Calculation of Gravitational Constant in line with Wheeler idea on Gravitation

Epoka University

A. Uka[1, 2], Sh. Nazarko

[1]Faculty of Architecture and Engineering, Epoka University, Tirana, Albania

[2]Physics Department, Tirana University, Tirana, Albania

Independent Researcher, Tirana, Albania

E-mail: auka@epoka.edu.al

Tirana University

Introduction

It is widely accepted that the general theory of relativity ceases to explain phenomena in the vicinity and inside a black hole. Wheeler holds the idea that on the surface of a Black hole the space parameters turn into quantum foam. He even contemplates on the geometry of space parameters as one zooms down on a point particle. In this work we aim to solve challenges by employing a pair of spacetime parameters of a quantum character. We call these of quantum character because they are not experimentally measurable but provide a very useful relations between different physical quantities. This pair of spacetime parameters are linked together through the limiting quantity of space: the Planck length. The realization of the idea of Wheeler helps to achieve a beautiful connection between gravitation and electromagnetism, an effort on which Einstein worked for around 40 years. These steps respect the hierarchy of the physical quantities of energy, momentum and force. This approach respects the idea of Einstein who searched for a theory that had the concepts of the energy – or the field – at its center. The space parameters are derived from a simple relation and are valid for the whole range of masses, from the mass of the electron to the mass of the Universe. From this relation the gravitational constant, and the electrostatic force are derived without using principles from classical mechanics and/or general relativity.

The energy of an object: i) The exposed (kinetic character), ii) unexposed (internal, potential character)

Einstein postulate emphasizes the constant character of the speed of light. This postulate (formulated before the discovery of mc²) can be replaced with a postulate that emphasizes the constant character of the energy, and the energy is seen as an intrinsic characteristic of an object that is independent of the form, type or the speed. Here we introduce a new quantity: the *Exposed Energy* (E_{exp}). E_{exp} prescribes the energy state of the object. Using E_{exp} in the Lagrangian formalism facilitates the derivation of the expressions for the classical (postulated in Classical Mech.) and relativistic momentum (modified by Einstein), and also the derivation of the equations of motion for both the classical and relativistic physics.

As v→c, $E_{exp} \rightarrow mc^2$. Force is found from momentum. Using the force, work done on the object (equal to KE) is found.

The field of an object (and its byproduct: the force) is related to the energy states and is related to parameter "*r*", defined here as space parameter. **Space parameters vs mass:** $mcr = \alpha\hbar$

