New Perspective in Achieving the Unification Theory according to the ideas of Einstein and Wheeler

Arban Uka
Faculty of Architecture and Engineering, Epoka University
Tirana, 1032, Albania
auka@epoka.edu.al
www.epoka.edu.al

Shpëtim Nazarko
Independent Researcher
Tirane, 1001, Albania
shpetim.nazarko@gmail.com

The paper aims at achieving the Unification Theory, through the reconciliation of the principles of Relativity, with the various formulations of Quantum Mechanics. The first step is to remove the main obstacle caused by the axiomatic character of the Principle of Relativity. This principle was discovered by Galileo and used by Newton to derive the laws of motion, and later was placed by Einstein at the center of the Special Theory and the General Relativity. This work considers the General Principle of Relativity as an expression of the inherent characteristic of the most important quantity in physics - the energy - that states that the energy is independent from the shape, type or speed of movement of the material object. The energy of an object is transformed with the speed and the transformed part we call the exposed energy and it represents the magnitude of the field of an object. The expression of the exposed energy that is defined in this work allows to derive the expression of the momentum and of the force for both the classical and relativistic physics. The idea of finding the force from an expression of the energy at all conditions, rises the question of how to relate the force with the object's energy when at rest. This issue is overcome by associating the energy state of an object with equivalent spacetime parameters that can be found using the equation $mcr = \alpha\hbar$. These spacetime parameters can be used to derive the electric and gravitational forces using neither the electrical charge nor the gravitational constant.

Keywords: General relativity, wave mechanics, spacetime parameters.

1. Introduction

Over time, through great efforts physicists have been able to construct elegant models of interaction of matter. Now the challenge is to unify these models as much as possible and to have a complete picture. Carefully designed experiments have often exhibited lack of naturalness and this has puzzled researchers to a great extent [1]. This issue may point to the idea that sometimes, if not frequently, we may need to be more creative than analytical. Aspects that have not been proven or elegantly derived, have often provided good solutions or important insights to all researchers. A good example of this is the Wheeler-Dewitt equation [2-3]. Over a very brief encounter at an airport, the courage of Dewitt to mumble a similarity with the Hamilton-Jacobi equation of general relativity and the enthusiasm of Wheeler gave to the world this equation that still may need more explanation. One possible explanation can be that the Hamiltonian as a constraint over the wavefunction, tells us that the space and time parameters – with certain quantum characteristics and not experimentally measurable quantities – should serve as measuring instruments for the curve of the energy. The need for such a set of spacetime parameters with a quantum character can help the researchers to measure other important physical quantities of matter. The rare equality among the physical and quantum spacetime parameters may have hindered our path to complete the full picture.

The first that associated an unexpected space parameter to an object was De Broglie (1892-1987) that postulated the wave characteristic for the electron, and upon the experimental confirmation of this on 1927, he received the Nobel prize two years later (1929). On one of his works dating 1964, de Broglie calls for a reinterpretation of the wave mechanics and states that there is a need to postulate a relation between the wave and the corpuscle [4]. In a unique work that applies topological methods to cosmology, Bartini uses an interesting model that a particle with a small inner radius (called also the gravitational radius) can undergo an inversion to the larger outer radius (called also the classical radius) [5]. He then proceeds to derive all the physical constants using only two parameters as the building blocks.

Here in this work we present the following aspects: (i) the energy is a constant quantity and is independent of the objects speed or form of motion, (ii) this concept of the energy allows one to associate a field to the object, (iii) the association of an object with a field that is a function of the object's mass only, allows one to define spacetime parameters with a quantum character, and (iv) the spacetime parameters are used to determine all the parameters of an object including the potential energy that the object creates, from which the force emerges.

