrophys. 231, 30--40, 1990.***

199 - 1990 *R. Ruffini*

Risultati recenti sulla natura e distribuzione della materia nell'universo

Reference ***Scientia, L'immagine e il Mondo, Comune di Milano 1990***

200 - 1990 *R. Ruffini*

Galassie, cosmologia e fisica fondamentale

Reference ***Scienza & Tecnica - Annuario della Est - Mondadori 1990***

201 - 1990 *S. Filippi, R. Ruffini, A. Sepulveda*

Nonlinear Velocities in Generalized Riemann Ellipsoids

The Dirichlet problem concerning the equilibrium conditions, under which a selfgravitating homogeneous fluid mass can maintain at every instant an ellipsoidal form, is here generalized. We provide the conditions necessary to solve the Dirichlet problem in a more general case of heterogeneous masses having nonlinear internal motions, using the second--order virial equations. The conditions for the stability are presented. It is also proved that the Dedekind theorem generalized to these new solutions is valid. These models may lead to a direct explanation of some basic features of galactic morphology.

Reference ***Il Nuove Cimento 105B, N. 8-9, 1047. 1990***

202 - 1990 *S. Filippi, R. Ruffini and A. Sepulveda*

On the Generalization of Dedekind-Riemann Sequences to Nonlinear Velocities

The well--known Dirichlet problem defining the ellipsoidal equilibrium configuration for a self--gravitating homogeneous fluid mass endowed with internal motion linear functions of the coordinates is here generalized. In the present work using the second--order virial equations we provide the conditions necessary to solve the Dirichlet problem in a more general case of heterogeneous masses having nonlinear internal motions. The equations for the stability are presented with the general algorithms for their solution. The generalization to these new solutions of Dedekind's theorem is also proved. These models may lead to a direct explanation of some basic features of galactic morphology. \ item (171) See no. 163

Reference ***Europhys. Lett. 12, 735. 1990***

203 - 1990 *R. Ruffini*

L'impresa di COBE

Reference ***Lettera Internazionale no.24 1990***

204 - 1990 *S. Filippi, R. Ruffini and A. Sepulveda*

On the generalized Riemann configurations and Dedekind's Theorem

Reference ***Astronomy and Astrophysics 231 , 30, 1990***

205 - 1990 *Edit. Kim Y.D., Lee C.H., Ruffini R.*

Proceedings of the "Second Italian-Korean Symposium on Relativistic Astrophysics" Rome - Limone Piemonte, July, 1989

Reference ***Società Italiana di Fisica, Bologna 1990***
Il Nuovo Cimento vol. 105B, n° 8-9, agosto-settembre 1990

206 - 1991 *D. Calzetti, Y.P. Jing, R. Ruffini*

A general treatment of two-point angular correlation function in cellular fractal structures

A general expression of two-point angular correlation function $\omega(\theta)$ is presented for the cellular fractal structures. The background contribution to $\omega(\theta)$ of the cellular distribution is fully considered in our derivation. A critical discussion about how to use the results presented here to test theoretical models is given.

Reference ***Astronomy and Astrophysics, Research Notes (Cosmology), 247, 1-2, 1991.***

207 - 1991 *D. Calzetti, M. Giavalisco, R. Ruffini, G. Wiedenmann*

The two point correlation functions applied to systems with or without a mean density

The definition of the correlation function is not unique and depends on thefreedom in choosing the normalization constraint. Such a lackness of uniqueness strongly influences the correlation amplitude and, as a consequence, may change the interpretation of physical quantities in the system considered.This effect occurs in systems where it is not possible to define a mean value for the probability distribution of the average densities (e.g., an infinite fractal), while in the opposite case (as, for instance, liquids, where the average density is well defined, since it does not depend on the sample geometry) there is no contradiction between the different definitions of the correlation function. In this paper we indicate the sample dependence of the amplitudes of the different correlation functions in sets where the mean density of the statistical population is unknown or cannot be defined.

Reference ***submitted to Astronomy and Astrophysics 251, 385, 1991.***

208 - 1991 *D. Calzetti, M. Giavalisco, R. Ruffini, S. Taraglio, N. A. Bahcall*

Clustering of galaxies: fractal or homogeneous infrastructure?

The two-point angular correlation function of galaxies is determined as a function of magnitude limit (i.e. depth) for the sample of galaxies in the Zwicky catalogue. The observed scaling of the correlation function with depth is compared with that expected from the following models: the standard clustering model within a generally homogeneous medium; a pure fractal model; and a cell-fractal model. We find that a pure fractal model is inconsistent with the data, in accord with previous observations. The homogeneous model and a cell-fractal model with an upper cut-off radius $R_co\sim 30 h^-1$ Mpc are both consistent with the present data.

Reference ***Astronomy and Astrophysics, 245, 1, 1991.***

209 - 1991 *R. Ruffini, Hyung-Won Lee*

Multipoint Spatial Correlation Function on the Self--Similar Observer Homogeneous Structure

We presented explicit forms of 2-- and 3--point spatial correlation function for observer homogeneous and slf--similar structure. Our results have a little difference with the usual form in the 3--point case, but it is the same in the sense of the second order of the 2--point function.

Reference ***\it Il Nuovo Cimento \bf 105B, 1021. 1991***

210 - 1991 *A. Bianconi, R. Ruffini, H.W. Lee*

Limits from Cosmological Nucleosynthesis on the Leptonic Numbers of the Universe

Constraints on chemical potentials and masses of "inos" are calculated using cosmological standard nucleosynthesis processes. It is shown that the electron neutrino chemical potential, ξ_ν_e, should not be greater than a value of order of 1 and the possible effective chemical potential of the other neutrino species, ξ, and electron neutrino chemical potential are related approximately $10\xi_\nu_e \sim \xi$ in order not to conflict with observational data. The allowed regions consistent with the ^{4}He abundance observations are insensitive to the baryon--to--proton ratio, η, while those imposed by other light elements (D, ^{3}He, ^{7}Li) strongly depend on η. Values of the chemical potentials calculated by Ruffini etal., in a previous paper in the series, on the basis of a cellular large--scale structure of the universe are shown to be consistent with cosmological nucleosynthesis.

Reference ***Il Nuove Cimento B 105, 1055, 1991***

211 - 1991 *A. Bianconi, R. Ruffini, H.W. Lee*

Limits from Cosmological Nucleosynthesis on the Leptonic Numbers of the Universe

Constraints on chemical potentials and masses of "inos" are calculated using cosmological standard nucleosynthesis processes. It is shown that the electron neutrino chemical potential, ξ_ν_e, should not be greater than a value of order of 1 and the possible effective chemical potential of the other neutrino species, ξ, and electron neutrino chemical potential are related approximately $10\xi_\nu_e \sim \xi$ in order not to conflict with observational data. The allowed regions consistent with the ^{4}He abundance observations are insensitive to the baryon--to--proton ratio, η, while those imposed by other light elements (D, ^{3}He, ^{7}Li) strongly depend on η. Values of the chemical potentials calculated by Ruffini etal., in a previous paper in the series, on the basis of a cellular large--scale structure of the universe are shown to be consistent with cosmological nucleosynthesis.

Reference ***Astronomy & Astrophysics 241, 343-357, 1991***

212 - 1991 *L.L. Feng, H.J. Mo, R. Ruffini*

The Cellular Structure of the Universe and Cosmological Tests

We realize the description of the cellular structure of the universe with a power law distribution of matter within the framework of generalized Friedmann model. The inhomogeneity is normalized to present matter distribution. The distortion in Hubble flow by density inhomogeneity is calculated for different models. The extrapolation procedure for a global Hubble constant and other cosmological quantities are discussed. It is shown that the distortion in the Hubble flow has great meaning in the common cosmological tests as well as in the measurement of density distribution, clustering properties and peculiar velocities on large scales.

Reference ***\it Astron. Astrophys. 1991, 243, 283-294, 1991.***

213 - 1991 *Bianchi M., Grasso D. and Ruffini R.*

Jeans mass of a cosmological coherent scalar field

Density fluctuations of a cosmological quantum real scalar field in a coherent state are interpreted as Bogoliubov compressional excitations of a condensed Bose--Einstein gas. The Jeans instability mechanism is generalized in this funy quantum context. The evolution of the Jeans mass in a FRW Universe that emerges from an inflationary stage is then studied in the nonrelativistic and ultrarelativistic phases. The behavior of the Jeans mass is found to be qualitatively similar, although quantitatively different, to that of a fermion matter field. The introduction of the gauge--invariant formalism is necessary to find the time evolution of the perturbations in the radiation dominated stage.

Reference ***\it Astron. Astrophys. \bf 231, 301. 1991***

214 - 1991 *Merafina M. and Ruffini R.*

The relativistic equilibrium configurations of systems of particles with a cutoff in their phase space distribution functions

Selfgravitating systems of classical particles with two distribution functions with different law of cutoff are considered: one corresponding to a truncated and one to a smoothed distribution. The results are compared and contrasted and large differences are found for low values of a suitably defined cutoff parameter. Some well known results due to Zel'dovich and Podurets are shown to be a consequence only of an arbitrary constraint imposed, by them, on the entire family of solutions.

Reference ***\it Astron. Astrophys. \bf 227, 415. 1991***

215 - 1991 *J.G. Gao, M. Merafina and R. Ruffini*

The Semidegenerate Configurations of a Selfgravitating System of Fermions

The semidegenerate equilibrium configurations of a selfgravitating system of fermions have usually been treated by an expansion of the thermodynamical quantities around the fully degenerate values. It is shown that such an expansion is invalid in the low density regimes where in general a distribution function far from the degenerate one applies. This point is explicitly illustrated by comparing and contrasting the results based on a first and second order expansionfrom the fully degenerate values with the exact ones. These exact values have been obtained by a direct computation of the Fermi integrals. We find that for any value of the temperature $T \neq 0$, a system selfgravitating fermions leads to a configuration of equilibrium with a density decreasing at large distances as $\rho \sim r^-2$, quite independantly of the value of its central density, and, therefore, always infinite both in mass and radius.

Reference ***Astron. Astrophys. 235, 1. 1991***

216 - 1991 *G. Ingrosso, M. Merafina and R. Ruffini*

Systems of selfgravitating bosons with a cutoff in their distribution function. Newtonian

We examine the Newtonian equilibrium configurations of a system of bosons undergoing quantum condensation, with a distribution function with a cut--off in the momentum space. Bounded configurations with a core of condensed particles surrounded by an uncondensed phase are obtained. The results are compared and contrasted with the ones in which the spatial divergences are removed by a cut--off in density. The well--known solution corresponding to fully condensed configurations is obtained for suitable values of the central density.

Reference ***Il Nuovo Cimento \bf 105B, 977. 1991***

217 - 1991 *S. Filippi, R. Ruffini, and A. Sepulveda*

Generalized Riemann ellipsoids: equilibrium and stability.

Generalization of the velocity field in an anisotropic and inhomogeneous ellipsoid to the non linear case proposed in a previous paper is extended to cover the most general directions of the vorticity and angular velocity. A Roberts form for density is used instead of the restricted Ferrers density. Equilibrium sequences are determined and their stability against odd and even modes of oscillation is discussed. Dedekind's and Riemann's theorems are extended. We also examine the dynamical case and the angular momentum, precession, vorticity and energy of the sequences.

Reference ***Astron. Astrophys., 1991, 246, 59-70 1991***

218 - 1991 *P. Carini, R. Ruffini*

Emission of gravitational waves from roto-vibrational modes of a compressible and homogeneous star

Based on Cahndrasekhar's and Lebovitz's treatment of the roto-vibrational modes of a homogeneous compressible star, the energy losses and damping rates of each mode by gravitational radiation are computed as a function of the eccentricity e of the equilibrium configuration. Numerical values are estimated for a neutron star. The limit of low eccentricity is considered, compared and contrasted to exixting treatment.

Reference ***Astronomy Astrophys. 1991, 248, 115-123***

219 - 1991 *H.W. Lee, R. Ruffini*

Three points spatial correlation function

We present explicit forms of two and three points spatial correlation functions for observer homogeneous and self similar structure. We obtained the two points one with the same form of Calzetti, et al., 1988, that is, power law with the sample size dependent amplitude. But three points one has the linear terms of the two points one, which was ignored in the usual hierarchical form, with overall coefficient 1/3, which is expected to be 1 in the usual hierarchical form. The crucial difference of our theoretical form is that it is increasing function of separation after a certain scale. Of course, our theoretical form does not contain any observational effects, say selection function, thus our results can not be compared directly with the real catalogue data unless we use a correct estimator for correlation functions. Assuming the selection effect is only given by the Schechter luminosity function and using the estimator expected by the theoretical derivation, we measured the two and three points functions for CfA catalogue. Our results for two points function gives the rather small power index, approximately 1.1. and shows the power law feature continue only up the scale 25 Mpc.

Reference ***Sumitted to Astr.Astrophysics 1991.***

220 - 1991 *Gao J.G., Merafina M. and Ruffini R.*

The semidegenerate configurations of a selfgravitating system of fermions

The semidegenerate equilibrium configurations of a selfgravitating system of fermions have usually been treated by an expansion of the thermodynamical quantities around the fully degenerate values. It is shown that such an expansion is invalid in the low density regimes where in general a distribution function far from the degenerate one applies. This point is explicitly illustrated by comparing and contrasting the results based on a first and second order expansion from the fully degenerate values with the \it exact ones. These exact values have been obtained by a direct computation of the Fermi integrals. We find that for \it any value of the temperature $T\neq 0$, a system of selfgravitating fermions leads to a configuration of equilibrium with a density decreasing at large distances as $\rho\sim r^-2$, quite independently on the value of its central density, and, therefore, \it always infinite both in mass and radius.

Reference ***Acta Astrophysica Sinica 11(4), 297 (1991)***

221 - 1991 *Boccaletti, D. Pucacco, G. Ruffini*

Multiple time-scales in stellar dynamics

The time-scales corresponding to the violent relaxation phase, to the subsequent collective relaxation phase and to the final binary relaxation phase are treated in the framework of the theory of flows in configuration manifolds of negative curvature. An unified picture of relaxation processes in stellar dynamics is therefore obtained.

Reference ***1991, Proc. of the Meeting to celebrate the 80th birthday of Livio Gratton, SIF, Bologna***

222 - 1991 *Boccaletti D., Pucacco G., Ruffini R.*

Multiple Relaxtion Time-Scales in Stellar Dynamics

A rigorous treatment of the violent relaxation phase of a large self-gravitating stellar system is made in the framework of the analytical dynamics. In the regime in which the coarse-grained virial theorem can be applied, the stellar system can be considered a \it mixing system. The consequent instability of the Anossov flow leads to the evaluation of the violent relaxation time scale.

Reference ***1991, Astron. Astrophys. 244, 48.***

223 - 1991 *G. Ingrosso, D. Grasso and R. Ruffini*

Quantum self-gravitating systems of bosons and fermions

We examine self-gravitating systems made of a mixture of condensed bosons and degenerate fermions in the Newtonian regime. We develop a numerical approach to determine the relevant quantities of the equilibrium configurations. An analytical treatment is also obtained in the limits in which the central density of one component is dominant. For the case in which the fermions are neutrons and the boson mass in greater than $10^-7eV c^-2$, we find : 1) for those configurations in which the central density of fermions dominates, the gravitational field confines the boson component to a region smaller than that occupied by the corresponding pure boson configuration. The size of such region $R_B \sim (\hbar/m_B \sqrtG \rho_F(0))^1/2$ is independent of the boson number and relates to the fermion density; 2) both in the cases of a boson density smaller or larger than the fermion density, the bosons do not perturb significantly the fermions, which distribute according to the usual solution of Chandrasekhar.

Reference ***Astron. Astrophys, 248, 481-484, 1991.***

224 - 1991 *D. Boccaletti,G. Pucacco, R. Ruffini*

Multiple relaxation time-scales in stellar dynamics

Reference ***Astron. Astrophys., 244, 48;***

225 - 1991 *Fang L.Z., Ruffini R.*

Basic concepts in relativistic astrophysics
Chinese version

Reference ***Taiwan, Eastern Asian Pu., 1991***

226 - 1992 *P.Carini, L.L. Feng, M. Li and R. Ruffini*

Phase Evolution in Photon in Kerr Spacetime.

Under eikonal approximation on Maxwell equation in curve space, the spin function of photon in degenerate metric is determined. Furthermore, we present an investigation of phase factor that photon may receive in Kerr geometry.The resulting phase factor consit of two parts, real and image one . The real part has been interpreted as making the rotation of polarization plane for linear polarized light, and irnage one make the light intensity descreasing along with photon propagating in gravitation field. Finany, so caned "Sagnac factor" concerning with phase shift is given.

Reference ***Physical Review D 46, 5407-5413 (1992)***

227 - 1992 *P. Cipriani, G. Pucacco, R. Ruffini*

On Axisymmetric solutions of Jeans equations

In this paper we use the results of a previous work to show an alternative explanation to the problem of slowly rotating elliptical galaxies. The main issue of our analysis is that it is possible to construct fully analytical solution of Jeans equations, with rotation and dispersion velocity curves in agreement with observational results, \it and that this can be achieved even when the distribution function $f(\xx,\vv)$ depends only on two isolating integrals of motion.

Reference ***in Proceedings of the Sixth Marcel Grossmann Meeting on General Relativity, 1991 - Word Scientific,1992, in press.***

228 - 1992 *P. Cipriani, G. Pucacco and R. Ruffini*

Some considerations on the issue of relaxation in N-body systems

The present status of the analysis of relaxation to equilibrium in \it N-body self-gravitating systems is blocked on the (unsolved) juxtaposition between the results of the classical theory of the binary relaxation (Chandrasekhar, 1942; Binney \& Tremaine, 1987) and that based on the ergodic theory of dynamical systems (Gurzadyan \& Savvidy, 1986 (GS); Kandrup, 1989). We present a possible explanation of the different mechanism involved in the two kinds of relaxation and discuss some consequences, physical as astronomical, thereof.

Reference ***Proceedings of the IX Santa Cruz Summer Meeting on Globular Cluster and their Galaxy Connection, 19-30 July 1992.***

229 - 1992 *V. Belinski and R. Ruffini.*

Exact Solutions and Gravitational Waves "Radiation from a relativisticmagnetized star"

Reference ***Astrophysical Journal 401: L27-L29, 1992 December 10.***

230 - 1992 *R. Fabbri, R. Ruffini*

Anisotropies of the Cosmic BackgroundRadiation and Characteristic Scale of a Cellular-Structure Universe

We provided detailed calculations of the anisotropies of the microwavebackground, from the arcminute range to the quadrupole scale, for thecellular-fractal universe introduced in Paper I of this series. Contrary toearlier estimates, we find that the model is consistent with microwave data fora fractal cell radius $R,50h^{-1}$ Mpc. The resulting picture also agrees withvery recent astronomical observations including the striking results ofBroadhurst et. al.(1990) which constitute a hard challenge for standardpower-law theories of galaxy formation. We sho that the anisotripies in thebackground radiation should be looked for mainly in the arcminute range, adirect imprint of the cosmic cell radius being predicted around 10'-20'.\vfill\eject{\bf E - Sistemi Classici Autogravitanti}\pto{\bf E - Classical Selfgravitating Systems}\pto\

Reference ***Astron. Astrophys. 254. 7-13 1992.***

231 - 1992 *Ingrosso G., Merafina M., Ruffini R., Strafella F.*

Galactic halos and limits on the particle mass

We study the gravitational equilibrium of systems composed byfermions obeying a modified Fermi-Dirac distribution function. An energy cutoff in the phase space is introduced to account for the existence of an escape velocity from the system. We further consider an angular momentum cutoff giving an anisotropy in the velocity space. Limits on the fermionmass are derived both from phase space constraints and from general features of the observed rotation curves in spiral galaxies.

Reference ***in Proceedings of the Sixth Marcel Grossmann Meeting on General Relativity, Kyoto 1991 - Word ScientificPublishing 1992.***

232 - 1992 *Merafina M., Bisnovatyi-Kogan G.S., Ruffini R., Vesperini E.*

Stability of the dense stellar clusters to relativistic collapse

Stability of dense stellar clusters to relativistic collapse is investigated by an approximate method, similar to static criteria of stellar stability. The equilibrium models with Maxwellian distribution function with cutoff, studied by Zel'dovich and Podurets (ZP), have been considered. The method considers asimple non-Maxwellian distribution function, obtained from the Maxwellian one by the condition of conservation of adiabatic invariant during collisionless perturbations: $f_a\sim\exp\{-[p^2c^2(R/R_0)^2+m^2c^4]^{1/2}/kT\}$. The method considered here gives approximate results about the stability, because adiabatic perturbations of Maxwellian model lead to complicated non-Maxwellian distribution, which cannot be written analytically. Nevertheless the resultsare much closer to the results of numerical simulations than the original ZP ones. \pto\

Reference ***in Proceedings of the Third Italian-Korean Symposium on Relativistic Astrophysics, 1991 - Journal of the Korean Physical Society (Suppl.) 25, S241 1992.***

233 - 1992 *P. Cipriani, G. Pucacco, R. Ruffini*

On the real occurrence of athird integral in axisymmetric models of elliptical galaxies

In this paper, we start to investigate on a class of solutions of Jeans equations for axisymmetric models of elliptical galaxies, characterizedby a low rotation velocity and a relatively high velocity dispersion, as seems to be the case for {\sl "real"} ellipticals.\ Nevertheless, we want to stress that it is possible to construct these models starting from a distribution function that depends only on two classical integrals of motion, the energy and the component of angular momentum along the symmetry axis, and therefore without{\it "radial"} anisotropy in the velocity dispersion tensor.\

Reference ***Third Italian-Korean Symposium on Relativistic Astrophysics, Seoul, Journal of Korean Physical Society (Suppl.) 25, S 212, 1992.***

234 - 1992 *H.W. Lee, R. Ruffini*

Directional two points correlation function: definition.

We defined a directional two points correlation function to analyze the structure of the universe. We analyze CfA catalogue using this directional two points correlation function instead of usual correlation function. This directional correlation function strongly depend on the distribution property of the universe, say string, sheet and sphere like clustering. This analysis will give a clue to distinguish between small and large scale clustering properties. \

Reference ***Proceedings of the Third Italian-Korean Symposium on RelativisticAstrophysics, Seoul, Journal of Korean Physical Society (Suppl.) 25, S 278, 1992.***

235 - 1992 *Boccaletti D., Merafina M., Ruffini R.*

Gravithermal instability of selfgravitating systems with an energy cut-off in their distribution function

The problem of the gravithermal instability is studied in the case of N-body selfgravitating systems with a King-like distribution function. Introducing a suitable {\it effective potential} the distribution is led to the Boltzmann one. At any radius r the system looks like an ideal gas submitted to an "external field". Due to the presence of the cut-off, a different behaviour is found with respect to the classical Lynden-Bell and Wood treatment.

Reference ***Proceedings of the Sixth Marcel Grossmann Meeting on General Relativity, Kyoto 1991 - Word Scientific Publishing , 1992.***

236 - 1992 *R. Fabbri, R. Ruffini*

Anisotropies of the Cosmic Background Radiation and Characteristic Scale of a Cellular-Structure Universe

We provide detailed calculations of the anisootropies of the microwave background from the arcminute range to the quadrupole scale, for the cellular-fractal universe introduced in Paper I of this series. Contrary to earlier estimates, we find that the model is consistent with microwave data for a fractal cell radius $R<50 h^-1 Mpc$. The resulting picture also agrees with very recent astronomical observations, including the striking results of Broadhurst et al. (1990), which constitute a hard challenge for standard power-law theories of galaxy formation. We show that the anisotropies in the background radiation should be looked for mainly in the arcminute range, a direct imprint of the cosmic cell radius being predicted around 10'-20'.

Reference ***Astron. Astrophys. 254, 7-13, 1992.***

237 - 1992 *Ingrosso G., Merafina M., Ruffini R., Strafella F.*

System of selfgravitating semidegenerate fermions with a cutoff of energy and angular momentum in their distribution function

We study the gravitational equilibrium of static, spherically symmetric, Newtonian systems consisting of a collisionless semidegenerate Fermi gas. A cutoff in the phase space distribution function of the particles is introduced in order to avoid the problems arising from the infinite radius of semidegenerate configurations when the usual Fermi-Dirac function is used. We consider, here, the more general case of a cutoff in energy and angular momentum, the latter giving an anisotropy in the velocity space. The treatment is applied to model massive galactic halos. Limits on the mass of the "inos" composing the halos are derived both from phase space constraints and from general features of the observed rotation curves in spiral galaxies.

Reference ***Astronomy and Astrophysics, 258, 223, 1992.***

238 - 1992 *Boccaletti D., Merafina M., Ruffini R.*

A re-investigation of the gravothermal catastrophe. The case of a self-gravitating gaseous sphere with a King-like distribution function

The problem of the gravithermal instability is studied in the case of N-body selfgravitating systems with a King-like distribution function. Introducing a suitable \it effective potential the distribution is led to the Boltzmann one. At any radius r the system looks like an ideal gas submitted to an "external field". Due to the presence of the cut-off, a different behavior is found with respect to the classical Lynden-Bell and Wood treatment.

Reference ***Third Italian-Korean Meeting on Relativistic Astrophysics, 1991 - Journal of the Korean Physical Society (Suppl.) 25, S201, 1992.***

239 - 1992 *M.Di Bari, R.Ruffini, S.Taraglio*

Neutrino parameters in a Cellular-Structured Universe

Reference ***J. Kor. Phys. Soc., 25, S185 (1992).***

240 - 1992 *M.Di Bari, R.Ruffini, S.Taraglio*

Limits on neutrino mass from improved Astrophysical observations

Reference ***Proc. "The Sixth Marcel Grossmann Meeting on General Relativity" (Kyoto, Japan, June 23-29 1991), p. 1554, World Scientific (1992).***

241 - 1992 *Editors Humitaka Sato, Takashi Nakamura*
Series Editor Ruffini R.

Proceedings of the "Sixth Marcel Grossmann Meeting on General Relativity"
Kyoto International Conference Hall, Kyoto, Japan June 23-29, 1991

Reference ***World Scientific Pub., 1992***

242 - 1993 *Bisnovatyi-Kogan G.S., Merafina M., Ruffini R., Vesperini E.*

Stability of the dense stellar clusters

Stability of dense stellar clusters to relativistic collapse is investigated by an approximate method, similar to static criteria of stellar stability. The equilibrium models with Maxwellian distribution function with cutoff, studied by Zel'dovich and Podurets (ZP), have been considered.

Reference ***in Proceedings of Workshop on Dynamics of Globular Clusters, 1992 - PASP Conference Series 50, 123 (1993).***

243 - 1993 *Boccaletti D., Merafina M., Ruffini R.*

Thermodynamic instabilities in King clusters

A new thermodynamic treatment of selfgravitating systems is given in the "mean field approximation". The introduction of a suitable \it effective potential let a King-like distribution function to be led to a Boltzmann one. In this context, the stability of the equilibrium configurations is investigated under small departures from thermal equilibrium.

Reference ***in Proceedings of XI S.Cruz Summer Workshop on Globular Clusters, 1992 - PASP Conference Series 48, 709 (1993).***

244 - 1993 *Bisnovatyi-Kogan G.S., Merafina M., Ruffini R., Vesperini E.*

Stability of the dense stellar clusters to relativistic collapse

Stability of dense stellar clusters to relativistic collapse is investigated by approximate methods, similar to the static criteria of stellar stability. The equilibrium models with Maxwellian distribution function with cutoff, studied by Zel'dovich \& Podurets (ZP), have been considered. The first method is based on the choice of the sequence of Maxwellian models with fixed cutoff parameter, in accordance with adiabatic conditions $p_cut\sim n_c^1/3$. The second one is based on the consideration of the sequence of Maxwellian models with the same value of the total entropy $S=\int\!\!\!\int f(1-\ln f)d\vec pd\vec r$. The third method considers simple non-Maxwellian distribution function of the clusters, obtained from the Maxwellian one by the condition of conservation of adiabatic invariant: $f\sim\exp\-[p^2c^2(n_c0/n_c)^2/3+m^2c^4]^1/2/T\$. The methods considered here give approximate results about the stability, because adiabatic perturbations of Maxwellian model lead to complicated non-Maxwellian distribution, which cannot be written analitically. Nevertheless these results are better than ones obtained from the considerations of the sequence of Maxwellian models with different temperature, made by ZP. They are more close to the results of numerical simulation than original ZP ones. The coincidence of the temperatures in the critical point, $T=0.223~mc^2$, obtained by two last methods, makes us to believe that these methods, being approximate, give rather good relative precision, which is not worse than 10^-3.

Reference ***Astrophysical Journal 414, 187 (1993).***

245 - 1993 *Merafina M., Bisnovatyi-Kogan G.S., Ruffini R., Vesperini E.*

Stability of the dense stellar clusters

Stability of dense stellar clusters to relativistic collapse is investigated by an approximate method, similar to static criteria of stellar stability. The equilibrium models with Maxwellian distribution function with cutoff, studied by Zel'dovich and Podurets (ZP), have been considered. The method considers a simple non-Maxwellian distribution function, obtained from the Maxwellian one by the condition of conservation of adiabatic invariant during non collisional perturbations: $f_a\sim\exp\p^2c^2(R/R_0)^2+m^2c^4]^1/2/kT\$. The method considered here gives results coincident with the ones carried out by the method based on sequences at constant entropy. These results are better than ones obtained from considerations of the sequence of Maxwellian models with different temperature, made by ZP. In particular they are much closer to the results of the numerical simulations of Shapiro and Teukolsky.

Reference ***in Proceedings of XI S.Cruz Summer Workshop on Globular Clusters, 1992 - PASP Conference Series 48, 705 (1993).***

246 - 1993 *S. Torres, R. Fabbri, R. Ruffini*

The power spectrum implied by COBE and the matter correlation function

A phenomenological power spectrum of primordial density perturbations has been constructed by using both COBE data to probe the large wavelength region, and a double power law, locally deduced from galaxy catalogs, which describes the matter correlation function up to tens of Megaparsec. The shape of the spectrum P(k) of density fluctuations exhibits a peak that singles out a characteristic wavelength proportional to the cutoff radius R0 in the matter distribution (comparable to the distance at which matter becomes anticorrelated). {}From a least squares fit to COBE's angular correlation function we obtain R0 = 35 +- 12 Mpc/h for the correlation length, and n = 0.76 +- 0.3 for the spectral index of P(k) in the large wavelength region. The inferred scale in the spectrum is 51 +- 18 Mpc/h. This number agrees with that derived from the analysis of the correlation function of matter and with a preferred scale identified in IRAS PSC.

Reference ***5, Latex, ICRA31-5-93***

247 - 1993 *Fang L.Z., Ruffini R.*

Basic concepts in relativistic astrophysics
Chinese version

Reference ***Taiwan, Eastern Asian Pu., 1993***

248 - 1994 *S. Torres, R. Fabbri and R. Ruffini*

The power spectrum implied by COBE and the matter corerlation function

A phenomenological power spectrum of primordial density perturbations has been constructed by using both COBE data to probe the large wavelength region, and a double power law, locally deduced from galaxy catalogs, which describes the matter correlation function up to tens of Megaparsec. The shape of the spectrum P(k) of density fluctuations exhibits a peak that singles out a characteristic wavelength proportional to the cutoff radius R0 in the matter distribution (comparable to the distance at which matter becomes anticorrelated). {}From a least squares fit to COBE's angular correlation function we obtain R0 = 35 +- 12 Mpc/h for the correlation length, and n = 0.76 +- 0.3 for the spectral index of P(k) in the large wavelength region. The inferred scale in the spectrum is 51 +- 18 Mpc/h. This number agrees with that derived from the analysis of the correlation function of matter andwith a preferred scale identified in IRAS PSC.

Reference ***Astron. Astrophys., 287, 15 (1994).***

249 - 1994 *Ohanian H.C., Ruffini R.*

"Gravitation and Spacetime"

Reference ***W.W. Norton & Co., Ney York 1994 (2nd ed.) - English version***

250 - 1996 *S. Filippi, A.Sepulveda, R.Ruffini*

The implications of the n-th order virial equations on the equilibrium of Jacobi, Dedekind and Riemann ellipsoids

Reference ***A.P.J., 460, 762-776, 1996***

251 - 1996 *R.T.Jantzen, G. Mac Keiser, R.Ruffini*

Proccedings of the 7th Marcell Grossmann Meeting on General Relativity

The proceedings of the Seventh Marcel Grossmann Meeting on General Relativity, more specifically, on recent developments in theoretical and experimental general relativity, gravitation, and relativistic field theories, which took place at Stanford University in July 1994. One of two trienniel international meetings regularly held in this field. Two volumes of nearly 1800 pages of almost 400 author contributions.

Reference ***Stanford University, CA U.S.A, July 24-30, 1994, World Scientific Singapore, 1996, 522-524a.***

252 - 1996 *R.Ruffini*

On the Equation of State of White Dwarfs

Reference ***December 3,1996***

253 - 1996 *R.Ruffini*

On an additional relativistic effect in fermionic stars

Reference ***Il Nuovo Cimento Vol.11 B, N.1, gennaio 1996, Pacs 04.20***

254 - 1996 *Merloni A., R. Ruffini*

Relativistic ionization by compression of atoms and ions: a propedeutical study for degenerate stellar structures

Reference ***International Journal of Modern Physics D, vol.5, n.5, 507-518 (1996)***

255 - 1996 *P. Cipriani, M.T. Menna, G. Pucacco, R. Ruffini*

Global Properties of energy truncated spheroidal stellar systems

Reference ***Proceedings "The seventh Marcel Grossman Meeting on General Relativity", Stanford, U.S.A. Luglio 1994, Series Ed. R. Ruffini, World Scientific, 1996.***

256 - 1996 *M.Merafina, G.Bisnovatyi-Kogan, R. Ruffini, E.Vesperini*

Stability of dense stellar clusters against relativistic collapse: Maxwellian distribution functions with different cutoff parameters

Reference ***Proceedings "The seventh Marcel Grossman Meeting on General Relativity", Stanford, U.S.A. Luglio 1994, Series Ed. R. Ruffini, World Scientific, 1996.***

257 - 1996 *R. Ruffini, M.Capalbi, S.Filippi, J.G.Gao, L.A.Sanchez*

Landau damping in semi-degenerate gravitating systems

Reference ***Proceedings "The seventh Marcel Grossman Meeting on General Relativity", Stanford, U.S.A. Luglio 1994, Series Ed. R. Ruffini, World Scientific, 1996.***

258 - 1996 *Editors Jantzen R.T., Mac Keiser G.*
Series Editor Ruffini R.