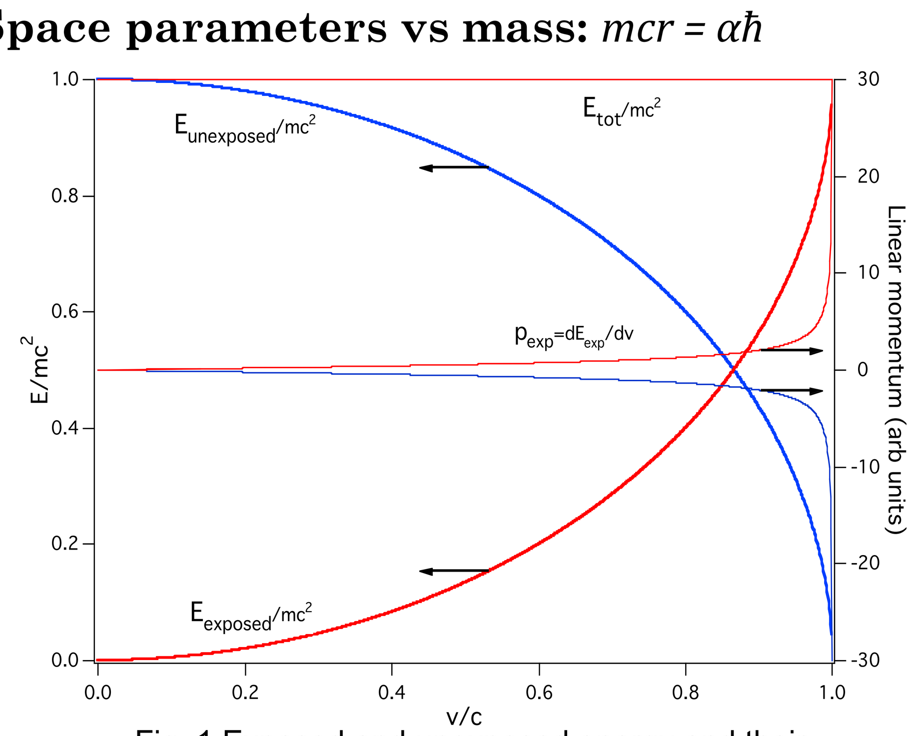

Fig. 1 Exposed and unexposed energy and their respective momentuma

$$E = \tfrac{1}{2}mv^2$$

$$\int p\,dv = ...+C_2$$

$$p = mv$$

$$\int F\,dt = ...+C_1$$

$$F = ma$$

$$E_{exp} = mc^2\left(1-\sqrt{1-\frac{v^2}{c^2}}\right)$$

$$p = \frac{dE_{exp}}{dv} = \frac{m\cdot v}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$F = \frac{dp}{dt} = \frac{m\cdot a}{\left(1-\frac{v^2}{c^2}\right)^{3/2}}$$

$$\int F\,dx = \int\left[\frac{\partial}{\partial t}\left(\frac{\partial E_{exp}}{\partial v}\right)\right]dx = (\gamma-1)mc^2 = KE$$

$$L = \left(1-\sqrt{1-\frac{v^2}{c^2}}\right)mc^2 - V(x)$$

Calculation of Gravitational Constant

The use of functional scale of the laws energy-momentum-force implies that the force of an object when at rest represent the minimum energetic state of an object. The fundamental equation $mcr = \alpha\hbar$, allows calculation of the minimum and the maximum energy state of objects in nano- and macroscale. Space parameters depend only on the mass (Table, & Fig 2).

$r_{min} \rightarrow F_{max}$ $\quad r_{max} \rightarrow F_{min}$

All objects at highest energy state have real space parameter $\lambda_{crit} \approx \lambda_{Planck}$

Every object has r_{min} & r_{max} with quantum character and these are scaled with the momentum of the object. The momentum exhibits an inversion at the Planck boundary.

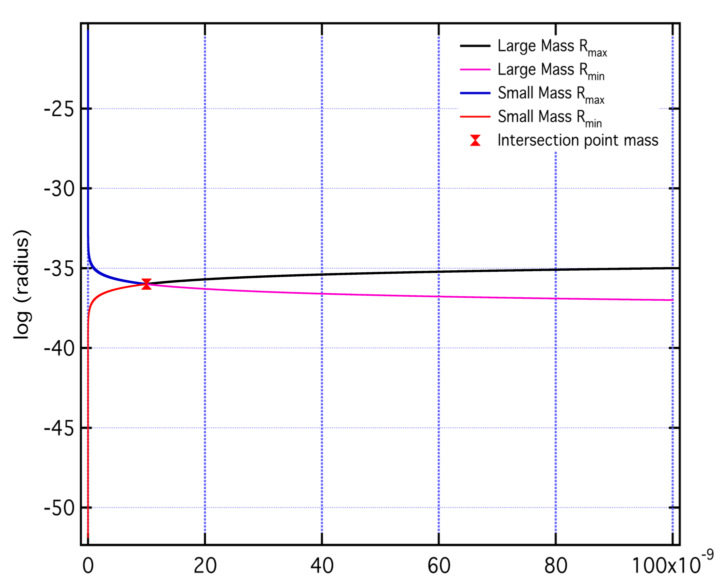

Fig. 2 The upper (max) and lower (min) boundaries of space parameters vs mass

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

Coulomb's Force

$$r_{el}^{min} = (mc)\alpha(2\pi\hbar) = 1.3\times10^{-57}\,m$$

$$F_{max}^{l_{crit}} = \frac{mc^2}{r_{el}^{min}} = \frac{(9.1\times10^{-31})(3\times10^8)^2}{1.3\times10^{-57}} = 6.1\times10^{43}\,N$$

$$F_{1m} = \frac{F_{max}^{l_{crit}}}{[1/l_{crit}]^2} \cong 10^{-28}\,N \cong k_C e^2$$

Gravitational Constant (G)

$$r_{min} = \frac{\alpha\hbar}{mc} = \frac{(7.3\times10^{-3})(1.05\times10^{-34})}{(1)(3\times10^8)} = 2.6\times10^{-45}\,m$$

$$F_{max} = \frac{mc^2}{r_{min}} = \frac{(1)(3\times10^8)^2}{2.6\times10^{-45}} = 3.5\times10^{61}\,kg\ \mathrm{m/s^2}$$

$$F_{r=1m}^{m=1kg} = \frac{F_{max}}{[r/\lambda_{crit}]^2} = \frac{3.5\times10^{61}}{[1/1.4\times10^{-36}]^2} = 6.5\times10^{-11}\,N = G$$