Employing the four steps mentioned above, we are able to firstly complete the idea of Einstein who envisioned a projectile as a field moving with the projectile's speed. This idea is often reported as an important step to unify the matter with the fields. We calculate the spacetime parameters of quantum character that are functions of the mass of the object only. From the spacetime parameters we calculate the force exerted by object as a function of mass only, thus dropping the gravitational constant, the Coulomb's constant and the concept of the charge. This may answer the worries of many researchers [6] including Prof. Guido Altarelli who rightfully asked: "How much are we willing to sacrifice from our understanding, in order to explain the observed physics at the Planck scales?" With the same equations we provide explanation about the non-expanding nature of the Universe that is in line with recent work in the literature [7].

2. Derivation of physical expressions and the equations of motion

We state that the principles upon which the physical theories are constructed, rather than having an axiomatic character, they are statements that describes the character of the most important fundamental quantity: the inherent character of the energy. The major principle should emphasizes the constant character of energy, and energy is seen as an intrinsic characteristic of a material object that is independent of the form, type or speed. The central idea emphasizes that as a force is exerted on an object, there is no change in its mass or its energy. There is only a transformation of the energy which remains constant. The object changes only its attributes such as inertia, an attribute that should not be confused with the mass or the energy. An object does not change its energy but only its energetic state, which exists even for an object at rest and its presence is asserted by the existence of forces such as electrostatic or gravitational force.

An object with a defined mass and energy transforms its energy as the velocity changes. The part of the energy that is transformed is defined as the **exposed energy** ($E_{exp} = mc^2\left(1-\sqrt{1-v^2/c^2}\right)$), whereas the other part is called the **unexposed energy** $E_{unexp} = mc^2\sqrt{1-v^2/c^2}$. The sum of these two energies is a constant quantity which is called the total energy of an object, $E = E_{exp} + E_{unexp} = mc^2$.

One can find the expression for the momentum by taking the derivative of the exposed energy – that represents the field of a material object as Einstein envisioned - with respect to the velocity: $p = dE/dv = mv/\sqrt{1-v^2/c^2}$ (valid for relativistic and classical physics). If we take the derivative of this momentum with time, one can find the expression of the force for both classical mechanics and relativistic mechanics: $F = dp/dt = ma/(1-v^2/c^2)^{3/2}$. After the intersection of the curves, the idea of Wheeler to measure based on a quantum theory of gravitation is materialized. As it will be shown below (see Table 2), the intersection of the curves corresponds to the point where an object has its Schwarzschild radius. After the intersection point, which would be beyond the black hole radius, all the space parameters have a quantum character.

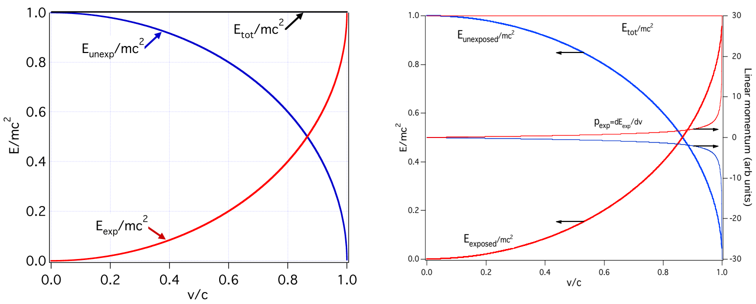

Fig. 1. The exposed (red) and unexposed (blue) energy as a function of velocity and their corresponding momentum

Checking the accuracy of the new form of the energy conservation law is done, as in all the other theories, through the use of the Lagrangian, which uses the expression of the exposed energy and provides the equations of motion for both classical and relativistic mechanics. $\mathcal{L} = \left(1-\sqrt{1-v^2/c^2}\right)mc^2 - V(x)$. We can eliminate the infinite quantities that are seen as the cause of the difficulties in achieving the Unification Theory. The expression for the momentum that is postulated by Newton and then by Einstein is found here by using the derivative (taking the derivative of the energy). We create a functional scale of laws energy-momentum-force that cannot be achieved from current physical theories. This then leads to a new formulation of Heisenberg's uncertainty principle.

