The Schwarzschild Proton

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Draft Paper

Abstract

We review our model of a proton that obeys the Schwarzschild condition. We find that only a very small percentage ($\sim 10^{-39}\%$) of the vacuum fluctuations available within a proton volume need be cohered and converted to mass-energy in order for the proton to meet the Schwarzschild condition. This proportion is similar to that between gravitation and the strong force where gravitation is thought to be $\sim 10^{-40}$ weaker than the strong force. Gravitational attraction between two contiguous Schwarzschild protons can easily accommodate both nucleon and quark confinement. In this picture, we can treat "strong" gravity as the strong force. We calculate that two contiguous Schwarzschild protons would rotate at c and have a period of 10^{-23}s and a frequency of 10^{22} Hz which is characteristic of the strong force interaction time and a close approximation of the gamma emission typically associated with nuclear decay. We include a scaling law and find that the Schwarzschild proton falls near the least squares trend line for organized matter. Using a semi-classical model, we find that a proton charge orbiting at a proton radius at c generates a good approximation to the measured anomalous magnetic moment.

Keywords: black holes, Schwarzschild radius, proton, strong force, anomalous magnetic moment

1. Introduction

We examine some of the fundamental issues related to black hole physics and the amount of potential energy available from the vacuum. We use a semi-classical analogy between strong interactions and the gravitational force under the Schwarzschild condition. We examine the role of the strong nuclear force relative to the gravitational forces between two Schwarzschild protons and find that the gravitational component is adequate for confinement. In an alternative approach we can utilize QCD to obtain similar results (work in progress). We also compare our results to a scaling law for organized matter and in particular, to the ubiquitous existence of black holes. We calculate the magnetic moment of such a Schwarzschild proton system and we find it to be a close approximation to the measured value for the so-called "anomalous" magnetic moment of the proton.

2. Fundamentals of the Schwarzschild Proton

In our approach to comprehend a fundamental relationship between the strong force and gravitational interactions we utilize a semi-classical approach in order to yield a more definitive understanding. The quantum vacuum density is given as $\rho_v = 5.16\times10^{93}\,gm/cm^3$. We can calculate the amount of vacuum density necessary from the quantum vacuum fluctuations to produce the Schwarzschild condition at a nucleon's radius. For a proton with a radius of $r_P = 1.32\,Fm$ and a volume of $V_p = 9.66\times10^{-39}\,cm^3$, the quantity of the density of the vacuum available in the volume of a proton, R_ρ is

$$R_\rho = \rho_v V_p \qquad (1)$$

then $R_\rho = 4.98\times10^{55}\,gm/\,proton\ \ volume$.

One can obtain a similar result utilizing the proton volume V_p and dividing it by the Planck volume v_{pl} given by $v_{pl} = \ell^3$. Therefore, $v_{pl} = 4.22\times10^{-99}\ cm^3$ where ℓ is the Planck length $\ell = 1.62\times10^{-33}cm$. Then, $\eta = {V_p}/{v_{pl}}$ yields the quantity 2.29×10^{60} where η is the ratio of the proton volume to the Planck volume. Since the Planck's mass m_p is given as $m_p = 2.18\times10^{-5}\,gm$, then the mass density within a proton volume is

$$R_\rho = m_p\,\eta \qquad (2)$$

then $R_\rho = 4.98\times10^{55}\ gm/\,proton\,volume$. We note that this value is typically given as the mass of matter in the universe. This may be an indication of an ultimate entanglement of all protons. We then calculate what proportion of the total vacuum density R_ρ available in a proton volume V_p is necessary for the nucleon to obey the Schwarzschild condition $R_s = \dfrac{2GM}{c^2}$. The mass M, needed to obey the Schwarzschild condition for a proton radius of $r_P = 1.32\ \ Fm$ is

$$M = \frac{c^2 R_s}{2G} \qquad (3)$$

where we choose the condition that $R_s = r_P = 1.32\,Fm$ and the gravitational constant is given as $G = 6.67\times10^{-8}\,cm^3/\,gm\,s^2$, and the velocity of light is given as

$c = 2.99 \times 10^{10}\ cm/s$. Then M equals the Schwarzschild mass of $M = 8.85 \times 10^{14} gm$ which is derived from the density of the vacuum available in a proton volume V_p.

