Maldwyn Centre for Theoretical Physics

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This update follows on from the paper and subsequent booklet called *A VISCOSITY HYPOTHESIS – THAT THE PRESENCE OR ABSENCE OF VISCOSITY SEPARATES RELATIVISTIC AND QUANTUM SYSTEMS BASED ON THE SIMPLEST POSSIBLE THEORY OF EVERYTHING* from 2016 and 2017 respectively and uses the same definitions.

The main change is actually minor in effect but major in simplifying understanding the whole loop hypothesis. The underlying idea is that the motional energy of the meons is used to drive them around a loop so that each meon, regardless of sign of mass energy twist $\boldsymbol{M_*j}$ or resultant fractional charge $\boldsymbol{Q_*j}$, rotates around the loop at the same frequency, by adjusting its velocity and radius of rotation to be the same size, positive or negative. The total energy of a loop is always zero when all energies are taken into account.

Mass energy considerations

The change from the paper mentioned is that the balancing of mass energies within loops, to maintain $+\boldsymbol{h}$ and $-\boldsymbol{h}$ angular momentum for each meon regardless of sign of twist energy, is more easily produced by instead balancing just the mass and twist energies themselves to have the same frequency as a rest-mass electron, when considering an electron loop. The formulae for a meon pair, one third of an electron loop, with each meon having additional $-\boldsymbol{Q_*j}$ charge, where $\boldsymbol{j} = (\boldsymbol{\alpha}/2\pi)^{½}/6$ and $\boldsymbol{Q_*j} = \boldsymbol{q}_e/6$, and $+\boldsymbol{M_*j}$ twist energy gives the set of mass energy formulae for a pair that is in a frame of reference where the loop is stationary as

$$\boldsymbol{E_m} \quad = +(+\boldsymbol{M_*}+\boldsymbol{M_*j})(\gamma_i-1)\boldsymbol{c}^2 \quad = \quad -(-\boldsymbol{M_*}+\boldsymbol{M_*j})(\gamma_o-1)\boldsymbol{c}^2 \quad = \quad (\gamma_e-1)\boldsymbol{M_*c}^2 \quad = \quad m_e\boldsymbol{c}^2$$

Where the $\boldsymbol{X_*}$ are DAPU values for meon mass and charge. The γ are for the inner velocity $\mathbf{v_i}$, the outer velocity $\mathbf{v_o}$ and the 'central' velocity $\mathbf{v_e}$ which is what each meon would have if it did not have any twist energy. The positive energy of the positive meon $(+\boldsymbol{M_*}+\boldsymbol{M_*j})$ rotating at the inner radius and velocity is equal in size to the negative energy of the negative meon $(-\boldsymbol{M_*}+\boldsymbol{M_*j})$ rotating at the outer radius and velocity. Both must have the same rotational frequency $\mathbf{w_e}$, set by the mass of the electron.

Although strictly the formulae use γ , at the velocities of our normal set of loops these are very much smaller than $\boldsymbol{c}$ and the use of $(\gamma-1) \sim (1+ ½\,\boldsymbol{v}^2/\boldsymbol{c}^2 -1) = ½\,\boldsymbol{v}^2/\boldsymbol{c}^2$ can be used thus

$$\boldsymbol{E_m} \quad = +(+\boldsymbol{M_*}+\boldsymbol{M_*j})\,\mathbf{v_i}^2 \quad = \quad -(-\boldsymbol{M_*}+\boldsymbol{M_*j})\,\mathbf{v_o}^2 \quad = \quad ½\,\boldsymbol{M_*}\mathbf{v_e}^2 \quad = \quad m_e\boldsymbol{c}^2$$

This set of mass formulae is the same for all pairs, adjusted for sign of $\boldsymbol{M_*j}$ twist and $\boldsymbol{Q_*j}$ charge energies. So all meons rotate at $\mathbf{v_i}$ or $\mathbf{v_o}$ velocities, regardless of the size of the loop. What sets the actual radii at which the meons rotate is the frequency of the loop, and so its mass.

From the formulae, simplifying the results, can be found

$\mathbf{v_i}^2 = \mathbf{v_e}^2 /(1+\boldsymbol{j})$ and $\mathbf{v_o}^2 = \mathbf{v_e}^2/(1-\boldsymbol{j})$

Where the Viscosity Hypothesis paper/book assumed that the change in distance needed to produce the constancy of angular momentum was of equal size away from the central radius of the loop, the mass set formulae show that the changes are not exactly equal inwards versus outwards.

