Why the intrinsic spin quantum number of a fermion is *h* and not ½ *h* and how to correctly reconcile velocities in momentum and energy equations

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The paper shows how the relativistic velocity factor, which appears in classical rotational equations of motion, has not been understood correctly. The factor is usually linked to *h* in quantum mechanics as the ½ *h* intrinsic spin quantum number for fermions, but is instead related to the dynamic properties of velocity, radius and angular frequency, so that fermion spin quantum number is exactly *h*. The factor needs to be split appropriately between the dynamic properties and followed through correctly in equations. This is done for momentum and energy to show how they can be better reconciled and the magnetic moment of the electron is used as an example. The further point shown is that the energy of the intrinsic spin of an electron is exactly equal and opposite to the mass energy of the electron which is itself the kinetic energy of the meons in the electron loop.

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I. INTRODUCTION

This paper follows on from previous work on the structure of fermions based on a pre-fermion framework [1][2][3] and uses the same definitions. Double-adjusted SI (DASI) units are used here throughout in order to simplify equations, except where specific sizes are quoted in SI units.

II. SIGNIFICANCE and OBJECTIVES

The significance is in explaining simply, in terms of the physical pre-fermion framework of loops, where the intrinsic spin quantum number of a fermion loop arises from, with the main example here being the electron loop, and why its value is $\boldsymbol{h}$ and not ½ $\boldsymbol{h}$.

The currently accepted interpretation of the intrinsic spin quantum number is that the factor ½ is linked to the angular momentum $\boldsymbol{h}$. No case is usually made that the spin of the electron wrongly includes a factor due to the angular rotational frequency $\boldsymbol{w}$ of the electron. This paper's objective is to show that the factor is instead a relativistic result related to the velocity of the meons around a loop and is therefore linked to that velocity and the angular rotational frequency of the loop, not the loop's intrinsic spin quantum number.

The significance is that the factor then adjusts the velocity and radius of rotation of the meons as well as the angular frequency, although with observable external effect limited to only the angular frequency.

The current energy and momentum equations mix how their components are treated. The analysis is extended to show how the angular momentum and energy equations can be adjusted to show the same relativistic properties identically in both.

The further point is to show that the energy of the intrinsic spin of an electron is exactly equal and opposite to the mass energy of the electron, which is itself the kinetic energy of the meons in the electron loop.

III. OUTLINE

The underlying foundation is that the total energy of a loop is always zero when all energies are taken into account because for positive mass-type energy there is an equal and opposite negative mass-type energy. The same is the case for positive and negative charge energies. Furthermore, that mass-type and charge-type energies are opposite types.

The energy equations for a positive meon in a loop will be expanded to show where the relativistic factor appears and why it is not linked to the angular momentum of the meons around the loop, which always remain at $\boldsymbol{h}$ regardless of the velocity of the meons.

IV. MASS ENERGY

The meon rest mass is the adjusted-Planck mass $\boldsymbol{M}_*$ and its rest mass energy is $\boldsymbol{M}_*\boldsymbol{c}^2$. The kinetic energy of the meon in motion at $\boldsymbol{v_e}$ in an circular electron loop, where the relativistic factor

$$\curlyvee_{v_e} = 1/\sqrt{(1-\boldsymbol{v_e}^2/\boldsymbol{c}^2)}$$

will be

$$E_{KE(v)} = \left(\curlyvee_{v_e} - 1\right)\boldsymbol{M}_*\boldsymbol{c}^2 = \boldsymbol{f_v}\boldsymbol{M}_*\boldsymbol{v_e}^2$$

Because the meon velocity in a stationary loop is usually low, then $\boldsymbol{v_e} \ll \boldsymbol{c}$ and $\boldsymbol{f_v} \cong ½$ and this is what is usually used for the general kinetic energy of a particle in motion.

However, since it is important to follow the factor, this approximation will not be used here. It is the factor that is of interest.

The kinetic energy can also be expressed in terms of the angular frequency w_e of the meon within the electron loop as

$$E_{KE(w)} = (\Upsilon_{w_e} - 1)\boldsymbol{hw_*} = \boldsymbol{f_w hw_e}$$

where the relativistic factor for the angular frequency is

$$\Upsilon_{w_e} = 1/\sqrt{(1 - \boldsymbol{w_e}/\boldsymbol{w_*})}$$

and $\boldsymbol{w_*}$ is the DASI adjusted-Planck frequency.