Proceedings of the "Seventh Marcel Grossmann Meeting on General Relativity" Stanford University July 24-30, 1994

Reference ***World Scientific Pub., Singapore 1996***

259 - 1997 *V.Cocco, R.Ruffini*

Proceedings of the 4th Italian-Korean Meeting on Relativistic Astrophysics

Reference ***Editors: V Cocco, R. Ruffini, Meeting held in Rome- Gran Sasso- Pescara, July 9-15, 1995, Editrice Compositori, Bologna, 1997***

260 - 1997 *D.Calzetti, J.Einasto, M.Giavalisco, R.Ruffini, E.Saar*

The correlation function of Galaxies in the direction of the coma cluster

Reference ***Astrophys.Space Science, 137, 101, 1997***

261 - 1997 *R.Ruffini, G.Spoliti, V.Torroni*

On atomic ionization by compression

The Feynman-Metropolis-Teller treatment for compressed atoms is here reexamined in view of the process of ionization by compression of atoms.

Reference ***Proceedings of the 4th Italian-Korean Meeting on Relativistic Astrophysics, Roma, Luglio 1995, Il Nuovo Cimento Vol. 112 B, 491-500, N. 2-3, 1997***

262 - 1997 *V.Cocco, R.Ruffini*

On metastable Einstein's clusters

Specific and explicit examples of Einstein's clusters are given. We introduce the concept of metastable clusters and we analyze, as well, the special cases of clusters endowed with an infinite central gravitational redshift.

Reference ***Proceedings of the 4th Italian-Korean Meeting (1995), Il Nuovo Cimento Vol. 112 B, N. 2-3, 271-287 , 1997***

263 - 1997 *S. Filippi, R.Ruffini, A.Sepulveda*

The n-th order virial theory. Permitted figures of equilibrium

In the virial method we take moments of the equations of motion, from which we study the equilibrium and the stability of ellipsoidal figures. The virial equations of the various orders given by Chandrasekhar (Ellipsoidal Figures of Equilibrium, 2nd edition (Dover, New York, N.Y.) 1987) in the case of homogeneous and uniformly rotating masses, are generalized to nonuniformly rotating ellipsoidal configurations of nonhomogeneous density, with internal fluid motions of nonuniform vorticity. We derive the permitted equilibrium figures using the higher-order virial equations and we give a suitable classification.

Reference ***Proceedings of the 4th Italian-Korean Meeting on Relativistic Astrophysics, Roma, Luglio 1995. Il Nuovo Cimento Vol. 112 B, N. 2-3, Febbraio-Marzo, 299-307, 1997***

264 - 1997 *M.Merafina, R.Ruffini*

On a new family of stable relativistic star clusters

Reference ***International Journal of Modern Physics D, Vol.6, N.6 (1997) 785-791***

265 - 1997 *Bini D., R.Ruffini, Spoliti G.*

Gravitoelectromagnetism in rotating black holes spacetimes

Gravitoelectromagnetism in the Kerr space-time is studied in analogy with electromagnetism in the Kerr-Newman space-time. A recent suggestion by Semerak that there is a close similarity between the Kerr-Newman electromagnetic fields and the Kerr gravitoelectromagnetic ones is reanalysed and clarified as referring to the fields measured by the static observers in the two geometries.

Reference ***Proceedings of "The fourth Italian - Korean meeting on Relativistic Astrophysics", Roma, Luglio 1995, Il Nuovo Cimento, vol. 112B, N. 2-3 , 173-180, (1997).***

266 - 1997 *Cocco V., Ruffini R.*

Proceedings of the "Fourth Italian-Korean Symposium on Relativistic Astrophysics" Rome - Gran Sasso - Pescara, July 9-15, 1995

Reference ***Editrice Compositori, Bologna 1997***

267 - 1997 *Ohanian H.C., Ruffini R.*

"Gravitazione e spazio-tempo" (Gravitation and Spacetime)

Reference ***Zanichelli Bologna, 1997 (2 nd ed.) - Italian version***

268 - 1998 *G. Preparata, R. Ruffini, S.S. Xue*

The dyadosphere of black holes and gamma-ray bursts

The "dyadosphere" has been defined (Ruffini \cite{r2}, Preparata et al. \cite{prx}) as the region outside the horizon of a black hole endowed with an electromagnetic field (abbreviated to EMBH for ``electromagnetic black hole") where the electromagnetic field exceeds the critical value, predicted by Heisenberg & Euler (\cite{he}) for e(+) e(-) pair production. In a very short time (~ O / mc(2),) a very large number of pairs is created there. We here give limits on the EMBH parameters leading to a Dyadosphere for 10M_{\odot} and 10^5M_{\odot} EMBH's, and give as well the pair densities as functions of the radial coordinate. We here assume that the pairs reach thermodynamic equilibrium with a photon gas and estimate the average energy per pair as a function of the EMBH mass. These data give the initial conditions for the analysis of an enormous pair-electromagnetic-pulse or ``P.E.M. pulse" which naturally leads to relativistic expansion. Basic energy requirements for gamma ray bursts (GRB), including GRB971214 recently observed at z=3.4$, can be accounted for by processes occurring in the dyadosphere. In this letter we do not address the problem of forming either the EMBH or the dyadosphere: we establish some inequalities which must be satisfied during their formation process.

Reference ***Astron.Astrophys. 338 (1998) L87-L90***

269 - 1998 *A.Merloni, R.Ruffini, V.Torroni*

A relativistic extended Fermi-Thomas-Like equation for a self-gravitating system of fermions

We extend previous results of a Fermi-Thomas model, describing selfgravitating fermions in their ground state, to a relativistic gravitational theory in Minkowski space. In such a theory the source term of the gravitational potential depends both on the pressure and the density of the fluid. It is shown that, in correspondence of this relativistic treatment, still a Fermi-Thomas–like equation can be derived
for the self-gravitating system, though the non-linearities are much more complex. No Fermi-Thomas–like equation can be obtained in the General Relativistic treatment. The canonical results for neutron stars and white dwarfs are recovered and also some erroneous statements in the scientific literature are corrected.
PACS 97.60.Jd – Neutron stars.
PACS 04.40.Dg – Relativistic stars: structure, stability and oscillations.

Reference ***Il Nuovo Cimento Vol.113 B, N.2., 255-263, Feb 1998.***

270 - 1998 *R. Ruffini, L. A. Sanchez, C. Sigismondi, , S. Filippi*

The Galaxy Distribution and the Hubble Law in a Neutrino Dominated Universe

We rediscuss the problem of the free-streaming (that should be the responsible of the neutrino structures vanishing when their mass is lower that Jeans' mass) because we have found a divergence in the damping thime of fermion collapsing structures lighter than the Jeans' mass. We suppose that this pure quantum mechanical effect may prevent the free-streaming at those scales. Because of the scale invariance of our treatment it is possible to explane the local power-law distribution of the galaxies in the universe. We take in to account the conseguences on the Hubble law within a single cell that corresponds to the superclaster mass; out of this dimension the universe becomes homogeneous.

Reference ***in Memorie della Società Astronomica Italiana, Journal of the Italian Astronomical Society, Vol. 69 n. 1-1998 "Views on Distance Indicators" Sant'Agata sui Due Golfi-Massalubrense, 3-6 September 1997, Edited by M. Arnaboldi, F. Caputo and A. Rifatto, Mem. S.A.It., 1998-Vol. 69 -1, pag. 311-314.***

271 - 1998 *R. Ruffini*

On the dyadosphere of black holes

The "dyadosphere" (from the Greek word "duas-duados" for pairs) is here defined as the region outside the horizon of a black hole endowed with an electromagnetic field (abbreviated to EMBH for "electromagnetic black hole") where the electromagnetic field exceeds the critical value, predicted by Heisenberg and Euler for electron-positron pair production. In a very short time, a very large number of pairs is created there. I give limits on the EMBH parameters leading to a Dyadosphere for 10 solar mass and 100000 solar mass EMBH's, and give as well the pair densities as functions of the radial coordinate. These data give the initial conditions for the analysis of an enormous pair-electromagnetic-pulse or "PEM-pulse" which naturally leads to relativistic expansion. Basic energy requirements for gamma ray bursts (GRB), including GRB971214 recently observed at z=3.4, can be accounted for by processes occurring in the dyadosphere.

Reference ***18pages (RevTex), 9 figures and to appear in the proceeding of Yamada conference in Kyoto Japan, April 1998***

272 - 1998 *G. Preparata, R. Ruffini, S.S. Xue*

On the Dyadosphere of Black Holes

Basic energy requirements of Gamma Ray Burst(GRB) sources can be easily accounted for by a pair creation process occurring in the "Dyadosphere" of a Black Hole endowed with an electromagnetic field (abbreviated to EMBH for "electromagnetic Black Hole"). This includes the recent observations of GRB971214 by Kulkarni et al. The "Dyadosphere" is defined as the region outside the horizon of an EMBH where the electromagnetic field exceeds the critical value for e^+ e^- pair production. In a very short time $\sim O(hbar mc^2}), very large numbers of pairs are created there. Further evolution then leads naturally to a relativistically expanding pair-electromagnetic-pulse (PEM-pulse). Specific examples of Dyadosphere parameters are given for 10 and 10^5 solar mass EMBH's. This process does occur for EMBH with charge-to-mass ratio larger than 2.210^{-5} and strictly smaller than one. From a fundamental point of view, this process represents the first mechanism proved capable of extracting large amounts of energy from a Black Hole with an extremely high efficiency (close to 100%).

Reference ***J.Korean Phys.Soc. 42 (2003) S99-S104***

273 - 1998 *R. Ruffini*

Beyond the critical mass: The Dyadosphere of Black Holes

Reference ***Black Holes and High Energy Astrophysics, Proceedings of the Yamada Conference XLIX on Black Holes and High Energy Astrophysics held on 6-10 April, 1998 in Kyoto, Japan. Edited by H. Sato and N. Sugiyama. Frontiers Science Series No. 23, Published by Universal Academic Press, 1998, p.167***

274 - 1998 *G.S.Bisnovatyi-Kogan, M.Merafina, R. Ruffini, E.Vesperini*

Stability of dense stellar clusters against relativistic collapse. II. Maxwellian distribution functions with different cutoff parameters

We investigate the stability of dense stellar clusters against relativistic collapse by approximate methods described in the previous paper in this series. These methods, together with the analysis of the fractional binding energy of the system, have been applied to sequences of equilibrium models, with cutoff in the distribution function, which generalize those studied by Zeldovich & Podurets. We show the existence of extreme configurations, which are stable all the way up to infinite values of the central redshift.

Reference ***The Astrophysical Journal, 500:217-232, 1998 June 10***

275 - 1998 *Bini D., Gemelli G., R. Ruffini*

Nongeodesic motion of charged spinning test particles

Reference ***Proceedings of "The first ICRA Network workshop and the third William Fairbank meeting", Roma and Pescara, Giugno 1998, Series Ed. R. Ruffini, World Scientific.***

276 - 1998 *Bini D., Gemelli G., R. Ruffini*

Energy first integral for spinning particles in the Schwarzschild background

Reference ***Proceedings of "The first ICRA Network workshop and the third William Fairbank meeting", Roma and Pescara, Giugno 1998, Series Ed. R. Ruffini, World Scientific.***

277 - 1998 *Merloni A., R. Ruffini*

On the Equation of State of White Dwarfs: the Mass Radius Relation

Reference ***Journal of the Korean Physical Society, Vol. 33, December 1998, pp. S554-S556, Proceedings of the 5th Korean-Italian Symposium on the Relativistic Astrophysics, (held in Korea, Sept 1-6, 1997)***

278 - 1998 *Filippi, S., R. Ruffini, C. Sigismondi*

The physical rerasons of a local fractal universe

Reference ***Abstracts of the 19th Texas Symposium on Relativistic Astrophysics and Cosmology, held in Paris, France, Dec. 14-18, 1998. Eds.: J. Paul, T. Montmerle, and E. Aubourg (CEA Saclay).***

279 - 1998 *S.Filippi, J.Gao, R. Ruffini*

On the influence of degeneracy on gravitational instability

The influence of degeneracy on gravitational instability in a collisionless particle system with a semi-degenerate distribution function is discussed. The collapse time and the Landau damping time are calculated. The influence of degeneracy on Jeans wave number and on stability have important implications in the theory of galaxy formation in a universe dominated by fermionic dark matter.

Reference ***Chinese Astronomy and Astrophysics, v. 22, p. 380-385, 1998.***

280 - 1998 *R. Ruffini, S.S. Xue*

Radiation and Time Scale Evolution of a P.E.M. pulse fromEMBH

The "dyadosphere" is defined as the region outside the horizon of a black hole endowed with an electromagnetic field (EMBH) where the electromagnetic field exceeds the critical value for e^+e^- pair production. In a very short time (~O(frac{hbar}{mc^2})), a very large number of pairs is created there. Basic energy requirements of GRB sources, including GRB971214 recently observed at z = 3.4, can be easily accounted for by a pair creation process occurring in the "Dyadosphere" of a charged Black Hole. In Dyadosphere, The pairs reach thermodynamic equilibrium with a photon gas and form together with baryonic remnant an enormous pair-electromagnetic-pulse or "P.E.M. pulse" which naturally leads to relativistic expansion. Radiations from these "P.E.M. pulse" are given and compared and contracted with the observed time scales and power laws of RGB's and their afterglow.

Reference ***Abstracts of the 19th Texas Symposium on Relativistic Astrophysics and Cosmology, held in Paris, France, Dec. 14-18, 1998. Eds.: J. Paul, T. Montmerle, and E. Aubourg (CEA Saclay). Publication Date:12/1998***

281 - 1998 *R. Ruffini, J. Salmonson, J. Wilson, S.S. Xue*

Radiation and Time Scale Evolution of a P.E.M. pulse fromEMBH

By using hydrodynamical computing codes, we discuss the possible patterns of relativistic expansion of an enormous pair-electromagnetic-pulse (P.E.M. pulse), a high density and temperature plasma composed of electron and positron pairs, photons and baryons, created by a charged black hole (EMBH). On the basis of total energy and entropy conservation during P.E.M. pulse's expansion, we study the relativistic bulk Gamma factor of expansion P.E.M. pulses both numerical and analytical approaches, by simple idealized models as well as for the detail model using supercomputer and codes at Livermore Lab.

Reference ***Abstracts of the 19th Texas Symposium on Relativistic Astrophysics and Cosmology, held in Paris, France, Dec. 14-18, 1998. Eds.: J. Paul, T. Montmerle, and E. Aubourg (CEA Saclay). Publication Date:12/1998***

282 - 1999 *S. Filippi, R. Ruffini, L.A. Sanchez, C. Sigismondi*

An universe made from neutrinos is still possible?

Reference ***in proc. of. III W. Fairbank Meeting, World Scientific pub. 1999.***

283 - 1999 *R. Ruffini*

The Dyadosphere of Black Holes and Gamma-Ray Bursts

I am proposing and give reasons that with Gamma Ray Bursts, for the first time we are witnessing, in real time, the moment of gravitational collapse to a Black Hole.
Even more important, the tremendous energies involved by the energetics of these sources, especially after the discoveries of their afterglows and their cosmological distances (Kulkarni *et. al.* 1998), clearly point to the necessity and give the opportunity to use as an energy source of these objects the extractable energy of Black Hole.

Reference ***A&A macros, 3 pages and 1 figure, proceedings of Rome 98 GRB workshop, ed. by L. Piro and F. Fontera, Recent works on the Dyadosphere are reviewed***

284 - 1999 *R. Ruffini, J. D.Salmonson, J. R. Wilson, S. Xue*

On Evolution of the Pair-Electromagnetic Pulse of a Charge Black Hole

Using hydrodynamic computer codes, we study the possible patterns of relativistic expansion of an enormous pair-electromagnetic-pulse (P.E.M. pulse); a hot, high density plasma composed of photons, electron-positron pairs and baryons deposited near a charged black hole (EMBH). On the bases of baryon-loading and energy conservation, we study the bulk Lorentz factor of expansion of the P.E.M. pulse by both numerical and analytical methods.

Reference ***A&A macros, 2 pages, 1 figure and postscrit file, Proceeding of Rome98 GRBworkshop ed. L. Pira and F. Frontera
Astron.Astrophys.Suppl.Ser. 138 (1999) 511-512***

285 - 1999 *R. Ruffini, J. D.Salmonson, J. R. Wilson, S. Xue*

On the pair electromagnetic pulse of a black hole with electromagnetic structure

We study the relativistically expanding electron-positron pair plasma formed by the process of vacuum polarization around an electromagnetic black hole (EMBH). Such processes can occur for EMBH's with mass all the way up to $6\cdot 10^5M_\odot$. Beginning with a idealized model of a Reissner-Nordstrom EMBH with charge to mass ratio $\xi=0.1$, numerical hydrodynamic calculations are made to model the expansion of the pair-electromagnetic pulse (PEM pulse) to the point that the system is transparent to photons. Three idealized special relativistic models have been compared and contrasted with the results of the numerically integrated general relativistic hydrodynamic equations. One of the three models has been validated: a PEM pulse of constant thickness in the laboratory frame is shown to be in excellent agreement with results of the general relativistic hydrodynamic code. It is remarkable that this precise model, starting from the fundamental parameters of the EMBH, leads uniquely to the explicit evaluation of the parameters of the PEM pulse, including the energy spectrum and the astrophysically unprecedented large Lorentz factors (up to $6\cdot 10^3$ for a $10^3 M_{\odot}$ EMBH). The observed photon energy at the peak of the photon spectrum at the moment of photon decoupling is shown to range from 0.1 MeV to 4 MeV as a function of the EMBH mass. Correspondingly the total energy in photons is in the range of 10^{52} to 10^{54} ergs, consistent with observed gamma-ray bursts. In these computations we neglect the presence of baryonic matter which will be the subject of forthcoming publications.

Reference ***Astronomy and Astrophysics, v.350, p.334-343 (1999)***

286 - 1999 *R. Ruffini*

The Dyadosphere of Black Holes and Gamma-Ray Bursts

Reference ***Astronomy and Astrophysics Supplement, v.138, p.513-514 (1999), 1999A&AS..138..513R, Recent works on the Dyadosphere are reviewed***

287 - 1999 *T.Piran, R. Ruffini*

Proceedings of the Eigth Marcel Grossman Meeting on Recent Developments in Theoretical and Experimental General Relativity, Gravitation, and Relativistic Field Theories

Reference ***World Scientific, Singapore 1999***

288 - 1999 *Filippi S., Sigismondi C., R. Ruffini*

On the Power Law Dependence of the Average Density of the Galaxies in the Universe

Recent Developments in Theoretical and Experimental General Relativity, Gravitation, and Relativistic Field Theories

Reference ***Proc. of Eighth Marcel Grossmann Meeting, Jerusalem 22-27 June, 1997. Edited by Tsvi Piran and Remo Ruffini. World Scientific Publ. (1999), p.1252***

289 - 1999 *S. Casanova, G. Montani, R. Ruffini, R.Zalaletdinov*

On the non-riemannian manifolds as framework for geometric unification theories affine connection geometry with asymmatric metric.

Recent Developments in Theoretical and Experimental General Relativity, Gravitation and relativistic field theories.

Reference ***Hebrew University of Jerusalem, 22-27 June, 1997. Edited by Tsvi Piran and Remo Ruffini. World Scientific Publishers, 1999., p.436***

290 - 1999 *D.Bini, G.Gemelli, R. Ruffini*

Gravitoelectromagnetism and Motion of Spinning Test Particles in General Relativity

Recent Developments in Theoretical and Experimental General Relativity, Gravitation, and Relativistic Field Theories

Reference ***Hebrew University of Jerusalem, 22-27 June, 1997. Edited by Tsvi Piran and Remo Ruffini. World Scientific Publishers, 1999., p.404***

291 - 1999 *R. Ruffini*

The Dyadosphere of Black Holes and Gamma-Ray Bursts

Recent works on the Dyadosphere are reviewed.

Reference ***Astronomy and Astrophysics macros, 4 pages and 3 figures. To appear in the proceedings of 19th Texas Symposium, Paris Dec. 1998. Recent works on the Dyadosphere are reviewed***

292 - 1999 *Editors Tsvi Piran*
Series Editor Ruffini R.

Proceedings of the "Eighth Marcel Grossmann Meeting on General Relativity"
Hebrew University, Jerusalem June 22-27, 1997

Reference ***World Scientific Pub., Singapor 1999***

293 - 2000 *R. Ruffini*

Black Hole Formation and Gamma Ray Bursts

Recent work on the dyadosphere of a black hole is reviewed with special emphasis on the explanation of gamma ray bursts. A change of paradigm in the observations of black holes is presented.

Reference ***"Black Holes in Binaries and Galactic Nuclei", in honour of Prof. R. Giacconi, edited by L. Kaper, E.P.J. van den Heuvel, and P.A. Woudt, and printed in the series ESO Astrophysics Symposia by Springer (2000)***

294 - 2000 *R. Ruffini, J. D.Salmonson, J. R. Wilson, S. S.Xue*

On the pair and electromagnetic pulse of an electromagnetic black hole with baryon remnant

The interaction of an expanding Pair-Electromagnetic pulse (PEM pulse) with a shell of baryonic matter surrounding a Black Hole with electromagnetic structure (EMBH) is analyzed for selected values of the baryonic mass at selected distances well outside the dyadosphere of an EMBH. The dyadosphere, the region in which a super critical field exists for the creation of electron-positron pairs, is here considered in the special case of a Reissner-Nordstrom geometry. The interaction of the PEM pulse with the baryonic matter is described using a simplified model of a slab of constant thickness in the laboratory frame (constant-thickness approximation) as well as performing the integration of the general relativistic hydrodynamical equations. The validation of the constant-thickness approximation, already presented in a previous paper Ruffini, et al.(1999) for a PEM pulse in vacuum, is here generalized to the presence of baryonic matter. It is found that for a baryonic shell of mass-energy less than 1% of the total energy of the dyadosphere, the constant-thickness approximation is in excellent agreement with full general relativistic computations. The approximation breaks down for larger values of the baryonic shell mass, however such cases are of less interest for observed Gamma Ray Bursts (GRBs). On the basis of numerical computations of the slab model for PEM pulses, we describe (i) the properties of relativistic evolution of a PEM pulse colliding with a baryonic shell; (ii) the details of the expected emission energy and observed temperature of the associated GRBs for a given value of the EMBH mass; 10^3 solar masses, and for baryonic mass-energies in the range 10^{-8} to 10^{-2} the total energy of the dyadosphere.

Reference ***Astron. Astrophys 359, 855-864 (2000)***

295 - 2000 *G.Preparata, R. Ruffini, S. S.Xue*

The role of the screen factor in GRBs

We derive the screen factor for the radiation flux from an optically thick plasma of electron-positron pairs and photons, created by vacuum polarization process around a black hole endowed with electromagnetic structure.

Reference ***IL Nuovo Cimento Vol. 115 B N.7-9 (2000) 915-919, astro-ph/0109024***

296 - 2000 *D.Bini, G.Gemelli, R. Ruffini*

Spinning test particles in general relativity: Nongeodesic motion in the Reissner-Nordstrom spacetime

The dynamics of a charged spinning test particle in general relativity is studied in the context of gravitoelectromagnetism. Various families of test observers and supplementary conditions are examined. The spin-gravity-electromagnetism coupling is investigated for motion in the background of a Reissner-Nordström black hole both in the exact spacetime and in the weak-field approximation. Results are compared with those of the theory.

Reference ***Physical Review D, Vol. 61, 3rd series, No. 6, 2000***

297 - 2000 *G.Bertone, R. Ruffini*

Equilibrium configurations of relativistic White Dwarfs

The Feynman-Metropolis-Teller treatment for compressed atoms is here reconsidered in the framework of the relativistic generalised Fermi-Thomas model, obtained by Ruffini et al. Physical properties of a zero temperature plasma is thus investigated and the resulting equation of state, which keeps into account quantum, relativistic and electromagnetic effects, is applied to the study of equilibrium configurations of relativistic White Dwarfs.
It is shown that numerical evaluation of such configuration leads, for the same central density ρ_c, to smaller values of radius R and of mass M than in the classical works of Chandrasekhar and Salpeter, the deviations being most marked at the lowest densities (up to 30% from the Chandrasekhar model and 10% from the Salpeter one for $\rho_c \sim 10^6g/cm^3$, corresponding to $M \sim 0.2 M_{\odot}$).
At high densities we considered the occurrence of inverse beta decays, whose effect is to introduce gravitational instability of the configurations. We consequently find the maximum mass of White Dwarfs, which, for an Oxygen and an Iron WD, is respectively $1.365 M_{\odot}$ and $1.063 M_{\odot}$.

Reference ***Proceedings of the 3rd Icra Network Workshop, C.Cherubini and R.Ruffini eds., SIF 2000.
Nuovo Cim. B115 (2000) 935-946***

298 - 2000 *R. Ruffini*

On the Critical Mass: the case of white dwarfs "Exploring the Universe"

We recall the generalization of the Feynman-Metropolis-Teller approximation for a compressed atom using a relativistic Fermi-Thomas model. These results within a Wigner-Seitz approximation lead to a new equation of state for white dwarfs and to a new value of their critical mass, smaller than the one obtained by Chandrasekhar. The possible observations of these effects in binary neutron stars are outlined.

Reference ***a Festschrift in honour of Riccardo Giacconi, H. Gursky, R. Ruffini and L. Stella eds., World Scientific, Singapore, 2000***

299 - 2000 *C. Sigismondi, S.Filippi, R. Ruffini, L. A. Sanchez*

A Scale Invariant Property in the Large Scale Structure Formation

Reference ***Proceedings of the Second ICRA Network Workshop, 547-556, Rome-Pescara, 1-5 february 1999, R. Ruffini and V. G. Gurzadyan editors., World Scientific Publ. p. 547-556 (2000).***

300 - 2000 *C. Sigismondi, R. Ruffini*

The Physical Reason of Cut-Off Radius in the Two Point Correlation Function of Galaxies

Reference ***Proceedings of the Second ICRA Network Workshop on "Chaos in the Universe", Roma-Pescara 1-5/2/1999, R. Ruffini and V. G. Gurzadyan editors., World Scientific Publ. p. 557-558 (2000).***

301 - 2000 *R. Ruffini*

On Alternative Formulations of the Cosmological Principle

Reference ***Proceedings of the Second ICRA Network Workshop, 656-666, Rome-Pescara, 1-5 february 1999, World Scientific (2000).***

302 - 2000 *Cherubini C. and Ruffini R.*

Coupled gravitational ad electromagnetic perturbations in Kerr-Newman geometry: A computer approach

Reference ***N. Cim. B, vol. 115, p.699-711,(2000)***

303 - 2000 *G.Montani, R.Ruffini, R.Zalaletdinov*

Gravitating macroscopic media in general relativity

The problem of construction of a continuous (macroscopic) matter model for a given point-like (microscopic) matter distribution in general relativity is formulated. The existing approaches are briefly reviewed and a physical analogy with a similar problem in classical macroscopic electrodynamics is pointed out. The procedure by Szekeres in the linearized general relativity on Minkowski background to construct a tensor of gravitational quadruple polarization by applying Kaufman's method of molecular moments for the derivation of the polarization tensor in macroscopic electrodynamics and to derive an averaged field operator by utilizing an analogy between the linearized Bianchi identities and Maxwell equations, is analyzed. It is shown that the procedure has some inconsistencies, in particular, 1) it has only provided the terms linear in perturbations for the averaged field operator which do not contribute to the dynamics of the averaged field, and 2) the analogy between electromagnetism and gravitation does break upon averaging. A macroscopic gravity approach in the perturbation theory up to the second order on a particular background space-time taken to be a smooth weak gravitational field is applied to write down a system of macroscopic field equations: Isaacson's equations with a source incorporating the quadruple gravitational polarization tensor, Isaacson's energy-momentum tensor of gravitational waves and energy-momentum tensor of gravitational molecules and corresponding equations of motion. A suitable set of material relations which relate all the tensors is proposed.

Reference ***Nuovo Cim. 115B (2000) 1343-1354***

304 - 2000 *Remo Ruffini, Jay D. Salmonson, James R. Wilson, She-Sheng Xue*

On the pair-electromagnetic pulse from an electromagnetic Black Hole surrounded by a Baryonic Remnant

The interaction of an expanding Pair-Electromagnetic pulse (PEM pulse) with a shell of baryonic matter surrounding a Black Hole with electromagnetic structure (EMBH) is analyzed for selected values of the baryonic mass at selected distances well outside the dyadosphere of an EMBH. The dyadosphere, the region in which a super critical field exists for the creation of electron-positron pairs, is here considered in the special case of a Reissner-Nordstrom geometry. The interaction of the PEM pulse with the baryonic matter is described using a simplified model of a slab of constant thickness in the laboratory frame (constant-thickness approximation) as well as performing the integration of the general relativistic hydrodynamical equations. The validation of the constant-thickness approximation, already presented in a previous paper Ruffini, et al.(1999) for a PEM pulse in vacuum, is here generalized to the presence of baryonic matter. It is found that for a baryonic shell of mass-energy less than 1% of the total energy of the dyadosphere, the constant-thickness approximation is in excellent agreement with full general relativistic computations. The approximation breaks down for larger values of the baryonic shell mass, however such cases are of less interest for observed Gamma Ray Bursts (GRBs). On the basis of numerical computations of the slab model for PEM pulses, we describe (i) the properties of relativistic evolution of a PEM pulse colliding with a baryonic shell; (ii) the details of the expected emission energy and observed temperature of the associated GRBs for a given value of the EMBH mass; 10^3 solar masses, and for baryonic mass-energies in the range 10^{-8} to 10^{-2}

Reference ***Astron. Astrophys 359, 855-864 (2000)***

305 - 2000 *Edit. Gursky H., Ruffini R. & Stella L.*

"Exploring the Universe"
a Festschrift in Honor of Riccardo Giacconi

Reference ***World Scientific Pub., Singapore 2000***

306 - 2000 *Gurzadyan V.G., Ruffini R. (Eds.)*

"The Chaotic Universe"
Proceedings of the second ICRA Networkshop

Reference ***World Scientific Pub., Singapore 2000***

307 - 2001 *R. Ruffini, C.L. Bianco, P. Chardonnet, F. Fraschetti, S.S. Xue*

On the physical processes which lie at the bases of time variability of GRBs

The relative-space-time-transformation (RSTT) paradigm and the interpretation of the burst-structure (IBS) paradigm are applied to probe the origin of the time variability of GRBs. Again GRB 991216 is used as a prototypical case, thanks to the precise data from the CGRO, RXTE and Chandra satellites. It is found that with the exception of the relatively inconspicuous but scientifically very important signal originating from the initial ``proper gamma ray burst'' (P-GRB), all the other spikes and time variabilities can be explained by the interaction of the accelerated-baryonic-matter pulse with inhomogeneities in the interstellar matter. This can be demonstrated by using the RSTT paradigm as well as the IBS paradigm, to trace a typical spike observed in arrival time back to the corresponding one in the laboratory time. Using these paradigms, the identification of the physical nature of the time variablity of the GRBs can be made most convincingly. It is made explicit the dependence of a) the intensities of the afterglow, b) the spikes amplitude and c) the actual time structure on the Lorentz gamma factor of the accelerated-baryonic-matter pulse. In principle it is possible to read off from the spike structure the detailed density contrast of the interstellar medium in the host galaxy, even at very high redshift.

Reference ***Il Nuovo Cimento Vol.116 B, N.1, 99-108 (2001) astro-ph/0106535***

308 - 2001 *C.L. Bianco, R. Ruffini, S.S. Xue*

The elementary spike produced by a pure e^+e^- pair-electromagnetic pulse from a Black Hole: The PEM Pulse

In the framework of the model that uses black holes endowed with electromagnetic structure (EMBH) as the energy source, we study how an elementary spike appears to the detectors. We consider the simplest possible case of a pulse produced by a pure e^+e^- pair-electro-magnetic plasma, the PEM pulse, in the absence of any baryonic matter. The resulting time profiles show a {\em Fast-Rise-Exponential-Decay} shape, followed by a power-law tail. This is obtained without any special fitting procedure, but only by fixing the energetics of the process taking place in a given EMBH of selected mass, varying in the range from 10 to 10^3 $M_\odot$ and considering the relativistic effects to be expected in an electron-positron plasma gradually reaching transparency. Special attention is given to the contributions from all regimes with Lorentz γ factor varying from $\gamma=1$ to $\gamma=10^4$ in a few hundreds of the PEM pulse travel time. Although the main goal of this paper is to obtain the elementary spike intensity as a function of the arrival time, and its observed duration, some qualitative considerations are also presented regarding the expected spectrum and on its departure from the thermal one. The results of this paper will be comparable, when data will become available, with a subfamily of particularly short GRBs not followed by any afterglow. They can also be propedeutical to the study of longer bursts in presence of baryonic matter currently observed in GRBs.

Reference ***Astron. & Astrophys. 368 (2001), 377-390***
astro-ph/0102060

309 - 2001 *R. Ruffini*

Black holes and gamma ray bursts: background for the theoretical model

The idea that the vacuum polarization process occurring during gravitational collapse to a black hole endowed with electromagnetic structure (EMBH) could be the origin of gamma ray bursts (GRBs) is further developed. EMBHs in the range 3.2 -- 10^6 solar masses are considered. The formation of such an EMBH, the extraction of its mass-energy by reversible transformations and the expansion of the pair-electromagnetic pulse (PEM pulse) are all examined within general relativity. The PEM pulse is shown to accelerate particles to speeds with Lorentz gamma factors way beyond any existing experiment on Earth. Details of the expected burst structures and other observable properties are examined.

