NEW DEVELOPMENTS 2008

The Proton As A Kerr-Newman Black Hole [February 2008]

Introduction

Paper #11 of the "Selected Papers" section of this website demonstrated that subatomic particles such as protons and alpha particles can be successfully modeled in terms of Atomic Scale black holes if an appropriate gravitational "constant" is used in the calculations. We have also seen (e.g., Paper #12 of the "Selected Papers" section) that the discrete fractal scaling of the SSCP leads to the following expression for the coupling constants that characterize the gravitational interactions on different cosmological Scales:

$$G_\Psi = [\Lambda^{1-D}]^\Psi G_0 , \qquad (1)$$

where G_0 is the conventional Newtonian gravitational coupling constant, which is appropriate for Stellar Scale calculations and is equal to 6.67×10^{-8} $cm^3/g\ sec^2$. The terms Λ (= 5.2×10^{17}) and D (= 3.174) are the dimensionless scaling constants that are fundamental to the SSCP. The term Ψ (= …-2, -1, 0, 1, 2…) designates specific cosmological Scales, and $\Psi = 0$ is assigned to the Stellar Scale.

Using Eq. (1) we can determine that the gravitational coupling constants on neighboring cosmological Scales are related by the general equation:

$$G_{\Psi-1} = \Lambda^{2.174} G_\Psi . \qquad (2)$$

In the specific case of Atomic Scale ($\Psi = -1$) systems,

$$G_{-1} = \Lambda^{2.174} G_0 = 2.18 \times 10^{31}\ cm^3/g\ sec^2. \qquad (3)$$

Here we will show in a little more detail than was given in Paper #11 that an empirical mass/spin/angular momentum relationship determined for the proton is in good agreement with the mass/spin/angular momentum relationship of a Kerr-Newman black hole.

Kerr-Newman Black Holes

Solutions of the Einstein field equations of General Relativity for spinning and charged black holes were achieved by Kerr and Newman several decades ago. An important and well known relationship that applies to Kerr-Newman black holes is:

$$J = a_*[G_\Psi M^2/c] \ . \qquad (4)$$

The symbol J designates the angular momentum of the object, a_* is referred to as the dimensionless spin parameter, G_Ψ is the appropriate gravitational coupling constant, M is the mass of the object, and c is the velocity of light. Below we will show that this equation, which was derived primarily for Stellar Scale black holes, also applies to the proton when the appropriate Atomic Scale values for J, G_Ψ and M are inserted.

The Proton As A Gravitational Black Hole

Conventional physics has determined that the angular momentum of the proton (J_p) is:

$$J_p = [j(j + 1)]^{1/2}\, \hbar \ , \qquad (5)$$

where j is the proton's dimensionless spin parameter, which equals ½, and ħ is Planck's constant divided by 2π. The SSCP asserts (New Developments 2007 – Fine Structure Constant) that

$$\hbar = G_{-1}\mathfrak{M}^2/c \ , \qquad (6)$$

where $\mathfrak{M}$ is the revised Planck mass based on G_{-1}, and is equal to 1.20×10^{-24} g.

Therefore,

$$J_p = [1/2(1/2 + 1)]^{1/2}\, [G_{-1}\, \mathfrak{M}^2/c] = 0.866\, [G_{-1}\, \mathfrak{M}^2/c] \ . \qquad (7)$$

If the proton is correctly modeled in terms of a Kerr-Newman black hole, then the following relationship should hold true in accordance with Eq. (4):

$$0.866\, [G_{-1}\, \mathfrak{M}^2/c] = a_*[G_{-1} m^2/c] \ , \qquad (8)$$

where m is the mass of the proton. Eq. (8) can be simplified since the G_{-1} and c terms cancel out. We can then insert values for $\mathfrak{M}$ (= 1.20×10^{-24} g) and m (= 1.67×10^{-24} g) into the remaining equation and solve for a_*.

$$a_* = 0.866\, (\mathfrak{M}/m)^2 = 0.866\, (0.72)^2 = 0.45 \ . \qquad (9)$$

The fact that $a_* = 0.45 \approx$ ½ is encouraging since this agrees with the proton's empirically and theoretically determined dimensionless spin parameter at the 90% level. Small but currently unavoidable uncertainties involved in determining the fundamental self-similar scaling constants Λ and D of the SSCP preclude a more exact quantitative test at present.

Conclusion

The main implication of the above results is that the equation

$$J_p = a_*[G_\Psi m^2/c] \qquad (10)$$

models the proton's mass/spin/angular momentum relationship correctly when the appropriate value of G_Ψ is used in the calculations, in close analogy to Eq. (4). Within the context of the SSCP, the proton appears to be an Atomic Scale Kerr-Newman black hole.