Since $\boldsymbol{M_* c^2} = \boldsymbol{hw_*}$ this means that

$$\boldsymbol{f_v M_* v_e^2} = \boldsymbol{f_w hw_e}$$

$$\boldsymbol{f_v M_* v_e^2}/(\boldsymbol{M_* c^2}) = \boldsymbol{f_w hw_e}/(\boldsymbol{hw_*})$$

$$\boldsymbol{f_v v_e^2}/\boldsymbol{c^2} = \boldsymbol{f_w w_e}/\boldsymbol{w_*}$$

Without the $\boldsymbol{h}$ in this equation, it is clear that the factors $\boldsymbol{f_v}$and $\boldsymbol{f_w}$ are not associated with $\boldsymbol{h}$ at all.

Now, assuming that the standard equation for a rotating body in a stable orbit $\boldsymbol{v} = \boldsymbol{rw}$ is correct, and specifically here that $\boldsymbol{v_e} = \boldsymbol{r_e w_e}$ and $\boldsymbol{h} = \boldsymbol{M_* v_e r_e}$ apply, then

$$\boldsymbol{f_v v_e r_e w_e}/\boldsymbol{c^2} = \boldsymbol{f_w w_e}/\boldsymbol{w_*}$$

$$\boldsymbol{f_v v_e r_e}/\boldsymbol{c^2} = \boldsymbol{f_w}/\boldsymbol{w_*}$$

$$\boldsymbol{f_v M_* v_e r_e}/(\boldsymbol{M_* c^2}) = \boldsymbol{f_w}/\boldsymbol{w_*}$$

$$\boldsymbol{f_v h}/(\boldsymbol{M_* c^2}) = \boldsymbol{f_w}/\boldsymbol{w_*}$$

$$\boldsymbol{f_v hw_*} = \boldsymbol{f_w M_* c^2}$$

So

$$\boldsymbol{f_v} = \boldsymbol{f_w}$$

This could have been deduced directly from

$$(\Upsilon_{v_e} - 1)\boldsymbol{M_* c^2} = (\Upsilon_{w_e} - 1)\boldsymbol{hw_*}$$

but it is preferable to show clearly that this is the case and has no dependency on $\boldsymbol{h}$.

From now on only the simpler factor identifier will be used, other than except where required, thus

$$\boldsymbol{f_v} = \boldsymbol{f_w} = \boldsymbol{f}$$

It is now possible to more simply split the factor into which variables it affects as follows

$$\boldsymbol{f v_e^2}/\boldsymbol{c^2} = \boldsymbol{f w_e}/\boldsymbol{w_*}$$

$$(\sqrt{\boldsymbol{f}}\boldsymbol{v_e}/\boldsymbol{c})^2 = \boldsymbol{f w_e}/\boldsymbol{w_*}$$

so that the $\sqrt{\boldsymbol{f}}$ factor can be seen to be linked to the velocity $\boldsymbol{v_e}$. This means that the actual velocity within the loop is affected by that amount.

Using $\boldsymbol{v_e} = \boldsymbol{r_e w_e}$ again, this implies that the correct relationship between velocity and radius of rotation should be

$$(\sqrt{\boldsymbol{f}}\boldsymbol{v_e}) = (\boldsymbol{r_e}/\sqrt{\boldsymbol{f}})(\boldsymbol{f w_e})$$

which in turn shows that

$$(\sqrt{\boldsymbol{f}}\boldsymbol{v_e}/\boldsymbol{c})(\boldsymbol{r_e}/\sqrt{\boldsymbol{f}})(\boldsymbol{f w_e})/\boldsymbol{c} = \boldsymbol{f w_e}/\boldsymbol{w_*}$$

$$(\sqrt{\boldsymbol{f}}\boldsymbol{v_e})(\boldsymbol{r_e}/\sqrt{\boldsymbol{f}}) = \boldsymbol{c^2}/\boldsymbol{w_*}$$