3. Wave mechanics and the associating space parameters for objects

The creation of a functional scale of the laws **energy-momentum-force** allows one to conclude that the forces on an object when at rest represent the minimum energetic state of a material object. The larger energetic states are multiples of the lowest energetic one, until the energetic state equals the general energy of an object. The functional scale allows calculation of the parameters of the state at rest, a calculation that cannot be accomplished using Einstein's energy conservation law or the concepts in quantum mechanics. We stress the importance of differentiating the concept of the energy of an object and the work done on an object.

Here we propose the use of $mcr = \alpha\hbar$ to find space parameters for any object. The new law that can be viewed as a reinterpretation of the Uncertainty Principle includes the Planck constant and the fine structure constant. The latter relates the state at rest with the state of minimum action, which is characterized by the Planck constant. **The fundamental equation $mcr = a\hbar$, allows calculation of the minimum and the maximum energy state of objects in nano- and macroscale.** Using this equation, we can calculate the minimum and maximum space parameters (referred here also as the radius) for all objects as a function of the mass. Using these space parameters, we can calculate all the other parameters including the force. We do find two values for the space parameters for each mass, a small value and a larger one. The equations to find the minimum and maximum radii exhibits an inversion at some critical mass, such as the maximum radii for heavier masses ($m > m_{crit}$) can be found using the same expression that finds the minimum radii for lighter masses ($m < m_{crit}$). The product of minimum and maximum radii gives a critical length squared. This critical length corresponds to the Planck length. An object exhibits its maximum field when it has its minimum radius, and after we find the maximum value for the field, we can find the field as a function of some real (experimentally measurable) distance.

$m < m_{crit}$		$m > m_{crit}$	
$r_{max} = \alpha\hbar/mc$	1.1	$r_{max} = mc\alpha(2\pi\hbar)$	1.2
$r_{min} = mc\alpha(2\pi\hbar)$	2.1	$r_{min} = \alpha\hbar/mc$	2.2
$r_{min}=\lambda_{real}^2/r_{max}=\lambda_{real}^2 mc/\alpha\hbar$	3.1	$r_{min}=\lambda_{real}^2/r_{max}=\lambda_{real}^2/ mca\hbar$	3.2
$F_{max}=mc^2/r_{min}=c/ah$	4.1	$F_{max}=mc^2/r_{min}=m^2c^3/a\hbar$	4.2
$F_{max}\lambda_{\mathbf{real}}^2 = F(r)r_{real}^2$	5		
$F(r) = \frac{c}{\alpha\hbar}\frac{\lambda_{real}^2}{r_{real}^2}$	6.1	$F(r) = \frac{c}{\alpha\hbar}m^2c^2\frac{\lambda_{\mathbf{real}}^2}{r_{real}^2}$	6.2

Table 1. The formulas for the calculation of space parameters and the forces

The determination of the maximum radius, minimum radius and real physical parameter of an object makes the use classical radius and Schwarzschild radius redundant. We provide below the table including masses smaller and larger than the critical mass. The critical mass is the analogous with the Planck mass ($m_c = \frac{1}{\sqrt{2\pi}}\frac{1}{c}$).

	Mass (kg)	r_{max} (m)	r_{min} (m)	l_{real} (m)
Electron	9.11E-31	2.83E-15	1.32E-57	1.37E-36
Proton	1.67E-27	1.54E-18	2.42E-54	1.37E-36
Critical mass	1.33E-09	1.93E-36	1.93E-36	1.37E-36
Earth	5.97E+24	**8.71E-03**	4.32E-70	1.37E-36
Sun	1.99E+30	**2.90E+03**	1.30E-75	1.37E-36
Universe	1.00E+53	**1.46E+26**	2.58E-98	1.37E-36

Table 2. The minimum and maximum radii for some objects

The numbers in bold (in Table 2) are maximum radii for objects that are heavier that the critical mass, and interestingly the values correspond to the Schwarzschild radii of these objects. Those numerical values correspond to the points where the curve of the exposed energy intersects the unexposed energy in Fig. 1. From Table 2, we observe that the calculated maximum radius for the Universe is the value that we assign to be its radius. This means that the Universe cannot expand beyond its current state.