Reference ***Astron. & Astrophys. 368 (2001), 377-390, 33 pages, 19 figures***
and
Proceedings of the Ninth Marcel Grossmann Meeting on General Relativity
(MGIXMM) Roma 2-8/7/2000, V. Gurzadyan, R.T. Jantzen, R. Ruffini, Eds.
World Scientific Publishing, 2002

310 - 2001 *R. Ruffini, C.L. Bianco, P. Chardonnet, F. Fraschetti, S.S. Xue*

Relative space-time transformations in GRBs

The GRB 991216 and its relevant data acquired from the BATSE experiment and RXTE and Chandra satellites are used as a prototypical case to test the theory linking the origin of gamma ray bursts (GRBs) to the process of vacuum polarization occurring during the formation phase of a black hole endowed with electromagnetic structure (EMBH). The relative space-time transformation paradigm (RSTT paradigm) is presented. It relates the observed signals of GRBs to their past light cones, defining the events on the worldline of the source essential for the interpretation of the data. Since GRBs present regimes with unprecedently large Lorentz γ factor, also sharply varying with time, particular attention is given to the constitutive equations relating the four time variables: the comoving time, the laboratory time, the arrival time at the detector, duly corrected by the cosmological effects. This paradigm is at the very foundation of any possible interpretation of the data of GRBs.

Reference ***Ap.J. 555 (2001), L107-L111,astro-ph/0106531***

311 - 2001 *R. Ruffini, C.L. Bianco, P. Chardonnet, F. Fraschetti, S.S. Xue*

On the interpretation of the burst structure of GRBs

Given the very accurate data from the BATSE experiment and RXTE and Chandra satellites, we use the GRB 991216 as a prototypical case to test the EMBH theory linking the origin of the energy of GRBs to the electromagnetic energy of black holes. The fit of the afterglow fixes the only two free parameters of the model and leads to a new paradigm for the interpretation of the burst structure, the IBS paradigm. It leads as well to a reconsideration of the relative roles of the afterglow and burst in GRBs by defining two new phases in this complex phenomenon: a) the injector phase, giving rise to the proper-GRB (P-GRB), and b) the beam-target phase, giving rise to the extended afterglow peak emission (E-APE) and to the afterglow. Such differentiation leads to a natural possible explanation of the bimodal distribution of GRBs observed by BATSE. The agreement with the observational data in regions extending from the horizon of the EMBH all the way out to the distant observer confirms the uniqueness of the model.

Reference ***Ap.J. 555 (2001), L113-L116***

312 - 2001 *R. Ruffini, C.L. Bianco, P. Chardonnet, F. Fraschetti, S.S. Xue*

On a possible GRB-supernova time sequence

The data from the Chandra satellite on the iron emission lines in the afterglow of GRB 991216 are used to give further support for the EMBH theory, which links the origin of the energy of GRBs to the extractable energy of electromagnetic black holes (EMBHs), leading to an interpretation of the GRB-supernova correlation. Following the relative space-time transformation (RSTT) paradigm and the interpretation of the burst structure (IBS) paradigm, we introduce a paradigm for the correlation between GRBs and supernovae. The following sequence of events is shown as kinematically possible and consistent with the available data: a) the GRB-progenitor star P_1 first collapses to an EMBH, b) the proper GRB (P-GRB) and the peak of the afterglow (E-APE) propagate in interstellar space until the impact on a supernova-progenitor star P_2 at a distance $\le 2.69\times 10^{17}$ cm, and they induce the supernova explosion, c) the accelerated baryonic matter (ABM) pulse, originating the afterglow, reaches the supernova remnants 18.5 hours after the supernova explosion and gives rise to the iron emission lines. Some considerations on the dynamical implementation of the paradigm are presented. The concept of induced supernova explosion introduced here specifically for the GRB-supernova correlation may have more general application in relativistic astrophysics.

Reference ***Ap.J. 555 (2001), L117-L120***
astro-ph/0106534

313 - 2001 *R. Ruffini*

Analogies, new paradigms and observational data as growing factors of Relativistic Astrophysics

Patterns in the scientific developments of Relativistic Astrophysics are analyzed with special attention to the physics and astrophysics of Black Holes and Gamma Ray Bursts.

Reference ***"Fluctuating Paths and Fields - Dedicated to Hagen Kleinert on the Occasion of His 60th Birthday", Eds. W. Janke, A. Pelster, H.-J. Schmidt, and M. Bachmann (World Scientific, Singapore, 2001), p. 771, astro-ph/0106075***

314 - 2001 *C. Sigismondi, S. Filippi, R. Ruffini, L. A.Sanchez*

Damping Time and Stability of Density Fermion Perturbations in the Expanding Universe

The classic problem of the growth of density perturbations in an expanding Newtonian universe is revisited following the work of Bisnovatyi-Kogan and Zel'dovich. We propose a more general analytical approach: a system of free particles satisfying semi-degenerate Fermi-Dirac statistics on the background of an exact expanding solution is examined in the linear approximation. This differs from the corresponding work of Bisnovatyi-Kogan and Zel'dovich where classical particles fulfilling Maxwell-Boltzmann statistics were considered. The solutions of the Boltzmann equation are obtained by the method of characteristics. An expression for the damping time of a decaying solution is discussed and a zone in which free streaming is hampered is found, corresponding to wavelengths less than the Jeans one. In the evolution of the system, due to the decrease of the Jeans length, those perturbations may lead to gravitational collapse. At variance with current opinions, we deduce that perturbations with lambda >=lambda_(J Max)/1.48 are able to generate structures and the lower limit for substructures mass is M = M_(J max)/(1.48)^3 ~ M_(J max)/3, where M_(J max) is the maximum value of the Jeans mass.

Reference ***International Journal of Modern Physics D, vol. 10, No. 5 (2001) 663-679; astro-ph/ 0101222***

315 - 2001 *C. Sigismondi, S. Filippi, L. A. Sanchez, R. Ruffini*

An Universe Made of Neutrino is Still Possible?

Reference ***Nuovo Cimento B, Submitted for Publication (2001).***

316 - 2001 *R. RUFFINI, C.L. BIANCO, P. CHARDONNET, F. FRASCHETTI, S.-S. XUE*

Trous noirs et sursauts gamma

Reference ***POUR LA SCIENCE. vol. 287, pp. 23, 2001***

317 - 2001 *Ohanian H.C., Ruffini R.*

"Gravitation and Spacetime"

Reference ***W.W. Norton & Co. and Shin Won Agency Co., Seoul, 2001, (2nd ed.) - Korean version***

318 - 2001 *Edit. Cherubini C., Ruffini R.*

Proceedings of the "Third ICRA Network Workshop" and The "Sixth Italo-Korean Meeting on electrodynamics and magneto hydrodynamics around black holes".

Reference ***Editrice Compositori, Bologna 2001***

319 - 2002 *R. Ruffini, L. Vitagliano*

Irreducible mass and energetics of an electromagnetic black hole

The mass-energy formula for a black hole endowed with electromagnetic structure (EMBH) is clarified for the nonrotating case. The irreducible mass M_{irr} is found to be independent of the electromagnetic field and explicitly expressable as a function of the rest mass, the gravitational energy and the kinetic energy of the collapsing matter at the horizon. The electromagnetic energy is distributed throughout the entire region extending from the horizon of the EMBH to infinity. We discuss two conceptually different mechanisms of energy extraction occurring respectively in an EMBH with electromagnetic fields smaller and larger than the critical field for vacuum polarization. For a subcritical EMBH the energy extraction mechanism involves a sequence of discrete elementary processes implying the decay of a particle into two oppositely charged particles. For a supercritical EMBH an alternative mechanism is at work involving an electron-positron plasma created by vacuum polarization. The energetics of these mechanisms as well as the definition of the spatial regions in which thay can occur are given. The physical implementations of these ideas are outlined for ultrahigh energy cosmic rays UHECR) and gamma ray bursts (GRBs).

Reference ***8 pages, 1 figure, Physics Letters B545 (2002) 233-237***

320 - 2002 *C. Cherubini, R. Ruffini, L. Vitagliano*

On the electromagnetic field of a charged collapsing spherical shell in general relativity

A new exact solution of the Einstein-Maxwell equations for the gravitational collapse of a shell of matter in an already formed black hole is given. Both the shell and the black hole are endowed with electromagnetic structure and are assumed spherically symmetric. Implications for current research are outlined.

Reference ***Physics Letters B, Phys.Lett. B545 (2002) 226-232***

321 - 2002 *G. Preparata, R. Ruffini, S.S. Xue*

On the Dyadosphere of Black Hole

Basic energy requirements of Gamma Ray Burst(GRB) sources can be easily accounted for by a pair creation process occurring in the "Dyadosphere" of a Black Hole endowed with an electromagnetic field (abbreviated to EMBH for "electromagnetic Black Hole"). This includes the recent observations of GRB971214 by Kulkarni et al. The "Dyadosphere" is defined as the region outside the horizon of an EMBH where the electromagnetic field exceeds the critical value for e^+ e^- pair production. In a very short time $\sim O(hbar mc^2}), very large numbers of pairs are created there. Further evolution then leads naturally to a relativistically expanding pair-electromagnetic-pulse (PEM-pulse). Specific examples of Dyadosphere parameters are given for 10 and 10^5 solar mass EMBH's. This process does occur for EMBH with charge-to-mass ratio larger than 2.210^{-5} and strictly smaller than one. From a fundamental point of view, this process represents the first mechanism proved capable of extracting large amounts of energy from a Black Hole with an extremely high efficiency (close to 100%).

Reference ***Phys.Lett. B545 (2002) 226-232***

322 - 2002 *R. Ruffini*

Observational tests of the Electro-Magnetic Black Hole Theory in Gamma-Ray Bursts

The Relative Space-Time Transformation (RSTT) Paradigm and the Interpretation of the Burst Structure (IBS) Paradigm are applied to the analysis of the structure of the burst and afterglow of Gamma-Ray Bursts within the theory based on the vacuum polarization process occurring in an Electro-Magnetic Black Hole, the EMBH theory. This framework is applied to the study of the GRB991216 which is used as a prototype. The GRB-Supernova Time Sequence (GSTS) Paradigm, which introduces the concept of induced gravitational collapse in the Supernovae-GRB association, is announced and will be applied, within the EMBH theory, to GRB980425 as a prototype in a forthcoming paper.

Reference ***19 pages, 11 figures, in Proceedings of the meeting "Lighthouses in the Universe", Springer-Verlag, Berlin, 2002***

323 - 2002 *R. Ruffini, C.L. Bianco, P. Chardonnet, F. Fraschetti, S.-S. Xue*

On the structures in the afterglow peak emission of gamma ray bursts

Using GRB 991216 as a prototype, it is shown that the intensity substructures observed in what is generally called the "prompt emission" in gamma ray bursts (GRBs) do originate in the collision between the accelerated baryonic matter (ABM) pulse with inhomogeneities in the interstellar medium (ISM). The initial phase of such process occurs at a Lorentz factor $\gamma\sim 310$. The crossing of ISM inhomogeneities of sizes $\Delta R\sim 10^{15}$ cm occurs in a detector arrival time interval of ~ 0.4 s implying an apparent superluminal behavior of $\sim 10^5c$. The long lasting debate between the validity of the external shock model vs. the internal shock model for GRBs is solved in favor of the first.

Reference ***AASTeX, 14 pages, 5 figures, Ap.J. 581 (2002), L19-L22***

324 - 2002 *D. Bini, C. Cherubini, R.T. Jantzen, R. Ruffini*

Perturbations of Black Hole spacetimes: a New Approach

A new compact form of the Teukolsky Master Equation suggests a meaningful interpretation of the perturbation theory at every order in every vacuum spacetime for which the De Rham-Lichnerowicz Laplacian plays an essential role. Very recent work on this subject is recovered and extended. The nonvacuum case as well as the half-integer spin cases can be obtained following the same procedure.

Reference ***Proceedings of the Ninth Marcel Grossmann Meeting on General Relativity (MGIXMM) Roma 2-8/7/2000, V. Gurzadyan, R.T. Jantzen, R. Ruffini, Eds. World Scientific Publishing, 2002, p. 1559 ISSN 981-238-010-8 (set) ISSN 981-238-995-4 (part A)***

325 - 2002 *D. Bini, C. Cherubini, R.T. Jantzen, R. Ruffini*

Teukolsky Master Equation: De Rham wave equation for the gravitational and electromagnetic fields in vacuum

A new version of the Teukolksy Master Equation, describing any massless field of different spin $s=1/2,1,3/2,2$ in the Kerr black hole, is presented here in the form of a wave equation containing additional curvature terms. These results suggest a relation between curvature perturbation theory in general relativity and the exact wave equations satisfied by the Weyl and the Maxwell tensors, known in the literature as the de Rham-Lichnerowicz Laplacian equations. We discuss these Laplacians both in the Newman-Penrose formalism and in the Geroch-Held-Penrose variant for an arbitrary vacuum spacetime. Perturbative expansion of these wave equations results in a recursive scheme valid for higher orders. This approach, apart from the obvious implications for the gravitational and electromagnetic wave propagation on a curved spacetime, explains and extends the results in the literature for perturbative analysis by clarifying their true origins in the exact theory.

Reference ***Progress of theoretical Physics, 107, no. 5 (2002) 967-992.***

326 - 2002 *C. Cherubini, D. Bini, S. Capozziello, R. Ruffini*

Second order scalar invariants of the Riemann Tensor: Applications to black hole spacetimes

We discuss the Kretschmann, Chern-Pontryagin and Euler invariants among the second order scalar invariants of the Riemann tensor in any spacetime in the Newman-Penrose formalism and in the framework of gravitoelectromagnetism, using the Kerr-Newman geometry as an example. An analogy with electromagnetic invariants leads to the definition of regions of gravitoelectric or gravitomagnetic dominance.

Reference ***International Journal of Modern Physics D, Vol 11, no. 6, 827-841, 2002.***

327 - 2002 *C.L. Bianco, R. Ruffini, S.S.Xue*

The temporal structure and duration of GRBs from a pair and electromagnetic pulse

In the framework of the model that uses black holes endowed with electromagnetic structure (EMBH) as the energy source of GRBs, we study how an elementary spike appears to the detectors. We consider the simplest possible case of a pulse produced by a pure e^+e^- pair-electro-magnetic plasma, the PEM pulse, in the absence of any baryonic matter.

Reference ***Proceedings of the Ninth Marcel Grossmann Meeting on General Relativity (MGIXMM) Roma 2-8/7/2000, V. Gurzadyan, R.T. Jantzen, R. Ruffini, Eds. World Scientific Publishing, 2002 ISSN 981-238-010-8 (set) ISSN 981-238-995-4 (part A)***

328 - 2002 *G.Bertone, R. Ruffini*

Relativistic Thomas-Fermi Model at Finite Temperatures

We briefly review the Thomas-Fermi statistical model of atoms in the classical non-relativistic formulation and in the generalised finite-nucleus relativistic formulation. We then discuss the classical generalisation of the model to finite temperatures in the non-relativistic approximation and present a new relativistic model at finite temperatures, investigating how to recover the existing theory in the limit of low temperatures. This work is intended to be a propedeutical study for the evaluation of equilibrium configurations of relativistic ``hot'' white dwarfs.

Reference ***Proceedings of the Ninth Marcel Grossmann Meeting on General Relativity (MGIXMM) Roma 2-8/7/2000, V. Gurzadyan, R.T. Jantzen, R. Ruffini, Eds. World Scientific Publishing, 2002 ISSN 981-238-010-8 (set) ISSN 981-238-995-4 (part A)***

329 - 2002 *R. Ruffini, M. Lattanzi, C. Sigismondi and G. Vereshchagin*

Chemical Potential of Massive Neutrinos in an Expanding Universe

We discuss recent constraints on degeneracy parameters and neutrino masses, focusing on cosmological implications of neutrinos. When neutrinos are considered as Dirac particles with quite high values of degeneracy parameter adopted, the contribution of two flavors to the total density parameter of the Universe can be as high as $\Omega_ \nu=0.45$. In this case constraints on other cosmological parameters like Ω_{CDM} andΩ_{Λ} have to be reconsidered.
Otherwise, if neutrinos are Majorana particles or neutrino oscillations are important at the early Universe, energy density of neutrinos is negligible. The Jeans mass and free streaming of degenerative neutrinos are considered.

Reference ***Spacetime & Substance No. 4(14), 174-178 (2002).***

330 - 2002 *S. Filippi, R. Ruffini, and A. Sepulveda*

Functional approach to the problem of self-gravitating systems: Conditions of integrability

Using a functional method based on the introduction of a velocity potential to solve the Euler, continuity and Poisson equations, a new analytic study of the equilibrium of self-gravitating rotating systems with a polytropic equation of state has permitted the formulation of the conditions of integrability. For the polytropic index n = 1 in the incompressible case ([del]·v-vector = 0), we are able to find the conditions for solving the problem of the equilibrium of polytropic self-gravitating systems that rotate and have nonuniform vorticity. This work contains the conditions which give analytic and quasi-analytic solutions for the equilibrium of polytropic stars and galactic systems in Newtonian gravity. In special cases, explicit analytic solutions are presented. ©2002 The American Physical Society

Reference ***Physical Review D 65, 044019 (2002)***

331 - 2002 *G. Montani, R. Ruffini and R.M. Zalaletdinov*

Macroscopic media and macroscopic gravity equations in general relativity

The problem of construction of a continuos (macroscopic) matter model for a given point-like (microscopic) matter distribution in general relativity is formulated. A suitable set of material relations necessary for the system of macroscopic gravity equations to be determined is proposed

Reference ***Proceedings of the Ninth Marcel Grossmann Meeting on General Relativity (MGIXMM) Roma 2-8/7/2000, V. Gurzadyan, R.T. Jantzen, R. Ruffini, Eds. World Scientific Publishing, 2002, p. 822-824 ISSN 981-238-010-8 (set) ISSN 981-238-995-4 (part A)***

332 - 2002 *R.Ruffini*

Gamma Ray Bursts and vacuum polarization process in electromagnetic Black Holes

The developments of the elctromgnetic black holes physics and vacuum polarization process are presented in the interpretation of Gamma-Ray Bursts.

Reference ***23 pages, 11 figures, in the proceeding of the conference "18th Advanced Icfa Beam Dynamics Workshop On Quantum Aspects Of Beam Physics" edited by P.C. Chen, Capri, October 15-20, 2000, World Scientific, Singapore, 2001***

333 - 2002 *Filippi S., Ruffini R., Sepulveda A.*

Equilibrium Solutions for Self-Gravitating Polytropic Systems.

Reference ***IX Marcel Grossmann Meeting. 2000. (vol. B, pp. 788-790).***

334 - 2002 *Filippi S., Sepulveda A., Ruffini R.*

Functional Method to solving the Euler Equation for Self-Gravitating Systems

Reference ***IX Marcel Grossmann Meeting. 2000. (vol. B, pp. 785-787). 2002***

335 - 2002 *R. RUFFINI, P. CHARDONNET, C.L. BIANCO, S.-S. XUE, F. FRASCHETTI*

Les sursaut gamma

Reference ***POUR LA SCIENCE. vol. 294, pp. 26-32, 2002***

336 - 2002 *R. RUFFINI, P. CHARDONNET, C.L. BIANCO, S.-S. XUE, F. FRASCHETTI*

Gli impulsi gamma

Reference ***LE SCIENZE. vol. 406, pp. 46-52, 2002***

337 - 2002 *R. RUFFINI, S.-S. XUE, C.L. BIANCO, F. FRASCHETTI, P. CHARDONNET*

Les trous noirs, source d'énergie

Reference ***LA RECHERCHE. vol. 353, pp. 30-32, 2002***

338 - 2002 *R. RUFFINI, S.-S. XUE, C.L. BIANCO, F. FRASCHETTI, P. CHARDONNET*

Buchi neri, sorgenti di energia

Reference ***SAPERE. vol. 3, pp. 64-69, 2002***

339 - 2002 *Gurzadyan V.G., Ruffini R. (Eds.)*

"Fermi e l'Astrofisica"
Ninth ICRANet Workshop

Reference ***Società Italiana di Fisica, Bologna 2002***
Il Nuovo Cimento, vol 117B, serie 12, n° 9-11, settembre-novembre 2002

340 - 2003 *M. Lattanzi, R. Ruffini, G. Vereshchagin*

On the possible role of massive neutrinos in the cosmological structure formation.

In addition to the problem of galaxy formation, one of the greatest open questions of cosmology is represented by the existence of an asymmetry between matter and antimatter in the baryonic component of the Universe. We believe that a net lepton number for the three neutrino species can be used to understand this asymmetry. This also implies an asymmetry in the matter-antimatter component of the leptons. The existence of a nonnull lepton number for the neutrinos can easily explain a cosmological abundance of neutrinos consistent with the one needed to explain both the rotation curves of galaxies and the flatness of the Universe. Some propedeutic results are presented in order to attack this problem.

Reference ***in Cosmology and Gravitation: Xth Brazilian School of Cosmology and Gravitation, 25th Anniversary (1977-2002), July 29 - August 9 2002, edited by M. Novello and S.E. Perez Bergliaffa, AIP Conference Proceedings 668, Melville, New York, 2003, pp.263-287***

341 - 2003 *Ruffini R., Bianco C.L., Chardonnet P., Fraschetti F., Vitagliano L., Xue S.S.*

New perspectives in physics and astrophysics from the theoretical understanding of Gamma-Ray Bursts

If due attention is given in formulating the basic equations for the Gamma-Ray Burst (GRB) phenomenon and in performing the corresponding quantitative analysis, GRBs open a main avenue of inquiring on totally new physical and astrophysical regimes. This program is very likely one of the greatest computational efforts in physics and astrophysics and cannot be actuated using shortcuts. A systematic approach is needed which has been highlighted in three basic new paradigms: the relative space-time transformation (RSTT) paradigm (\textcite{lett1}), the interpretation of the burst structure (IBS) paradigm (\textcite{lett2}), the GRB-supernova time sequence (GSTS) paradigm (\textcite{lett3}). From the point of view of fundamental physics new regimes are explored: (1) the process of energy extraction from black holes; (2) the quantum and general relativistic effects of matter-antimatter creation near the black hole horizon; (3) the physics of ultrarelativisitc shock waves with Lorentz gamma factor $\gamma > 100$. From the point of view of astronomy and astrophysics also new regimes are explored: (i) the occurrence of gravitational collapse to a black hole from a critical mass core of mass $M\agt 10M_\odot$, which clearly differs from the values of the critical mass encountered in the study of stars "catalyzed at the endpoint of thermonuclear evolution" (white dwarfs and neutron stars); (ii) the extremely high efficiency of the spherical collapse to a black hole, where almost 99.99% of the core mass collapses leaving negligible remnant; (iii) the necessity of developing a fine tuning in the final phases of thermonuclear evolution of the stars, both for the star collapsing to the black hole and the surrounding ones, in order to explain the possible occurrence of the "induced gravitational collapse". New regimes are as well encountered from the point of view of nature of GRBs: (I) the basic structure of GRBs is uniquely composed by a proper-GRB (P-GRB) and the afterglow; (II) the long bursts are then simply explained as the peak of the afterglow (the E-APE) and their observed time variability is explained in terms of inhomogeneities in the interstellar medium (ISM); (III) the short bursts are identified with the P-GRBs and the crucial information on general relativistic and vacuum polarization effects are encoded in their spectra and intensity time variability. A new class of space missions to acquire information on such extreme new regimes are urgently needed.

Reference ***Proceedings of the Xth Brazilian School of Cosmology and Gravitation, July 29 - August 9 2002, editors M. Novello, S.E. Perez Bergliaffa, AIP Conf.Proc. 668 (2003) 16-107***

342 - 2003 *R. Ruffini, C.L. Bianco, S.-S. Xue, P. Chardonnet, F. Fraschetti*

On the Structure of the Burst and Afterglow of Gamma-Ray Bursts I: the Radial Approximation

We have recently proposed three paradigms for the theoretical interpretation of gamma-ray bursts (GRBs). (1) The relative space-time transformation (RSTT) paradigm emphasizes how the knowledge of the entire world-line of the source from the moment of gravitational collapse is a necessary condition in order to interpret GRB data.\cite{lett1} (2) The interpretation of the burst structure (IBS) paradigm differentiates in all GRBs between an injector phase and a beam-target phase.\cite{lett2} (3) The GRB-supernova time sequence (GSTS) paradigm introduces the concept of {\em induced supernova explosion} in the supernovae-GRB association.\cite{lett3} The RSTT and IBS paradigms are enunciated and illustrated using our theory based on the vacuum polarization process occurring around an electromagnetic black hole (EMBH) theory. The results are summarized using figures, diagrams and a complete table with the space-time grid, the fundamental parameters and the corresponding values of the Lorentz gamma factor for GRB~991216 used as a prototype. In the following sections the detailed treatment of the EMBH theory needed to understand the results of the three above paradigms is presented. We start from the considerations on the dyadosphere formation. We then review the basic hydrodynamic and rate equations, the equations leading to the relative space-time transformations as well as the adopted numerical integration techniques. We then illustrate the five fundamental eras of the EMBH theory: the self acceleration of the e^+e^- pair-electromagnetic plasma (PEM pulse), its interaction with the baryonic remnant of the progenitor star, the further self acceleration of the e^+e^- pair-electromagnetic radiation and baryon plasma (PEMB pulse). We then study the approach of the PEMB pulse to transparency, the emission of the proper GRB (P-GRB) and its relation to the "short GRBs". Particular attention is given to the free parameters of the theory and to the values of the thermodynamical quantities at transparency. Finally the three different regimes of the afterglow are described within the fully radiative and radial approximations: the ultrarelativistic, the relativistic and the nonrelativistic regimes. The best fit of the theory leads to an unequivocal identification of the "long GRBs" as extended emission occurring at the afterglow peak (E-APE). The relative intensities, the time separation and the hardness ratio of the P-GRB and the E-APE are used as distinctive observational test of the EMBH theory and the excellent agreement between our theoretical predictions and the observations are documented. The afterglow power-law indexes in the EMBH theory are compared and contrasted with the ones in the literature, and no beaming process is found for GRB~991216. Finally, some preliminary results relating the observed time variability of the E-APE to the inhomogeneities in the interstellar medium are presented, as well as some general considerations on the EMBH formation. The issue of the GSTS paradigm will be the object of a forthcoming publication while the relevance of the iron-lines observed in GRB~991216 is shortly reviewed. The general conclusions are then presented based on the three fundamental parameters of the EMBH theory: the dyadosphere energy, the baryonic mass of the remnant, the interstellar medium density. An in depth discussion and comparison of the EMBH theory with alternative theories is presented as well as indications of further developments beyond the radial approximation, which will be the subject of paper II in this series.\cite{rbcfx02e_paperII} Future needs for specific GRB observations are outlined.

Reference ***96 pages, 40 figures,***
International Journal of Modern Physics D12, no. 2 (2003) 173-270
ISSN 0218-2718, IF 1.507

343 - 2003 *Donato Bini, Christian Cherubini, Robert T. Jantzen, Remo Ruffini*

De Rham Wave Equation For Tensor Valued *p*-Forms

The de Rham Laplacian ?(dR) for differential forms is a geometric generalization of the usual covariant Laplacian ?, and it may be extended naturally to tensor-valued p-forms using the exterior covariant derivative associated with a metric connection. Using it the wave equation satisfied by the curvature tensors in general relativity takes its most compact form. This wave equation leads to the Teukolsky equations describing integral spin perturbations of black hole spacetimes.

Reference ***International Journal of Modern Physics D, Vol. 12, No. 8 (2003), 1363-1384, Copyright: World Scientific Publishing Company***

344 - 2003 *M. Lattanzi, R. Ruffini & G. Vereshchagin*

in AIP conference proceedings, Cosmology and Gravitation

In addition to the problem of galaxy formation, one of the greatest open questions of cosmology is represented by the existence of an asymmetry between matter and antimatter in the baryonic component of the Universe. We believe that a net lepton number for the three neutrino species can be used to understand this asymmetry. This also implies an asymmetry in the matter-antimatter component of the leptons. The existence of a nonnull lepton number for the neutrinos can easily explain a cosmological abundance of neutrinos consistent with the one needed to explain both the rotation curves of galaxies and the flatness of the Universe. Some propedeutic results are presented in order to attack this problem.

Reference ***ed. M. Novello and S.E. Perez Bergliaffa, New York, AIP, 16 (2003)***

345 - 2003 *R. Ruffini, L. Vitagliano*

Energy Extraction from Gravitational Collapse to Static Black Holes

Abstract. The mass--energy formula of black holes implies that up to 50\% of the energy can be extracted from a static black hole. Such a result is reexamined using the recently established analytic formulas for the collapse of a shell and expression for the irreducible mass of a static black hole. It is shown that the efficiency of energy extraction process during the formation of the black hole is linked in an essential way to the gravitational binding energy, the formation of the horizon and the reduction of the kinetic energy of implosion. Here a maximum efficiency of 50\% in the extraction of the mass energy is shown to be generally attainable in the collapse of a spherically symmetric shell: surprisingly this result holds as well in the two limiting cases of the Schwarzschild and extreme Reissner-Nordstr\"{o}m space-times. Moreover, the analytic expression recently found for the implosion of a spherical shell onto an already formed black hole leads to a new exact analytic expression for the energy extraction which results in an efficiency strictly less than 100\% for any physical implementable process. There appears to be no incompatibility between General Relativity and Thermodynamics at this classical level.

Reference ***International Journal of Modern Physics D12 (2003) 121-128.***

346 - 2003 *R. Ruffini, L. Vitagliano, S.-S. Xue*

On Plasma Oscillations in Strong Electric Fields

We describe the creation and evolution of electron-positron pairs in a strong electric field as well as the pairs annihilation into photons. The formalism is based on generalized Vlasov equations, which are numerically integrated. We recover previous results about the oscillations of the charges, discuss the electric field screening and the relaxation of the system to a thermal equilibrium configuration. The timescale of the thermalization is estimated to be $\sim 10^{3}-10^{4}\ \hbar /m_{e}c^{2}$.

Reference ***10 pages, 2 figures***
Phys. Lett. B559 (2003) 12-19

347 - 2003 *G. Montani, R. Ruffini, R.Zalaletdinov*

The gravitational polarization in general relativity: solution to Szekeres' model of quadrupole polarization

A model for the static weak-field macroscopic medium is analysed and the equation for the macroscopic gravitational potential is derived. This is a biharmonic equation which is a non-trivial generalization of the Poisson equation of Newtonian gravity. In the case of strong gravitational quadrupole polarization, it essentially holds inside a macroscopic matter source. Outside the source the gravitational potential fades away exponentially. The equation is equivalent to a system of the Poisson equation and the non-homogeneous modified Helmholtz equations. The general solution to this system is obtained by using the Green function method and it is not limited to Newtonian gravity. In the case of insignificant gravitational quadrupole polarization, the equation for macroscopic gravitational potential becomes the Poisson equation with the matter density renormalized by a factor including the value of the quadrupole gravitational polarization of the source. The general solution to this equation obtained by using the Green function method is limited to Newtonian gravity.

Reference ***Classical and Quantum Gravity, vol 20, no. 7, 4195-4212, 2003***

348 - 2003 *V. Gurzadyan, R.T. Jantzen, R. Ruffini*

Proceedings of the Ninth Marcel Grossmann Meeting on General Relativity (2000)

Three volumes of 2400 some pages of some 500(?) articles on the current state of physics touching upon classical and quantum gravity and relativistic astrophysics and space measurements. Complemented by an on-line version.

The idea that the vacuum polarization process occurring during gravitational collapse to a black hole endowed with electromagnetic structure (EMBH) could be the origin of gamma ray bursts (GRBs) is further developed. EMBHs in the range 3.2 -- 10^6 solar masses are considered. The formation of such an EMBH, the extraction of its mass-energy by reversible transformations and the expansion of the pair-electromagnetic pulse (PEM pulse) are all examined within general relativity.The PEM pulse is shown to accelerate particles to speeds with Lorentz gamma factors way beyond any existing experiment on Earth. Details of the expected burst structures and other observable properties are examined.

Reference ***Eds.World Scientific, Singapore, 2003***

349 - 2003 *Giuseppe Aprea, Giovanni Montani, Remo Ruffini*

Test Particles Behavior in the Framework of a Lagrangian Geometric Theory with Propagating Torsion

Working in the Lagrangian framework, we develop a geometric theory in vacuum with propagating torsion; the antisymmetric and trace parts of the torsion tensor, considered as derived from local potential fields, are taken and, using the minimal action principle, their field equations are calculated. Actually these will show themselves to be just equations for propagating waves giving torsion a behavior similar to that of metric which, as known, propagates through gravitational waves. Then we establish a principle of minimal substitution to derive test particles equation of motion, obtaining, as result, that they move along autoparallels. We then calculate the analogous of the geodesic deviation for these trajectories and analyze their behavior in the nonrelativistic limit, showing that the torsion trace potential ? has a phenomenology which is indistinguishable from that of the gravitational newtonian field; in this way we also give a reason for why there have never been evidence for it.

Reference ***International Journal of Modern Physics D, Vol. 12, No. 10 (2003) 1875-1888***

350 - 2003 *R. Ruffini, L. Vitagliano, S.-S. Xue*

On a Separatrix in the Gravitational Collapse to an Overcritical Electromagnetic Black Hole

The dynamical properties of an electron--positron--photon plasma created by the vacuum polarization process occurring around a charged gravitationally collapsing core of an initially neutral star are examined within the framework of General Relativity and Quantum Field Theory. The Reissner--Nordstr\"{o}m geometry is assumed to apply between the collapsing core and the oppositely charged remnant of the star. The appearance of a separatrix at radius $\bar{R}$, well outside the asymptotic approach to the horizon, is evidenced. The neutral electron--positron--photon plasma created at radii $r>\bar{R}$ self-propels outwards to infinity, following the classical PEM--pulse analysis. The plasma created at $r<\bar{R}$ remains trapped and follows the gravitational collapse of the core only contributing to the reduction of the electromagnetic energy of the black hole and to the increase of its irreducible mass. This phenomenon has consequences for the observational properties of gamma--ray bursts and is especially relevant for the theoretical prediction of the temporal and spectral structure of the short bursts.