$$(\sqrt{\boldsymbol{f}}\boldsymbol{v_e})(\boldsymbol{r_e}/\sqrt{\boldsymbol{f}}) = \boldsymbol{c^2}/\boldsymbol{w_*} = \boldsymbol{h}/\boldsymbol{M_*}$$

so that

$$\boldsymbol{h} = \boldsymbol{M_*}(\sqrt{\boldsymbol{f}}\boldsymbol{v_e})(\boldsymbol{r_e}/\sqrt{\boldsymbol{f}})$$

or alternatively the normal

$$\boldsymbol{h} = \boldsymbol{M_* v_e r_e}$$

This latter equation, the usual one used, hides the way the relativistic factor affects the split between the velocity and radius properties. This is usually not observable because the two properties always appear together in momenta equations and the split disappears.

However, when looking at the energy of orbitals, for example, the extra angular velocity introduces the relativistic factor, but in a way that only shows the total effect $\boldsymbol{f}$

$$\boldsymbol{f w_e h} = \boldsymbol{M_* v_e r_e f w_e}$$

$$\boldsymbol{f h w_e} = \boldsymbol{f M_* v_e^2}$$

which in normal circumstances where $\boldsymbol{f} \cong ½$ becomes the usual

$$½\boldsymbol{hw_e} = ½\boldsymbol{M_* v_e^2} = \boldsymbol{m_e c^2}$$

Where $\boldsymbol{m_e}$ is the stationary electron mass.

The electron mass will be increased from its stationary value as its frequency increases through the $\boldsymbol{f}$ factor, although the means to achieve this without translational velocity is obscure.

It is worth asking what the theoretical maximum dynamic value of the velocity of the meons in any loop could be and comparing that to the maximum physical constraint of meons within an electron loop.

V. DYNAMIC MEON VELOCITY LIMIT

This limit will be when the overall relativistic effect takes the increase to its maximum, when

$$f{v_e}^2/c^2 = 1$$

or

$$f = c^2/{v_e}^2$$

so that

$$(1/\sqrt{(1 - {v_a}^2/c^2)} - 1) = 1$$

Where v_a is the actual velocity of the meon around the loop at that maximum. Thus

$$v_a/c = \sqrt{3/4}$$

At this velocity, the kinetic energy of the meon will be equal to its rest mass energy M_*c^2 and it will have a total mass energy of $2M_*c^2$.

The radius at velocity v_a will be

$$r_a/r_s = \sqrt{4/3}$$

This is not though the maximal physical limit.

VI. PHYSICAL MEON VELOCITY LIMIT

This is set by the closest that two positive meons (or two negative meons) can approach in a loop. Although there will be a negative meon overlapping to a large extent between the two, the non-compressibility of same-type meons against each other will mean that they cannot overlap at all. So the minimum separation r_b will be twice their radius r_s, where r_s is the DAPU adjusted-Planck distance.

At that separation, then

$$r_b/r_s = 2$$

and

$$v_b/c = ½$$

This physical constraint is stronger than the dynamic one and so no stationary loop can have its meons reach kinetic energy M_*c^2.

VII. ELECTRON LOOP LIMITS

From the earlier relationship

$$½hw_e = ½M_*{v_e}^2 = m_ec^2$$

converted into a factor relationship as

$$fM_*{v_e}^2 = m_ec^2$$

can be found that

$$v_e/c = \sqrt{m_e/M_*}/\sqrt{f}$$

and

$$r_e/r_s = \sqrt{f}\sqrt{M_*/m_e}$$

When f_L is the theoretical maximum dynamical velocity for any loop which has a stationary loop mass m_L and meon velocity v_L ,then

$$f_L = c^2/{v_L}^2$$

then

$$v_L/c = (v_L/c)\sqrt{m_L/M_*}$$

So

$$m_L = M_*$$

and

$$r_L/r_s = c\sqrt{M_*/m_L}/v_L$$

giving again

$$m_L = M_*$$

For both velocity and radius this means that the stationary loop mass has been raised to the same as the adjusted-Planck mass, although the dynamic and physical constraints still apply.

VIII. ITERATION OR NOT

It is possible to ask whether there should be a series of iterations involved in finding the final velocity of the meons when using the relativistic relationship.

After all, when the meons change from their ‘expected’ velocity v_e to their new velocity $\sqrt{f}v_e$ surely their new velocity requires an adjustment of the relativistic factor?

