TECHNICAL NOTES 2007

GRAVITATIONAL BOHR RADIUS [Sept 2007]

According to pre-SSCP physics, one can calculate what the radius of the hydrogen atom would be if the atom is governed by the conventional gravitational interaction between the proton and the electron. This radius is referred to as the Gravitational Bohr Radius (R), and it can be determined by:

$$R = \hbar^2/Gm^2M \qquad (1)$$

where ħ is Planck's constant divided by 2π, G is the gravitational coupling factor, m is the mass of the electron and M is the mass of the proton. The conventional calculation of R, using 6.67 x 10^{-8} $cm^3/g\ sec^2$ as the appropriate value for G, yields

$$R = 1.20 \times 10^{31} \text{ cm.}$$

This radius is larger than the radius of the observable universe. It is clearly a ridiculously large value and is usually cited as iron-clad proof that Atomic Scale systems are primarily bound by electrostatic rather than gravitational interactions.

Unfortunately, this conclusion is almost certainly incorrect.

The SSCP argues that when one understands the discrete scale invariance of nature and the appropriate cosmological scaling rules, then one realizes that 6.67 x 10^{-8} $cm^3/g\ sec^2$ is <u>not</u> the correct value of G to use in Eq. (1). Rather, we know that $G_{-1} = \Lambda^{2.174}\ G_0 = 2.18 \times 10^{31}$ $cm^3/g\ sec^2$ is the G-value that applies <u>within</u> Atomic Scale systems. The scaling of G_Ψ is explained near the beginning of Paper #12 ("Discrete Scale Relativity") of the Selected Papers section of this website.

When G_{-1} is used in Eq. (1), we find that

$$R = 3.67 \times 10^{-8} \text{ cm,}$$

which is roughly 2π times the Bohr Radius (a_0) for the hydrogen atom. Whereas a_0 equals the radius at which the probability of finding the electron is maximized, the value $2\pi a_0$ is a much better estimate of the physical radius of the hydrogen atom, i.e., the limiting radial extent of the electron's wavefunction.

As expected, the SSCP leads once again to the conclusion that the dynamics <u>within</u> atoms are governed by gravitational interactions which are ~ 10^{38} times stronger than those <u>assumed</u> by conventional physics. As we have learned from the exploration of the fine structure constant (see New Developments – 2007), within Atomic Scale systems, or their analogues on any cosmological Scale, gravitational interactions tend to be stronger than electrostatic interactions by a factor of $1/\alpha = 137.036$.