The actual changes depend on the loop frequencies and, for the electron at rest, with mass 9.10938×10^{-31} kg, frequency 2.47112×10^{20} Hz , can be shown to be velocity changes of $+5.76635 \times 10^{-12}$ ms^{-1} outwards and -5.71744×10^{-12} m s^{-1} inwards, leading to radius changes of $+2.33349 \times 10^{-32}$ m outwards and -2.31370×10^{-32} m inwards relative to central velocity and rotational radius of 1.73246×10^{-3} ms^{-1} and 7.01064×10^{-24} m respectively. However, since they are very close to being equal, it will usually be simpler to use the same size change, equal to $\pm \frac{1}{2} \boldsymbol{j}\, v_e$,or $\pm \frac{1}{2} \boldsymbol{j}\, r_e$, in the case of the electron since the former is 0.50214 $\boldsymbol{j}$ when related to the central velocity v_e and the latter 0.49788 $\boldsymbol{j}$. The same ratio will apply to all sized loops.

Charge energy considerations

The result of the radii at which each meon is balanced, in the case of the electron being the larger size mass, positive meon, rotating closer in means that the negative meon with its larger size negative charge rotates further out. The total charge energy thus generated by the pair in an electron will be

$$\boldsymbol{E_Q} = Q_t \boldsymbol{c}^3 = +(-\boldsymbol{Q_*}-\boldsymbol{Q_*j})\, \gamma_o \boldsymbol{c}^3 + (+\boldsymbol{Q_*}-\boldsymbol{Q_*j})\, \gamma_i \boldsymbol{c}^3$$

Or, in simplified form

$$\boldsymbol{E_Q} = Q_t \boldsymbol{c}^3 = + \tfrac{1}{2} (-\boldsymbol{Q_*}-\boldsymbol{Q_*j})\, \boldsymbol{c}\, \mathbf{v_o}^2 + \tfrac{1}{2} (+\boldsymbol{Q_*}-\boldsymbol{Q_*j})\, \boldsymbol{c}\, \mathbf{v_i}^2$$

$$= - \tfrac{1}{2} \boldsymbol{Q_* c} \left[(1+\boldsymbol{j})\, \mathbf{v_o}^2 -(1-\boldsymbol{j})\, \mathbf{v_i}^2\right]$$

Which can be adjusted using the mass set of formulae to the charge energy of an electron pair

$$\boldsymbol{E_Q} = Q_t \boldsymbol{c}^3 = - \tfrac{1}{2} \boldsymbol{Q_* c}\, \mathbf{v_e}^2 \left[(1+\boldsymbol{j}) /(1-\boldsymbol{j}) - (1-\boldsymbol{j}) /(1+\boldsymbol{j})\right]$$

$$= - \tfrac{1}{2} \boldsymbol{Q_* c}\, \mathbf{v_e}^2 \left(4\boldsymbol{j}/(1-\boldsymbol{j}^2)\right)$$

So for a loop of three identical pairs, and using $v_e = r_e\, w_e$ this will be

$$\boldsymbol{E_{Q3}} = Q_t \boldsymbol{c}^3 = - \tfrac{1}{2} \boldsymbol{Q_* c}\, \mathbf{v_e}\, \mathbf{r_e}\, \mathbf{w_e} \left(12\boldsymbol{j}/(1-\boldsymbol{j}^2)\right)$$

$$= -6\, \boldsymbol{Q_* j\, c}\, (\boldsymbol{M_*}\mathbf{v_e}\, \mathbf{r_e})\, \mathbf{w_e}/(\boldsymbol{M_*}(1-\boldsymbol{j}^2))$$

$$= -\boldsymbol{q}_e\, \boldsymbol{c\, h}\, \mathbf{w_e}/(\boldsymbol{M_*}(1- \boldsymbol{\alpha} /(72\, \pi)))$$

So, using $\boldsymbol{M_* c}^2 = \boldsymbol{h\, w_*}$, the effective charge Q_t in the loop will be

$$Q_t = - \boldsymbol{q}_e\, \mathbf{w_e}/(\boldsymbol{w_*}\, (1- \boldsymbol{\alpha} /(72\, \pi)))$$

$$= - \boldsymbol{q}_e\, (\mathbf{w_e}/\boldsymbol{w_*})/ (1- \boldsymbol{\alpha} /(72\, \pi))$$

Magnetic moment of circulating meons

To turn the effective charge into a magnetic moment due to the rotation of the meons around the loop, excluding any contribution due to the moving of the electric fields between opposing meons, for the electron uses $\mu_t = \frac{1}{2} Q_t \boldsymbol{h}/m_e$ to give

$$\mu_t = -\tfrac{1}{2} \boldsymbol{q}_e (\mathbf{w_e}/\boldsymbol{w_*})\, \boldsymbol{h}/(m_e (1- \boldsymbol{\alpha} /(72\,\pi)))$$

And since $m_e \boldsymbol{c}^2 = \frac{1}{2} \boldsymbol{h}\, \mathbf{w_e}$ and $\mu_e = \frac{1}{2} \boldsymbol{q}_e\, \boldsymbol{h}/m_e$

$$\mu_t = - (\tfrac{1}{2} \boldsymbol{q}_e\, \boldsymbol{h}/m_e) (\mathbf{w_e}/\boldsymbol{w_*})/ (1- \boldsymbol{\alpha} /(72\,\pi))$$

$$= - \mu_e (\mathbf{w_e}/\boldsymbol{w_*})/ (1- \boldsymbol{\alpha} /(72\,\pi))$$

which is much smaller than could provide any measurable anomalous moment to the electron loop. However, adjusted for twist and fractional charges, this set of formulae will provide the basic anomalous starting point for all loops. The anomalous moments should therefore be due to the three rotating electric fields acting across each loop from positive to negative meons.