However, this is not the case, as can be seen by performing the iteration.

From the above calculations

1	v_e	becomes	$(\sqrt{f})^1 v_e$
2	$(\sqrt{f})^1 v_e$	becomes	$(\sqrt{f})^2 v_e$
3	$(\sqrt{f})^2 v_e$	becomes	$(\sqrt{f})^3 v_e$

and so on. Since in low velocity cases ≅ ½ **,** the product of all the factors will rapidly approach zero. For all loops where $f < 1$, the products will always approach zero.

Only where $\boldsymbol{f} > 1$ will the product explode, but since the fermions exist under this then this shows that there can be no iteration..

When $\boldsymbol{f} = 1$, then

$$\boldsymbol{v_e}^2/\boldsymbol{c}^2 = (1/\sqrt{(1-\boldsymbol{v_d}^2/\boldsymbol{c}^2)} - 1)$$

with velocity $\boldsymbol{v_d}$ at this value given by

$$\boldsymbol{v_d}^2 = (2\boldsymbol{v_e}^2 + \boldsymbol{v_e}^4)/(\boldsymbol{c}^2 + 2\boldsymbol{v_e}^2 + \boldsymbol{v_e}^4)$$

whose maximum is, assuming $\boldsymbol{v_e} \to \boldsymbol{c}$, the same as before

$$\boldsymbol{v_d}/\boldsymbol{c} \to \sqrt{\boldsymbol{3/4}}$$

IX. PHOTONS

Since a photon can be composed of an electron and a positron loop stacked together and chasing each other, the same equations and limits can be used as above, although without the constraints of the initial loop size being locked in as a rest mass and the loops being stationary.

The extra translational velocity of the photon adds in relativistically to the meon orthogonal velocity around the loops but, since the rotational velocity is always below $\boldsymbol{c}$, adding that translational velocity of $\boldsymbol{c}$ does not increase the total velocity above $\boldsymbol{c}$.

The recent paper [4] shows how the physical spiral path of the meons in a photon implies that they have the ability to move at $\sqrt{2}\boldsymbol{c}$.

X. MOMENTUM AND ENERGY EQUATIONS

It needs restating that the most basic dynamic equations are the same for both mass and charge systems, and that there is currently a difference between the momentum and energy interpretations which the appropriate use of the relativistic factor reconciles.

The following uses the 'ideal' DASI values in any loop for charge $\boldsymbol{Q}_*$, mass $\boldsymbol{M}_*$, radius $\boldsymbol{r}$, velocity $\boldsymbol{v}$ and frequency $\boldsymbol{w}$ of the meons in a loop, without their adjustment for $\boldsymbol{s/6}$ and $\boldsymbol{q/6}$ sized mass and charge additions, except where mentioned.

XI. MOMENTUM

Usually the momentum equations are

Mass

$$\boldsymbol{h} = \boldsymbol{M}_*\boldsymbol{vr}$$

Charge

$$\boldsymbol{\mu} = \boldsymbol{Q}_*\boldsymbol{vr}$$

As has been shown above, these can be restated as

Mass

$$\boldsymbol{h} = \boldsymbol{M}_*(\sqrt{\boldsymbol{f}}\boldsymbol{v})(\boldsymbol{r}/\sqrt{\boldsymbol{f}})$$

Charge

$$\boldsymbol{\mu} = \boldsymbol{Q}_*(\sqrt{\boldsymbol{f}}\boldsymbol{v})(\boldsymbol{r}/\sqrt{\boldsymbol{f}})$$

The result is the same, but the value of the properties is better defined. This is similar to the stretching of SI units into DASI units when eliminating the gravitational constant G from all equations [5].