We note that only a very small proportion of the available mass-energy density from the vacuum within V_p is required for a nucleon to obey the Schwarzschild condition. In fact, the ratio of the quantity of density of the vacuum in the volume of a proton, $R_\rho = 4.98 \times 10^{55}$ to the quantity sufficient for the proton to meet the Schwarzschild condition, $M = 8.85 \times 10^{14} gm$ is:

$$\frac{M}{R_\rho} = 1.78 \times 10^{-41} \tag{4}$$

Therefore, only 1.78×10^{-39} % of the mass-energy density of the vacuum is required to form a "*Schwarzschild proton.*" This contribution from the vacuum may be the result of a small amount of the vacuum energy becoming coherent and polarized near and at the boundary of the "horizon" [1] (Sec 4 pgs 11-16) of the proton due to spacetime torque and Coreolis effects as described by the Haramein-Rauscher solution [2, 3].

Now let us consider the gravitational force between two contiguous Schwarzschild protons. In a semi-classical approach the force between these protons is given as

$$F = \frac{GM^2}{(2r_p)^2} \tag{5}$$

where the distance between the protons' centers is $2r_P = 2.64\ Fm$, yielding a force of $7.49 \times 10^{47}\ dynes$.

We now calculate the velocity of two Schwarzschild protons orbiting each other with their centers separated by a proton diameter. We utilize the force from Eq. 5 to calculate the associated acceleration

$$a = \frac{F}{M} \tag{6}$$

which yields $a = 8.46 \times 10^{32} cm/s^2$.

We utilized this acceleration to derive the relativistic velocity as

$$v = 2\sqrt{2ar_P}\,. \tag{7}$$

Then $v = 2.99 \times 10^{10} cm/s$. Thus, $v = c$, the velocity of light. The period of rotation of such a system is then given by

$$t = \frac{2\pi\ r_P}{v} \tag{8}$$

which yields $t = 5.55 \times 10^{-23} s$. Interestingly, this is the characteristic interaction time of the strong force.

The strong interaction manifests itself in its ability to react in a very short time. For example, for a particle which passes an atomic nucleus of about $10^{-13} cm$ in diameter with a velocity of approximately $10^{10} cm/s$, having a kinetic energy of approximately 50 MeV for a proton (and 0.03 MeV for an electron), the time of the strong interaction is $10^{-23} s$ [4].

Therefore, the frequency of the Schwarzschild proton system is

$$f = \frac{1}{t} \tag{9}$$

or $f = 1.806 \times 10^{22} Hz$, which is within the measured gamma ray emission frequencies of the atomic nucleus. This is a most interesting result and is consistent with hadronic particle interactions.

Further, we calculate the centrifugal forces that may contribute to the rapid weakening of the attractive force at the horizon of such a Schwarzschild proton system. As a first order approximation we utilize a semi-classical equation that expresses the centrifugal potential between two orbiting bodies. Note that we utilize the reduced mass as typically used in nuclear physics for rotational frames of reference, calculated by

$$m_{red} = \frac{M_1 M_2}{M_1 + M_2} \tag{10}$$

where $M = 8.85 \times 10^{14} gm$, yielding, (in our case) half the total mass or $4.45 \times 10^{14} gm$. The expression for the centrifugal potential is:

$$V(r) = \frac{L^2}{2mr^2} = \frac{(mrc)^2}{2mr^2} = \frac{mc^2}{2}. \tag{11}$$

Therefore, the centrifugal potential reduces to the kinetic energy of the system, resulting in

$$V(r) = 1.98 \times 10^{35} ergs \tag{12}$$

We divide by r to obtain the centrifugal force of $7.49 \times 10^{47} Dynes$ from the centrifugal potential.

Now we calculate the Coulomb repulsion of such a system as it contributes to the total repulsive force and should be added to the centrifugal component. The repulsion of two protons just touching is given by

$$Force = \frac{Kc\ q_1\ q_2}{r^2} \tag{13}$$

where $\mathrm{Kc} = 8.988 \times 10^{9} Nm^{2}C^{2}$ and $q_1 = q_2 = 1.602 \times 10^{-19} Coulomb$, the charge of the proton. Then

$$F = 33N \ or \ 3.3 \times 10^{6} dynes \tag{14}$$

We then add the Coulomb repulsion of $3.3 \times 10^{6} dynes$ to the centrifugal component and find a negligible change on a value of $\sim 10^{47} dynes$ of centrifugal force.

From the Equation 5, above, the gravitational attraction between two Schwarzschild protons is $7.49 \times 10^{47} dynes$. Therefore, we obtain a stable orbit for two orbiting Schwarzschild protons at a diameter apart.