It would be a nice result if μ_t was related directly to m_e and $\mathbf{w_e}$, rather than $\boldsymbol{M_*}$ and $\boldsymbol{w_*}$, so that the $(1- \boldsymbol{\alpha} /(72\,\pi)$ factor provided a reasonable proportion of the anomalous moment of the electron loop, but strictly it is the rotating $\pm\boldsymbol{Q_*} \pm \boldsymbol{Q_*j}$ located with the $\pm\boldsymbol{M_*} \pm \boldsymbol{M_*j}$, rather than the total effective loop mass m_e (which is actually the frequency of the loop $\mathbf{w_e}$ since the total meon and twist mass energies always total zero), which is generating the magnetic moment. So the denominator of μ_t is $\boldsymbol{M_*}$ or $\boldsymbol{w_*}$ not m_e or $\mathbf{w_e}$.

For loops moving in a frame of reference, especially at translational velocities approaching $\boldsymbol{c}$, the mass formulae set becomes

$$+(+\boldsymbol{M_*}+\boldsymbol{M_*j})(\gamma_{is}-1)\boldsymbol{c}^2 = -(-\boldsymbol{M_*}+\boldsymbol{M_*j})(\gamma_{os}-1)\boldsymbol{c}^2 = (\gamma_{es}-1)\boldsymbol{M_*}\boldsymbol{c}^2 = \gamma_s\, m_e \boldsymbol{c}^2$$

Where γ_{xs} represents the additional velocity factor $\mathbf{v_s}$ for the moving loop, and the extra subscript $\boldsymbol{s}$ denotes the new total velocities of the meons, assuming the external motion to be perpendicular to the plane of the loop and energies are conserved.

For the new central rotational velocity $\mathbf{v_{es}}$, needed to show the total energy that the meons in the loop possess when the loop appears to be stationary in a co-moving frame of reference the formula is

$$(\gamma_{es}-1)\boldsymbol{M_*}\boldsymbol{c}^2 = \gamma_s\, m_e \boldsymbol{c}^2$$

So that

$$\gamma_{es} = 1+ (\gamma_s\, m_e/ \boldsymbol{M_*})$$

At low velocities, with $m_e/ \boldsymbol{M_*} = \frac{1}{2} \mathbf{v_e}^2/\boldsymbol{c}^2$, this approximates to

$$\mathbf{v_{es}}^2 = \mathbf{v_e}^2(1+ \tfrac{1}{2} \boldsymbol{v_s}^2/\boldsymbol{c}^2)$$

This is different to both the relativistic addition of velocities and of velocities squared. It is the rotational system of loop velocities that produces this effect and corresponds to conservation of energies.

The same analysis can be undertaken for all fermion loops using appropriate signs of additional $\boldsymbol{j}$ sized positive or negative twist and charge energies. There are only two possible relative velocities for any meon in a loop, related to the central velocity by $(1\pm\boldsymbol{j})$, and the radius of the loop is set by the frequency which represents the mass of the loop. Provided the size of the mass and twist energies of each meon in the loop, set by the velocity of each, is the same, positive or negative, then the loop will be stable.

The magnetic moment may be set mostly by the three rotating electric fields whose size will depend on the signs of additional twist and charge and the distance between each opposing pair of positive and negative meons. A change from electron to muon, for example, is only a change in rotational radius due to a change in rotational frequency whose total energy change is always zero.

Electric and magnetic fields of opposing meons

Looking at the electron loop, there will be three electric fields rotating between meons on opposite sides of the loop. Each negative meon will rotate at $\boldsymbol{r_o}$ from the centre of rotation and have charge $\boldsymbol{Q_*}(-1-\boldsymbol{j})$. Each opposite positive meon will rotate at $\boldsymbol{r_i}$ from the centre and have charge $\boldsymbol{Q_*}(+1-\boldsymbol{j})$.