Gravitation & Electromagnetism Equivalence at Planck scale

$$F_{max}^{Newton} = G\frac{m^2}{r_{min}^2} = 6.5\times10^{-11}\frac{(9.1\times10^{-31})^2}{(1.3\times10^{-57})^2} = 3.2\times10^{43}\,N$$

Determining F_{max} using space parameters shows that Coulomb force and the Gravitational force are equivalent at Planck scale ~ 10⁴³ N. r_{min}~10^{-57} m has quantum character for the electron, and it is not accepted as a physical reality. r_{max}=~10^{-15} m (electron).

$$\lambda_{crit} = \lambda_{Planck}\sqrt{\alpha}$$

The forces are shown in Fig. 3 for the electron, proton, Planck mass and a mass of 1 kg.

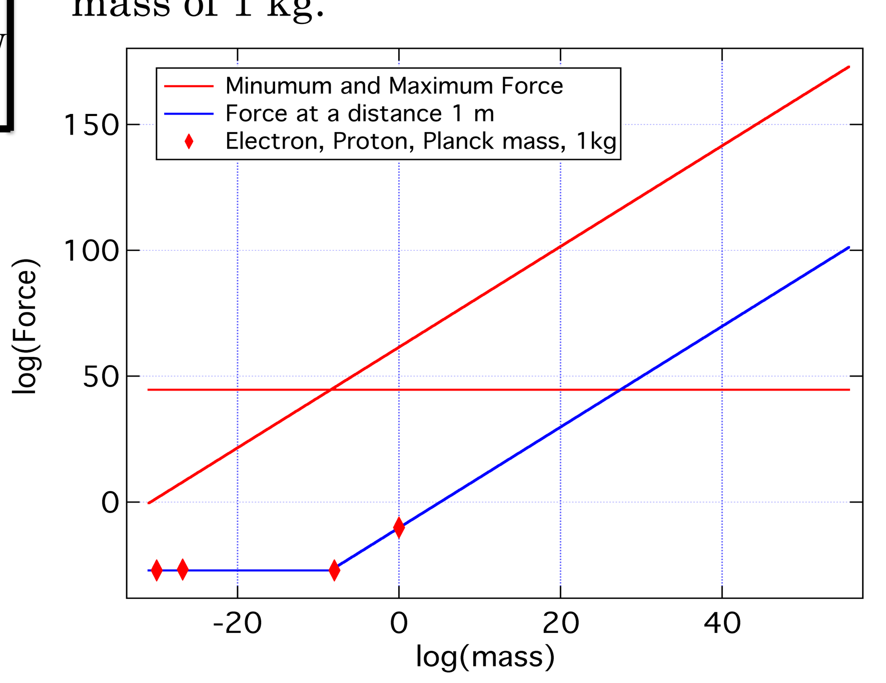

Fig. 3 Force as a function of the mass. (in blue) the force at a distance of 1 m

Conclusions and Outlook

In this work the Gravitational Constant is calculated in a different way from the current theories. In the analysis of the figures above, we notice that the Schwarzchild radius for objects with mass larger than the m_P, corresponds to the point when the exposed and the nuexposed energy are equal, at a v=0.86c. This allowed the use of concepts that are in line with Wheeler that beyond the Schwarzchild radius, one has to use techniques that are linked with the quantization of the spacetime. The results, at least from the quantitative aspect, show that at the Planck scale the differences between the electromagnetism and gravitation are eliminated. The results are based on the idea that physical quantities have a hierarchical structure and it is always easier to derive them from the energy and are not postulated, as the momentum is postulated in classical and relativistic mechanics. This technique is inevitable as the derivation of the physical quantities by integrating requires the design of precise experiments to determine the constants of integration.

[1] Guido 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] Carlo Rovelli, "The Strange Equation of Quantum Gravity", Class. Quantum Grav. 32 (2015) 124005. arXiv:1506.00927. [4] M. Shaposhnikov. Is there a new Physics between electroweak and Planck scales? arXiv:0708.3550 [hep-th] [5] C. Wetterich. Universe without expansion. Physics of the Dark Universe. 2, 184-187, (2013)