However, the charge momentum has dimensionality as shown of $\boldsymbol{Y}^{-2}$ so needs to be adjusted to have the same dimensionality as mass momentum, which at $\boldsymbol{Y}^0$ is as should be expected for a universal constant

Since the DASI units are defined to be

$$\boldsymbol{M}_* = \sqrt{\boldsymbol{hc}} \qquad \boldsymbol{Q}_* = \sqrt{\boldsymbol{h/c}}$$

and $\boldsymbol{M}_* = \boldsymbol{Q}_*\boldsymbol{c}$

to make the charge momentum equation equal to $\boldsymbol{Y}^0$ dimensionality involves multiplying by $\boldsymbol{c}$ to become

$$\boldsymbol{\mu c} = (\boldsymbol{Q}_*\boldsymbol{c})(\sqrt{\boldsymbol{f}}\boldsymbol{v})(\boldsymbol{r}/\sqrt{\boldsymbol{f}})$$

XII. ENERGY

The generalized mass kinetic energy of the meon in a loop is

$$E_{MKE} = (\gamma - 1)\boldsymbol{M}_*\boldsymbol{c}^2 = \boldsymbol{M}_*(\boldsymbol{f}\boldsymbol{v}^2) = \boldsymbol{h}(\boldsymbol{fw}) = \boldsymbol{m_{loop}}\boldsymbol{c}^2$$

This is the same size for both positive and negative meons, although they have positive and negative mass motional energies respectively.

Charge energy is treated in the same way, thus

$$E_{QKE} = (\gamma - 1)\boldsymbol{Q}_*\boldsymbol{c}^3 = \boldsymbol{Q}_*\boldsymbol{c}(\boldsymbol{f}\boldsymbol{v}^2)$$

There being no equivalent to $\boldsymbol{h}$ in charge momentum a new charge angular momentum property $\boldsymbol{H}$ is defined

$$\boldsymbol{H}{=}\boldsymbol{\mu c} = (\boldsymbol{Q}_*\boldsymbol{c})(\sqrt{\boldsymbol{f}}\boldsymbol{v})(\boldsymbol{r}/\sqrt{\boldsymbol{f}})$$

so that

$$E_{QKE} = \boldsymbol{H}(\boldsymbol{fw})$$

which is the same form as the mass energy equation, although not currently recognised as such. Usually in both the value of $\boldsymbol{f} \cong ½$.

There is no acknowledged equivalent of the mass of the loop for charge, but it is the same size as the mass energy and is actually the spin energy because $\boldsymbol{Q}_*\boldsymbol{c}$ in $\boldsymbol{H}$ can be replaced with $\boldsymbol{M}_*$ and we then have

$$\boldsymbol{H} = \boldsymbol{M}_*(\sqrt{\boldsymbol{f}}\boldsymbol{v})(\boldsymbol{r}/\sqrt{\boldsymbol{f}}) = \boldsymbol{h}$$

The spin is currently taken to mean that the fermions have spin ½ $\boldsymbol{h}$, but they actually have spin 1 $\boldsymbol{h}$, which is adjusted by the $\boldsymbol{f}$ of the loop angular frequency $\boldsymbol{w}$ as described above.

The main point is that the charge energy of the intrinsic spin of an electron is exactly equal and opposite to the mass energy of the electron.

XIII. MAGNETIC MOMENT

This in turn leads to the wrongful interpretation of the magnetic moment of the electron (ignoring the anomalous component). Since the magnetic moment is a moment, then it takes the moment formula. So for a negative meon

$$\boldsymbol{\mu c} = -(\boldsymbol{Q_* c})(\sqrt{\boldsymbol{f}}\boldsymbol{v})(\boldsymbol{r}/\sqrt{\boldsymbol{f}})$$

$$= -(\boldsymbol{Q_* c})[\boldsymbol{M_*}(\sqrt{\boldsymbol{f}}\boldsymbol{v})(\boldsymbol{r}/\sqrt{\boldsymbol{f}})]/\boldsymbol{M_*}$$

$$= -(\boldsymbol{Q_* c})\boldsymbol{h}/\boldsymbol{M_*}$$

and now

$$\boldsymbol{\mu} = -(\boldsymbol{Q_* c})\boldsymbol{h}/\boldsymbol{M_*}$$

which is the same form as the accepted magnetic moment of the electron, except without the ½, based on the meon DASI values.

For the electron loop, the formula requires that we use the total loop charge which, with the additional $-\boldsymbol{q}/\boldsymbol{6}$ charges to each positive or negative $\boldsymbol{Q_*}$, is equal to $-\boldsymbol{q}$ in total. The mass that the formula uses is just the electron mass $\boldsymbol{m_e}$, so that

$$\boldsymbol{\mu_e} = -\boldsymbol{q}\boldsymbol{h}/\boldsymbol{m_e}$$

which is twice the expected size and means that the spin $\boldsymbol{g}$ factor is 2, as observed (excluding the anomalous part).