Considering a small test charge $+\boldsymbol{q}$ at the centre of rotation, the attractive force of the negative meon due to its charge will be

$$\boldsymbol{F_o} = \boldsymbol{Q_*}(-1-\boldsymbol{j})\, \boldsymbol{q}\, \boldsymbol{c}^2/\boldsymbol{r_o}^2 = \boldsymbol{Q_*}(-1-\boldsymbol{j})\, \boldsymbol{q}\, \boldsymbol{c}^2\, (+1-\boldsymbol{j})/\boldsymbol{r_e}^2 = -\boldsymbol{Q_*}\, \boldsymbol{q}\, \boldsymbol{c}^2\, (1-\boldsymbol{j}^2)/\boldsymbol{r_e}^2$$

And for the positive meon the repulsive force will be

$$\boldsymbol{F_i} = \boldsymbol{Q_*}(+1-\boldsymbol{j})\, \boldsymbol{q}\, \boldsymbol{c}^2/\boldsymbol{r_i}^2 = \boldsymbol{Q_*}(+1-\boldsymbol{j})\, \boldsymbol{q}\, \boldsymbol{c}^2\, (+1+\boldsymbol{j})/\boldsymbol{r_e}^2 = \boldsymbol{Q_*}\, \boldsymbol{q}\, \boldsymbol{c}^2\, (1-\boldsymbol{j}^2)/\boldsymbol{r_e}^2$$

So both forces at the centre on a test particle of the same charge are the same, and in the same direction on the test particle, towards the negative meon. When the meons are stationary, this charge-charge force between the two opposing meons is the only charge-related one present and the electric field $\boldsymbol{\varepsilon}$ between the positive and negative meons represents this force (which is balanced by the mass-mass chasing force between them).

Between the two meons directly across the loop, the force will be

$$\boldsymbol{F_t} = \boldsymbol{Q_*}\,(+1-\boldsymbol{j})\, \boldsymbol{Q_*}\,(-1-\boldsymbol{j})\, \boldsymbol{c}^2/(\boldsymbol{r_i}+\boldsymbol{r_o})^2 = -\boldsymbol{Q_*}^2\,(1-\boldsymbol{j}^2)^2\, \boldsymbol{c}^2/[\boldsymbol{r_e}^2\, ((1+\boldsymbol{j})^{½} + (1-\boldsymbol{j})^{½}\,)^2]$$

When the meons are in rotational motion in an external field, there will be an additional magnetic field generated. The size of this magnetic field will be proportional to the velocity of the electric field at each point across the loop.

Since the force formulae for each meon is the same, it can be split into two parts, from the centre to the negative meon and from the centre to the positive meon. The direction of the electric field is the same across the loop because it starts, for example, on the positive meon at +$\boldsymbol{Q_*}$(1-$\boldsymbol{j}$) and ends on the negative meon at –$\boldsymbol{Q_*}$(1+$\boldsymbol{j}$) with no discontinuity at the centre, where the field rotational velocity will be zero.

The electric field $\boldsymbol{\varepsilon}$ in each case, at points across the loop at distance $\boldsymbol{r}$ from the centre, will be

$$\boldsymbol{\varepsilon} \quad = \quad \pm \boldsymbol{F}/\boldsymbol{q} \quad = \quad \pm\, \boldsymbol{Q_*}\, \boldsymbol{c}^2\, (1-\boldsymbol{j}^2)/\boldsymbol{r}^2$$

in the same direction towards the negative meon despite the positive or negative notation.

The resulting magnetic field will be the integral along the line and can be integrated between $\boldsymbol{r}=\boldsymbol{r_e}$ and $\mathbf{r}=0$ in both cases, despite the two different rotational distance $\boldsymbol{r_i}$ and $\boldsymbol{r_o}$ because of their equivalence to rotating at $\boldsymbol{r_e}$. So effectively the point of zero electric field velocity, and inflection of magnetic field, is at the centre of rotation.

The magnetic field for each side of the line will be given by

$$\boldsymbol{B} \quad = \quad \int_0^{ve} \boldsymbol{\varepsilon/v\, dv} \quad = \quad \int_0^{re} \boldsymbol{\varepsilon/rw\, dr} = \int_0^{re} \boldsymbol{Q_* c^2 (1-j^2)/r^3 w\, dr}$$

From the left hand rule, the magnetic field generated by the rotating electric field will be upwards on one side of the central point and downwards on the other side, relative to the plane of the loop and of equal value. So the total magnetic field generated in this way will be zero, even though it is composed of positive and negative values. Due to the zero velocity at the centre of rotation, the magnetic field will both peak and inflect at this point. From this perspective, and that the two sides of the electric field produce the same but opposite sized magnetic fields, this cannot be the source of the missing anomalous magnetic moment of the electron loop.

However, the large magnetic peaks and inflection points of the three field lines are another of the ways in which loops signal their size, by way of rotating perpendicular magnetic fields at frequency $\boldsymbol{w}$, to other loops, and produces another set of symmetry keys that enable stacking of loops to form photons and bosons.

M Lawrence
Maldwyn Theoretical Physics
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