Reference ***Phys.Lett. B573 (2003) 33-38***

351 - 2003 *P. Chardonnet , A.Mattei, R.Ruffini and S.S. Xue*

The emission of Ultra High Energy Cosmic Rays from Electro-Magnetic Black Holes

We propose a new, simple solution to the Ultra High Energy Cosmic Rays puzzle. The Electro-Magnetic Black Holes (EMBHs) are thought to be the GRB progenitors. EMBHs not reaching critical conditions have to discharge. ISM H atoms surrounding an EMBH can efficiently be ionized via Stark effect. Then free protons accelerate up to energies of 1023 eV, while the EMBH discharges itself accreting electrons. This process lasts several years and accounts for the present observations, also explaining doublets and triplets of events.

Reference ***Il Nuovo Cimento B, vol. 118, Issue 10-12, 2003, p.1063-1070***

352 - 2003 *G. Montani, R. Ruffini and R. Zalaletdinov*

Modelling self-gravitating macroscopic media in general relativity: Solution to Szekeres' model of gravitational quadrupole

A model for the static weak-field macroscopic medium is analyzed and the equation for the macroscopic gravitational potential is derived. This is a biharmonic equation which is a non-trivial generalization of the Poisson equation of Newtonian gravity. In case of the strong gravitational quadrupole polarization it essentially holds inside a macroscopic matter source. Outside the source the gravitational potential fades away exponentially. The equation is equivalent to a system of the Poisson equation and the nonhomogeneous modified Helmholtz equations. The general solution to this system is obtained by using Greenâ€™s function method and it does not have a limit to Newtonian gravity. In case of the insignificant gravitational quadrupole polarization the equation for macroscopic gravitational potential becomes the Poisson equation with the matter density renormalized by the factor including the value of the quadrupole gravitational polarization of the source. The general solution to this equation obtained by using Greenâ€™s function method has a limit to Newtonian gravity

Reference ***in: Black Holes, Gravitational Waves and Cosmology, In celebration of 60th birthday of Remo Ruffini, Rome/Pescara, Italy, July 2002, Il Nuovo Cimento, Vol. 118B, No. 10-12 (2003) p. 1109-1123***

353 - 2003 *Giovanni Montani, Remo Ruffini, Roustam Zalaletdinov*

Gravitational polarization in general relativity: Solution to Szekeres' model of gravitational quadrupole polarization

A model for the static weak-field macroscopic medium is analyzed and the equation for the macroscopic gravitational potential is derived. This is a biharmonic equation which is a non-trivial generalization of the Poisson equation of Newtonian gravity. In case of the strong gravitational quadrupole polarization it essentially holds inside a macroscopic matter source. Outside the source the gravitational potential fades away exponentially. The equation is equivalent to a system of the Poisson equation and the nonhomogeneous modified Helmholtz equations. The general solution to this system is obtained by using Green's function method and it does not have a limit to Newtonian gravity. In case of the insignificant gravitational quadrupole polarization the equation for macroscopic gravitational potential becomes the Poisson equation with the matter density renormalized by the factor including the value of the quadrupole gravitational polarization of the source. The general solution to this equation obtained by using Green's function method has a limit to Newtonian gravity.

Reference ***Class.Quant.Grav. 20 (2003) 4195-4212***

354 - 2003 *Ruffini R., Sigismondi C. (Eds.)*

"Non Linear Gravitodynamics. The Lense-Thirring Effect"

Reference ***World Scientific Pub., Singapore 2003***

355 - 2003 *Editors Gurzadyan G., Jantzen R.T.*
Series Editor Ruffini R.

Proceedings of the "Ninth Marcel Grossmann Meeting on General Relativity"
University of Rome "La Sapienza", July 2-8, 2000

Reference ***World Scientific Pub., Singapore 2003***

356 - 2004 *R. Ruffini, M.G. Bernardini, C.L. Bianco, P. Chardonnet, F. Fraschetti, S.-S. Xue*

GRB 980425-SN1998bw and the EMBH model

The EMBH model, previously developed using GRB 991216 as a prototype, is here applied to GRB 980425. We fit the luminosity observed in the 40-700 keV, 2-26 keV and 2-10 keV bands by the BeppoSAX satellite. In addition we present a novel scenario in which the supernova SN1998bw is the outcome of an ``induced gravitational collapse'' triggered by GRB 980425, in agreement with the GRB-Supernova Time Sequence (GSTS) paradigm (Ruffini et al. 2001c). A further outcome of this astrophysically exceptional sequence of events is the formation of a young neutron star generated by the SN1998bw event. A coordinated observational activity is recommended to further enlighten the underlying scenario of this most unique astrophysical system.

Reference ***Proceedings of the Gamma Ray Burst Symposium, Santa Fe, New Mexico, USA, 8-12 September 2003***
Adv.Sp.Res. 34 (2004) 2715-2722

357 - 2004 *R. Ruffini, C.L. Bianco, P. Chardonnet, F. Fraschetti, S.-S. Xue*

The EMBH model in GRB 991216 and GRB 980425

This is a summary of the talks presented at the Rome GRB meeting by C.L. Bianco and R. Ruffini. It was shown that by respecting the relative space-time transformation paradigm (RSTT), important inferences are possible in the new physics occurring in the energy sources of GRBs, on the structure of the bursts as well as on the composition of the interstellar matter surrounding the source. All current theoretical models of GRBs, by neglecting the implementation of this paradigm, lack the fundamental cognitive tools relating the physical nature of the source to the received GRBs light signals.

Reference ***8 pages, 3 figures, in the Proceedings of the "Third Rome Workshop on Gamma-Ray Bursts in the Afterglow Era", 17-20 September 2002, M. Feroci, F. Frontera, N. Masetti, L. Piro (editors)***
ASP Conf.Ser. 312 (2004) 349-356

358 - 2004 *R. Ruffini, L. Vitagliano, S.-S. Xue*

Electron-Positron-Photon Plasma around a collapsing Star

We describe electron-positron pairs creation around an electrically charged star core collapsing to an electromagnetic black hole (EMBH), as well as pairs annihilation into photons. We use the kinetic Vlasov equation formalism for the pairs and photons and show that a regime of plasma oscillations is established around the core. As a byproduct of our analysis we can provide an estimate for the thermalization time scale.

Reference ***QUANTUM ASPECTS OF BEAM PHYSICS 2003***
Proceedings of the Joint 28th ICFA Advanced Beam Dynamics and Advanced & Novel Accelerators Workshop
January 7-11, 2003, Hiroshima University, Higashi-Hiroshima, Japan,
edited by Pisin Chen & Kevin Reil (Stanford Linear Accelerator Center, USA).

359 - 2004 *R. Ruffini, L. Vitagliano, S.-S. Xue*

Plasma Expansion in the Geometry of a Collapsing Star

We describe the evolution of an electron-positron-photon plasma created by Sauter--Heisenberg--Euler--Schwinger mechanism around a collapsing charged star core in the Reissner-Nordstr\"{o}%m geometry external to the core, in view of the application in the framework of the EMBH theory for gamma ray bursts.

Reference ***QUANTUM ASPECTS OF BEAM PHYSICS 2003***
Proceedings of the Joint 28th ICFA Advanced Beam Dynamics and Advanced & Novel Accelerators Workshop
January 7-11, 2003, Hiroshima University, Higashi-Hiroshima, Japan,
edited by Pisin Chen & Kevin Reil (Stanford Linear Accelerator Center, USA).

360 - 2004 *C. L. Bianco, R. Ruffini*

Exact versus approximate equitemporal surfaces in Gamma-Ray Burst afterglows

By integrating the relativistic hydrodynamic equations introduced by Taub we have determined the exact EQuiTemporal Surfaces (EQTSs) for the Gamma-Ray Burst (GRB) afterglows. These surfaces are compared and contrasted to the ones obtained, using approximate methods, by Panaitescu & Meszaros (1998), Sari (1998), Granot et al. (1999).

Reference ***4 pages, 4 figures,***
Astrophys. J. 605 (2004) L1-L4

361 - 2004 *R.Ruffini, C.L.Bianco, P.Chardonnet, F.Fraschetti, V.Gurzadyan, S.-S.Xue*

On the instantaneous spectrum of Gamma-Ray Bursts

A theoretical attempt to identify the physical process responsible for the afterglow emission of Gamma-Ray Bursts (GRBs) is presented, leading to the occurrence of thermal emission in the comoving frame of the shock wave giving rise to the bursts. The determination of the luminosities and spectra involves integration over an infinite number of Planckian spectra, weighted by appropriate relativistic transformations, each one corresponding to a di□erent viewing angle in the past light cone of the observer. Therelativistic transformations have been computed using the equations of motion of GRBs within our theory, giving special attention to the determination of the equitemporal surfaces. The only free parameter of the present theory is the "e□ective emitting area" in the shock wave front. A self consistent model for the observed hard-to-soft transition in GRBs is also presented. When applied to GRB 991216 a precise fit

Reference ***International Journal of Modern Physics D13, 843-852, 2004***

362 - 2004 *M.G. Bernardini, C.L. Bianco, P. Chardonnet, F. Fraschetti, R. Ruffini, S.-S. Xue*

A New Astrophysical "Triptych": GRB030329/SN2003dh/URCA-2

We analyze the data of the Gamma-Ray Burst/Supernova GRB030329/SN2003dh system obtained by HETE-2 (GCN [1]), R-XTE (GCN [2]), XMM (Tiengo et al. [3]) and VLT (Hjorth et al. [4]) within our theory (Ruffini et al. [5] and references therein) for GRB030329. By fitting the only three free parameters of the EMBH theory, we obtain the luminosity in fixed energy bands for the prompt emission and the afterglow (see Fig.1). Since the Gamma-Ray Burst (GRB) analysis is consistent with a spherically symmetric expansion, the energy of GRB030329 is E = 2.1 * 10^{52} erg, namely ~ 2 * 10^3 times larger than the Supernova energy. We conclude that either the GRB is triggering an induced-supernova event or both the GRB and the Supernova are triggered by the same relativistic process. In no way the GRB can be originated from the supernova. We also evidence that the XMM observations (Tiengo et al. [3]), much like in the system GRB980425/SN1998bw (Ruffini et al. [6], Pian et al. [7]), are not part of the GRB afterglow, as interpreted in the literature (Tiengo et al. [3]), but are associated to the Supernova phenomenon. A dedicated campaign of observations is needed to confirm the nature of this XMM source as a newly born neutron star cooling by generalized URCA processes.

Reference ***4 pages, 1 figure, Proceedings of the Los Alamos "Gamma Ray Burst Symposium" in Santa Fe, New Mexico, September 8-12 2003 (AIP Conf. Ser.), CHAPTER: GRB030329***
AIP Conf.Proc. 727 (2004) 312-315

363 - 2004 *A. Corsi, M.G. Bernardini, C.L. Bianco, P. Chardonnet, F. Fraschetti, R. Ruffini, S.-S. Xue*

GRB 970228 Within the EMBH Model

We consider the gamma-ray burst of 1997 February 28 (GRB 970228) within the ElectroMagnetic Black Hole (EMBH) model. We first determine the value of the two free parameters that characterize energetically the GRB phenomenon in the EMBH model, that is to say the dyadosphere energy, $E_{dya}=5.1\times10^{52}$ ergs, and the baryonic remnant mass M_{B} in units of E_{dya}, $B=M_{B}c^{2}/E_{dya}=3.0\times10^{-3}$. Having in this way estimated the energy emitted during the beam-target phase, we evaluate the role of the InterStellar Medium (ISM) number density (n$_{ISM}$) and of the ratio ${\cal R}$ between the effective emitting area and the total surface area of the GRB source, in reproducing the observed profiles of the GRB 970228 prompt emission and X-ray (2-10 keV energy band) afterglow. The importance of the ISM distribution three-dimensional treatment around the central black hole is also stressed in this analysis.

Reference ***4 pages, 1 figure, Proceedings of the Los Alamos "Gamma Ray Burst Symposium" in Santa Fe, New Mexico, September 8-12 2003, CHAPTER: GRB Connection to Supernovae***
AIP Conf.Proc. 727 (2004) 428-431

364 - 2004 *R.Ruffini*

Extracting energy from black holes: Short-GRBs, Long-GRBs and GRB afterglows

The extractable energy from a black hole, as origin of the Gamma-Ray Burst (GRB) phenomenon is reviewed.

Reference ***14 pages, 8 figures, "Frontier in Astroparticle Physics and Cosmology", Proceedings of the 6th RESCEU International Symposium held on 4-7 November 2003, Tokyo, Japan, Universal Academy Press***

365 - 2004 *Remo Ruffini*

Charges in gravitational fields: from Fermi, via Hanni-Ruffini-Wheeler, to the "electric Meissner effect"

Recent developments in obtaining a detailed model for gamma ray bursts have shown the need for a deeper understanding of phenomena described
by solutions of the Einstein-Maxwell equations, reviving interest in the behavior of charges close to a black hole. In particular a drastic difference has been found between the lines of force of a charged test particle in the fields of Schwarzschild and Reissner-Nordstr¨om black holes. This difference characterizes a general relativistic effect for the electric field of a charged test particle around a (charged) Reissner-Nordstr¨om black hole similar to the “Meissner effect” for a magnetic field around a superconductor. These new results are related to earlier work by Fermi and Hanni-Ruffini-Wheeler.
PACS 04.20 – . PACS 04.20 – .

Reference ***25 pages, 17 figures, Proceedings of "Analysis, manifolds and geometric structures in physics", International Conference in Honour of Y. Choquet-Bruhat, Isola d'Elba June 24th-26th, 2004***
Nuovo Cim. B119 (2004) 785-808

366 - 2004 *F. Fraschetti, M.G. Bernardini, C.L. Bianco, P. Chardonnet, R. Ruffini, S.-S. Xue*

The GRB980425-SN1998bw Association in the EMBH Model

Our GRB theory, previously developed using GRB 991216 as a prototype, is here applied to GRB 980425. We fit the luminosity observed in the 40--700 keV, 2--26 keV and 2--10 keV bands by the BeppoSAX satellite. In addition the supernova SN1998bw is the outcome of an ``induced gravitational collapse'' triggered by GRB 980425, in agreement with the GRB-Supernova Time Sequence (GSTS) paradigm (\citet{lett3}). A further outcome of this astrophysically exceptional sequence of events is the formation of a young neutron star generated by the SN1998bw event (\citet{cospar02}). A coordinated observational activity is recommended to further enlighten the underlying scenario of this most unique astrophysical system.

Reference ***Proceedings of the Los Alamos "Gamma Ray Burst Symposium" in Santa Fe, New Mexico, September 8-12 2003 (AIP Conf. Ser.)***
AIP Conf.Proc. 727 (2004) 424-427

367 - 2005 *Vereshchagin G., Lattanzi M., Lee H.W., Ruffini R.*

Cosmological Massive Neutrinos with non-zero Chemical Potential: I. Perturbations in cosmological models with neutrinos in ideal fluid approximation

Recent constraints on neutrino mass and chemical potential are discussed with application to large scale structure formation. Power spectra in cosmological model with hot and cold dark matter, baryons and cosmological term are calculated in newtonian approximation using linear perturbation theory. All components are considered to be ideal ?uids. Dissipative processes are taken into account by initial spectrum of perturbations so the problem is reduced to a simple system of equations. Our results are in good agreement with those obtained before using more complicated treatments.

Reference ***in "Proceedings of the X Marcel Grossmann Meeting on General Relativity", Eds. M. Novello, S. Perez Bergliaffa, R. Ruffini. Singapore, World Scientific (2005), p. 1246.***

368 - 2005 *R. Ruffini, C.L. Bianco, P. Chardonnet, F. Fraschetti, V. Gurzadyan, S.-S. Xue*

Emergence of a filamentary structure in the fireball from GRB spectra

It is shown that the concept of a fireball with a definite filamentary structure naturally emerges from the analysis of the spectra of Gamma-Ray Bursts (GRBs). These results, made possible by the recently obtained analytic expressions of the equitemporal surfaces in the GRB afterglow, depend crucially on the single parameter R describing the e□ective area of the fireball emitting the X- and gamma ray radiation. The X- and gamma ray components of the afterglow radiation are shown to have a thermal spectrum in the co-moving frame of the fireball and originate from a stable shock front described self-consistently by the Rankine-Hugoniot equations. Precise predictions are presented on a correlations between spectral changes and intensity variations in the prompt radiation verifiable, e.g., by the Swift and future missions. The highly variable optical and radio emission depends instead on the parameters of the surrounding medium. The GRB 991216 is used as a prototype for this model.
Keywords: black hole physics — gamma rays: bursts — gamma rays: theory — ISM: clouds — ISM: structure — radiation mechanisms: thermal

Reference ***9 pages, 3 figures,***
International Journal of Modern Physics D14 (2005) 97-106

369 - 2005 *C.L.Bianco, R.Ruffini*

On the exact analytic expressions for the equitemporal surfaces in Gamma-Ray Burst afterglows

We have recently shown (see Bianco & Ruffini 2004) that marked differences exist between the EQuiTemporal Surfaces (EQTSs) for the Gamma-Ray Burst (GRB) afterglows numerically computed by the full integration of the equations of motion and the ones found in the current literature expressed analytically on the grounds of various approximations. In this Letter the exact analytic expressions of the EQTSs are presented both in the case of fully radiative and adiabatic regimes. The new EQTS analytic solutions validate the numerical results obtained in Bianco & Ruffini (2004) and offer a powerful tool to analytically perform the estimates of the physical observables in GRB afterglows.

Reference ***3 pages, 1 figure,***
Astrophys.J. 620 (2005) L23-L26
ISSN 1538-4365

370 - 2005 *R. Ruffini, F. Fraschetti, L. Vitagliano, S.-S. Xue*

Observational signatures of an electromagnetic overcritical gravitational collapse

We present theoretical predictions for the spectral, temporal and intensity signatures of the electromagnetic radiation emitted during the process of the gravitational collapse of a stellar core to a black hole, during which electromagnetic field strengths rise over the critical value for e^+e^- pair creation. The last phases of this gravitational collapse are studied, leading to the formation of a black hole with a subcritical electromagnetic field, likely with zero charge, and an outgoing pulse of initially optically thick e^+e^--photon plasma. Such a pulse reaches transparency at Lorentz gamma factors of 10^2--10^4. We find a clear signature in the outgoing electromagnetic signal, drifting from a soft to a hard spectrum, on very precise time-scales and with a very specific intensity modulation. The relevance of these theoretical results for the understanding of short gamma-ray bursts is outlined.

Reference ***11 pages, 3 figures, International Journal of Modern Physics D14 (2005) 131-142***

371 - 2005 *R.Ruffini, L.Vitagliano and S.S.Xue*

On Dynamical formation of Dyadosphere

We discuss the evolution of the plasma around a collapsing star core endowed with a net electric charge described by the Reissner-Norstrom geometry. The star is assumed to reach values of the electric field larger than the Heisenberg-Euler-Schwinger critical value for pair production. We consider the dynamical formation of the Dyadosphere.
We show that the plasma near the event horizon falls into the black hole, while the outer plasma expands reaching ultrarelativistic velocities.

Reference ***Proceeding of the Tenth Marcel Grossmann meeting, ICRA, CBPF, Rio de Janeiro, Brazil, July 20-26, 2003***
World Scientific 29-12-2005

372 - 2005 *R. Ruffini, L. Vitagliano and S.S. Xue*

Electron-positron-photon plasma around a collapsing massive star

Reference ***Proceeding of the Tenth Marcel Grossmann meeting, ICRA, CBPF, Rio de Janeiro, Brazil, July 20-26, 2003***
World Scientific 29-12-2005

373 - 2005 *R.Ruffini, M.G. Bernardini, C.L. Bianco, P.Chardonnet, F. Fraschetti, V. Gurzadyan, L. Vitagliano, S.S. Xue*

The Blackholic energy: long and short Gamma-Ray Bursts (New perspectives in physics and astrophysics from the theoretical understanding of Gamma-Ray Bursts, II)

[...] We turn then to the theoretical developments in the short GRBs: we first report some progress in the understanding the dynamical phase of collapse, the mass-energy formula and the extraction of blackholic energy which have been motivated by the analysis of the short GRBs. In this context progress has also been accomplished on establishing an absolute lower limit to the irreducible mass of the black hole as well as on some critical considerations about the relations of general relativity and the second law of thermodynamics. We recall how this last issue has been one of the most debated in theoretical physics in the past thirty years due to the work of Bekenstein and Hawking. Following these conceptual progresses we analyze the vacuum polarization process around an overcritical collapsing shell. We evidence the existence of a separatrix and a dyadosphere trapping surface in the dynamics of the electron-positron plasma generated during the process of gravitational collapse. We then analyze, using recent progress in the solution of the Vlasov-Boltzmann-Maxwell system, the oscillation regime in the created electron-positron plasma and their rapid convergence to a thermalized spectrum. We conclude by making precise predictions for the spectra, the energy fluxes and characteristic time-scales of the radiation for short-bursts. If the precise luminosity variation and spectral hardening of the radiation we have predicted will be confirmed by observations of short-bursts, these systems will play a major role as standard candles in cosmology. These considerations will also be relevant for the analysis of the long-bursts when the baryonic matter contribution will be taken into account.

Reference ***86 pages, 50 figures, to appear on the "Proceedings of the XIth Brazilian School of Cosmology and Gravitation",***
AIP Conf.Proc. 782 (2005) 42-127

374 - 2005 *Remo Ruffini, Maria Grazia Bernardini, Carlo Luciano Bianco, Pascal Chardonnet, Federico Fraschetti, Vahe Gurzadyan, Luca Vitagliano, She-Sheng Xue*

Black hole physics and astrophysics: The GRB-Supernova connection and URCA-1 - URCA-2

We outline the confluence of three novel theoretical fields in our modeling of Gamma-Ray Bursts (GRBs): 1) the ultrarelativistic regime of a shock front expanding with a Lorentz gamma factor ~ 300; 2) the quantum vacuum polarization process leading to an electron-positron plasma originating the shock front; and 3) the general relativistic process of energy extraction from a black hole originating the vacuum polarization process. There are two different classes of GRBs: the long GRBs and the short GRBs. We here address the issue of the long GRBs. [...] We are specially interested, in this report, to a subclass of long GRBs which appear to be accompanied by a supernova explosion. We are considering two specific examples: GRB980425/SN1998bw and GRB030329/SN2003dh [...].

Reference ***55 pages, 31 figures, to appear in the "Proceedings of the Tenth Marcel Grossmann Meeting",***
World Scientific 29-12-2005

375 - 2005 *Remo Ruffini, Maria Grazia Bernardini, Carlo Luciano Bianco, Pascal Chardonnet, Federico Fraschetti, She-Sheng Xue*

Evidence for isotropic emission in GRB991216

The issue of the possible presence or absence of jets in GRBs is here re-examined for GRB991216, which has a claimed half-opening beaming angle of $\vartheta_\circ=3^\circ$. We compare and contrast our theoretically predicted afterglow luminosity in the 2--10 keV band for spherically symmetric versus jetted emission. Jetted emission can be excluded and data analysis confirms spherical symmetry. These theoretical fits are expected to be largely improved by the forthcoming data of the Swift mission. In addition to the source GRB991216, our model has been applied successfully, assuming spherical symmetry, to GRB980519, GRB980425, GRB030329 and to GRB970228.

Reference ***7 pages, 1 figure, Advances in Space Research***
In the Proceedings of the 35th COSPAR scientific assembly
New version to fit into the limit of 6 pages and to fix the format of the reference list

376 - 2005 *M.G. Bernardini, C.L. Bianco, P. Chardonnet, F. Fraschetti, R. Ruffini, S.-S. Xue*

Theoretical interpretation of luminosity and spectral properties of GRB 031203

The X and gamma-ray observations of the source GRB 031203 by INTEGRAL are interpreted within our theoretical model. In addition to a complete space-time parametrization of the GRB, we specifically assume that the afterglow emission originates from a thermal spectrum in the co-moving frame of the expanding baryonic matter shell. By determining the two free parameters of the model and estimating the density and filamentary structure of the ISM, we reproduce the observed luminosity in the 20-200 keV energy band. As in previous sources, the prompt radiation is shown to coincide with the peak of the afterglow and the luminosity substructure are shown to originate in the filamentary structure of the ISM. We predict a clear hard-to-soft behavior in the instantaneous spectra. The time-integrated spectrum over 20 seconds observed by INTEGRAL is well fitted. Despite this source has been considered "unusual", it appears to us a normal low energetic GRB.

Reference ***4 pages, 4 figures***
Astrophys.J. 634 (2005) L29-L32

377 - 2005 *C.L. Bianco, R. Ruffini*

Exact versus approximate solutions in Gamma-Ray Burst afterglows

We have recently obtained the exact analytic solutions of the relativistic equations relating the radial and time coordinate of a relativistic thin uniform shell expanding in the interstellar medium in the fully radiative and fully adiabatic regimes. We here re-examine the validity of the constant-index power-law relations between the Lorentz gamma factor and its radial coordinate, usually adopted in the current Gamma-Ray Burst (GRB) literature on the grounds of an "ultrarelativistic" approximation. Such expressions are found to be mathematically correct but only approximately valid in a very limited range of the physical and astrophysical parameters and in an asymptotic regime which is reached only for a very short time, if any, and are shown to be not applicable to GRBs.

Reference ***4 pages, 2 figures***
Astrophys.J. 633 (2005) L13-L16

378 - 2005 *M. Lattanzi, R. Ruffini, G.V. Vereshchagin*

Joint constraints on the lepton asymmetry of the Universe and neutrino mass from the Wilkinson Microwave Anisotropy Probe

We use the Wilkinson Microwave Anisotropy Probe (WMAP) data on the spectrum of cosmic microwave background anisotropies to put constraints on the present amount of lepton asymmetry L, parameterized by the dimensionless chemical potential (also called degeneracy parameter) xi and on the effective number of relativistic particle species. We assume a flat cosmological model with three thermally distributed neutrino species having all the same mass and chemical potential, plus an additional amount of effectively massless exotic particle species. The extra energy density associated to these species is parameterized through an effective number of additional species DeltaN_oth$. We find that 0<|xi|<1.1 and correspondingly 0<|L|<0.9 at 2sigma, so that WMAP data alone cannot firmly rule out scenarios with a large lepton number; moreover, a small preference for this kind of scenarios is actually found. We also discuss the effect of the asymmetry on the estimation of other parameters and in particular of the neutrino mass. In the case of perfect lepton symmetry, we obtain the standard results. When the amount of asymmetry is left free, we find \sum m_nu < 3.6 eV at 2sigma. Finally we study how the determination of |L| is affected by the assumptions on DeltaN_oth. We find that lower values of the extra energy density allow for larger values of the lepton asymmetry, effectively ruling out, at 2sigma level, lepton symmetric models with DeltaN_oth=0.

Reference ***Phys.Rev. D72 (2005) 063003***

379 - 2005 *R. Ruffini, M.G. Bernardini, C.L. Bianco, P. Chardonnet, F. Fraschetti, V. Gurzadyan, M. Lattanzi, L. Vitagliano, S.-S. Xue*

Extracting energy from black holes: "long" and "short" GRBs and their astrophysical settings

The introduction of the three interpretational paradigms for Gamma-Ray Bursts (GRBs) and recent progress in understanding the X- and gamma ray luminosity in the afterglow allow us to make assessments about the astrophysical settings of GRBs. In particular, we evidence the distinct possibility that some GRBs occur in a binary system. This subclass of GRBs manifests itself in a "tryptich": one component formed by the collapse of a massive star to a black hole, which originates the GRB; a second component by a supernova and a third one by a young neutron star born in the supernova event. Similarly, the understanding of the physics of quantum relativistic processes during the gravitational collapse makes possible precise predictions about the structure of short GRBs.

Reference ***8 pages, 2 figures, "Gamma-Ray Burst in the Afterglow Era: 4th Workshop", held in Rome, October 18-22, 2004, L. Piro, L. Amati, S. Covino, B. Gendre (eds.), Il Nuovo Cim. 28C (2005) 589-596***

380 - 2005 *M. Lattanzi, H.W. Lee, R. Ruffini, G.V. Vereshchagin*

Cosmological Massive Neutrinos with non-zero Chemical Potential: II. Effect on the Estimation of Cosmological Parameters

The recent analysis of the cosmic microwave background data carried out by the WMAP team seems to show that the sum of the neutrino masses is < 0.7 eV. However, this result is not model-independent, depending on precise assumptions on the cosmological model. We study how this result is modi?ed when the assumption of perfect lepton symmetry is dropped out.

Reference ***in "Proceedings of the X Marcel Grossmann Meeting on General Relativity", Eds. M. Novello, S. Perez Bergliaffa, R. Ruffini. Singapore, World Scientific (2005), p. 1255.***

381 - 2005 *Ohanian H.C., Ruffini R.*

"Gravitation and Spacetime"

Reference ***W.W. Norton & Co. New York (1994), translated and published in Chinese (2005)***

382 - 2006 *Maria Grazia Bernardini, Carlo Luciano Bianco, Pascal Chardonnet, Federico Fraschetti, Remo Ruffini, She-Sheng Xue*

General features of GRB 030329 in the EMBH model

GRB~030329 is considered within the EMBH model. We determine the three free parameters and deduce its luminosity in given energy bands comparing it with the observations. The observed substructures are compared with the predictions of the model: by applying the result that substructures observed in the extended afterglow peak emission (E-APE) do indeed originate in the collision of the accelerated baryonic matter (ABM) pulse with the inhomogeneities in the interstellar medium around the black-hole, masks of density inhomogeneities are considered in order to reproduce the observed temporal substructures. The induced supernova concept is applied to this system and the general consequences that we are witnessing are the formation of a cosmological thriptych of a black hole originating the GRB~030329, the supernova SN2003dh and a young neutron star. Analogies to the system GRB~980425--SN1998bw are outlined

Reference ***Proceedings del "X Marcel Grossmann Meeting", Rio de Janeiro, Brasile, 20-26 Luglio 2003, World Scientific (2006) 2459-2464.***

383 - 2006 *Carlo Luciano Bianco, Remo Ruffini*

Exact versus approximate beaming formulas in Gamma-Ray Burst afterglows

We present the exact analytic expressions to compute, assuming the emitted Gamma-Ray Burst (GRB) radiation is not spherically symmetric but is confined into a narrow jet, the value of the detector arrival time at which we start to "see" the sides of the jet, both in the fully radiative and adiabatic regimes. We obtain this result using our exact analytic expressions for the EQuiTemporal Surfaces (EQTSs) in GRB afterglows. We re-examine the validity of three different approximate formulas currently adopted for the adiabatic regime in the GRB literature. We also present an empirical fit of the numerical solutions of the exact equations, compared and contrasted with the three above approximate formulas. The extent of the differences is such as to require a reassessment on the existence and entity of beaming in the cases considered in the current literature, as well as on its consequences on the GRB energetics.

Reference ***4 pages, 4 figures, to appear on ApJ Lett***
Jornal-ref: Astrophys.J.644 (2006)L105-L108

384 - 2006 *Remo Ruffini, Maria Grazia Bernardini, Carlo Luciano Bianco, Pascal Chardonnet, Federico Fraschetti, She-Sheng Xue*

Theoretical interpretation of GRB031203 and URCA-3

We present an analysis of the late time X-ray emission (URCA-3) connected with GRB 031203 and SN 2003lw.

Reference ***3 pages, 2 figures, proceedings of "Relativistic Astrophysics and Cosmology - Einstein's Legacy" meeting, November 7-11, 2005, Munich, Germany, edited by B. Aschenbach, V. Burwitz, G. Hasinger, and B. Leibundgut***

385 - 2006 *Remo Ruffini, Maria Grazia Bernardini, Carlo Luciano Bianco, Pascal Chardonnet, Federico Fraschetti, Roberto Guida, She-Sheng Xue*

GRB 050315: A step in the proof of the uniqueness of the overall GRB structure

Using the Swift data of GRB 050315, we progress in proving the uniqueness of our theoretically predicted Gamma-Ray Burst (GRB) structure as composed by a proper-GRB, emitted at the transparency of an electron-positron plasma with suitable baryon loading, and an afterglow comprising the "prompt radiation" as due to external shocks. Detailed light curves for selected energy bands are theoretically fitted in the entire temporal region of the Swift observations ranging over 10^6 seconds

Reference ***6 pages, 3 figures, Proceedings of the 16th Annual October Astrophysics Conference in Maryland "Gamma Ray Bursts in the Swift Era", November 29-December 2, 2005, edited by Stephen S. Holt, Neil Gehrels and John Nousek***

386 - 2006 *Remo Ruffini, Maria Grazia Bernardini, Carlo Luciano Bianco, Pascal Chardonnet, Federico Fraschetti, Roberto Guida, She-Sheng Xue*

GRB 050315: A step toward the uniqueness of the overall GRB structure

Using the Swift data of GRB 050315, we progress on the uniqueness of our theoretically predicted Gamma-Ray Burst (GRB) structure as composed by a proper-GRB (P-GRB), emitted at the transparency of an electron-positron plasma with suitable baryon loading, and an afterglow comprising the so called ``prompt emission'' as due to external shocks.
Thanks to the \emph{Swift} observations, the P-GRB is identified and for the first time we can theoretically fit detailed light curves for selected energy bands on a continuous time scale ranging over 10^6 seconds. The theoretically predicted instantaneous spectral distribution over the entire afterglow is presented, confirming a clear hard-to-soft behavior encompassing, continuously, the ``prompt emission'' all the way to the latest phases of the afterglow.

Reference ***Astrophys.J. 645 (2006) L109-L112***

387 - 2006 *Remo Ruffini, Carlo Luciano Bianco, Gregory Vereshchagin, She-Sheng Xue*

Baryonic loading and e^+e^- rate equation in GRB sources

The expansion of the electron-positron plasma in the GRB phenomenon is compared and contrasted in the treatments of Mèszàros, Laguna and Rees, of Shemi, Piran and Narayan, and of Ruffini et al.. The role of the correct numerical integration of the hydrodynamical equations, as well as of the rate equation for the electron-positron plasma loaded with a baryonic mass, are outlined and confronted for crucial differences.