It is clear from these results that the "strong force" may be accounted for by a gravitational attraction between two Schwarzschild protons. In the standard model the strong force is typically given as 38 to 39 orders of magnitude stronger than the gravitational force however, the origin of the energy necessary to produce such a force is not given. Remarkably, a Schwarzschild condition proton as a mass ($8.85 \times 10^{14} gm$) approximately 38 orders of magnitude higher than the standard proton mass ($1.67 \times 10^{-24} gm$), producing a gravitational effect strong enough to confine both the protons and the quarks. Our approach, therefore, offers the source of the binding energy as spacetime curvature resulting from a slight interaction (1.78×10^{-39} %) of the proton with the vacuum fluctuations and offers a unification from cosmological objects to atomic nuclei. Therefore, we write a scaling law [1] to verify that the Schwarzschild proton falls appropriately within the mass distribution of organized matter in the universe.

A Scaling Law for Organized Matter of Mass vs. Radius

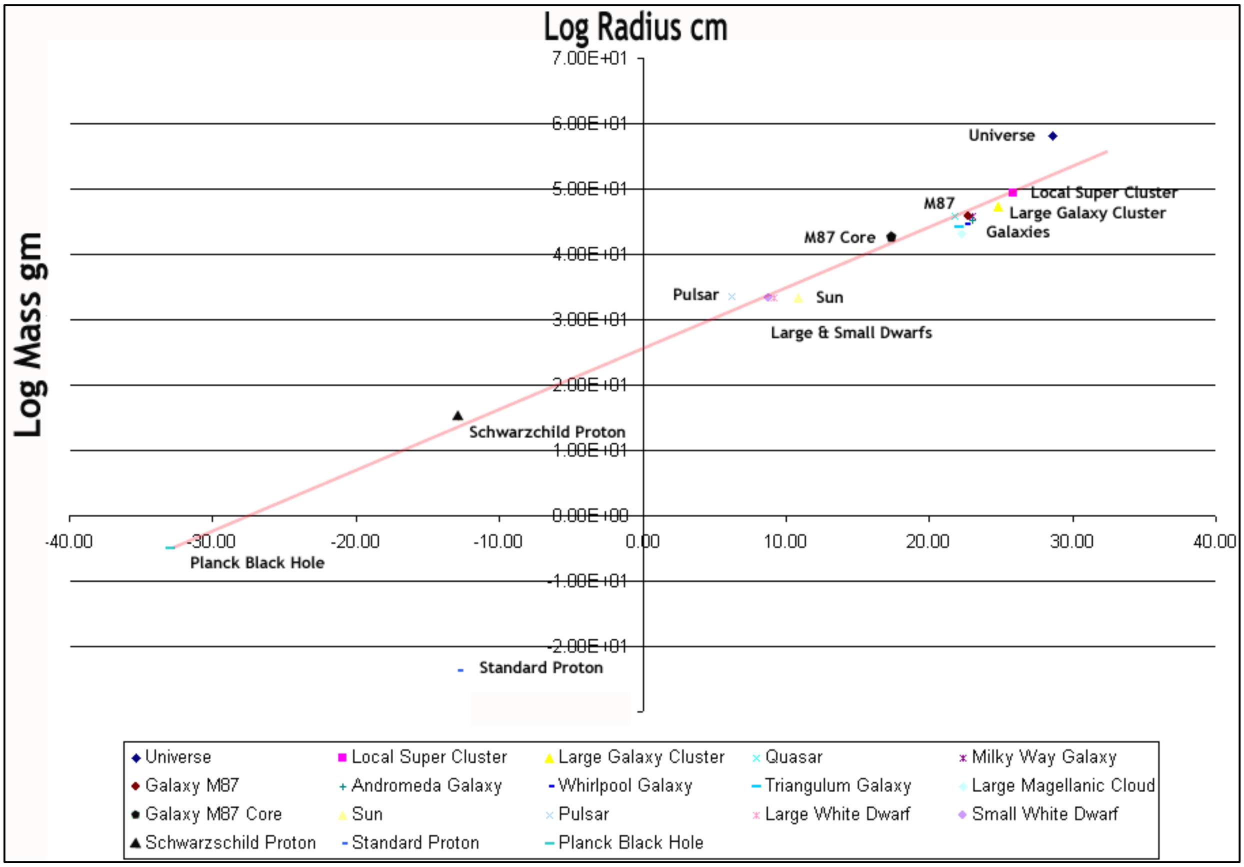

Figure 1. Mass vs. Radius

A plot of Log Mass (gm) vs. Log Radius (cm) for objects from the Universe to a Planck black hole. The light red line is a least squares trend line. The graph clearly demonstrates a tendency for different scales' masses to form and cluster along an approximate linear progression. Although the Schwarzschild proton falls nicely on the trend line, the standard proton is far from it.

