APPENDIX I

Electrostatic Energy and Magnetic Moment of Spinning Charge

Consider a sphere of radius a containing an electric charge e. The charge distribution within this sphere is determined by the condition of uniform pressure. The electric charge has an intrinsic mutual repulsion and it is constrained against the action of such internal forces to occupy the limited volume of the sphere. Pressure has to be uniform inside this charge. The charge distribution must be radial due to symmetry. Within any spherical shell concentric with the centre of the sphere the charge distribution is uniform over the solid angle subtended. Thus, if e_x denotes the charge contained within radius x and de_x is the charge in the shell of radial thickness dx, we may calculate the outward repulsive force due to their interaction as $e_x de_x/x^2$ from Coulomb's law. This is the force differential across the shell and it must equal the pressure, denoted P, multiplied by an increment in surface area across the shell. This is the differential of $4\pi x^2$ or $8\pi x dx$. From the equality:

$$8\pi P x^3 dx = e_x de_x \tag{1}$$

Since P is constant, it follows from this that:

$$4\pi P x^2 d(x^2) = e_x de_x \tag{2}$$

whence:

$$e_x = x^2 \sqrt{4\pi P} \tag{3}$$

This gives:

$$P = e^2/4\pi a^4 \tag{4}$$

From (3), the electric field intensity e_x/x^2 within the charge may be shown to be constant and equal to $\sqrt{4\pi P}$. The internal electrostatic energy of the charge is then found by multiplying its volume $4\pi a^3/3$ by this field intensity squared and dividing by 8π. The energy E' is then:

$$E' = 2\pi a^3 P/3 \tag{5}$$

From (4) and (5) this is simply $e^2/6a$. This is to be added to the well-known value of the field energy outside the charge radius of $e^2/2a$ to obtain the total electrostatic energy E of the charge given as:

$$E = 2e^2/3a \tag{6}$$

It is to be noted that the charge must adopt spherical form because it would otherwise occupy the same volume and have a higher electrostatic energy. It is the contention of the theory presented in this work that space is strictly quantized. The volume available for the charge e is limited. According to this volume, the energy of the particle is determined on the assumption that it is a minimum. Thus, taking the spherical form as reference, imagine an element of charge to be pushed out to distort the sphere at some point. Then elsewhere an element of charge must receed inwards to keep the occupied volume constant. Electrostatic energy is decreased less for the outward displaced element than it is increased for the inward displaced one. As a result, minimum energy means a spherical charge. This facilitates spin about an axis through the centre of the charge sphere, since rotation about this axis can occur without disturbing the medium outside the sphere containing the charge.

By differentiating (3) with respect to x and dividing by the volume of a spherical shell $4\pi x^2 dx$, it can be shown that the charge density within the sphere of charge varies inversely with distance from the charge centre. The charge de_x of the shell is $2x\sqrt{4\pi P}\,dx$, so, noting that the velocity moment of a spherical shell is $\frac{2}{3}$ times its radius squared per unit angular velocity, the magnetic moment of the charge e becomes:

$$\frac{\omega}{2c}\int_o^a \tfrac{2}{3}x^2 2x\sqrt{4\pi P}\,dx \tag{7}$$

or:

$$\frac{a^4}{6c}\sqrt{4\pi P}\,\omega \tag{8}$$

ω denotes angular velocity. To explain the parameter $2c$, remember that the magnetic moment of unit electromagnetic charge is 4π times its velocity moment times its frequency of rotation, $1/2\pi$ per unit angular velocity.

From (4) and (8), the magnetic moment of the charge e is:

$$\frac{ea^2\omega}{6c} \tag{9}$$