Reference ***Relativistic Astrophysics Legacy and Cosmology - Einstein's, ESO Astrophysics Symposia, Volume . ISBN 978-3-540-74712-3. Springer-Verlag Berlin Heidelberg, 2008, p. 402***

388 - 2006 *Remo Ruffini, Maria Grazia Bernardini, Carlo Luciano Bianco, Pascal Chardonnet, Federico Fraschetti, Roberto Guida, She-Sheng Xue*

GRB 050315: A step in the proof of the uniqueness of the overall GRB structure

to appear in the Proceedings of the 16th Annual October Astrophysics Conference in Maryland "Gamma Ray Bursts in the Swift Era", November 29-December 2, 2005, edited by Stephen S. Holt, Neil Gehrels and John Nousek

Reference ***AIP Conf.Proc. 836 (2006) 103-108***

389 - 2006 *C. L. Bianco, R. Ruffini, G. V. Vereshchagin and S.-S. Xue*

Equations of Motion and Initial and Boundary Conditions for Gamma-ray Burst

We compare and contrast the different approaches to the optically thick adiabatic phase of GRB all the way to the transparency. Special attention is given to the role of the rate equation to be self consistently solved with the relativistic hydrodynamic equations. The works of Shemi and Piran, Piran, Shemi and Narayan, Meszaros, Laguna and Rees and Ruffini, Salmonson, Wilson and Xue are compared and contrasted. The role of the baryonic loading in these three treatments is pointed out. Constraints on initial conditions for the fireball produced by electro-magnetic black hole are obtained.

Reference ***Journal of the Korean Physical Society, Vol. 49, (2006), No. 2, pp. 722-731.***

390 - 2006 *M. Lattanzi, R. Ruffini and G.V. Vereshchagin*

Do WMAP data constraint the lepton asymmetry of the Universe to be zero?"

It is shown that extended flat ΛCDM models with massive neutrinos, a sizeable lepton asymmetry and an additional contribution to the radiation content of the Universe, are not excluded by the Wilkinson Microwave Anisotropy Probe (WMAP) first year data. We assume a flat cosmological model with three thermally distributed neutrino species having all the same mass and chemical potential, plus an additional amount of effectively massless exotic particle species X.
After maximizing over seven other cosmological parameters, we derive from WMAP first year data the following constraints for the lepton asymmetry L of the Universe (95\% CL): $0<|L|<0.9$, so that WMAP data alone cannot firmly rule out scenarios with a large lepton number; moreover, a small preference for this kind of scenarios is actually found. We also find for the neutrino mass $m_\nu < 1.2$~eV and for the effective number of relativistic particle species $-0.45 < \Delta\Neff<2.10$, both at 95\% CL. The limit on $\Delta\Neff$ is more restrictive than others found in the literature, but we argue that this is due to our choice of priors.

Reference ***in Albert Einstein Century International Conference, edited by J.-M. Alimi, and A. Füzfa, AIP Conference Proceedings, Vol. 861, Melville, New York, 2006, pp.912-919***

391 - 2006 *Remo Ruffini, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Pascal Chardonnet, Maria Giovanna Dainotti, Federico Fraschetti, Roberto Guida, Gregory Vereshchagin, She-Sheng Xue*

The role of GRB 031203 in clarifying the astrophysical GRB scenario

The luminosity and the spectral distribution of the afterglow of GRB 031203 have been presented within our theoretical framework [3], which envisages the GRB structure as composed by a proper-GRB, emitted at the transparency of an electron-positron plasma with suitable baryon loading, and an afterglow comprising the “prompt emission” as due to external shocks. In addition to the GRB emission, there appears to be a prolonged soft XRay
emission lasting for 106–107 seconds followed by an exponential decay. This additional source has been called by us URCA-3. It is urgent to establish if this component is related to the GRB or to the Supernova (SN). In this second case, there are two possibilities: either the interaction
of the SN ejecta with the interstellar medium or, possibly, the cooling of a young neutron star formed in the SN 2003lw process. The analogies and the differences between this triptych GRB 031203 / SN 2003lw / URCA- 3 and the corresponding ones GRB 980425 / SN 1998bw / URCA-1 and GRB 030329 / SN 2003dh / URCA-2, as well as GRB 060218 / SN 2006aj are discussed.

Reference ***8 pages, 11 figures, to appears in the proceedings of "The 6th INTEGRAL Workshop - The Obscured Universe", Moscow, 2006, ESA Special Publication, SP-622, in press***

392 - 2006 *Remo Ruffini, Maria Grazia Bernardini, Carlo Luciano Bianco, Pascal Chardonnet, Federico Fraschetti, Roberto Guida, She-Sheng Xue*

GRB 050315: A step toward the uniqueness of the overall GRB structure and the true nature of long GRBs

Using the Swift data of GRB 050315, we progress on the uniqueness
of our theoretically predicted Gamma-Ray Burst (GRB) structure as composed by a proper-GRB (P-GRB), emitted at the transparency of an electron-positron plasma with suitable baryon loading, and an afterglow comprising the so called “prompt emission” as due to external shocks. Thanks to the Swift observations, we can theoretically fit detailed light curves for selected energy bands on a continuous time
scale ranging over 106 seconds. The theoretically predicted instantaneous spectral distribution over the entire afterglow confirms a clear hard-to-soft behavior encompassing, continuously, the “prompt emission” all the way to the latest phases of the afterglow. Consequences of the instrumental threshold on the definition of “short” and “long” GRBs are discussed.

Reference ***Nuovo Cim. 121B (2006) 1367-1372***

393 - 2006 *Carlo Luciano Bianco, Letizia Caito, Remo Ruffini*

Theoretical interpretation of GRB 011121

GRB011121 is analyzed as a prototype to understand the “flares”
recently observed by Swift in the afterglow of many GRB sources. Detailed theoretical computation of the GRB011121 light curves in selected energy bands are presented and compared and contrasted with observational BeppoSAX data.

Reference ***Nuovo Cim. 121B (2006) 1441-1442***

394 - 2006 *Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Pascal Chardonnet, Alessandra Corsi, Maria Giovanna Dainotti, Federico Fraschetti, Roberto Guida, Remo Ruffini, She-Sheng Xue*

GRB970228 as a prototype for short GRBs with afterglow

GRB970228 is analyzed as a prototype to understand the relative
role of short GRBs and their associated afterglows, recently observed by Swift and HETE-II. Detailed theoretical computation of the GRB970228 light curves in selected energy bands are presented and compared with observational BeppoSAX
data.

Reference ***Nuovo Cim. 121B (2006) 1439-1440***

395 - 2006 *Federico Fraschetti, Remo Ruffini, Luca Vitagliano, She-Sheng Xue*

Theoretical predictions of spectral evolution of short GRBs

We present the properties of spectrum of radiation emitted during gravitational collapse in which electromagnetic field strengths rise over the critical
value for e+e− pair creation. A drift from soft to a hard energy and a high energy cut off have been found; a comparison with a pure black body spectrum is outlined.

Reference ***2 pages, 1 picture, Proceedings of the "Swift and GRBs: Unveiling the Relativistic Universe", in Venice (Italy), June 5-9, 2006 (IL NUOVO CIMENTO)***

396 - 2006 *Remo Ruffini, Maria Grazia Bernardini, Carlo Luciano Bianco, Pascal Chardonnet, Federico Fraschetti, Roberto Guida, She-Sheng Xue*

GRB 050315: a step toward understanding the uniqueness of the overall Gamma-Ray Burst structure

Reference ***ApJ Lett. 645 (2006) 109-112***

397 - 2006 *Remo Ruffini, Maria Grazia Bernardini, Carlo Luciano Bianco, Pascal Chardonnet, Alessandra Corsi, Federico Fraschetti, She-Sheng Xue*

GRB970228 and its associated Supernova within the EMBH mode

We outline the confluence of three novel theoretical fields in our modeling of Gamma-Ray Bursts (GRBs): 1) the ultrarelativistic regime of a shock front expanding with a Lorentz gamma factor ~ 300; 2) the quantum vacuum polarization process leading to an electron-positron plasma originating the shock front; and 3) the general relativistic process of energy extraction from a black hole originating the vacuum polarization process. There are two different classes of GRBs: the long GRBs and the short GRBs. We here address the issue of the long GRBs.
The theoretical understanding of the long GRBs has led to the detailed description of their luminosities in fixed energy bands, of their spectral features and made also possible to probe the astrophysical scenario in which they originate. We are specially interested, in this report, to a subclass of long GRBs which appear to be accompanied by a supernova explosion. We are considering two specific examples: GRB980425/SN1998bw and GRB030329/SN2003dh. While these supernovae appear to have a standard energetics of 10^{49} ergs, the GRBs are highly variable and can have energetics 10^4 -- 10^5 times larger than the ones of the supernovae. Moreover, many long GRBs occurs without the presence of a supernova. It is concluded that in no way a GRB can originate from a supernova. The precise theoretical understanding of the GRB luminosity we present evidence, in both these systems, the existence of an independent component in the X-ray emission, usually interpreted in the current literature as part of the GRB afterglow. This component has been observed by Chandra and XMM to have a strong decay on scale of months. We have named here these two sources respectively URCA-1 and URCA-2, in honor of the work that George Gamow and Mario Shoenberg did in 1939 in this town of Urca identifying the basic mechanism, the Urca processes, leading to the process of gravitational collapse and the formation of a neutron star and a supernova. The further hypothesis is considered to relate this X-ray source to a neutron star, newly born in the Supernova. This hypothesis should be submitted to further theoretical and observational investigation. Some theoretical developments to clarify the astrophysical origin of this new scenario are outlined.

Reference ***in the Proceedings of the “X Marcel Grossmann Meeting” in Rio de Janeiro, Brazil, July 20-26, 2003, ed. M. Novello, S. Perez-Bergliaffa and R. Ruffini, World Scientific (2006) 2465-2467***

398 - 2006 *Federico Fraschetti, Maria Grazia Bernardini, Carlo Luciano Bianco, Pascal Chardonnet, Remo Ruffini, She-Sheng Xue*

Inferences on the ISM structure around GRB980425 and GRB980425-SN1998bw association in the EMBH model

We determine the four free parameters within the EMBH model for
GRB~980425 and deduce its luminosity in given energy bands, its spectra and its time variability in the prompt radiation. We compute the basic kinematical parameters of GRB~980425. In the extended afterglow peak emission the Lorentz γ factor is lower than the critical value 150 which has been found in Ruffini et al. (2002) to be necessary in order to perform the tomography of the ISM surrounding the GRB as suggested by Dermer & Mitman (1999). The detailed structure of the density inhomogeneities as well as the effects of radial apparent superluminal effects are evaluated within the EMBH model. Under the assumption that the energy distribution of emitted radiation is thermal in the comoving frame, time integrated spectra of EMBH model for prompt emission are computed. The induced supernova concept is applied to this system and general consequences on the astrophysical and cosmological scenario are derived.

Reference ***in the Proceedings of the "X Marcel Grossmann Meeting" in Rio de Janeiro, Brazil, July 20-26, 2003, ed. M. Novello, S. Perez-Bergliaffa and R. Ruffini, World Scientific (2006) 2451-2458***

399 - 2006 *R. Guida, M. Lattanzi, R. Ruffini*

Emergence of self-similar properties in the evolution of density perturbations

We discuss the emergence of self-similarity during the linear phase of the gravitational collapse of a perturbed cloud of pressureless gas.
We study the relationship between the initial density and velocity fields and the self similar properties of the final matter
distribution: we find that, for reasonable initial conditions, the final matter distribution presents different correlation properties at different lengths. This behavior is actually observed in the present day distribution of matter.

Reference ***J. Kor. Phys. Soc. 49, 797 (2006).***

400 - 2006 *Ruffini R. et al.*

Proceedings of the "1ST Stueckelberg Workshop on Relativistic Field Theories"

Reference ***Editors Cianfrani F., Montani G., Ruffini R., SIF Bologna, 2006***

401 - 2007 *Bini D., Geralico A., Ruffini R.*

Charged massive particle at rest in the field of a Reissner-Nordström black hole

The interaction of a Reissner-Nordstr\"om black hole and a charged massive particle is studied in the framework of perturbation theory.
The particle backreaction is taken into account, studying the effect of general static perturbations of the hole following the approach of Zerilli.
The solutions of the combined Einstein-Maxwell equations for both perturbed gravitational and electromagnetic fields at first order of the perturbation are exactly reconstructed by summing all multipoles, and are given explicit closed form expressions.
The existence of a singularity-free solution of the Einstein-Maxwell system requires that the charge to mass ratios of the black hole and of the particle satisfy an equilibrium condition which is in general dependent on the separation between the two bodies.
If the black hole is undercritically charged (i.e. its charge to mass ratio is less than one), the particle must be overcritically charged, in the sense that the particle must have a charge to mass ratio greater than one. If the charge to mass ratios of the black hole and of the particle are both equal to one (so that they are both critically charged, or \lq\lq extreme"), the equilibrium can exist for any separation distance, and the solution we find coincides with the linearization in the present context of the well known Majumdar-Papapetrou solution for two extreme Reissner-Nordstr\"om black holes. In addition to these singularity-free solutions, we also analyze the corresponding solution for the problem of a massive particle at rest near a Schwarzschild black hole, exhibiting a strut singularity on the axis between the two bodies. The relations between our perturbative solutions and the corresponding exact two-body solutions belonging to the Weyl class are also discussed.

Reference ***Phys. Rev. D, 75, 044012 2007***

402 - 2007 *Bini D., Geralico A., Ruffini R. J.*

On the equilibrium of a charged massive particle in the field of a Reissner-Nordström black hole

The multiyear problem of a two-body system consisting of a Reissner-Nordström black hole and a charged massive particle at rest is here solved by an exact perturbative solution of the full Einstein-Maxwell system of equations. The expressions of the metric and of the electromagnetic field, including the effects of the electromagnetically induced gravitational perturbation and of the gravitationally induced electromagnetic perturbation, are presented in closed analytic formulas.

Reference ***Physics Letters A, vol. 360, 515-517, 2007***

403 - 2007 *Xue She Sheng, Remo Ruffini, Michael Rotondo*

Electrodynamics for Nuclear Matter in Bulk

We present an approach to analyze the electrodynamics of nuclear matter in bulk using the relativistic Thomas-Fermi equation. We generalize to the case of N ~ (mPlanck/mn)3 nucleons of mass mn an approach well tested in very heavy nuclei (Z ~10^6). Particular attention is given to implement the condition of charge neutrality globally on the entire configuration, versus the one usually adopted on a microscopic scale. As the limit N ~ (mPlanck/mn)3 is approached the penetration of electrons inside the core increases and a relatively small tail of electrons persists leading to a significant electron density outside the core. Within a region of 102 electron Compton wavelength near the core, surface electric fields close to the critical value for pair creation by vacuum polarization effect develop. These results can have important consequences on the understanding of physical process in neutron star structures as well as on the initial conditions leading to the process of gravitational collapse to a black hole.

Reference ***International Journal of Modern Physic D, Vol. 16, no. 1, pp. 1-9, 2007***

404 - 2007 *Remo Ruffini, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Pascal Chardonnet, Maria Giovanna Dainotti, Federico Fraschetti, Roberto Guida, Michael Rotondo, Gregory Vereshchagin, Luca Vitagliano, She-Sheng Xue*

The Blackholic energy and the canonical Gamma-Ray Burst

Gamma-Ray Bursts (GRBs) represent very likely “the” most extensive computational, theoretical and observational
effort ever carried out successfully in physics and astrophysics. The extensive campaign of observation from space
based X-ray and g -ray observatory, such as the Vela, CGRO, BeppoSAX, HETE-II, INTEGRAL, Swift, R-XTE, Chandra,
XMM satellites, have been matched by complementary observations in the radio wavelength (e.g. by the VLA) and in the
optical band (e.g. by VLT, Keck, ROSAT). The net result is unprecedented accuracy in the received data allowing the determination
of the energetics, the time variability and the spectral properties of these GRB sources. The very fortunate situation
occurs that these data can be confronted with a mature theoretical development. Theoretical interpretation of the above data
allows progress in three different frontiers of knowledge: a) the ultrarelativistic regimes of a macroscopic source moving at
Lorentz gamma factors up to ∼ 400; b) the occurrence of vacuum polarization process verifying some of the yet untested
regimes of ultrarelativistic quantum field theories; and c) the first evidence for extracting, during the process of gravitational
collapse leading to the formation of a black hole, amounts of energies up to 1055 ergs of blackholic energy — a new form of
energy in physics and astrophysics. We outline how this progress leads to the confirmation of three interpretation paradigms
for GRBs proposed in July 2001. Thanks mainly to the observations by Swift and the optical observations by VLT, the outcome
of this analysis points to the existence of a “canonical” GRB, originating from a variety of different initial astrophysical
scenarios. The communality of these GRBs appears to be that they all are emitted in the process of formation of a black
hole with a negligible value of its angular momentum. The following sequence of events appears to be canonical: the vacuum
polarization process in the dyadosphere with the creation of the optically thick self accelerating electron-positron plasma; the
engulfment of baryonic mass during the plasma expansion; adiabatic expansion of the optically thick “fireshell” of electronpositron-
baryon plasma up to the transparency; the interaction of the accelerated baryonic matter with the interstellar medium
(ISM). This leads to the canonical GRB composed of a proper GRB (P-GRB), emitted at the moment of

Reference ***AIP Conf.Proc. 910 (2007) 55-217***

405 - 2007 *Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini*

GRB970228 and a class of GRBs with an initial spikelike emission

The discovery by Swift and HETE-2 of an afterglow emission associated possibly with short GRBs opened the new problematic
of their nature and classification. This issue has been further enhanced by the observation of GRB060614 and by a new analysis
of the BATSE catalog which led to the identification of a new class of GRBs with “an occasional softer extended emission lasting
tenths of seconds after an initial spikelike emission”.
Aims. We plan a twofold task: a) to fit this new class of “hybrid” sources within our “canonical GRB” scenario, where all GRBs are
generated by a “common engine” (i.e. the gravitational collapse to a black hole); b) to propose GRB970228 as the prototype of the
above mentioned class, since it shares the same morphology and observational features.
Methods. We analyze BeppoSAX data on GRB970228 within the “fireshell” model and we determine the parameters describing the
source and the CircumBurst Medium (CBM) needed to reproduce its light curves in the 40–700 keV and 2–26 keV energy bands.
Results. We find that GRB970228 is a “canonical GRB”, like e.g. GRB050315, with the main peculiarity of a particularly low
average density of the CBM hncbmi ∼ 10−3 particles/cm3. We also simulate the light curve corresponding to a rescaled CBM density
profile with hncbmi = 1 particle/cm3. From such a comparison it follows that the total time-integrated luminosity is a faithful indicator
of the nature of GRBs, contrary to the peak luminosity which is merely a function of the CBM density.
Conclusions. We call attention on discriminating the short GRBs between the “genuine” and the “fake” ones. The “genuine” ones are
intrinsically short, with baryon loading B <∼ 10−5, as stated in our original classification. The “fake” ones, characterized by an initial
spikelike emission followed by an extended emission lasting tenths of seconds, have a baryon loading 10−4 <∼ B ≤ 10−2. They are
observed as such only due to an underdense CBM consistent with a galactic halo environment which deflates the afterglow intensity.

Reference ***A&A Lett. 474 (2007) 13-17***

406 - 2007 *A. G. Aksenov, R. Ruffini, G. V. Vereshchagin*

Thermalization of a nonequilibrium electron-positron-photon plasma

Starting from a nonequilibrium configuration we analyse the essential role of the direct and the inverse binary and triple interactions in reaching an asymptotic thermal equilibrium in a homogeneous isotropic electron-positron-photon plasma. We focus on energies in the range 0.1–10 MeV.
We numerically integrate the integro-partial differential relativistic Boltzmann equation with the exact QED collisional integrals taking into account all binary and triple interactions in the plasma.
We show that first, when detailed balance is reached for all binary interactions on a timescale tk . 10−14sec, photons and electron-positron pairs establish kinetic equilibrium. Successively, when
triple interactions fulfill the detailed balance on a timescale teq . 10−12sec, the plasma reaches thermal equilibrium. It is shown that neglecting the inverse triple interactions prevents reaching thermal equilibrium. Our results obtained in the theoretical physics domain also find application in astrophysics and cosmology.

Reference ***Phys.Rev.Lett. 99 (2007) 125003***

407 - 2007 *R. Ruffini, G.V. Vereshchagin, S.-S. Xue*

Vacuum polarization and plasma oscillations

We evidence the existence of plasma oscillations of electrons-positron pairs created by the vacuum polarization in an uniform electric field with E . Ec. Our general treatment, encompassing also the traditional, well studied case of E > Ec, shows the existence in both cases of a maximum Lorentz factor acquired by electrons and positrons and allows determination of the a maximal length of oscillation. We quantitatively estimate how plasma oscillations reduce the rate of pair creation and increase the time scale of the pair production. These results are particularly relevant in view of the experimental progress in approaching the field strengths E . Ec.

Reference ***Phys. Lett. A371 (2007) 399***

408 - 2007 *Maria Giovanna Dainotti, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Roberto Guida, Remo Ruffini*

GRB060218 and GRBs associated with Supernovae Ib/c

The Swift satellite has given continuous data in the range 0.3–150 keV from 0 s to 106 s for GRB060218 associated with SN2006aj. This GRB which has an unusually long duration (T90 ∼ 2100 s) fulfills the Amati relation. These data offer the opportunity to probe theoretical models for Gamma-Ray Bursts (GRBs) connected with Supernovae (SNe).
Aims. We plan to fit the complete γ- and X-ray light curves of this long duration GRB, including the prompt emission, in order to clarify the nature of the progenitors and the astrophysical scenario of the class of GRBs associated to SNe Ib/c.
Methods. We apply our “fireshell” model based on the formation of a black hole, giving the relevant references. It is characterized by the precise equations of motion and equitemporal surfaces and by the role of thermal emission.
Results. The initial total energy of the electron-positron plasma Etot e± = 2.32 × 1050 erg has a particularly low value similarly to the other GRBs associated with SNe. For the first time we observe a baryon loading B = 10−2 which coincides with the upper limit for the dynamical stability of the fireshell. The effective CircumBurst Medium (CBM) density shows a radial dependence ncbm ∝ r−α with 1.0 <∼ α <∼ 1.7 and monotonically decreases from 1 to 10−6 particles/cm3. Such a behavior is interpreted as due to a fragmentation in the fireshell. Analogies with the fragmented density and filling factor characterizing Novae are outlined. The fit presented is particularly significant in view of the complete data set available for GRB060218 and of the fact that it fulfills the Amati relation.
Conclusions. We fit GRB060218, usually considered as an X-Ray Flash (XRF), as a “canonical GRB” within our theoretical model.
The smallest possible black hole, formed by the gravitational collapse of a neutron star in a binary system, is consistent with the especially low energetics of the class of GRBs associated with SNe Ib/c.We give the first evidence for a fragmentation in the fireshell. Such a fragmentation is crucial in explaining both the unusually large T90 and the consequently inferred abnormal low value of the CBM effective density.

Reference ***Astron.Astrophys. 471 (2007) L29-L32***

409 - 2007 *S. Casanova, O. M. Lecian, G. Montani, R. Ruffini, R. Zalaletdinov*

Extended Schouten classification for non-Riemannian geometries

A generalized connection, including Christoffel coefficients, torsion, non-metricity tensor and metric-asymmetricity object, is analyzed according to the Schouten classification. The inverse structure matrix is found in the linearized regime, autoparallel trajectories are defined and the contribution of the components of the connection are clarified at first-order approximation.

Reference ***7 pages, to appear on Mod. Phys. Lett. A***

410 - 2007 *Remo Ruffini, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Pascal Chardonnet, Maria Giovanna Dainotti, Federico Fraschetti, Roberto Guida, Gregory Vereshchagin, She-Sheng Xue*

The role of GRB031203 in clarifying the astrophysical GRB scenario

The luminosity and the spectral distribution of the afterglow of GRB
031203 have been presented within our theoretical framework, which envisages the GRB structure as composed by a proper-GRB, emitted at the transparency of an electron-positron plasma with suitable baryon loading, and an afterglow comprising the ``prompt emission'' as due to external shocks. In addition to the GRB emission, there appears to be a prolonged soft X-Ray emission lasting for 10^6--10^7 seconds followed by an exponential decay. This additional source has been called by us URCA-3. It is urgent to establish if this component is related to the GRB or to the Supernova (SN). In this second case, there are two possibilities: either the interaction of the SN ejecta with the interstellar medium or, possibly, the cooling of a young neutron star formed in the SN 2003lw process. The analogies and the differences between this triptych GRB 031203 / SN 2003lw / URCA-3 and the corresponding ones GRB 980425 / SN 1998bw / URCA-1 and GRB 030329 / SN 2003dh / URCA-2, as well as GRB 060218 / SN 2006aj are discussed.

Reference ***in the Proceedings of the "6th INTEGRAL Workshop – The obscured universe" in Moscow, Russia, July 2-8, 2006, ed. S. Grebenev, R. Sunyaev and C. Winkler, ESA Special Publication 622 (2007) 561-568***

411 - 2007 *Michael Rotondo, Remo Ruffini, She-Sheng Xue*

Neutral nuclear core vs super charged one

Based on the Thomas-Fermi approach, we describe and distinguish the electron distributions around extended nuclear cores: (i) in the case that cores are neutral for the same proton and electron numbers; (ii) in the case that super charged cores are bare, electrons (positrons) produced by vacuum polarization fall (fly) into cores (infinity).

Reference ***Proceedings of the eleventh Marcell Grossmann meeting, World Scientific, Singapore 2008, p.1352***

412 - 2007 *A.G. Aksenov, M. Lattanzi, R. Ruffini, G.V. Vereshchagin*

From massive neutrinos and inos and the upper cut-off to the fractal structure of the Universe to recent progress in theoretical cosmology

We study pair plasma approaching thermal equilibrium, starting from nonequilibrium con?guration in the energy range 0.1–10 MeV. In this energy range a number of important phenomena takes place during cosmological expansion, such as decoupling of neutrinos and the synthesis of the light elements. Dynamics of these phenomena is sensitive to the assumption of thermal equilibrium, adopted in relativistic cosmology. By numerical solution of relativistic Boltzmann equations we show that the plasma reaches thermal equilibrium on a short timescale $t_{th} < 10^{?12}$ s, which is much shorter than the expansion timescale $t_{ex} = H(t)^{?1}$ at that moment. This result proves the assumption on thermal equilibrium in the above-mentioned energy range, thus con?rming predictions of the standard cosmological model.

Reference ***Nuovo Cim. 122B, 1377 (2007)***

413 - 2007 *Michael Rotondo, Remo Ruffini, She-Sheng Xue*

On the electrodynamics properties of nuclear matter in bulk

We present an approach to analyze the electrodynamics of nuclear matter in bulk using the relativistic Thomas-Fermi equation. We generalize to the case of $N \simeq (m_{\rm Planck}/m_n)^3$ nucleons of mass m_n an approach well tested in very heavy nuclei ($Z \simeq 10^6$). Particular attention is given to implement the condition of charge neutrality globally on the entire configuration, versus the one usually adopted on a microscopic scale. As the limit $N \simeq (m_{\rm Planck}/m_n)^3$ is approached the penetration of electrons inside the core increases and a relatively small tail of electrons persists leading to a significant electron density outside the core. Within a region of 10^2 electron Compton wavelength near the core surface electric fields close to the critical value for pair creation by vacuum polarization effect develop. These results can have important consequences on the understanding of physical process in neutron stars structures as well as on the initial conditions leading to the process of gravitational collapse to a black hole.

Reference ***International Journal of Modern Physic D, Vol. 16, no. 1, pp. 1-9, 2007***

414 - 2008 *R. Ruffini, G.V. Vereshchagin, S.-S. Xue*

Vacuum polarization and Electron-Positron Plasma Oscillations"

We study plasma oscillations of electrons-positron pairs created by the vacuum polarization in an uniform electric field. Our treatment, encompassing the case of E>E_{c}, shows also in the case E<E_{c} the existence of a maximum Lorentz factor acquired by electrons and positrons and allows determination of the a maximal length of oscillation. We quantitatively estimate how plasma oscillations reduce the rate of pair creation and increase the time scale of the pair production.

Reference ***RELATIVISTIC ASTROPHYSICS: 4th Italian-Sino Workshop, AIP Conference Proceedings, Vol. 966, Melville, New York, 2008, pp. 207-212.***

415 - 2008 *A.G. Aksenov, R. Ruffini, G.V. Vereshchagin*

Thermalizationof Electron-Positron-Photon Plasmas with a Application to GRB

The pair plasma with photon energies in the range 0.1--10 MeV is believed to play crucial role in cosmic Gamma-Ray Bursts. Starting from a nonequilibrium configuration we analyze the role of the direct and the inverse binary and triple interactions in reaching thermal equilibrium in a homogeneous isotropic pair plasma. We numerically integrate the relativistic Boltzmann equation with the exact QED collisional integrals taking into account all binary and triple interactions. We show that first, when a detailed balance is reached for all binary interactions on a time scale t_{k}≲10⁻©ö©ù sec , photons and electron-positron pairs establish kinetic equilibrium. Subsequently, when triple interactions satisfy the detailed balance on a time scale t_{eq}≲10⁻©ö©÷ sec , the plasma reaches thermal equilibrium. It is shown that neglecting the inverse triple interactions prevents reaching thermal equilibrium. Our results obtained in the theoretical physics domain also find application in astrophysics and cosmology.

Reference ***RELATIVISTIC ASTROPHYSICS: 4th Italian-Sino Workshop, AIP Conference Proceedings, Vol. 966, Melville, New York, 2008, pp. 191-196.***

416 - 2008 *R. Ruffini, S.-S. Xue*

Dyadosphere formed in Gravitational Collapse

We first recall the concept of Dyadosphere (electron-positron-photon plasma around a formed black holes) and its motivation, and recall on (i) the Dirac process: annihilation of electron-positron pairs to photons; (ii) the Breit-Wheeler process: production of electron-positron pairs by photons with the energy larger than electron-positron mass threshold; the Sauter-Euler-Heisenberg effective Lagrangian and rate for the process of electron-positron production in a constant electric field. We present a general formula for the pair-production rate in the semi-classical treatment of quantum mechanical tunneling. We also present in the Quantum Electro-Dynamics framework, the calculations of the Schwinger rate and effective Lagrangian for constant electromagnetic fields. We give a review on the electron-positron plasma oscillation in constant electric fields, and its interaction with photons leading to energy and number equipartition of photons, electrons and positrons. The possibility of creating an overcritical field in astrophysical condition is pointed out. We present the discussions and calculations on (i) energy extraction from gravitational collapse; (ii) the formation of Dyadosphere in gravitational collapsing process, and (iii) its hydrodynamical expansion in Reissner Nordstr\"om geometry. We calculate the spectrum and flux of photon radiation at the point of transparency, and make predictions for short Gamma-Ray Bursts.

Reference ***29 pages, 34 figures in Proceedings of the 5th Sino-Italian Workshop***

417 - 2008 *B. Patricelli, M. Rotondo, J. A. Rueda H., R. Ruffini*

The Electrodynamics of the Core and the Crust components in Neutron Stars

We study the possibility of having a strong electric field (E) in Neutron Stars. We consider a system composed by a core of degenerate relativistic electrons, protons and neutrons, surrounded by an oppositely charged leptonic component and show that at the core surface it is possible to have values of E of the order of the critical value for electron-positron pair creation, depending on the mass density of the system. We also describe Neutron Stars in general relativity, considering a system composed by the core and an additional component: a crust of white dwarf - like material. We study the characteristics of the crust, in particular we calculate its mass M_{crust}. We propose that, when the mass density of the star increases, the core undergoes the process of gravitational collapse to a black hole, leaving the crust as a remnant; we compare M_{crust} with the mass of the baryonic remnant considered in the fireshell model of GRBs and find that their values are compatible.

Reference ***AIP Conference Proceedings, Vol. 1059, pp. 68-71 (2008)***

418 - 2008 *Roberto Guida, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Maria Giovanna Dainotti, Remo Ruffini,*

The Amati relation in the fireshell model

Context: The cosmological origin of gamma-ray bursts (GRBs) has been ?rmly established, with redshifts up to z = 6.29. They are possible candidates for use as "distance indicators" for testing cosmological models in a redshift range hardly achievable by other cosmological probes. Asserting the validity of the empirical relations among GRB observables is now crucial for their calibration.
Aims: Motivated by the relation proposed by Amati and collaborators, we look within the "fireshell" model for a relation between the peak energy Ep of the nu-Fnu total time-integrated spectrum of the afterglow and the total energy of the afterglow Eaft , which in our model encompasses and extends the prompt emission.
Methods: The fit within the fireshell model, as for the "canonical" GRB 050315, uses the complete arrival time coverage given by the Swift satellite. It is performed simultaneously, self-consistently, and recursively in the four BAT energy bands (15–25 keV, 25–50 keV, 50–100 keV, and 100–150 keV), as well as in the XRT one (0.2–10 keV). It uniquely determines the two free parameters characterizing the GRB source, the total energy Etot of the e+- plasma and its baryon loading B, as well as the effective CircumBurst Medium (CBM) distribution. We can then build two sets of “gedanken” GRBs varying the total energy of the electron-positron plasma Etot and keeping the same baryon loading B of GRB 050315. The first set assumes the one obtained in the fit of GRB 050315 for the effective CBM density.
The second set assumes instead a constant CBM density equal to the average value of the GRB 050315 prompt phase.
Results: For the first set of "gedanken" GRBs we find a relation Ep \propto (Eaft)a , with a = 0.45 +- 0.01, whose slope strictly agrees with the Amati one. Such a relation, in the limit B -> 10^?2 , coincides with the Amati one. Instead, no correlation is found in the second set of "gedanken" GRBs.
Conclusions: Our analysis excludes the proper GRB (P-GRB) from the prompt emission, extends all the way to the latest afterglow phases, and is independent of the assumed cosmological model, since all "gedanken" GRBs are at the same redshift. The Amati relation, on the other hand, includes the P-GRB, focuses only on the prompt emission, being therefore influenced by the instrumental threshold that fixes the end of the prompt emission, and depends on the assumed cosmology. This might explain the intrinsic scatter observed in the Amati relation.

Reference ***A&A Lett 487 (2008) 37-40***

419 - 2008 *Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini*

Preliminary analysis of GRB060607A within the fireshell model

GRB060607A is a very distant ($z=3.082$) and energetic event ($E_{iso}\sim 10^{53}$ erg). Its main peculiarity is that the peak of the near-infrared afterglow has been observed with the REM robotic telescope, allowing to infer the initial Lorentz gamma factor of the emitting system. We present a preliminary analysis of the spectra and light curves of GRB060607A prompt emission within the fireshell model. We show that the N(E) spectrum of the prompt emission, whose behavior is usually described as ``simple power-law'', can also be fitted in a satisfactory way by a convolution of thermal spectra as predicted by the model we applied. The theoretical time-integrated spectrum of the prompt emission as well as the light curves in the BAT and XRT energy band are in good agreement with the observations, enforcing the plausibility of our approach.
Furthermore, the initial value of Lorentz gamma factor we predict is compatible with the one deduced from the REM observations.