TABLE 1. Mass and Radius Data for the Scaling Law

	Mass	Log Mass	Radius	Log Radius
Universe	**1.59E+58**	**5.82E+01**	**4.40E+28**	**28.64**
Local Super Cluster	**1.99E+49**	**4.93E+01**	**7.10E+25**	**25.85**
Large Galaxy Cluster	**1.99E+47**	**4.73E+01**	**6.17E+24**	**24.79**
Quasar	**7.96E+45**	**4.59E+01**	**6.17E+21**	**21.79**
Milky Way Galaxy	**5.97E+45**	**4.58E+01**	**9.46E+22**	**22.98**
Galaxy M87	**5.37E+45**	**4.57E+01**	**5.68E+22**	**22.75**
Andromeda Galaxy	**1.41E+45**	**4.52E+01**	**1.04E+23**	**23.02**
Whirlpool Galaxy	**3.18E+44**	**4.45E+01**	**3.60E+22**	**22.56**
Triangulum Galaxy	**1.41E+44**	**4.42E+01**	**1.04E+22**	**22.02**
Large Magellanic Cloud	**1.19E+43**	**4.31E+01**	**1.84E+22**	**22.27**
Galaxy M87 Core	**3.98E+42**	**4.26E+01**	**2.37E+17**	**17.37**
Sun	**1.99E+33**	**3.33E+01**	**6.95E+10**	**10.84**
Pulsar	**2.79E+33**	**3.34E+01**	**1.50E+06**	**6.18**
Large White Dwarf	**2.65E+33**	**3.34E+01**	**1.39E+09**	**9.14**
Small White Dwarf	**1.99E+33**	**3.33E+01**	**5.56E+08**	**8.75**
Schwarzschild Proton	**8.89E+14**	**1.49E+01**	**1.32E-13**	**-12.88**
Standard Proton	**1.67E-24**	**-2.38E+01**	**-2.97E+01**	**-12.88**
Planck Black Hole	**1.00E-05**	**-5.00E+00**	**-7.60E+01**	**-33.00**

On a graph of Log Mass vs. Log Radius, (Figure 1.) we find interestingly that most organized matter tends to cluster along a fairly narrow linear region as mass increases. The Schwarzschild proton falls nicely near the least squares trend line clustering organized matter whereas the standard proton falls many orders of magnitude away from it.

3. The "Anomalous" Magnetic Moment

We calculate the "anomalous" magnetic moment [5] of the proton using a simple model where the proton is a sphere with a Compton radius of 1.321 Fermi spinning at the speed of light, c, with a point proton charge at its equator. The magnetic moment is given as:

$$\mu = \frac{qrv}{2} \tag{15}$$

where q is an elementary charge of 1.60217653×10^{-19} *Coulombs*, the proton radius is $r_p = 1.321\times10^{-15}$ *meters* and the velocity $v = 2.998\times10^{8}\ m/s$ giving a value of the magnetic moment of such a proton of 3.17259×10^{-26} *Joules*/*Tesla*.

The measured magnetic moment of the proton is 1.40895×10^{-26} *Joules*/*Tesla*, which is only 2.25 times smaller than our calculated value. The magnetic moment calculated for a Schwarzschild proton model is remarkably close the measured value for such a crude first approximation.

4. Conclusions

We have presented evidence that the proton may be considered as a Schwarzschild entity and that such a system predicts remarkably well, even under crude approximations utilizing semi-classical mechanics, its interaction time, its radiation emissions, its magnetic moment, and even the origin of the strong force as a gravitational component. We are still examining the fundamental nature of mass, inertia, charge, magnetism, spin and angular momentum in the context of the Haramein-Rauscher solution which considers spacetime torque [2]. These aspects are usually assumed as "given" without a source. Here the coherent structure of the vacuum and its gravitational curvature begin to give us an appropriate accounting of the energies necessary to produce these effects.

The Schwarzschild proton strongly suggests that matter at many scales may be organized by black-holes and black hole-like phenomena and thereby lead to a scale unification of the fundamental forces and matter.

Acknowledgements

The author acknowledges Dr. Michael Hyson for his valuable assistance in the completion of this paper and Dr. Elizabeth Rauscher for her advice and careful reading of the manuscript**.**

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