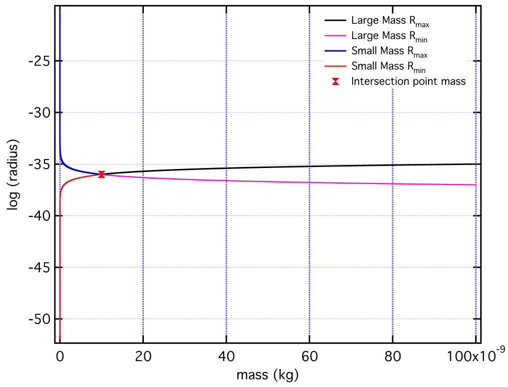

Fig. 2 The maximum and minimum space parameters as a function of the mass using Eqns. 1.1, 2.1, 2.1, 2.2.

According to our approach, an object exhibits the maximum force when it attains its maximum exposed energy and at that point the object has its smallest physical parameters, which are equal to the Planck length. We accept that the force is inversely proportional to the square of the real physical distance. We use the term physical distance so that it is not confused with the minimum and maximum space parameters that have a quantum character rather than a physical character. The space parameters that have the quantum character are used only to determine the energetic state of the object.

$$F_{max}\lambda_{Planck}^2 = Fr_{real}^2$$

3.1 First Example: Newton's gravitational constant

One can define the gravitational constant as the force between two objects each of a mass of 1 kg at a distance of 1 meter. In the new approach presented here, the force is the derivative of the field (of the object) that originates from the object. At first we calculate the minimum radius of the object using the formulas 1.2, 2.2, 3.2 and 4.2:

$$r_{min} = \frac{\alpha\hbar}{mc} = \frac{7.297\times10^{-3}\ 1.054\times10^{-34}}{1.3\times10^{8}} = 2.563\times10^{-45}m$$

The second step involves finding the maximum force when the object has minimum radius. From the relation $F_{max}r_{min} = mc^2$ and after substituting the values we find:

$$F_{max} = \frac{(1\times3\times10^{8})^2}{2.563\times10^{-45}} = 3.511\times10^{61}kg\ m/sec^2$$

The maximum force decreases with the square of the distance, and we consider that the distance is ***1,364.10 $^{-36}$ m*** when the force is maximum. As the distance increases from the minimum value to 1 meter, we find:

$$F_1 = \frac{F_{max}}{[r_1/l_{real}]^2} = \frac{3.511\times10^{61}}{[1/1.364\times10^{-36}]^2} = 6.53\times10^{-11}kg\ m/sec^2$$

The result is ***98%*** of the gravitational constant ***G***. In classical mechanics the value of G is found experimentally by Cavendish. The theoretical calculation proposed here is based

on principles that are completely compatible with quantum mechanics, and in this way we show that the laws of classical physics and special relativity can be derived from the quantum mechanics.
If we use the equations 1.1, 2.2, 3.1 and 4.1 for the electron ($m < m_{crit}$), we find a force that is equal numerically to the Coulomb force. We want to firstly stress that in the graph below the force is expressed as a function of the mass only. An interesting observation is that the force is independent of the mass for objects lighter than the Planck's mass. This means that the force exerted by the electron and by the proton is the same.