Reference ***in the Proceedings of the “2008 Nanjing Gamma-Ray Burst Conference”, in Nanjing, China, June 23-27, 2008, ed. Y.-F. Huang, Z.-G. Dai, B. Zhang, AIP Conf. Proc., 1065 (2008) 227-230.***

420 - 2008 *Carlo Luciano Bianco, Maria Grazia Bernardini, Letizia Caito, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini*

The ``fireshell'' model and the ``canonical GRB'' scenario

The Swift observation of GRB 060614, as well as the catalog analysis by Norris & Bonnell, opened the door ``on a new Gamma-Ray Bursts (GRBs) classification scheme that straddles both long and short bursts''.
Within the ``fireshell'' model for the Gamma-Ray Bursts (GRBs) we define a ``canonical GRB'' light curve with two sharply different components: the Proper-GRB (P-GRB), emitted when the optically thick fireshell of electron-positron plasma originating the phenomenon reaches transparency, and the afterglow, emitted due to the collision between the remaining optically thin fireshell and the CircumBurst Medium (CBM). We here outline our ``canonical GRB'' scenario, which implies three different GRB classes: the ``genuine'' short GRBs, the ``fake'' or ``disguised'' short GRBs and the other (so-called ``long'') GRBs. We also outline some implications for the theoretical interpretation of the Amati relation

Reference ***in the Proceedings of the "2008 Nanjing Gamma-Ray Burst Conference", in Nanjing, China, June 23-27, 2008, ed. Y.-F. Huang, Z.-G. Dai, B. Zhang, AIP Conf. Proc., 1065 (2008) 223-226***

421 - 2008 *Gustavo De Barros, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini*

Is GRB 050509b a "genuine" short GRB?

Within our "fireshell" model we introduced a "canonical" GRB scenario which differentiates physically the "proper GRB" (P-GRB) emission when photons decouple, and the afterglow emission due to interaction of the accelerated baryons with the CircumBurst Medium (CBM). The ratio between energetics of the two components is ruled by the baryon loading of the fireshell. We here analyse the possibility that GRB050509b is the first case of a "genuine" short GRB the ones with smaller baryon loading. In such a case, the GRB050509b "prompt emission" would be dominated by the "proper GRB" and, moreover, the P-GRB total energy would be greater than the afterglow one. Our fit of the afterglow data and of the P-GRB energetics indicates that this source present the smallest baryon loading we ever encountered so far, being on the order of 10^-4

Reference ***in the Proceedings of the "2008 Nanjing Gamma-Ray Burst Conference", in Nanjing, China, June 23-27, 2008, ed. Y.-F. Huang, Z.-G. Dai, B. Zhang, AIP Conf. Proc. (2008) 231-234.***

422 - 2008 *Remo Ruffini, A. Aksenov, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Maria Giovanna Dainotti, Gustavo De Barros, Roberto Guida, Gregory Vereshahgin, She-Sheng Xue,*

The canonical Gamma-Ray Bursts and their ``precursors

The fireshell model for Gamma-Ray Bursts (GRBs) naturally leads to a canonical GRB composed of a proper-GRB (P-GRB) and an afterglow. P-GRBs, introduced by us in 2001, are sometimes considered ``precursors'' of the main GRB event in the current literature. We show in this paper how the fireshell model leads to the understanding of the structure of GRBs, with precise estimates of the time sequence and intensities of the P-GRB and the of the afterglow. It leads as well to a natural classification of the canonical GRBs which overcomes the traditional one in short and long GRBs.

Reference ***in the Proceedings of the "2008 Nanjing Gamma-Ray Burst Conference", in Nanjing, China, June 23-27, 2008, ed. Y.-F. Huang, Z.-G. Dai, B. Zhang, AIP Conf. Proc., 1065 (2008) 219-222***

423 - 2008 *Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini*

The ``Canonical'' GRBs within the fireshell model

Within the fireshell model we define a ``canonical'' GRB light curve with two sharply different components: the Proper-GRB (P-GRB), emitted when the optically thick fireshell of electron-positron plasma originating the phenomenon reaches transparency, and the afterglow, emitted due to the collision between the remaining optically thin fireshell and the CircumBurst Medium (CBM). On the basis of the recent understanding of GRB970228 as the prototype for a new class of GRBs with ``an occasional softer extended emission lasting tenths of seconds after an initial spikelike emission'' we outline our ``canonical'' GRB scenario, originating from the gravitational collapse to a black hole, with a special emphasis on the discrimination between short GRBs and the ones appearing as such due to their peculiar astrophysical setting

Reference ***in the Proceedings of the "2nd Kolkata Conference", in Kolkata, India, February 10-17, 2008, ed. S.K. Chakrabarti, A.S. Majumdar, AIP Conf. Proc. 1053 (2008) 267.***

424 - 2008 *Carlo Luciano Bianco, Maria Grazia Bernardini, Letizia Caito, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini*

The Equations of motion of the ``fireshell''

The Fireshell originating a Gamma-Ray Burst (GRB) encompasses an optically thick regime followed by an optically thin one. In the first one the fireshell self-accelerates from a Lorentz gamma factor equal to 1 all the way to 200-300. The physics of this system is based on the continuous annihilation of electron-positron pairs in an optically thick e+e- plasma with a small baryon loading. In the following regime, the optically thin fireshell, composed by the baryons left over after the transparency point, ballistically expands into the CircumBurst Medium (CBM). The dynamics of the fireshell during both regimes will be analyzed. In particular we will re-examine the validity of the constant-index power-law relation between the fireshell Lorentz gamma factor and its radial coordinate, usually adopted in the current literature on the grounds of an ``ultrarelativistic'' approximation. Such expressions are found to be mathematically correct but only approximately valid in a very limited range of the physical and astrophysical parameters and in an asymptotic regime which is reached only for a very short time, if any.

Reference ***in the Proceedings of the "2nd Kolkata Conference", in Kolkata, India, February 10-17, 2008, ed. S.K. Chakrabarti, A.S. Majumdar, AIP Conf. Proc. 1053 (2008) 259.***

425 - 2008 *Letizia Caito, Maria Grazia Bernardini, Carlo Luciano Bianco, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini*

GRB 060614 in the canonical fireshell model

Gamma-Ray Burst (GRB) 060614 is the first nearby long duration GRB clearly not associated to any bright Ib/c Supernova. The explosion of this burst undermines one of the fundamental assumptions of the standard scenario and opens new horizons and hints of investigation.
GRB 060614, hardly classifiable as a short GRB, is not either a "typical" long GRB since it occurs in a low star forming region.
Moreover, it presents deep similarities with GRB 970228, which is the prototype of the "fake" short bursts, or better canonical GRBs disguised as short ones. Within the "fireshell" model, we test if this "anomalous" source can be a disguised short GRB.

Reference ***in the Proceedings of the "2nd Kolkata Conference", in Kolkata, India, February 10-17, 2008, ed. S.K. Chakrabarti, A.S. Majumdar, AIP Conf. Proc. 1053 (2008) 291.***

426 - 2008 *Maria Giovanna Dainotti, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Roberto Guida, Remo Ruffini*

GRB 060218: the density mask and its peculiarity compared to the other sources"

The Swift satellite has given continuous data in the range 0.3–150 keV from 0 s to 10^6s for GRB060218 associated with SN2006aj. It has an unusually long duration (T90 ~ 2100 s). We plan to fit the complete
gamma- and X-ray light curves of this long duration GRB, including the prompt emission and we give peculiar attention to the afterglow lightcurve in order to better constrain the density mask. We apply our "fireshell" model based on the formation of a black hole, giving the relevant references. The initial total energy of the electron-positron plasma E^{tot}_{e±} = 2.32x10^50 erg has a particularly low value similarly to the other GRBs associated with SNe. For the first time we observe a baryon loading B = 10^-2 which coincides with the upper limit for the dynamical stability of the fireshell. The effective CircumBurst Medium (CBM) density shows a radial dependence n_{cbm} \propto r^{-a} with 1.0 < a < 1.7 and monotonically decreases from 1 to 10^-6 particles/cm^3. Such a behavior is interpreted as due to a fragmentation in the fireshell. Such a fragmentation is crucial in explaining both the unusually large T90 and the consequently inferred abnormal low value of the CBM effective density. We present the comparison between the density mask of this source and the ones of a normal GRB 050315 and a fake short, GRB 970228, making some assunptions on the CBM behaviour in the surrounding of the Black hole

Reference ***in the Proceedings of the "2nd Kolkata Conference", in Kolkata, India, February 10-17, 2008, ed. S.K. Chakrabarti, A.S. Majumdar, AIP Conf. Proc. 1053 (2008) 283.***

427 - 2008 *Carlo Luciano Bianco, Maria Grazia Bernardini, Letizia Caito, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini,*

Short and Canonical GRBs

Within the ``fireshell'' model for the Gamma-Ray Bursts (GRBs) we define a ``canonical GRB'' light curve with two sharply different components: the Proper-GRB (P-GRB), emitted when the optically thick fireshell of electron-positron plasma originating the phenomenon reaches transparency, and the afterglow, emitted due to the collision between the remaining optically thin fireshell and the CircumBurst Medium (CBM). We outline our ``canonical GRB'' scenario, with a special emphasis on the discrimination between ``genuine'' and ``fake'' short GRBs

Reference ***in the Proceedings of the Conference "Gamma-Ray Bursts 2007" in Santa Fe, New Mexico (USA), November 5-9, 2007, ed. M. Galassi, D. Palmer, E.E. Fenimore, AIP Conf. Proc., 1000 (2008) 305-308.***

428 - 2008 *Roberto Guida, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Maria Giovanna Dainotti, Remo Ruffini*

Theoretical interpretation of the Amati relation within the fireshell model

Reference ***in the Proceedings of the Conference "Gamma-Ray Bursts 2007" in Santa Fe, New Mexico (USA), November 5-9, 2007, ed. M. Galassi, D. Palmer, E.E. Fenimore, AIP Conf. Proc., 1000 (2008) 60-63***

429 - 2008 *Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini*

GRB970228 and the class of GRBs with an initial spikelike emission: do they fulfill the Amati relation?

On the basis of the recent understanding of GRB050315 and GRB060218,
we return to GRB970228, the first Gamma-Ray Burst (GRB) with detected afterglow. We proposed it as the prototype for a new class of GRBs with ``an occasional softer extended emission lasting tenths of seconds after an initial spikelike emission''. Detailed theoretical computation of the GRB970228 light curves in selected energy bands for the prompt emission are presented and compared with observational \emph{Beppo}SAX data. From our analysis we conclude that GRB970228 and likely the ones of the above mentioned new class of GRBs are ``canonical GRBs'' have only one peculiarity: they exploded in a galactic environment, possibly the halo, with a very low value of CBM density. Here we investigate how GRB970228 unveils another peculiarity of this class of GRBs: they do not fulfill the ``Amati relation''. We provide a theoretical explanation within the fireshell model for the apparent absence of such correlation for the GRBs belonging to this new class.

Reference ***in the Proceedings of the "4th Italian-Sino Workshop on Relativistic Astrophysics" in Pescara, Italy, July 20-30, 2007, ed. C.L. Bianco, S.S. Xue, AIP Conf. Proc., 966 (2008) 7-11***

430 - 2008 *Carlo Luciano Bianco, Maria Grazia Bernardini, Letizia Caito, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini*

The fireshell model and the canonical GRB scenario

In the ``fireshell'' model we define a ``canonical GRB'' light curve with two sharply different components: the Proper-GRB (P-GRB), emitted when the optically thick fireshell of electron-positron plasma originating the phenomenon reaches transparency, and the afterglow, emitted due to the collision between the remaining optically thin fireshell and the CircumBurst Medium (CBM). We outline our ``canonical GRB'' scenario, originating from the gravitational collapse to a black hole, with a special emphasis on the discrimination between ``genuine''
and ``fake'' short GRBs

Reference ***in the Proceedings of the "4th Italian-Sino Workshop on Relativistic Astrophysics" in Pescara, Italy, July 20-30, 2007, ed. C.L. Bianco, S.S. Xue, AIP Conf. Proc., 966 (2008) 12-15***

431 - 2008 *Maria Giovanna Dainotti, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Roberto Guida, Remo Ruffini*

On GRB060218 and binaries as progenitors of GRB-SN systems

We study the Gamma-Ray Burst (GRB) 060218: a particularly close source at $z=0.033$ with an extremely long duration, namely $T_{90}\sim 2000$ s, related to SN 2006aj. This source appears to be a very soft burst, with a peak in the spectrum at 4.9 keV, therefore interpreted as an X-Ray Flash (XRF). It fullfills the Amati relation.
I present the fitting procedure, which is time consuming. In order to show its sensitivity I also present two examples of fits with the same value of B and different value of $E_{e^\pm}^{tot}$.
We fit the X- and γ-ray observations by Swift of GRB 060218 in the 0.1--150 keV energy band during the entire time of observations from 0 all the way to 10^6 s within a unified theoretical model.
The free parameters of our theory are only three, namely the total energy $E_{e\pm}^{tot}$ of the $e^\pm$ plasma, its baryon loading $B \equiv M_Bc^2/E_{e\pm}^{tot}$, as well as the CircumBurst Medium (CBM) distribution. We justify the extremely long duration of this GRB by a total energy $E_{e\pm}^{tot} = 2.32\times 10^{50}$ erg, a very high value of the baryon loading $B=1.0\times 10^{-2}$ and the effective CircumBurst Medium (CBM) density which shows a radial dependence $n_{cbm} \propto r^{-\alpha}$ with $1.0 \leq \alpha \leq 1.7$ and monotonically decreases from 1 to 10^{-6} particles/cm^3. We recall that this value of the B parameter is the highest among the sources we have analyzed and it is very close to its absolute upper limit expected. By our fit we show that there is no basic differences between XRFs and more general GRBs. They all originate from the collapse process to a black hole and their difference is due to the variability of the three basic parameters within the range of full applicability of the theory. We also think that the smallest possible black hole, formed by the gravitational collapse of a neutron star in a binary system, is consistent with the especially low energetics of the class of GRBs associated with SNe Ib/c.

Reference ***in the Proceedings of the "4th Italian-Sino Workshop on Relativistic Astrophysics" in Pescara, Italy, July 20-30, 2007, ed. C.L. Bianco, S.S. Xue, AIP Conf. Proc., 966 (2008) 25-30***

432 - 2008 *Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini*

GRB970228 as a prototype for the class of GRBs with an initial spikelike emission

Reference ***in the Proceedings of the "XI Marcel Grossmann Meeting", in Berlin, Germany, July 23-29, 2006, ed. H. Kleinert, R. Jantzen and R. Ruffini, World Scientific (2008) 1992-1994***

433 - 2008 *Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini*

GRB980425 and the puzzling URCA1 emission

We applied our ``fireshell'' model to GRB980425 observational data, reproducing very satisfactory its prompt emission. We use the results of our analysis to provide a possible interpretation for the X-ray emission of the source S1. The effect on the GRB analysis of the lack of data in the pre-\emph{Swift} observations is also outlined

Reference ***in the Proceedings of the "XI Marcel Grossmann Meeting", in Berlin, Germany, July 23-29, 2006, ed. H. Kleinert, R. Jantzen and R. Ruffini, World Scientific (2008) 1959-1961***

434 - 2008 *Carlo Luciano Bianco, Maria Grazia Bernardini, Letizia Caito, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini*

Theoretical interpretation of short and long GRBs

Within the ``fireshell'' model we define a ``canonical GRB'' light curve with two sharply different components: the Proper-GRB (P-GRB), emitted when the optically thick fireshell of electron-positron plasma originating the phenomenon reaches transparency, and the afterglow, emitted due to the collision between the remaining optically thin fireshell and the CircumBurst Medium (CBM). We here present the consequences of such a scenario on the theoretical interpretation of the nature of ``long'' and ``short'' GRBs

Reference ***in the Proceedings of the "XI Marcel Grossmann Meeting", in Berlin, Germany, July 23-29, 2006, ed. H. Kleinert, R. Jantzen and R. Ruffini, World Scientific (2008) 1974-1976***

435 - 2008 *Letizia Caito, Maria Grazia Bernardini, Carlo Luciano Bianco, Maria Giovanna Dainotti, Roberto Guida, Remo Ruffini*

Theoretical interpretation of GRB011121

GRB 011121, detected by the BeppoSAX satellite, is studied as a prototype to understand the presence of flares observed by Swift in the afterglow of many GRB sources. Detailed theoretical analysis of the GRB
011121 light curves in selected energy bands are presented and compared with observational data. An interpretation of the flare of this source is provided by the introduction of the three-dimensional structure of the Circum Burst Medium(CBM

Reference ***in the Proceedings of the "XI Marcel Grossmann Meeting", in Berlin, Germany, July 23-29, 2006, ed. H. Kleinert, R. Jantzen and R. Ruffini, World Scientific (2008) 1977-1980.***

436 - 2008 *Maria Giovanna Dainotti, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Roberto Guida, Remo Ruffini*

On GRB060218 and the GRBs related to Supernovae Ib/c

We study the Gamma-Ray Burst (GRB) 060218: a particularly close source at $z=0.033$ with an extremely long duration, namely $T_{90}\sim 2000$ s, related to SN 2006aj. This source appears to be a very soft burst, with a peak in the spectrum at 4.9 keV, therefore interpreted as an X-Ray Flash (XRF) and it obeys to the Amati relation. We fit the X- and γ-ray observations by \emph{Swift} of GRB 060218 in the 0.1--150 keV energy band during the entire time of observations from 0 all the way to 10^6 s within a unified theoretical model.
The details of our theoretical analysis have been recently published in a series of articles. The free parameters of the theory are only three, namely the total energy $E_{e\pm}^{tot}$ of the $e^\pm$ plasma, its baryon loading $B \equiv M_Bc^2/E_{e\pm}^{tot}$, as well as the CircumBurst Medium (CBM) distribution. We fit the entire light curve, including the prompt emission as an essential part of the afterglow. We recall that this value of the B parameter is the highest among the sources we have analyzed and it is very close to its absolute upper limit expected. We successfully make definite predictions about the spectral distribution in the early part of the light curve, exactly we derive the instantaneous photon number spectrum $N(E)$ and we show that although the spectrum in the co-moving frame of the expanding pulse is thermal, the shape of the final spectrum in the laboratory frame is clearly non thermal. In fact each single instantaneous spectrum is the result of an integration of thousands of thermal spectra over the corresponding EQuiTemporal Surfaces (EQTS). By our fit we show that there is no basic differences between XRFs and more general GRBs. They all originate from the collapse process to a black hole and their difference is due to the variability of the three basic parameters within the range of full applicability of the theory

Reference ***in the Proceedings of the "XI Marcel Grossmann Meeting", in Berlin, Germany, July 23-29, 2006, ed. H. Kleinert, R. Jantzen and R. Ruffini, World Scientific (2008) 1981-1988***

437 - 2008 *Roberto Guida, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Maria Giovanna Dainotti, Remo Ruffini*

Theoretical interpretation of GRB060124

We show the preliminary results of the application of our "fireshell" model to GRB060124. This source is very peculiar because it is the first event for which both the prompt and the afterglow emission were observed simultaneously by the three Swift instruments: BAT (15-350 keV), XRT (0.2-10 keV) and UVOT (170-650 nm), due to the presence of a precursor around 570 s before the main burst. We analyze GRB060124 within our "canonical" GRB scenario, identifying the precursor with the P-GRB and the prompt emission with the afterglow peak emission. In this way we reproduce correctly the energetics of both these two components. We reproduce also the observed time delay between the precursor (P-GRB) and the main burst. The effect of such a time delay in our model will be discussed

Reference ***in the Proceedings of the "XI Marcel Grossmann Meeting", in Berlin, Germany, July 23-29, 2006, ed. H. Kleinert, R. Jantzen and R. Ruffini, World Scientific (2008) 1995-1998***

438 - 2008 *Remo Ruffini, Maria Grazia Bernardini, Carlo Luciano Bianco, Pascal Chardonnet, Federico Fraschetti, Roberto Guida, She-Sheng Xue*

Theoretical interpretation of GRB031203 and URCA-3

Reference ***in the Proceedings of "Relativistic Astrophysics and Cosmology – Einstein's Legacy" Meeting in Munich, Germany, November 7 - 11, 2005, ed. B. Ashenbach, V. Burwitz, G. Hasinger and B. Leibundgut, Springer – Verlag (2008) 399-401.***

439 - 2008 *V. Popov, Michael Rotondo, Remo Ruffini, She-Sheng Xue*

On the gravitational and electrodynamical stability of nuclear matter core

Reference ***submitted to Phys. Rev. Lett. (2008)***

440 - 2008 *Hagen Kleinert, Remo Ruffini, She-Sheng Xue*

Electron-positron production in non-uniform electric fields

Reference ***Phys. Rev. D 78 (2008) 02501***

441 - 2008 *Remo Ruffini, Gregory Vereshchagin , She-Sheng Xue*

Electron-positron pairs in physics and astrophysics

Reference ***Phys. Rep. (2008)***

442 - 2008 *Remo Ruffini, She-Sheng Xue*

Electron-positron pair production in a marcoscopic object Q/M

Reference ***submitted to Phy. Lett. B .***

443 - 2008 *M. Lattanzi, R. Ruffini, G.V. Vereshchagin*

Constraining the cosmological lepton asymmetry through cosmic microwave background observations

Many models of leptogenesis predict the creation of a large leptonic asymmetry in the early Universe. We show that extended flat $\Lambda $CDM models with massive neutrinos and a sizeable lepton asymmetry are not excluded by the Wilkinson Microwave Anisotropy Probe (WMAP) first year data. We derive from WMAP first year data the following
constraints for the lepton asymmetry L of the Universe (95\% CL):
$0<|L|<0.9$, so that WMAP data alone cannot firmly rule out scenarios with a large lepton number. We also find for the sum of neutrino mass $M_\nu < 3.6$~eV at 95\% CL.

Reference ***in "Proceedings of the Eleventh Marcel Grossmann Meeting on General Relativity", Eds. H. Kleinert, R.T. Jantzen and R. Ruffini, World Scientific, Singapore (2008).***

444 - 2008 *CHERUBINI C., FILIPPI S, RUFFINI R, SEPULVEDA A, ZULUAGA J. I.*

Non-Homogeneous Axisymmetric Models of Self-Gravitating Systems

Reference ***Proceedings of the Eleventh Marcel Grossman Meeting on Recent Developments in Theoretical and Experimental General Relativity, Gravitation and Relativistic Field Theories edited by H. Kleinert, R.T. Jantzen and R. Ruffini. The Eleventh Mercel Grossman Meeting. Berlin, Germany. 23-29 July 2006. (vol. C, pp. 2340-2342). ISBN 978-981-283-426-3(set). : World Scientific Publishing Company (SINGAPORE)***

445 - 2008 *CHERUBINI C., GERALICO A, RUEDA H.J.A, RUFFINI R.*

On the "Dyadotorus" of the Kerr-Newman Spacetime

Reference ***In: Relativistic Astrophysics: 4th Italian-Sino Workshop. Relativistic Astrophysics: 4th Italian-Sino Workshop. Pescara, Italy. 20-28 July 2007. (vol. 966, pp. 123-126). ISBN/ISSN: 978-0-7354-0483-0. : American Institute of Physics (UNITED STATES)***

446 - 2008 *RUFFINI R, BERNARDINI M.G, BIANCO C. L, CAITO L, CHARDONNET P, CHERUBINI C., DAINOTTI M.G, FRASCHETTI F, GERALICO A. GUIDA R, PATRICELLI B, ROTONDO M, RUEDA H.J.A, VERESHCHAGIN G, XUE S.S.*

On Gamma Ray Bursts

(Shortened) We show by example how the uncoding of Gamma-Ray Bursts (GRBs) offers unprecedented possibilities to foster new knowledge in fundamental physics and in astrophysics. After recalling some of the classic work on vacuum polarization in uniform electric fields by Klein, Sauter, Heisenberg, Euler and Schwinger, we summarize some of the efforts to observe these effects in heavy ions and high energy ion collisions. We then turn to the theory of vacuum polarization around a Kerr-Newman black hole, leading to the extraction of the blackholic energy, to the concept of dyadosphere and dyadotorus, and to the creation of an electron-positron-photon plasma. We then present a new theoretical approach encompassing the physics of neutron stars and heavy nuclei. It is shown that configurations of nuclear matter in bulk with global charge neutrality can exist on macroscopic scales and with electric fields close to the critical value near their surfaces. These configurations may represent an initial condition for the process of gravitational collapse, leading to the creation of an electron-positron-photon plasma: the basic self-accelerating system explaining both the energetics and the high energy Lorentz factor observed in GRBs. We then turn to recall the two basic interpretational paradigms of our GRB model. [...] We then turn to the special role of the baryon loading in discriminating between "genuine" short and long or "fake" short GRBs [...] We finally turn to the GRB-Supernova Time Sequence (GSTS) paradigm: the concept of induced gravitational collapse. [...] We then present some general conclusions

Reference ***Proceedings of the Eleventh Marcel Grossman Meeting on Recent Developments in Theoretical and Experimental General Relativity, Gravitation and Relativistic Field Theories edited by H. Kleinert, R.T. Jantzen and R. Ruffini. The Eleventh Mercel Grossman Meeting. Berlin, Germany. 23 - 29 July 2006. (vol. A, pp. 368-506). ISBN 978-981-283-426-3(set). : World Scientific Publishing (SINGAPORE).***

447 - 2008 *Bini D., Geralico A., Ruffini R.*

On the linearization of the Belinski-Alekseev exact solution for two charged masses in equilibrium,

A perturbative solution describing a two-body system consisting of a Reissner-Nordström black hole and a charged massive particle at rest is presented. The coincidence between such a solution and the linearized form of the recently obtained Belinski-Alekseev exact solution is explicitly shown.

Reference ***IJMPA, vol. 23, 1226 - 1230, 2008***

448 - 2008 *de Barros, G.; Aksenov, A.; Bianco, C. L.; Ruffini, R.; Vereshchagin, G.*

Fireshell versus Fireball scenarios

We revisit Cavallo and Rees classification based on the analysis of initial conditions in electron-positron-photon plasma which appears suddenly around compact astrophysical objects and gives origin to GRBs. These initial conditions were recently studied in [1,2] by numerical integration of relativistic Boltzmann equations with collision integrals, including binary and triple interactions between particles. The main conclusion is that the pair plasma in GRB sources quickly reaches thermal equilibrium well before its expansion starts. In light of this work we comment on each of the four scenarios proposed by Cavallo and Rees and discuss their applicability to describe evolution of GRB sources.

Reference ***2008 NANJING GAMMA-RAY BURST CONFERENCE. AIP Conference Proceedings, Volume 1065, pp. 234-237 (2008).***

449 - 2008 *Aksenov, A. G.; Bianco, C. L.; Ruffini, R.; Vereshchagin, G. V.*

GRBs and the thermalization process of electron-positron plasmas

We discuss the temporal evolution of the pair plasma created in Gamma-Ray Burst sources. A particular attention is paid to the relaxation of the plasma into thermal equilibrium. We also discuss the connection between the dynamics of expansion and the spatial geometry of the plasma. The role of the baryonic loading parameter is emphasized.

Reference ***GAMMA-RAY BURSTS 2007: Proceedings of the Santa Fe Conference. AIP Conference Proceedings, Volume 1000, pp. 309-312 (2008).***

450 - 2008 *Vereshchagin, Gregory; Aksenov, Alexey; Ruffini, Remo*

Thermalization of the pair plasma and the consequences for Gamma-Ray Bursts

We consider initial conditions in the sources of Gamma-Ray Bursts. We show that hot and dense pair plasma, created in the source, relaxes to thermal equilibrium configuration with zero chemical potentials well before it starts to expand driven by the radiative pressure. The relaxation process follows the sequence: pairs, protons, photons, thus the first particles reaching the same temperature are electrons and positrons, while photons join the thermal math latest. We also show that light nuclear elements cannot be synthesized in the fireball.

Reference ***American Physical Society, 2008 APS April Meeting and HEDP/HEDLA Meeting, April 11-15, 2008, abstract #8HE.045***

451 - 2008 *Bianco, Carlo; Ruffini, Remo; Vereshchagin, Gregory; Xue, She-Sheng*

On the self-acceleration of fireshell

The Fireshell in a Gamma-Ray Burst (GRB) has the most unique feature in the entire field of physics of self-accelerating from a Lorentz gamma factor equal to 1 all the way to 200-300. The hysics of this most extraordinary system is based on the continuous annihilation of electron-positron pairs in an optically thick e^+e^- plasma. The physical reasons for this self-acceleration reanalyzed and the fireshell dynamics is compared with the ``fireball'' solution usually adopted in GRB literature.

Reference ***American Physical Society, 2008 APS April Meeting and HEDP/HEDLA Meeting, April 11-15, 2008, abstract #8HE.044***

452 - 2008 *Aksenov, Alexey; Ruffini, Remo; Vereshchagin, Gregory*

Relativistic Boltzmann equations for the pair plasma in presence of baryon loading

In the recent publication we analyzed the role of the direct and the inverse binary and triple interactions in reaching thermal equilibrium in homogeneous isotropic pair plasma, starting from a nonequlibrium state. In the present work we extend the analysis to the case of baryon-loaded plasma. The corresponding timescales for thermalization of electrons, positrons, protons and photons are determined out from the numerical solution of the relativistic Boltzmann equations. We include all exact QED collisional integrals for binary reactions, while for the corresponding radiative variants we reduce reaction rates to the known expressions of kinetic coefficients in the thermal equilibrium.

Reference ***American Physical Society, 2008 APS April Meeting and HEDP/HEDLA Meeting, April 11-15, 2008, abstract #8HE.036***

453 - 2008 *Aksenov, A. G.; Ruffini, R.; Vereshchagin, G. V.*

Thermalization of Electron-Positron-Photon Plasmas with an application to GRB

The pair plasma with photon energies in the range 0.1-10 MeV is believed to play crucial role in cosmic Gamma-Ray Bursts. Starting from a nonequilibrium configuration we analyze the role of the direct and the inverse binary and triple interactions in reaching thermal equilibrium in a homogeneous isotropic pair plasma. We numerically integrate the relativistic Boltzmann equation with the exact QED collisional integrals taking into account all binary and triple interactions. We show that first, when a detailed balance is reached for all binary interactions on a time scale tk<~10-14 sec, photons and electron-positron pairs establish kinetic equilibrium. Subsequently, when triple interactions satisfy the detailed balance on a time scale teq<~10-12 sec, the plasma reaches thermal equilibrium. It is shown that neglecting the inverse triple interactions prevents reaching thermal equilibrium. Our results obtained in the theoretical physics domain also find application in astrophysics and cosmology.

Reference ***RELATIVISTIC ASTROPHYSICS: 4th Italian-Sino Workshop. AIP Conference Proceedings, Volume 966, pp. 191-196 (2008)***

454 - 2008 *Ruffini, Remo; Xue, She-Sheng*

Effective Dyadosphere

In astrophysical conditions, we discuss (i) an overcritical electric field, (ii) electron-positron-photon plasma, and (iii) the effective Dyadosphere formed in gravitational collapsing process.

Reference ***2008 NANJING GAMMA-RAY BURST CONFERENCE. AIP Conference Proceedings, Volume 1065, pp. 289-293 (2008***

455 - 2008 *Lemos, L. J. Rangel; Casanova, S.; Ruffini, R.; Xue, S. S.*

Fermi's approach to the study of pp interactions

The physics of hadronic interactions found much difficulties for explain the experimental data. In this work we study the approach of Fermi (1950) about the multiplicity of pions emitted in pp interactions and in follow we compare with the modern approach.

Reference ***OBSERVATIONAL EVIDENCE FOR BLACK HOLES IN THE UNIVERSE: Proceedings of the 2nd Kolkata Conference on Observational Evidence for Black Holes in the Universe held in Kolkata India, 10-15 February 2008 and the Satellite Meeting on Black Holes, Neutron Stars, and Gamma-Ray Bursts held 16-17 February 2008. AIP Conference Proceedings, Volume 1053, pp. 275-282***

456 - 2008 *Ruffini, Remo; Rotondo, Michael; Xue, She-Sheng*

The Thomas-Fermi Approach and Gamma-Ray Bursts

The energy extraction process from a black hole which is considered at the basis of modeling Gamma-Ray Bursts appear to be mediated by an electron-positron plasma created in an overcritical electric field. The role of the Thomas-Fermi approach in Neutron Star matter cores is presented and discussed with special attention to solutions globally neutral and not fulfilling the traditional condition of local charge neutrality. A new stable configuration is found with a field well above the critical value, confined to a shell close to the surface with a thickness of a few electron Compton wavelength. This new solution can be of relevance in understanding unsolved issues of the gravitational collapse processes and their energetics leading to the formation of a Kerr-Newman black hole.

Reference ***OBSERVATIONAL EVIDENCE FOR BLACK HOLES IN THE UNIVERSE: Proceedings of the 2nd Kolkata Conference on Observational Evidence for Black Holes in the Universe held in Kolkata India, 10-15 February 2008 and the Satellite Meeting on Black Holes, Neutron Stars, and Gamma-Ray Bursts held 16-17 February 2008. AIP Conference Proceedings, Volume 1053, pp. 243-252***

457 - 2008 *Caito, L.; Bernardini, M. G.; Bianco, C. L.; Dainotti, M. G.; Guida, R.; Ruffini, R*

GRB 060614: a Fake Short Gamma-Ray Burst

The explosion of GRB 060614 produced a deep break in the GRB scenario and opened new horizons of investigation because it can't be traced back to any traditional scheme of classification. In fact, it has features both of long bursts and of short bursts and, above all, it is the first case of long duration near GRB without any bright Ib/c associated Supernova. We will show that, in our canonical GRB scenario [1], this ``anomalous'' situation finds a natural interpretation and allows us to discuss a possible variation to the traditional classification scheme, introducing the distinction between ``genuine'' and ``fake'' short bursts.

