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Research Article

THE PAIS "SUPER FORCE" AND ITS COSMOLOGICAL RELATIONSHIP TO THE GEM UNIFICATION THEORY

[1,] * J.E. Brandenburg and [2]Salvatore Pais

[1]Kepler Aerospace LTD, Midland TX, United States.
[2]private citizen / Aerospace Engineer' employed at NAVAIR PAX, MD, USA.

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ABSTRACT

The term c^4/G in the Einstein equations of General Relativity is identified as a universal "Super Force" that can be understood physically as the force of gravity at the point of contact of two identical merging black holes and is proportional to the Entropic Surface Tension of a Black Hole. It exists from the Planck to the Cosmic scaleIn the context of the GEM unification theory it is shown that the universal force forms an extension of the Dirac Large Numbers Hypothesis.

Keywords: Gravity, Electromagnetism, Super Force, General Relativity, Unification Theory.

INTRODUCTION THE PAIS SUPER FORCE AND ITS IMPORTANCE CONCEPTUALLY

The Bohr Model of the Hydrogen atom was a seminal advance in physics, modeling the hydrogen atoms as a miniature Solar System with the electron as a planet but with its orbital angular momentum quantized in units of Planck's constant of action, h. This explained the observed spectrum of hydrogen but prompted questions as to the physics of the quantization of the electron's motion. De Broglie then achieved a conceptual breakthrough by proposing that the electrons moved as waves in the hydrogen atom, yielding quantization as a resonant condition on the orbits. This was an advance in thought that led directly to the Schrodinger Wave Equation. The hydrogen spectrum did not change, but the concept of matter itself was forever altered. So it is with the recent discovery by Salvatore Pais, who has identified a mathematical term (1) in the center of Einstein's Equations of GR (General Relativity): G/c^4 as a the reciprocal of a universal SF("Super Force"), with units of energy over distance.

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \frac{8\pi G}{c^4}T_{\mu\nu} \qquad (1)$$

This term unifies reality from the Cosmic down to Planck scale. This term had been formerly considered an energy per unit length of a string [2] in String Theory, important only at the Planck Scale.However, the SF's appearance is general and appears at all scales in the Cosmos. The term in question has the immediate physical interpretation as 16 times the force between two merging, non-spinning, Black Holes of equal mass, M_{BH} separated 2 event horizon radii $R_{BH} = 2GM_{BH}/c^2$

$$\frac{GM_{BH}^2}{R_{BH}^2} = \frac{1}{16}\frac{c^4}{G} \qquad (2)$$

Alternatively, the G/c^4term, may found more abstractly as proportional to the "Entropic Surface Tension", S/A, of a non-spinning Black Hole, where A is the area of its radius or "event horizon", and the Entropy S of such a simple Black Hole is defined as ¼ the surface area of the Black Hole event horizon, divided by the Planck Length squared, $r_p^2=G\hbar/c^3$and multiplied, in turn, by the Boltzmann Constant k_B

$$S = k_B\frac{A}{4r_p^2} \qquad (3a)$$

The Entropic Surface Tension of the non-spinning Black Hole is then found to be the SF times a proportionality constant:

$$\frac{S}{A} = \frac{k_B}{4\hbar c}\frac{c^4}{G} \qquad (3b)$$

This is a property of all Black Holes, from the Planck to the Cosmic scale, including the entire visible Comos where the Hubble Radius, R_H can be defined as the Schwarzschild Radius of the mass of the visible Cosmos, M_C:

$$\frac{GM_C^2}{R_H^2} = \frac{1}{4}\frac{c^4}{G} \qquad (4)$$

THE COSMOLOGICAL INTERPRETATION OF THE SUPER FORCE IN TERMS OF THE DIRAC RELATION AND THE GEM UNIFICATION THEORY

In the GEM Unification theory [3] the Dirac Relations for the Cosmos, or Large Number Hypothesis, is shown to arise to the underlying unity of EM and Gravity forces, and can be written (in cgs) as:

$$\frac{r_e}{R_H} = \frac{Gm_pm_e}{e^2} \qquad (5)$$

Where m_p and m_e are the proton and electron masses respectively and r_e is the electron classical radius. It can be derived as the simultaneous co-existence of the conditions of critical EM optical thickness of the Cosmos with its critical gravitational closure [3].

The Super Force relation, applying from the Cosmic to the Planck scales, allows a similar condition to be written

***Corresponding Author: J.E. Brandenburg,**
1Kepler Aerospace LTD, Midland TX, United States.

$$\frac{M_P}{M_C} = \frac{r_P}{R_H} \qquad (6)$$

where M_P is the Planck Mass, $\hbar c/r_P$. Using the GEM theory, we can write (in cgs) [3]

$$\frac{Gm_pm_e}{e^2} = \alpha \exp(-2\sigma) \qquad (7)$$

Where $\sigma = (m_p/m_e)^{1/2} = 42.8503\ldots$, is a central number of the Cosmos in the GEM theory. Its value is seemly related to the fine structure constant: $\pi\sigma \cong 1/(\alpha(1+\alpha)^{5/2})$.

This expression is derived from the central formula of the GEM theory

$$\ln\left(r_o/r_p\right) = \sigma \qquad (8)$$

Where we have defined

$$r_o = \frac{e^2}{(m_pm_e)^{1/2}c^2} = \frac{r_e}{\sigma} \qquad (9)$$

Accordingly, by Eq. 8 we have

$$\frac{r_p}{r_e} = \frac{e^{-\sigma}}{\sigma} \qquad (10)$$

By Eq. 5, Eq. 6, and Eq.10 this leads to the expression, from combining the Dirac Relation, the Pais Super Force, and GEM theory:

$$\frac{r_p}{R_H} = \frac{\alpha}{\sigma}\exp(-3\sigma) \qquad (11)$$

Which yields finally

$$\frac{M_C}{M_p} = \sigma\alpha^{1/2}\left[\frac{R_H}{r_e}\right]^{3/2} \qquad (12)$$

Where $\sigma\alpha^{1/2} \cong 3.66$. This is consistent with a physical picture of mass arising both at the Planck scale and at the Cosmic scale from a quantum cross section effect that also creates a mass density at the same size scale.

SUMMARY AND CONCLUSIONS

The Pais Super Force is a present at all scales from the Planck to the Cosmic and changes our physical concept of quantum reality from being based on linear Strings to more classical spherical membranes, a structure which is also universal at all scales and is linked to the isotropy of space-time. Also, force is a concept foreign to many students of GR where, because of the Equivalence Principle, Gravity not considered a true force like EM. Therefore, the identification of thec^4/G as a Super Force also prompts deeper inquiry into the physical interpretation of the Einstein GR equations in terms of force rather than the more abstract curvature. Written this way the GR equation assumes the form:

$$\frac{c^4}{G} = \frac{8\pi T_{\mu v}}{R_{\mu v} - \frac{1}{2}Rg_{\mu v}} \qquad (13)$$

which has the physical interpretation of a universal Force being due to a pressure $T_{\mu v}$on a surface of area $8\pi R_s^2$, where $R_s$is a radius of curvature of space-time. Also, since the SF depends on G and c, it prompts the question as to whether these terms are actually fixed but instead can be modified in certain situations for technological purposes, as others have suggested..Therefore, in conclusion, the basic physics of universe is due to force, as seen in the c^4/G term and dynamics at all scales.

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