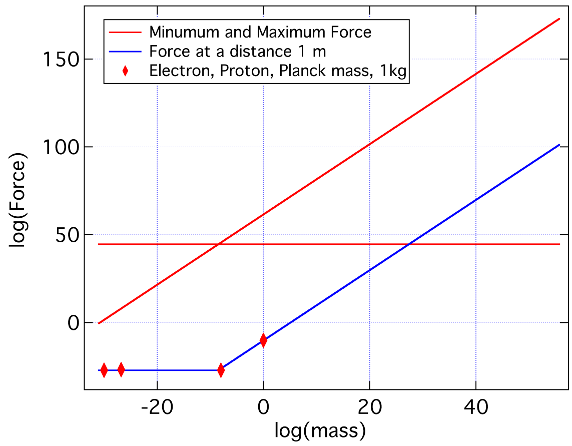

Fig. 3 Minimum and maximum force as a function of the mass. The forces shown in red are found as a function of the space parameters that have quantum character. The force in blue is the force of an object at a distance of 1 m. The four markers (in red) are the forces between two electrons, between two protons, two objects with a mass equal to the Planck mass and two objects with mass of 1 kg (equal to gravitational constant $G = 6.53\times10^{-11}$).

The force of an electron and a proton at a distance of 1 m is found using the Coulomb constant and the charges ($F = k\,e^2/r^2$). The force of an object of 1 kg at a distance of 1 m ($F = G\,m^2/r^2$) is found using the gravitational constant and the mass. Using the approach of our work we can find all these forces and rather than using four parameters (k, e, G, m) we use only the mass, thus removing the difference between the gravitational and nongravitational forces. (note that we do not need the Coulomb's and gravitational constants).

4. Conclusions

Here in this work we propose a model of how to unify the forces. We first presented the method that one would follow in the efforts of unification by firstly clarifying the axiomatic character of the Galilean principle. In the first part we established the idea that the energy should stand at the top of the theories and all the expressions of physical quantities should be derived from the energy. This was shown using the Lagrangian formalism as we derived the equations of motion for both the relativistic and classical physics. Once the idea of deriving all the physical quantities (the momentum and the force) from the energy is established, we argued that even for an object at rest, the force that it exhibits should be derived from its energy states. In the case of the electron at rest, one can state that its energy has a quantum character and this energy can be increased in multiples of the minimum energy.

In the following sections of this work we stated that the energy – unlike in the special theory – has a well-defined value and is independent of the speed. Also the energy has another essential inherent property: it has a discrete character. All the quantities that can be derived from bounded and discrete quantities cannot diverge to infinity. In the special theory of relativity some physical quantities such as the momentum or the force diverge to infinity as the speed converges to the speed of light. The energy is transformed and it dictates to the space and time parameters how they should change - without diverging but having precisely calculable values - as the energy is transformed. The expression that is used to calculate the spacetime parameters exhibits an inversion at a mass that is analogous with the Planck mass. We use these space parameters to find the force that emerges as a result of the field of an object. We provided three examples that prove that our method of calculating the forces is accurate. The calculation of the time parameter of the celestial bodies using the spacetime parameters, is a good example that shows the derivation of classical parameters from the reinterpretation of the wave mechanics. The same set of equations was used to determine the electric force between a proton and electron, and then predict the force between a proton and a neutron. The forces that are used to model the particle interaction in the scattering experiments involving protons and neutrons have all yielded theoretical results that cannot explain the experimental observations. The use of the expression of the force that we present here could be used to predict the experimental observations of elementary particles.

References

1. G. Altarelli. The Higgs: so simple yet so unnatural http://dx.doi.org/10.1051/epjconf/20147100005
2. B. S. DeWitt. Quantum Theory of Gravity. I. The Canonical Theory Phys. Rev. 160, 1113
3. C. Rovelli, "The Strange Equation of Quantum Gravity", Class. Quantum Grav. 32 (2015) 124005. arXiv:1506.00927.
4. L. de Broglie. The Thermodynamics of the isolated particle. GAUTHIER VILLARS, Paris, 1964.
5. R. O. di Bartini. Relations between physical constants. Progress in Physics. 3, 2005, pp 34-40.
6. M. Shaposhnikov. Is there a new Physics between electroweak and Planck scales? arXiv:0708.3550 [hep-th]
7. C. Wetterich. Universe without expansion. Physics of the Dark Universe. 2, 184-187, (2013)