Reference ***GAMMA-RAY BURSTS 2007: Proceedings of the Santa Fe Conference. AIP Conference Proceedings, Volume 1000, pp. 301-304***

458 - 2008 *Roberto Guida, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Maria Giovanna Dainotti, Remo Ruffini*

Theoretical interpretation of GRB060124: preliminary results

We show the preliminary results of the application of our "fireshell" model to GRB060124. This source is very peculiar because it is the first event for which both the prompt and the afterglow emission were observed simultaneously by the three Swift instruments: BAT (15-350 keV), XRT (0.2-10 keV) and UVOT (170-650 nm), due to the presence of a precursor ~ 570 s before the main burst. We analyze GRB060124 within our "canonical" GRB scenario, identifying the precursor with the P-GRB and the prompt emission with the afterglow peak emission. In this way we reproduce correctly the energetics of both these two components. We reproduce also the observed time delay between the precursor (P-GRB) and the main burst. The effect of such a time delay in our model will be discussed.

Reference ***6 pages, 2 figures, Proceedings of the Eleventh Marcel Grossmann Meeting, Berlin (Germany), July 2006***

459 - 2008 *Carlo Luciano Bianco, Remo Ruffini*

The "Fireshell" model in the Swift era

We here re-examine the validity of the constant-index power-law relation between the fireshell Lorentz gamma factor and its radial coordinate, usually adopted in the current Gamma-Ray Burst (GRB) literature on the grounds of an "ultrarelativistic" approximation. Such expressions are found to be mathematically correct but only approximately valid in a very limited range of the physical and astrophysical parameters and in an asymptotic regime which is reached only for a very short time, if any.

Reference ***3 pages, 1 figure, to appear on the Proceedings of the Eleventh Marcel Grossmann Meeting, Berlin (Germany), July 2006***

460 - 2008 *Rotondo, Michael; Ruffini, Remo; Xue, She-Sheng*

Solutions of the ultra-relativistic Thomas-Fermi equation

The general solutions of a massive core at nuclear density are presented both from an analytic and numerical treatment. The analytic solutions generalize the solution introduced by Migdal, Volskerenskii and Popov in the case of heavy nuclei extending their treatment from Z˜10^7 all the way to Z˜10^57, corresponding to stellar massive cores. Special attention is given to the energetics of these configurations. It is shown that the solutions obeying the condition of global neutrality are much more bound than the traditional ones adopting the condition of local neutrality. The relevance of these solutions for X-ray busters models is outlined.

Reference ***American Physical Society, 2008 APS April Meeting and HEDP/HEDLA Meeting, April 11-15, 2008, abstract #8HE.095***

461 - 2008 *Ruffini, Remo; Rotondo, Michael; Xue, She-Sheng*

The relativistic Thomas-Fermi equation for extended nuclear matter

The derivation of the dimensionless form of the relativistic Thomas-Fermi equation for extended nuclear matter are described, taking into due account the process of inverse beta decay. The equations of the binding energy of such a configuration are also derived. The analogy and the differences between this treatment and the classical one by Greiner, Migdal, Popov and their schools are presented.

Reference ***American Physical Society, 2008 APS April Meeting and HEDP/HEDLA Meeting, April 11-15, 2008, abstract #8HE.094***

462 - 2008 *Rueda, Jorge; Patricelli, Barbara; Rotondo, Michael; Ruffini, Remo*

The extended nuclear matter model with smooth transition surface

The existence of electric fields close to their critical value Ec=(mec^3)/(e) has been proved for massive cores of 10^7 up to 10^57 nucleons using a distribution of constant nuclear density and a sharp step function at its boundary. We explore the modifications of this effect by considering a smoother density profile with a proton distribution fulfilling a Wood-Saxon dependence. The occurrence of a critical field has been confirmed. We discuss how the location of the maximum of the electric field as well as its magnitude is modified by the smoother distribution.

Reference ***American Physical Society, 2008 APS April Meeting and HEDP/HEDLA Meeting, April 11-15, 2008, abstract #8HE.093***

463 - 2008 *Patricelli, Barbara; Rotondo, Michael; Ruffini, Remo*

The atomic number -- charge relation in the nuclear matter in bulk

We determine theoretically the atomic number (A)- charge relation in the nuclear matter in bulk with the model recently proposed by Ruffini et al. (2007). We compare this relation with the data of the Periodic Table, finding a very good agreement. Our relation also agrees with the semi-empirical one obtained from the Weizsacker mass formula up to A˜10^4. For higher values of A our relation has a different behaviour and we interpret this as a result of the penetration of electrons (initially confined in an external shell) inside the core that becomes more and more important by increasing the atomic number; these effects are not taken into account in the semi-empirical mass-formula.

Reference ***American Physical Society, 2008 APS April Meeting and HEDP/HEDLA Meeting, April 11-15, 2008, abstract #8HE.092***

464 - 2008 *Geralico, Andrea; Bini, Donato; Ruffini, Remo*

The electrostatics of naked singularity

In order to further explore the physical reasons leading to an equilibrium configuration of a charged naked singularity in the field of the black hole the structure of the naked singularity and its mass energy are examined. Particular attention is given to define the physical achievable, stable equilibrium configurations.

Reference ***American Physical Society, 2008 APS April Meeting and HEDP/HEDLA Meeting, April 11-15, 2008, abstract #8HE.052***

465 - 2008 *Bini, Donato; Geralico, Andrea; Ruffini, Remo*

Charged particles in the Reissner-Nordström geometry

The multiyear problem of a two-body system consisting of a Reissner-Nordström black hole and a charged massive particle at rest is here solved by an exact perturbative solution of the full Einstein-Maxwell system of equations. The expressions of the metric and of the electromagnetic field, including the effects of the electromagnetically induced gravitational perturbation and of the gravitationally induced electromagnetic perturbation, are presented in closed analytic formulas. Particular attention is given to the analysis of the lines of force of the system formed by the black hole and the naked singularity describing the test particle. The new general relativistic effects leading to an electric Meissner effect are explored.

Reference ***American Physical Society, 2008 APS April Meeting and HEDP/HEDLA Meeting, April 11-15, 2008, abstract #8HE.051***

466 - 2008 *Xue, She-Sheng; Ruffini, Remo*

Electron-positron pairs production in an electric potential of massive cores

Negative energy states of electrons bounded by a massive core with the charge-mass-radio Q/M and macroscopic radius Rc are discussed. We show that the negative energies of bound states are lower than the negative electron mass-energy (-mc^2), and energy-level-crossing occurs. If these bound states are not occupied, electron-positron pair production takes place by quantum tunneling. Electrons fill into these bound states and positrons go to infinity. We explicitly calculate the rate of such pair-production, and compare it with the rates of electron-positron production by the Sauter-Euler-Heisenberg-Schwinger and Hawking processes.

Reference ***American Physical Society, 2008 APS April Meeting and HEDP/HEDLA Meeting, April 11-15, 2008, abstract #8HE.038***

467 - 2008 *Kleinert, Hagen; Ruffini, Remo; Xue, She-Sheng*

Pair production in non-uniform electric fields

Treating the production of electron and positron pairs in vacuum by a strong electric field as a quantum tunneling process, we derive in semiclassical approximation the pair production rate for nonuniform fields E(z) pointing the z-direction. In addition, we discuss tunneling processes in which an empty atomic bound state is spontaneously filled with a negative-energy electron creating a positron. The general expression is applied to a confined field, a semi-confined field, and a linearly increasing field. The boundary effects of the confined fields on pair-production rates are explicitly evaluated. Finally, we calculate the rate at which the atomic level of a bare nucleus of finite size and large Z are filled by electrons from the vacuum under positrons emission.

Reference ***American Physical Society, 2008 APS April Meeting and HEDP/HEDLA Meeting, April 11-15, 2008, abstract #8HE.037***

468 - 2008 *Bini, D.; Geralico, A.; Ruffini, R.*

Charged massive particle at rest in the field of a Reissner-Nordström black hole. II. Analysis of the field lines and the electric Meissner effect

The properties of the electric field of a two-body system consisting of a Reissner-Nordström black hole and a charged massive particle at rest have recently been analyzed in the framework of first order perturbation theory following the standard approach of Regge, Wheeler, and Zerilli. In the present paper we complete this analysis by numerically constructing and discussing the lines of force of the “effective” electric field of the sole particle with the subtraction of the dominant contribution of the black hole. We also give the total field due to the black hole and the particle. As the black hole becomes extreme an effect analogous to the Meissner effect arises for the electric field, with the “effective field” lines of the point charge being expelled by the outer horizon of the black hole. This effect existing at the level of test field approximation, i.e. by neglecting the backreaction on the background metric and electromagnetic field due to the particle’s mass and charge, is here found also at the complete perturbative level. We point out analogies with similar considerations for magnetic fields by Bièák and Dvoøák. We also explicitly show that the linearization of the recently obtained Belinski-Alekseev exact solution coincides with our solution in the Regge-Wheeler gauge. Our solution thus represents a bridge between the test field solution, which neglects all the feedback terms, and the exact two-body solution, which takes into account all the nonlinearity of the interaction.

Reference ***Physical Review D, vol. 77, Issue 6, id. 064020***

469 - 2008 *Rangel Lemos, L. J.; Casanova, S.; Kelner, S. R.; Ruffini, R.*

Fermi's approach to the study of hadronic interactions

We study Fermi's work of 1950 concerning the multiplicity of pions emitted in hadronic interactions and the modern approach to the study of hadronic interactions.

Reference ***RELATIVISTIC ASTROPHYSICS: 4th Italian-Sino Workshop. AIP Conference Proceedings, Volume 966, pp. 325-330 (2008***

470 - 2008 *Rotondo, Michael; Ruffini, Remo; Xue, She Sheng*

On the electrodynamical properties of nuclear matter in bulk

We analyze the properties of solutions of the relativistic Thomas-Fermi equation for globally neutral cores with radius of the order of R~10 Km, at constant densities around the nuclear density. By using numerical tecniques as well as well tested analytic procedures developed in the study of heavy ions, we confirm the existence of an electric field close to the critical value Ec = me2c3/eℏ in a shell ÄR~l04ℏ/mðc near the core surface. For a core of ~10 Km the difference in binding energy reaches 1049 ergs. These results can be of interest for the understanding of very heavy nuclei as well as physics of neutron stars, their formation processes and further gravitational collapse to a black hole.

Reference ***RELATIVISTIC ASTROPHYSICS: 4th Italian-Sino Workshop. AIP Conference Proceedings, Volume 966, pp. 147-152, 2008***

471 - 2008 *Patricelli, B.; Rotondo, M.; Ruffini, R.*

On the Charge to Mass Ratio of Neutron Cores and Heavy Nuclei

We determine theoretically the relation between the total number of protons Np and the mass number A (the charge to mass ratio) of nuclei and neutron cores with the model recently proposed by Ruffini et al. (2007) and we compare it with other Np versus A relations: the empirical one, related to the Periodic Table, and the semi-empirical relation, obtained by minimizing the Weizsäcker mass formula. We find that there is a very good agreement between all the relations for values of A typical of nuclei, with differences of the order of per cent. Our relation and the semi-empirical one are in agreement up to A~104 for higher values, we find that the two relations differ. We interprete the different behaviour of our theoretical relation as a result of the penetration of electrons (initially confined in an external shell) inside the core, that becomes more and more important by increasing A; these effects are not taken into account in the semi-empirical mass-formula.

Reference ***RELATIVISTIC ASTROPHYSICS: 4th Italian-Sino Workshop. AIP Conference Proceedings, Volume 966, pp. 143-146 (2008)***

472 - 2008 *Dainotti, Maria Giovanna; Bernardini, Maria Grazia; Bianco, Carlo Luciano; Caito, Letizia; Guida, Roberto; Ruffini, Remo*

GRB 060218 and the binaries as progenitors of GRB-SN systems

We study the Gamma-Ray Burst (GRB) 060218: a particularly close source at z = 0.033 with an extremely long duration, namely T90~2000 s, related to SN 2006aj. This source appears to be a very soft burst, with a peak in the spectrum at 4.9 keV, therefore interpreted as an X-Ray Flash (XRF). It fullfills the Amati relation. I present the fitting procedure, which is time consuming. In order to show its sensitivity I also present two examples of fits with the same value of B and different value of Ee+/-tot. We fit the X- and ƒÁ-ray observations by Swift of GRB 060218 in the 0.1-150 keV energy band during the entire time of observations from 0 all the way to 106 s within a unified theoretical model. The free parameters of our theory are only three, namely the total energy Ee+/-tot. of the e+/- plasma, its baryon loading B□ßMBc2/Ee+/-tot, as well as the CircumBurst Medium (CBM) distribution. We justify the extremely long duration of this GRB by a total energy Ee+/-tot = 2.32□~1050 erg, a very high value of the baryon loading B = 1.0□~10-2 and the effective CircumBurst Medium (CBM) density which shows a radial dependence ncbm~r-ƒ¿ with 1.0<=ƒ¿<=1.7 and monotonically decreases from 1 to 10-6 particles/cm3. We recall that this value of the B parameter is the highest among the sources we have analyzed and it is very close to its absolute upper limit expected.
By our fit we show that there is no basic differences between XRFs and more general GRBs. They all originate from the collapse process to a black hole and their difference is due to the variability of the three basic parameters within the range of full applicability of the theory. We also think that the smallest possible black hole, formed by the gravitational collapse of a neutron star in a binary system, is consistent with the especially low energetics of the class of GRBs associated with SNe Ib/c.

Reference ***RELATIVISTIC ASTROPHYSICS: 4th Italian-Sino Workshop. AIP Conference Proceedings, Volume 966, pp. 25-30 (2008).***

473 - 2008 *Caito, L.; Bernardini, M. G.; Bianco, C. L.; Dainotti, M. G.; Guida, R.; Ruffini, R.*

GRB 060614: a progress report

The explosion of GRB 060614, detected by the Swift satellite, produced a deep break in the GRB scenario opening new horizons of investigation, because it can't be traced back to any traditional scheme of classification. In fact, it manifests peculiarities both of long bursts and of short bursts. Above all, it is the first case of long duration near GRB without any bright Ib/c associated Supernova. We will show that, in our canonical GRB scenario ([I]), this ``anomalous'' situation finds a natural interpretation and allows us to discuss a possible variation to the traditional classification scheme, introducing the distinction between ``genuine'' and ``fake'' short bursts

Reference ***RELATIVISTIC ASTROPHYSICS: 4th Italian-Sino Workshop. AIP Conference Proceedings, Volume 966, pp. 16-20 (2008)***

474 - 2008 *Bernardini, M. G.; Bianco, C. L.; Caito, L.; Dainotti, M. G.; Guida, R.; Ruffini, R.*

GRB970228 and the class of GRBs with an initial spikelike emission: do they follow the Amati relation?

On the basis of the recent understanding of GRB050315 and GRB060218, we return to GRB970228, the first Gamma-Ray Burst (GRB) with detected afterglow. We proposed it as the prototype for a new class of GRBs with ``an occasional softer extended emission lasting tenths of seconds after an initial spikelike emission''. Detailed theoretical computation of the GRB970228 light curves in selected energy bands for the prompt emission are presented and compared with observational BeppoSAX data. From our analysis we conclude that GRB970228 and likely the ones of the above mentioned new class of GRBs are ``canonical GRBs'' have only one peculiarity: they exploded in a galactic environment, possibly the halo, with a very low value of CBM density. Here we investigate how GRB970228 unveils another peculiarity of this class of GRBs: they do not fulfill the ``Amati relation''. We provide a theoretical explanation within the fireshell model for the apparent absence of such correlation for the GRBs belonging to this new class.

Reference ***RELATIVISTIC ASTROPHYSICS: 4th Italian-Sino Workshop. AIP Conference Proceedings, Volume 966, pp. 7-11 (2008)***

475 - 2008 *Ruffini, Remo; Xue, She-Sheng*

The Boundary Effect on Electron-Positron Pair-Productions

We present a study on the boundary effect on the rate of pair-production in Sauter electric field.

Reference ***International Journal of Modern Physics A, Volume 23, Issue 08, pp. 1231-1234 (2008)***

476 - 2008 *Ruffini, Remo; Cherubini, Christian; Geralico, Andrea; Patricelli, Barbara; Rueda Hernandez, Jorge Armando; Rotondo, Michael; Xue, She-Sheng*

On the electrodynamics properties of nuclear matter cores

It is by now clear that Gamma ray Bursts originate from an electron positron plasma formed during the process of gravitational collapse to a Black Hole. It is crucial to identify the initial conditions in the neutron star core originating such a collapse which give origin to the vast electrodynamics process originating such an electron positron plasma during the late phases of the collapse as the horizon of the Black Hole is reached. We present a new approach, based on a ultra-relativistic Thomas-Fermi approach, to the nuclear matter in bulk enforcing the condition of global charge neutrality as opposed to the local charge neutrality usually imposed. A new ground state is found that can differ by 1049 ergs from the ones where local charge neutrality is implemented. Electric fields close to the critical value can exist at the surface of the core at the onset of the gravitational instability. We outline consequences of these results in nuclear physics, in the formation process of neutron stars and the supernovae emission in the X and Gamma rays as well as possibly in the process of ejection of the remnant.

Reference ***37th COSPAR Scientific Assembly. Held 13-20 July 2008, in Montréal, Canada., p.2667***

477 - 2008 *Bianco C., Bernardini M.G., Chardonnet P., Fraschetti F., Ruffini R. Xue S.-S.*

Theoretical interpretation of Luminosity and Spectral properties of GRB 031203

We show how an emission endowed with an instantaneous thermal spectrum in the co-moving frame of the expanding fireshell can reproduce the time-integrated GRB observed non-thermal spectrum. An explicit example in the case of GRB 031203 is presented

Reference ***in the Proceedings of the "XI Marcel Grossmann Meeting", in Berlin, Germany, July 23-29, 2006, ed. H. Kleinert, R. Jantzen and R. Ruffini, World Scientific (2008)***

478 - 2008 *Bini D., Geralico A., Ruffini R.*

Static perturbation of a Reissner-Nordström Black Hole by a Charged massive particle

Reference ***in the Proceedings of the "XI Marcel Grossmann Meeting", in Berlin, Germany, July 23-29, 2006, ed. H. Kleinert, R. Jantzen and R. Ruffini, World Scientific (2008)***

479 - 2008 *Bini D., Geralico A., Ruffini R.*

Static perturbation by a Point Mass on a Schwarzschild Black Hole

Reference ***in the Proceedings of the "XI Marcel Grossmann Meeting", in Berlin, Germany, July 23-29, 2006, ed. H. Kleinert, R. Jantzen and R. Ruffini, World Scientific (2008)***

480 - 2008 *Ruffini R. et al.*

Proceedings of the "2nd Stueckelberg Workshop on Relativistic Field Theories"

Reference ***Editors Cianfrani F., Montani G., Ruffini R., International Journal of Modern Physics A, Vol. 23, Number 8, March 30***

481 - 2008 *Ruffini R. et al.*

Proceedings of the "11th Marcel Grossmann Meeting on General Relativity" Berlin, July 23 - 29, 2006

Reference ***Editors Ruffini R., Kleinert H., Jantzen R., World Scientific Pub.***

482 - 2009 *R. Guida, M.G. Bernardini, C.L. Bianco, L. Caito, M.G. Dainotti, R.Ruffini*

The Amati Relation within the Fireshell Model

Reference ***in Relativistic Astrophysics – Proceedings of the 4th Italian-Sino Workshop, Pescara (Italy), July 2007, C.L. Bianco, S.-S. Xue, Editors; AIP Conference Proceedings, 966, 46***

483 - 2009 *R. Ruffini, A.G. Aksenov, M.G. Bernardini, C.L. Bianco, L. Caito, M.G. Dainotti, G. De Barros, R. Guida, G. Vereshchagin, S.-S. Xue*

The canonical Gamma-Ray Bursts: long, "fake"-"disguised" and "genuine" short bursts

Reference ***in PROBING STELLAR POPULATIONS OUT TO THE DISTANT UNIVERSE: CEFALU 2008, Proceedings of the International Conference; Cefalù (Italy), September 2008, G. Giobbi, A. Tornambe, G. Raimondo, M. Limongi, L. A. Antonelli, N. Menci, E. Brocato, Editors; AIP Conference Proceedings, 1111, 325 (2009)***

484 - 2009 *M.G. Bernardini, M.G. Dainotti, C.L. Bianco, L. Caito, R. Guida, R. Ruffini*

Prompt emission and X-ray flares: the case of GRB 060607 A

Reference ***in PROBING STELLAR POPULATIONS OUT TO THE DISTANT UNIVERSE: CEFALU 2008, Proceedings of the International Conference; Cefalù (Italy), September 2008, G. Giobbi, A. Tornambe, G. Raimondo, M. Limongi, L. A. Antonelli, N. Menci, E. Brocato, Editors; AIP Conference Proceedings, 1111, 383***

485 - 2009 *C.L. Bianco, M.G. Bernardini, L. Caito, M.G. Dainotti, R. Guida, R. Ruffini*

The "fireshell" model and the "canonical GRB" scenario. Implications for the Amati relation

Reference ***in PROBING STELLAR POPULATIONS OUT TO THE DISTANT UNIVERSE: CEFALU 2008, Proceedings of the International Conference; Cefalù (Italy), September 2008, G. Giobbi, A. Tornambe, G. Raimondo, M. Limongi, L. A. Antonelli, N. Menci, E. Brocato, Editors; AIP Conference Proceedings, 1111, 587***

486 - 2009 *A. G. Aksenov, R. Ruffini, G. V. Vereshchagin*

Thermalization of the mildly relativistic plasma

Reference ***http://dx.doi.org/10.1103/PhysRevD.79.043008 Phys. Rev. D, Vol. 79***

487 - 2009 *A. G. Aksenov, R. Ruffini, and G. V. Vereshchagin*

Thermalization of pair plasma with proton loading

Reference ***http://dx.doi.org/10.1063/1.3141571 in the Proceedings of "PROBING STELLAR POPULATIONS OUT TO THE DISTANT UNIVERSE" meeting, AIP Conference Proceedings 1111 (2009) 344-350***

488 - 2009 *CHERUBINI C., GERALICO A, RUEDA J.A.H, R. RUFFINI*

e--e+ pair creation by vacuum polarization around electromagnetic black holes.

Reference ***PHYSICAL REVIEW D, PARTICLES, FIELDS, GRAVITATION, AND COSMOLOGY, vol. 79; p. 124002-1-124002-15, ISSN: 1550-7998, doi: 10.1103/PhysRevD.79.124002***

489 - 2009 *M. Rotondo, Jorge A. Rueda, R. Ruffini, She-Sheng Xue*

On the relativistic Thomas-Fermi treatment of compressed atoms and compressed massive nuclear density cores

Using the recently established scaling laws for the solutions of the relativistic Thomas-Fermi equation we consider the two limiting cases of compressed atoms and compressed massive nuclear density cores. The Feynman, Metropolis and Teller treatment of compressed atoms is extended to the relativistic regimes. Each configuration is confined by a Wigner-Seitz cell and is characterized by a positive electron Fermi energy. There exists a limiting configuration with a maximum value of the electrons Fermi energy $(E_e^F)_{max}$ reached when the Wigner--Seitz cell radius equals the radius of the nucleus, and it can be expressed analytically in the ultra-relativistic approximation. The results are compared and contrasted to approximate treatments in the literature. This treatment is then extrapolated to compressed massive nuclear density cores with $A\simeq (m_{\rm Planck}/m_n)^3 \sim 10^{57}$. Again an entire family of equilibrium configurations exist for selected values of the electron Fermi energy varying in the range $0 < E_e^F \leq (E_e^F)_{max}$. The configuration with $E_e^F=(E_e^F)_{max}$ has global and local charge neutrality and no electrodynamical structure. The remaining configurations have electric fields on the core surface, increasing for decreasing values of the electron Fermi energy reaching values much larger than the critical value $E_c = m_e^2c^3/(e\hbar)$ for $E_e^F=0$. We compare and contrast our results with the ones of Thomas-Fermi model in strange stars. In both, the case of atoms and the massive nuclear density cores, the configuration with $E_e^F=0$, reached when the Wigner-Seitz cell radius tends to infinity corresponds to the ground state of the system.

Reference

490 - 2009 *Valentino Lacquaniti, Giovanni Montani, Daniela Pugliese, Remo Ruffini*

Effective potential approach to the motion of massive test particles in Kaluza-Klein gravity

Effective potential for a class of static solutions of Kaluza-Klein equations with three- dimensional spherical symmetry is studied. Test particles motion is analyzed. In attempts to read the obtained results with the experimental data, particular attention is devoted to the Schwarzschild's limit of the four{dimensional counterpart of these electromagnetic- free solutions. Massive particles stable circular orbits in particular are studied, and a comparison between the well{known results if the Schwarzschild's case and those found for the static higher-dimensional case is performed. A modification of the circular stable orbits is investigated in agreement with the experimental constraints.

Reference ***3 pages. To appear in the proceedings of MG12, Marcel Grossman Meeting, Paris, France, 12-18 Jul 2009***

491 - 2009 *Jorge A. Rueda, Remo Ruffini, She-Sheng Xue*

On the self-consistent general relativistic equilibrium equations of neutron stars

We address the existence of globally neutral neutron star configurations in contrast with the traditional ones constructed by imposing local neutrality. The equilibrium equations describing this system are the Einstein-Maxwell equations which must be solved self-consistently with the general relativistic Thomas-Fermi equation and β-equilibrium condition. To illustrate the application of this novel approach we adopt the Baym, Bethe, and Pethick (1971) strong interaction model of the baryonic matter in the core and of the white-dwarf-like material of the crust. We illustrate the crucial role played by the boundary conditions satisfied by the leptonic component of the matter at the interface between the core and the crust. For every central density an entire new family of equilibrium configurations exists for selected values of the Fermi energy of the electrons at the surface of the core. Each such configuration fulfills global charge neutrality and is characterized by a non-trivial electrodynamical structure. The electric field extends over a thin shell of thickness $\sim \hbar/(m_e c)$ between the core and the crust and becomes largely overcritical in the limit of decreasing values of the crust mass.

Reference ***submitted to Phys. Rev. Lett.***

492 - 2009 *Remo Ruffini, Alexey G. Aksenov, Maria Grazia Bernardini, Carlo Luciano Bianco, Letizia Caito, Pascal Chardonnet, Maria Giovanna Dainotti, Gustavo De Barros, Roberto Guida, Luca Izzo, Barbara Patricelli, Luis Juracy Rangel Lemos, Michael*

The Blackholic energy and the canonical Gamma-Ray Burst IV: the "long", "genuine short" and "fake - disguised short" GRBs

(Shortened) [...] After recalling the basic features of the "fireshell model", we emphasize the following novel results: 1) the interpretation of the X-ray flares in GRB afterglows as due to the interaction of the optically thin fireshell with isolated clouds in the CircumBurst Medium (CBM); 2) an interpretation as "fake - disguised" short GRBs of the GRBs belonging to the class identified by Norris & Bonnell [...] consistent with an origin from the final coalescence of a binary system in the halo of their host galaxies with particularly low CBM density [...]; 3) the first attempt to study a genuine short GRB with the analysis of GRB 050509B, that reveals indeed still an open question; 4) the interpretation of the GRB-SN association in the case of GRB 060218 via the "induced gravitational collapse" process; 5) a first attempt to understand the nature of the "Amati relation", a phenomenological correlation between the isotropic-equivalent radiated energy of the prompt emission E_{iso} with the cosmological rest-frame \nu F_{\nu} spectrum peak energy E_{p,i}. In addition, recent progress on the thermalization of the electron-positron plasma close to their formation phase, as well as the structure of the electrodynamics of Kerr-Newman Black Holes are presented. An outlook for possible explanation of high-energy phenomena in GRBs to be expected from the AGILE and the Fermi satellites are discussed. As an example of high energy process, the work by Enrico Fermi dealing with ultrarelativistic collisions is examined. It is clear that all the GRB physics points to the existence of overcritical electrodynamical fields. In this sense we present some progresses on a unified approach to heavy nuclei and neutron stars cores, which leads to the existence of overcritical fields under the neutron star crust

Reference ***68 pages, 50 figures, in the Proceedings of the XIII Brazilian School on Cosmology and Gravitation, M. Novello, S.E. Perez-Bergliaffa, editors***
Journal-ref: AIP Conf.Proc. 1132 (2009) 199-266

493 - 2009 *R. Giacconi, R. Ruffini*

Physics and Astrophysics of NeutronStars and Black Holes

Reference

494 - 2009 *M.G. Dainotti, M.G. Bernardini, C.L. Bianco, L. Caito, R. Guida, R. Ruffini*

The astrophysical trypthic: GRB, SN and URCA can be extended to GRB060218?

The \emph{Swift} satellite has given continuous data in the range 0.3--150 keV from 0 s to 10^6 s for GRB060218 associated with SN2006aj. This GRB is the fourth GRB spectroscopically associated with SNe after the cases of GRB980425-SN1998bw, GRB031203-SN2003lw, GRB 030329-SN2003dh. It has an unusually long duration ($T_{90}\sim 2100$ s). These data offer the opportunity to probe theoretical models for Gamma-Ray Bursts (GRBs) connected with Supernovae (SNe).We plan to fit the complete γ- and X-ray light curves of this long duration GRB, including the prompt emission, in order to clarify the nature of the progenitors and the astrophysical scenario of the class of GRBs associated to SNe Ib/c. We apply our ``fireshell'' model based on the formation of a black hole, giving the relevant references. The initial total energy of the electron-positron plasma $E_{e^\pm}^{tot} = 2.32\times 10^{50}$ erg has a particularly low value similarly to the other GRBs associated with SNe. For the first time we observe a baryon loading $B =10^{-2}$ which coincides with the upper limit for the dynamical stability of the fireshell. The effective CircumBurst Medium (CBM) density shows a radial dependence $n_{cbm} \propto r^{-\alpha}$ with $1.0 \lesssim \alpha \lesssim 1.7$ and monotonically decreases from 1 to 10^{-6} particles/cm^3. Such a behavior is interpreted as due to a fragmentation in the fireshell. Such a fragmentation is crucial in explaining both the unusually large T_{90} and the consequently inferred abnormal low value of the CBM effective density. We fit GRB060218, usually considered as an X-Ray Flash (XRF), as a ``canonical GRB'' within our theoretical model. The smallest possible black hole, formed by the gravitational collapse of a neutron star in a binary system, is consistent with the especially low energetics of the class of GRBs associated with SNe Ib/c. We present the URCA process and the connection between the GRBs associated with SNe extended also to the case of GRB060218.

Reference ***Journal of the Korean Physical Society, 56, 1588***

495 - 2010 *M.G. Dainotti, M.G. Bernardini, C.L. Bianco, L. Caito, R. Guida, R. Ruffini*

The astrophysical trypthic: GRB, SN and URCA can be extended to GRB060218?

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Reference ***Journal of the Korean Physical Society, 56, 1588***

496 - 2010 *L. Caito, L. Amati, M.G. Bernardini, C.L. Bianco, G. De Barros, L. Izzo, B. Patricelli, R. Ruffini*

GRB 071227: an additional case of a disguised short burst

(shortened) [...] In the context of the fireshell model, [...] a new family of disguised short bursts has been identified: long bursts with a protracted low instantaneous luminosity due to a low density CircumBurst Medium (CBM). In the 15-150 keV energy band GRB 071227 exhibits a short duration (about 1.8s) spike-like emission followed by a very soft extended tail up to one hundred seconds after the trigger. It is a faint (E_{iso}=5.8x10^{50}) nearby GRB (z=0.383) that does not have an associated type Ib/c bright supernova (SN). For these reasons, GRB 071227 has been classified as a short burst not fulfilling the Amati relation holding for long burst. We check the classification of GRB 071227 provided by the fireshell model. In particular, we test whether this burst is another example of a disguised short burst, after GRB 970228 and GRB 060614, and, for this reason, whether it fulfills the Amati relation. We simulate GRB 071227 light curves in the Swift BAT 15-50 keV bandpass and in the XRT (0.3-10 keV) energy band within the fireshell model. We perform simulations of the tail in the 15-50 keV bandpass, as well as of the first part of the X-ray afterglow. This infers that: E_{tot}^{e^\pm}=5.04x10^{51} erg, B=2.0x10^{-4}, E_{P-GRB}/E_{aft}~0.25, and <n_{cbm}>=3.33 particles/cm^3. These values are consistent with those of "long duration" GRBs. We interpret the observed energy of the first hard emission by identifying it with the P-GRB emission. The remaining long soft tail indeed fulfills the Amati relation. Previously classified as a short burst, GRB 071227 on the basis of our analysis performed in the context of the fireshell scenario represents another example of a disguised short burst, after GRB 970228 and GRB 060614. Further confirmation of this result is that the soft tail of GRB 071227 fulfills the Amati relation

Reference ***Astronomy & Astrophysics, (2010) in press***

497 - 2010 *L. Izzo, M.G. Bernardini, C.L. Bianco, L. Caito, B. Patricelli, R. Ruffini*

GRB 090423 at Redshift 8.1: a Theoretical Interpretation

GRB 090423 is the farthest GRB ever observed, with a redshift of about 8.1.We present within the Fireshell scenario a complete analysis of this GRB.We model the prompt emission and the first rapid flux decay of the afterglow emission as due to the canonical emission of the interaction, in the interval $0 \leq t \leq 440$ s, by the accelerated baryonic matter with the CBM.After the data reduction of the Swift data in the BAT (15-150 keV) and XRT (0.2-10 keV) energy bands, we interpret the light curves and the spectral distribution in the context of the Fireshell scenario.We confirm also in this source the existence of a second component, the plateau phase, as responsible for the late emission in the X-ray light curve.This extra component originates from the fact that the ejecta have a range of bulk Lorentz Γ factor, which starts to interact each other at the start of the plateau phase.

Reference ***Journal of the Korean Physical Society, 57, 551***

498 - 2010 *L. Caito, M.G. Bernardini, C.L. Bianco, M.G. Dainotti, R. Guida, R. Ruffini*

GRB060614: a “fake” short GRB from a merging binary system

Context: GRB060614 observations by VLT and by Swift have infringed the traditionally accepted gamma-ray burst (GRB) collapsar scenario that purports the origin of all long duration GRBs from supernovae (SN). GRB060614 is the first nearby long duration GRB clearly not associated with a bright Ib/c SN. Moreover, its duration (T90 ~ 100 s) makes it hardly classifiable as a short GRB. It presents strong similarities with GRB970228, the prototype of a new class of “fake” short GRBs that appear to originate from the coalescence of binary neutron stars or white dwarfs spiraled out into the galactic halo.
Aims: Within the “canonical” GRB scenario based on the “fireshell” model, we test if GRB060614 can be a “fake” or “disguised” short GRB. We model the traditionally termed “prompt emission” and discriminate the signal originating from the gravitational collapse leading to the GRB from the process occurring in the circumburst medium (CBM).
Methods: We fit GRB060614 light curves in Swift's BAT (15-150 keV) and XRT (0.2-10 keV) energy bands. Within the fireshell model, light curves are formed by two well defined and different components: the proper-GRB (P-GRB), emitted when the fireshell becomes transparent, and the extended afterglow, due to the interaction between the leftover accelerated baryonic and leptonic shell and the CBM.
Results: We determine the two free parameters describing the GRB source within the fireshell model: the total e^± plasma energy (E_tote^± = 2.94×1051 erg) and baryon loading (B = 2.8×10-3). A small average CBM density ~ 10-3 particles/cm3 is inferred, typical of galactic halos. The first spikelike emission is identified with the P-GRB and the following prolonged emission with the extended afterglow peak. We obtain very good agreement in the BAT (15-150 keV) energy band, in what is traditionally called “prompt emission”, and in the XRT (0.2-10 keV) one.
Conclusions: The anomalous GRB060614 finds a natural interpretation within our canonical GRB scenario: it is a “disguised” short GRB. The total time-integrated extended afterglow luminosity is greater than the P-GRB one, but its peak luminosity is smaller since it is deflated by the peculiarly low average CBM density of galactic halos. This result points to an old binary system, likely formed by a white dwarf and a neutron star, as the progenitor of GRB060614 and well justifies the absence of an associated SN Ib/c. Particularly important for further studies of the final merging process are the temporal structures in the P-GRB down to 0.1 s.

Reference ***Astronomy & Astrophysics, 498, 501***

499 - 2010 *M.G. Bernardini, C.L. Bianco, L. Caito, M.G. Dainotti, R. Guida, R. Ruffini*

GRB970228 in the “canonical GRB” scenario

Within the ``fireshell'' model we define a ``canonical GRB'' light curve with two sharply different components: theProper-GRB (P-GRB), emitted when the optically thick fireshell of electron-positron plasma originating the phenomenonreaches transparency, and the afterglow, emitted due to the collision between the remaining optically thin fireshell and theCircumBurst Medium (CBM). On the basis of the recent understanding of GRB970228 as the prototype for a new class of GRBs with ``an occasional softer extended emission lasting tenths of seconds after an initial spikelike emission'' we outline our ``canonical GRB'' scenario, originating from the gravitational collapse to a black hole, with a special emphasis on the discrimination between ``genuine'' and ``fake'' short GRBs. Furthermore, we investigate how the GRB970228 analysis provides a theoretical explanation for the apparent absence of such correlation for the GRBs belonging to this new class.

Reference ***Journal of the Korean Physical Society, 56, 1575***

500 - 2010 *L. Caito, M.G. Bernardini, C.L. Bianco, M.G. Dainotti, R. Guida, R. Ruffini*

GRB060614: a preliminary result

The explosion of GRB 060614 produced a deep break in the GRB scenario and opened new horizons of investigation because it can't be traced back to any traditional scheme of classification. In fact, it manifests peculiarities both of long bursts and of short bursts and, above all, it is the first case of long duration near GRB without any bright Ib/c associated Supernova.We will show that, in our canonical GRB scenario (\cite{APJ645Ruffini}), this "anomalous" situation finds a natural interpretation and allows us to discuss a possible variation to the traditional classification scheme, introducing the distinction between ``genuine" and ``fake" short bursts.

Reference ***Journal of the Korean Physical Society, 56, 1579***

501 - 2010 *R. Ruffini, A.G. Aksenov, M.G. Bernardini, C.L. Bianco, L. Caito, P. Chardonnet, M.G. Dainotti, G. De Barros, R. Guida, L. Izzo, B. Patricelli, L.J. Rangel Lemos, M. Rotondo, J.A. Rueda Hernandez, G. Vereshchagin, S.-S. Xue*

The Blackholic energy and the canonical Gamma-Ray Burst IV: the “long”, “genuine short” and “fake – disguised short GRBs

(Shortened) [...] After recalling the basic features of the "fireshell model", we emphasize the following novel results: 1) the interpretation of the X-ray flares in GRB afterglows as due to the interaction of the optically thin fireshell with isolated clouds in the CircumBurst Medium (CBM); 2) an interpretation as "fake - disguised" short GRBs of the GRBs belonging to the class identified by Norris & Bonnell [...] consistent with an origin from the final coalescence of a binary system in the halo of their host galaxies with particularly low CBM density [...]; 3) the first attempt to study a genuine short GRB with the analysis of GRB 050509B, that reveals indeed still an open question; 4) the interpretation of the GRB-SN association in the case of GRB 060218 via the "induced gravitational collapse" process; 5) a first attempt to understand the nature of the "Amati relation", a phenomenological correlation between the isotropic-equivalent radiated energy of the prompt emission E_{iso} with the cosmological rest-frame \nu F_{\nu} spectrum peak energy E_{p,i}. In addition, recent progress on the thermalization of the electron-positron plasma close to their formation phase, as well as the structure of the electrodynamics of Kerr-Newman Black Holes are presented. An outlook for possible explanation of high-energy phenomena in GRBs to be expected from the AGILE and the Fermi satellites are discussed. As an example of high energy process, the work by Enrico Fermi dealing with ultrarelativistic collisions is examined. It is clear that all the GRB physics points to the existence of overcritical electrodynamical fields. In this sense we present some progresses on a unified approach to heavy nuclei and neutron stars cores, which leads to the existence of overcritical fields under the neutron star crust.

Reference ***Proceedings of the XIIIth Brazilian School on Cosmology Proceedings, 1132, 199 2008, M. Novello, S.E. Perez Bergliaffa, Editors; AIP Conference and Gravitation, Mangaratiba, Rio de Janeiro (Brazil), July-Augus***

502 - 2010 *A.G. Aksenov, M.G. Bernardini, C.L. Bianco, L. Caito, C. Cherubini, G. De Barros, A. Geralico, L. Izzo, F.A. Massucci, B. Patricelli, M. Rotondo, J.A. Rueda Hernandez, R. Ruffini, G. Vereshchagin, S.-S. Xue*

The fireshell model for Gamma-Ray Bursts

Reference ***The Shocking Universe, Proceedings of the conference held in Venice(Italy), September 2009, G, Chincarini, P. D’Avanzo, R. Margutti, R. Salvaterra, Editors; SIF Conference Proceedings, 102, 451***

503 - 2010 *M.G. Bernardini, C.L. Bianco, L. Caito, L. Izzo, B. Patricelli, R. Ruffini*

The end of the prompt emission within the fireshell model

Reference ***The Shocking Universe, Proceedings of the conference held in Venice (Italy), September 2009, G, Chincarini, P. D’Avanzo, R. Margutti, R. Salvaterra, Editors; SIF Conference Proceedings, 102, 489***

504 - 2010 *L. Izzo, M.G. Bernardini, C.L. Bianco, L. Caito, B. Patricelli, R. Ruffini*

GRB 090423 in the fireshell scenario

Reference ***The Shocking Universe, Proceedings of the conference held in Venice (Italy),September 2009, G, Chincarini, P. D'Avanzo, R. Margutti, R. Salvaterra Editors; SIF Conference Proceedings, 102, 537***

505 - 2010 *B. Patricelli, M.G. Bernardini, C.L. Bianco, L. Caito, L. Izzo, R. Ruffini, G. Vereshchagin*

A new spectral energy distribution of photons in the fireshell model of GRBs

Reference ***The Shocking Universe, Proceedings of the conference held in Venice (Italy), September 2009, G, Chincarini, P. D'Avanzo, R. Margutti, R. Salvaterra, Editors; SIF Conference Proceedings, 102, 559 (2010).***

506 - 2010 *W-B. Han, R. Ruffini and S-S. Xue*

Electron–positron pair oscillation in spatially inhomogeneous electric fields and radiation

Reference ***Phys. Lett.B (2010) 99–104***

507 - 2010 *Patricelli, B.; Bernardini, M. G.; Bianco, C. L.; Caito, L.; de Barros, G.; Izzo, L.; Ruffini, R.*

DECIPHERING THE ANCIENT UNIVERSE WITH GAMMA-RAY BURSTS

Within the fireshell model, Gamma Ray Bursts (GRBs) originate from an optically thick e+/- plasma created by vacuum polarization process during the formation of a Black Hole (BH). Here we briefly recall the basic features of this model, then we show how it is possible to interpret GRB observational properties within it. In particular we present, as a specific example, the analysis of GRB 050904 observations of the prompt emission light curve and spectrum in the Swift BAT energy band (15-150 keV).

Reference ***AIP Conference Proceedings, Volume 1279, pp. 406-408 (2010).***

508 - 2010 *Izzo, L.; Bernardini, M. G.; Bianco, C. L.; Caito, L.; Patricelli, B.; Rangel Lemos, L. J.; Ruffini, R.*

On GRB 080916C and GRB 090902B observed by the Fermi satellite

We propose a possible explanation, in the context of the Fireshell scenario, for the high-energy emission observed in GRB 080916C and GRB 090902B. The physical process underlying this emission consists mainly in the interaction of the baryon in the Fireshell with some high-density region around the burst site. Moreover we associate the observed delay of the onset of the high-energy emission as due to the P-GRB emission.

Reference ***DECIPHERING THE ANCIENT UNIVERSE WITH GAMMA-RAY BURSTS. AIP Conference Proceedings, Volume 1279, pp. 343-345***

509 - 2010 *Bianco, Carlo Luciano; Bernardini, Maria Grazia; Caito, Letizia; de Barros, Gustavo; Izzo, Luca; Patricelli, Barbara; Ruffini, Remo*

Disguised Short Bursts and the Amati Relation

The class of ``Disguised short'' GRBs implied by the fireshell scenario is presented, with special emphasis on the implications for the Amati relation

Reference ***DECIPHERING THE ANCIENT UNIVERSE WITH GAMMA-RAY BURSTS. AIP Conference Proceedings, Volume 1279, pp. 343-345***

510 - 2010 *Rueda, Jorge A.; Rotondo, M.; Ruffini, Remo; Xue, S.-S.*

A self-consistent approach to neutron stars

Reference ***Journal of the Korean Physical Society, vol. 57, issue 31, p. 560***

511 - 2010 *Aksenov, A. G.; Ruffini, R.; Vereshchagin, G. V.*

Pair plasma relaxation time scales

By numerically solving the relativistic Boltzmann equations, we compute the time scale for relaxation to thermal equilibrium for an optically thick electron-positron plasma with baryon loading. We focus on the time scales of electromagnetic interactions. The collisional integrals are obtained directly from the corresponding QED matrix elements. Thermalization time scales are computed for a wide range of values of both the total-energy density (over 10 orders of magnitude) and of the baryonic loading parameter (over 6 orders of magnitude). This also allows us to study such interesting limiting cases as the almost purely electron-positron plasma or electron-proton plasma as well as intermediate cases. These results appear to be important both for laboratory experiments aimed at generating optically thick pair plasmas as well as for astrophysical models in which electron-positron pair plasmas play a relevant role.

Reference ***Physical Review E, vol. 81, Issue 4, id. 046401***

512 - 2010 *Rueda, Jorge A.; Ruffini, Remo; Xue, S.-S.*

On the electrostatic structure of neutron stars

We consider neutron stars composed by, (1) a core of degenerate neutrons, protons, and electrons above nuclear density; (2) an inner crust of nuclei in a gas of neutrons and electrons; and (3) an outer crust of nuclei in a gas of electrons. We use for the strong interaction model for the baryonic matter in the core an equation of state based on the phenomenological Weizsacker mass formula, and to determine the properties of the inner and the outer crust below nuclear saturation density we adopt the well-known equation of state of Baym-Bethe-Pethick. The integration of the Einstein-Maxwell equations is carried out under the constraints of â-equilibrium and global charge neutrality. We obtain baryon densities that sharply go to zero at nuclear density and electron densities matching smoothly the electron component of the crust. We show that a family of equilibrium configurations exists fulfilling overall neutrality and characterized by a non-trivial electrodynamical structure at the interface between the core and the crust. We find that the electric field is overcritical and that the thickness of the transition surface-shell separating core and crust is of the order of the electron Compton wavelength

Reference ***THE SUN, THE STARS, THE UNIVERSE AND GENERAL RELATIVITY: International Conference in Honor of Ya.B. Zeldovich's 95th Anniversary. AIP Conference Proceedings, Volume 1205, pp. 143-147***

513 - 2010 *Aksenov, A. G.; Ruffini, R.; Vereshchagin, G. V.*

Kinetics of the mildly relativistic plasma and GRBs

We consider optically thick photon-pair-proton plasma in the framework of Boltzmann equations. For the sake of simplicity we consider the uniform and isotropic plasma. It has been shown that arbitrary initial distribution functions evolve to the thermal equilibrium state through so called kinetic equilibrium state with common temperature of all particles and nonzero chemical potentials. For the plasma temperature 0.1-10 MeV relevant for GRB (Gamma-Ray Burst) sources we evaluate the thermalization time scale as function of total energy density and baryonic loading parameter

Reference ***THE SUN, THE STARS, THE UNIVERSE AND GENERAL RELATIVITY: International Conference in Honor of Ya.B. Zeldovich's 95th Anniversary. AIP Conference Proceedings, Volume 1205, pp. 11-16***

514 - 2010 *Ruffini, Remo*

Moments with Yakov Borisovich Zeldovich

A recollection of special moments spent with Yakov Borisovich Zeldovich and with the scientists of Soviet Union and abroad.

Reference ***THE SUN, THE STARS, THE UNIVERSE AND GENERAL RELATIVITY: International Conference in Honor of Ya.B. Zeldovich's 95th Anniversary. AIP Conference Proceedings, Volume 1205, pp. 1-10***

515 - 2010 *Remo Ruffini, Vereshchagin, Gregory; Xue, She-Sheng*

Electron-positron pairs in physics and astrophysics: From heavy nuclei to black holes

Due to the interaction of physics and astrophysics we are witnessing in these years a splendid synthesis of theoretical, experimental and observational results originating from three fundamental physical processes. They were originally proposed by Dirac, by Breit and Wheeler and by Sauter, Heisenberg, Euler and Schwinger. For almost seventy years they have all three been followed by a continued effort of experimental verification on Earth-based experiments. The Dirac process, e+e‑→2γ, has been by far the most successful. It has obtained extremely accurate experimental verification and has led as well to an enormous number of new physics in possibly one of the most fruitful experimental avenues by introduction of storage rings in Frascati and followed by the largest accelerators worldwide: DESY, SLAC etc. The Breit-Wheeler process, 2γ→e+e‑, although conceptually simple, being the inverse process of the Dirac one, has been by far one of the most difficult to be verified experimentally. Only recently, through the technology based on free electron X-ray laser and its numerous applications in Earth-based experiments, some first indications of its possible verification have been reached. The vacuum polarization process in strong electromagnetic field, pioneered by Sauter, Heisenberg, Euler and Schwinger, introduced the concept of critical electric field Ec=me2c3/(eħ). It has been searched without success for more than forty years by heavy-ion collisions in many of the leading particle accelerators worldwide. The novel situation today is that these same processes can be studied on a much more grandiose scale during the gravitational collapse leading to the formation of a black hole being observed in Gamma Ray Bursts (GRBs). This report is dedicated to the scientific race. The theoretical and experimental work developed in Earth-based laboratories is confronted with the theoretical interpretation of space-based observations of phenomena originating on cosmological scales. What has become clear in the last ten years is that all the three above mentioned processes, duly extended in the general relativistic framework, are necessary for the understanding of the physics of the gravitational collapse to a black hole. Vice versa, the natural arena where these processes can be observed in mutual interaction and on an unprecedented scale, is indeed the realm of relativistic astrophysics. We systematically analyze the conceptual developments which have followed the basic work of Dirac and Breit-Wheeler. We also recall how the seminal work of Born and Infeld inspired the work by Sauter, Heisenberg and Euler on effective Lagrangian leading to the estimate of the rate for the process of electron-positron production in a constant electric field. In addition to reviewing the intuitive semi-classical treatment of quantum mechanical tunneling for describing the process of electron-positron production, we recall the calculations in Quantum Electro-Dynamics of the Schwinger rate and effective Lagrangian for constant electromagnetic fields. We also review the electron-positron production in both time-alternating electromagnetic fields, studied by Brezin, Itzykson, Popov, Nikishov and Narozhny, and the corresponding processes relevant for pair production at the focus of coherent laser beams as well as electron-beam-laser collision. We finally report some current developments based on the general JWKB approach which allows us to compute the Schwinger rate in spatially varying and time varying electromagnetic fields. We also recall the pioneering work of Landau and Lifshitz, and Racah on the collision of charged particles as well as the experimental success of AdA and ADONE in the production of electron-positron pairs. We then turn to the possible experimental

Reference ***Physics Reports, Volume 487, Issue 1-4, p. 1-140***

516 - 2010 *Remo Ruffini, Vereshchagin Gregory*

THE SUN, THE STARS, THE UNIVERSE AND GENERAL RELATIVITY: International Conference in Honor of Ya.B. Zeldovich's 95th Anniversary

Reference ***AIP Conference Proceedings, Volume 1205***

517 - 2010 *Patricelli, B.; Bernardini, M. G.; Bianco, C. L.; Caito, L.; de Barros, G.; Izzo, L.; Ruffini, R.*

Black Holes in Gamma Ray Bursts

Within the fireshell model, Gamma Ray Bursts (GRBs) originate from an optically thick e+/- plasma created by vacuum polarization process during the formation of a Black Hole (BH). Here we briefly recall the basic features of this model, then we show how it is possible to interpret GRB observational properties within it. In particular we present, as a specific example, the analysis of GRB 050904 observations of the prompt emission light curve and spectrum in the Swift BAT energy band (15-150 keV).

Reference ***DECIPHERING THE ANCIENT UNIVERSE WITH GAMMA-RAY BURSTS. AIP Conference Proceedings, Volume 1279, pp. 406-408 (2010)***

518 - 2010 *D. Pugliese, H. Quevedo, R. Ruffini*

Circular motion of neutral test particles in Reissner-Nordström spacetime

We investigate the motion of neutral test particles in the gravitational field of a mass M with charge Q described by the Reissner-Nordstr\"om (RN) spacetime. We focus on the study of circular stable and unstable orbits around configurations describing either black holes or naked singularities. We show that at the classical radius, defined as Q^2/M, there exist orbits with zero angular momentum due to the presence of repulsive gravity. The analysis of the stability of circular orbits indicates that black holes are characterized by a continuous region of stability. In the case of naked singularities, the region of stability can split into two non-connected regions inside which test particles move along stable circular orbits.

Reference ***23 pages, 22 figures. To be published Phys. Rev. D***

519 - 2010 *Jorge A. Rueda, M. Rotondo, R. Ruffini, S.-S. Xue*

The relativistic Feynman-Metropolis-Teller theory for white-dwarfs in general relativity

The recently formulation of the relativistic Thomas-Fermi model within the Feynman-Metropolis-Teller theory for compressed atoms, is applied to the study of general relativistic white-dwarf equilibrium configurations. The equation of state, which takes into account the beta equilibrium and the Coulomb interaction between the nuclei and the surrounding electrons, is obtained as a function of the compression by considering each atom constrained in a Wigner-Seitz cell. The contribution of quantum statistics, weak and electromagnetic interaction is obtained by the determination of the chemical potential of the Wigner-Seitz cell. The further contribution of the general relativistic equilibrium of white-dwarf matter is expressed by the simple formula $\sqrt{g_{00}}\mu_{\rm ws}=$ constant, which links the chemical potential of the Wigner-Seitz cell $\mu_{\rm ws}$ with the general relativistic gravitational potential g_{00} at each point of the configuration. The configuration outside each Wigner-Seitz cell is strictly neutral and therefore no global electric field is necessary to warranty the equilibrium of the white-dwarf. These equations modify the ones used by Chandrasekhar by taking into due account the Coulomb interaction between the nuclei and the electrons as well as inverse beta decay. They also generalize the work of Salpeter by considering a unified self-consistent approach to the Coulomb interaction in each Wigner-Seitz cell. The consequences on the numerical value of the Chandrasekhar-Landau mass limit are presented. The modifications of the mass-radius relation for ^{4}He and ^{56}Fe white-dwarf equilibrium configurations are also presented. These effects should be taken into account in processes requiring a precision knowledge of the white-dwarf parameters

Reference

520 - 2010 *M. Rotondo, Jorge A. Rueda, R. Ruffini, She-Sheng Xue*

On the relativistic Thomas-Fermi treatment of compressed atoms and compressed nuclear matter cores of stellar dimensions

The Feynman, Metropolis and Teller treatment of compressed atoms is extended to the relativistic regimes. Each atomic configuration is confined by a Wigner-Seitz cell and is characterized by a positive electron Fermi energy. The non-relativistic treatment assumes a point-like nucleus and infinite values of the electron Fermi energy can be attained. In the relativistic treatment there exists a limiting configuration, reached when the Wigner-Seitz cell radius equals the radius of the nucleus, with a maximum value of the electron Fermi energy $(E_e^F)_{max}$, here expressed analytically in the ultra-relativistic approximation. The corrections given by the relativistic Thomas-Fermi-Dirac exchange term are also evaluated and shown to be generally small and negligible in the relativistic high density regime. The dependence of the relativistic electron Fermi energies by compression for selected nuclei are compared and contrasted to the non-relativistic ones and to the ones obtained in the uniform approximation. The relativistic Feynman, Metropolis, Teller approach here presented overcomes some difficulties in the Salpeter approximation generally adopted for compressed matter in physics and astrophysics. The treatment is then extrapolated to compressed nuclear matter cores of stellar dimensions with $A\simeq (m_{\rm Planck}/m_n)^3 \sim 10^{57}$ or $M_{core}\sim M_{\odot}$. A new family of equilibrium configurations exists for selected values of the electron Fermi energy varying in the range $0 < E_e^F \leq (E_e^F)_{max}$. Such configurations fulfill global but not local charge neutrality. They have electric fields on the core surface, increasing for decreasing values of the electron Fermi energy reaching values much larger than the critical value $E_c = m_e^2c^3/(e\hbar)$, for $E_e^F=0$. We compare and contrast our results with the ones of Thomas-Fermi model in strange stars

Reference

521 - 2010 *Michael Rotondo, Remo Ruffini, She-Sheng Xue*

Analytic Solutions of the Ultra-relativistic Thomas-Fermi Equation

It is well known that the ultra-relativistic Thomas-Fermi equation, amply adopted in the study of heavy nuclei, admits an exact solution for a constant proton distribution within a spherical core of radius Rc. Here exact solutions of a generalized ultra-relativistic Thomas-Fermi equation are presented, assuming a Wood-Saxon-like proton distribution and its further generalizations. These solutions present an overcritical electric field close to their surface. The variation of the electric fields as a function of the generalized Wood-Saxon parameters are studied.

Reference ***5 pages, 1 figure, 2 tables, to appear in the Proceedings of the Third Stueckelberg Workshop on Relativistic Field Theories, Cambridge Scientific Publisher***

522 - 2010 *A.G. Aksenov, R. Ruffini, G.V. Vereshchagin*

Thermalization of the mildly relativistic plasma

In the recent Letter [1] we considered the approach of nonequilibrium pair plasma towards thermal equilibrium state adopting a kinetic treatment and solving numerically the relativistic Boltzmann equations. It was shown that plasma in the energy range 0.1-10 MeV first reaches kinetic equilibrium, on a timescale t_{k}<10^{-14} sec, with detailed balance between binary interactions such as Compton, Bhabha and Moller scattering, and pair production and annihilation. Later the electron-positron-photon plasma approaches thermal equilibrium on a timescale t_{th}<10^{-12} sec, with detailed balance for all direct and inverse reactions. In the present paper we systematically present details of the computational scheme used in [1], as well as generalize our treatment, considering proton loading of the pair plasma. When proton loading is large, protons thermalize first by proton-proton scattering, and then with the electron-positron-photon plasma by proton-electron scattering. In the opposite case of small proton loading proton-electron scattering dominates over proton-proton one. Thus in all cases the plasma, even with proton admixture, reaches thermal equilibrium configuration on a timescale t_{th}<10^{-11} sec. We show that it is crucial to account for not only binary but also triple direct and inverse interactions between electrons, positrons, photons and protons. Several explicit examples are given and the corresponding timescales for reaching kinetic and thermal equilibria are determined.

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523 - 2011 *G. de Barros, L. Amati, M.G. Bernardini, C.L. Bianco, L. Caito, L. Izzo, B. Patricelli, R. Ruffini*

On the nature of GRB 050509b: a disguised short GRB

Reference ***ASTRONOMY & ASTROPHYSICS, vol.529, p. A130-1-A130-6, ISSN: 0004-6361, doi: 10.1051/0004-6361/201116659***

524 - 2011 *M.G. Bernardini, C.L. Bianco, L. Caito, M.G. Dainotti, R. Guida, R. Ruffini*

The GRB classificatio within the fireshell model: short, long and "fake" short GRBs

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525 - 2011 *C.L. Bianco, M.G. Bernardini, L. Caito, M.G. Dainotti, R. Guida, R. Ruffini, G.V. Vereshchagini, S.-S. Xue*

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526 - 2011 *L. Caito, M.G. Bernardini, C.L. Bianco, M.G. Dainotti, R. Guida, R. Ruffini*

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Reference ***Proceedings of the 3rd Stueckelberg Workshop on Relativistic Field Theories p.127-132, CAMBRIDGE: Cambridge Scientific Publishers, ISBN: 978-1-904868-73-6***

527 - 2011 *G. de Barros, M.G. Bernardini, C.L. Bianco, L. Caito, R. Guida, R. Ruffini*

Analysis of GRB 050509b

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528 - 2011 *C.L. Bianco, F.A. Massucci, R.Ruffini*

The luminosity evolution over the equitemporal surfaces in the prompt emission of gamma-ray bursts

Reference ***International Journal of Modern Physics D, vol.20, p.1919-1929, ISSN:0218-2718, doi: 10.1142/S0218271811019943***

529 - 2011 *L. Caito, M.G. Bernardini, C.L. Bianco, L. Izzo, B. Patricelli, R. Ruffini*

GRB 071227: Another disguised short burst

Reference ***International Journal of Modern Physics D, vol.20, p. 1931-1935, ISSN: 0218-2718, doi: 10.1142/S0218271811019955***

530 - 2011 *L. Izzo, M.G. Bernardini, C.L. Bianco, L. Caito, B. Patricelli, L.J. Rangel Lemos, R. Ruffini*

GRB 080916C and the high energy emission in the fireshell scenario

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531 - 2011 *B. Patricelli, M.G. Bernardini, C.L. Bianco, L. Caito, L. Izzo, R. Ruffini, G. Vereshchagin*

A new spectral energy distribution of photons in the fireshell model of GRBs

Reference ***International Journal of Modern Physics D, vo.20, p.1983-1987, ISSN: 0218-2718, doi:10.1142/S0218271811020056***

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Black holes energetics and GRBs

Reference ***The sun, the stars, the universe and general relativity p.67-140, CAMBRIDGE: Cambridge Scientific Publishers, ISBN: 978-1-908106-12-4***

533 - 2011 *R. Ruffini, I.A. Siutsou, G. Vereshchagin*

Theory of photospheric emission from relativistic outflows

In this paper we reexamine the optical depth of ultrarelativistic spherically symmetric outflows and reevaluate the photospheric radius for each model during both the acceleration and coasting phases. It is shown that for both the wind and the shell models there are two asymptotic solutions for the optical depth during the coasting phase of the outflow. In particular we show that quite counterintuitively a geometrically thin shell may appear as a thick wind for photons propagating inside it. For this reason we introduce notions of photon thick and photon thin outflows, which appear more general and better physically motivated with respect to winds and shells. Photosphere of relativistic outflow is a dynamic surface. We study its geometry and find that the photosphere of photon thin outflow has always a convex shape, while in the photon thick one it is initially convex (there is always a photon thin layer in any outflow) and then it becomes concave asymptotically approaching the photosphere of an infinitely long wind. We find that both instantaneous and time integrated observed spectra are very close to the thermal one for photon thick outflows, in line with existing studies. It is our main finding that the photospheric emission from the photon thin outflow produces non thermal time integrated spectra, which may be described by the Band function well known in the GRB literature. We find that energetic GRBs should produce photon thin outflows with photospheric emission lasting less than one second for the total energy $E_0\leq10^{54}$ erg and baryonic loading parameter $B\leq10^{-2}$. It means that only time integrated spectra may be observed from such GRBs.

Reference ***ARXIV***

534 - 2011 *A. Benedetti, W.-B. Han, R. Ruffini, G. Vereshchagin*

On the frequency of oscillations in the pair plasma generated by a strong electric field

We study the frequency of the plasma oscillations of electron-positron pairs created by the vacuum polarization in a uniform electric field with strength E in the range 0.2E<E<10E. Following the approach adopted in Ruffini, et al. (2007) [1] we work out one second order ordinary differential equation for a variable related to the velocity from which we can recover the classical plasma oscillation equation when E→0. Thereby, we focus our attention on its evolution in time studying how this oscillation frequency approaches the plasma frequency. The time-scale needed to approach to the plasma frequency and the power spectrum of these oscillations are computed. The characteristic frequency of the power spectrum is determined uniquely from the initial value of the electric field strength. The effects of plasma degeneracy and pair annihilation are discussed.

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535 - 2012 *A.V. Penacchioni, R. Ruffini, L.Izzo, M. Muccino, C.L. Bianco, L. Caito, B. Patricelli, L. Amati*

Evidence for a proto-black hole and a double astrophysical component in GRB 101023

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536 - 2012 *R. Negreiros, R. Ruffini, C.L. Bianco, J.A. Rueda*

Cooling of young neutron stars in GRB associated to supernovae

Reference ***ASTRONOMY & ASTROPHYSICS, vol.540, p. A12(1)-A12(6), ISSN:0004-6361, doi:10.1051/0004-6361/201117006***

537 - 2012 *L.Izzo, R. Ruffini, C.L. Bianco, L. Caito, S. K. Chakrabarti, J.A. Rueda, A. Nandi, B. Patricelli*

A double component in GRB 090618: a proto-black hole and a genuinely long gamma-ray burst

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538 - 2012 *B. Patricelli, M.G. Bernardini, C.L. Bianco, L. Caito, G. de Barros, L. Izzo, R. Ruffini, G.V. Vereshchagin*

Analysis of GRB 080319B and GRB 050904 within the fireshell model: evidence for a broader spectral energy distribution

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539 - 2012 *C.L. Bianco, M.G. Bernardini, L. Caito, G. de Barros, L. Izzo, M. Muccino, B. Patricelli, A.V. Penacchioni, G.B. Pisani, R. Ruffini*

Needs for a new GRB classification following the fireshell model: "genuine short", "disguised short" and "long" GRBs

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540 - 2012 *A.V. Penacchioni, G.B. Pisani, R. Ruffini, C.L. Bianco, L. Izzo, M. Muccino*

The proto-black hole concept in GRB 101023 and its possible extension to GRB 110709B

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Evidences for a double component in the emission of GRB 101023

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542 - 2012 *C.L. Bianco, L. Amati, M.G. Bernardini, L. Caito, G. de Barros, L. Izzo, B. Patricelli, R. Ruffini*

The class of "disguised" short GRBs and its implications for the Amati relation

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543 - 2012 *M.G. Bernardini, C.L. Bianco, L. Caito, L. Izzo, B. Patricelli, R. Ruffini*

The x-ray Flares of GRB 060607A within the fireshell model

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544 - 2012 *L. Izzo, M.G. Bernardini, C.L. Bianco, L. Caito, B. Patricelli, R. Ruffini*

GRB 090423 in the fireshell scenario: a canonical GRB at redshift 8.2

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545 - 2012 *B. Patricelli, M.G. Bernardini, C.L. Bianco, L. Caito, L. Izzo, R. Ruffini*

The study of high redshift GRB within the Fireshell Model

Reference ***Twelfth Marcel Grossmann Meeting p.1597-1599, SINGAPORE: World Scientific, ISBN: 978-981-4374-51-4, doi: 10.1142/9789814374552-0280***

546 - 2012 *R. Ruffini, G. Vereshchagin*

Electron-positron plasma in GRBs and in cosmology

Electron-positron plasma is believed to play imporant role both in the early Universe and in sources of Gamma-Ray Bursts (GRBs). We focus on analogy and difference between physical conditions of electron-positron plasma in the early Universe and in sources of GRBs. We discuss a) dynamical differences, namely thermal acceleration of the outflow in GRB sources vs cosmological deceleration; b) nuclear composition differences as synthesis of light elements in the early Universe and possible destruction of heavy elements in GRB plasma; c) different physical conditions during last scattering of photons by electrons. Only during the acceleration phase of the optically thick electron-positron plasma comoving observer may find it similar to the early Universe. This similarity breaks down during the coasting phase. Reprocessing of nuclear abundances may likely take place in GRB sources. Heavy nuclear elements are then destroyed, resulting mainly in protons with small admixture of helium. Unlike the primordial plasma which recombines to form neutral hydrogen, and emits the Cosmic Microwave Background Radiation, GRB plasma does not cool down enough to recombine.

Reference ***Il Nuovo Cimento C***

547 - 2012 *A.G. Aksenov, R. Ruffini, I. A. Siutsou, G. Vereshchagin*

Dynamics and Emission of Mildly Relativistic Plasma

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548 - 2012 *B. Patricelli, M.G. Bernardini, C.L. Bianco, L. Caito, G. de Barros, L. Izzo, R. Ruffini, G.V. Vereshchagin*

High Energetic Gamma Ray Bursts and Their Spectral Properties Within the Fireshell Model

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