This should be compared with the orbital spin of an electron around a nucleus where the $\boldsymbol{v_t}$ and $\boldsymbol{r_t}$ components are orbital rather than loop properties.

For orbital systems the mass angular momentum is given by the usual formula, which includes the 2π factor when using the angular frequency $\boldsymbol{w}$ instead of the simple frequency, as

$$\boldsymbol{h}/(\boldsymbol{2\pi}) = \boldsymbol{m_e v_t r_t}$$

The dynamic properties can be split in the same way as for the loop system, so that

$$\boldsymbol{h}/(\boldsymbol{2\pi}) = \boldsymbol{m_e}(\sqrt{\boldsymbol{f_{es}}}\boldsymbol{v_t})(\boldsymbol{r_t}/\sqrt{\boldsymbol{f_{es}}})$$

Using the normal magnetic moment definition relating current and area, with $\boldsymbol{t} = \boldsymbol{2\pi}/\boldsymbol{w}$, then

$$\boldsymbol{\mu_e} = \boldsymbol{IA}$$

$$\boldsymbol{\mu_e} = \boldsymbol{q}(\boldsymbol{\pi r_t}^{\boldsymbol{2}})/\boldsymbol{t}$$

$$\boldsymbol{\mu_e} = \tfrac{1}{2}\boldsymbol{q v_t r_t}$$

which in factor terms is

$$\boldsymbol{\mu_e c} = \tfrac{1}{2}(\boldsymbol{qc})(\sqrt{\boldsymbol{f_{es}}}\boldsymbol{v_t})(\boldsymbol{r_t}/\sqrt{\boldsymbol{f_{es}}})$$

so that

$$\boldsymbol{\mu_e c} = \tfrac{1}{2}(\boldsymbol{qc})\boldsymbol{h}/\boldsymbol{m_e}$$

or

$$\boldsymbol{\mu_e} = \tfrac{1}{2}\boldsymbol{q h}/\boldsymbol{m_e}$$

as expected and without any factor dependency. The 2 is from the 2π factor.

In this system, $\boldsymbol{v_t}$ is actually relatively large compared with normal meon loop velocities. Using the $\boldsymbol{n}$=1 energy level for the first electron orbital corresponds to a 'standard' velocity of $\boldsymbol{\alpha c}$ which gives an $\boldsymbol{f_{es}}$ = 0.50001997.

The charge kinetic energy levels for this orbital system do however contain the $\boldsymbol{f}$ factor as the core of the energy values for the orbitals which can be derived from the correct magnetic moment equation

$$\boldsymbol{\mu_{eorb}} = -\boldsymbol{q}(\sqrt{\boldsymbol{f}}\boldsymbol{v_t})(\boldsymbol{r_t}/\sqrt{\boldsymbol{f}})$$

multiplied by $\boldsymbol{c\ f\ w_t}$ to become

$$\boldsymbol{E_{Qorb}} = \boldsymbol{\mu_{eorb} c\ f\ w_t} = -(\boldsymbol{qc})(\sqrt{\boldsymbol{f}}\boldsymbol{v_t})(\boldsymbol{r_t}/\sqrt{\boldsymbol{f}})(\boldsymbol{f w_t})$$

$$= -(\boldsymbol{qc})(\sqrt{\boldsymbol{f}}\boldsymbol{v_t})^{\boldsymbol{2}}$$

$$\boldsymbol{E_{Qorb}} = -\boldsymbol{f}(\boldsymbol{qc})\boldsymbol{v_t}^{\boldsymbol{2}}$$

which should use $\boldsymbol{f} = \boldsymbol{f_{es}}$ = 0.50001997.

The mass kinetic energy equivalent for the core of the eigenvalues for the orbitals is the same as explained previously, that

$$\boldsymbol{E_{Morb}} = \boldsymbol{h}\ (\boldsymbol{f_{es}\ w_t})/(\boldsymbol{2\pi})$$

$$= (\boldsymbol{m_e})(\sqrt{\boldsymbol{f_{es}}}\boldsymbol{v_t})(\boldsymbol{r_t}/\sqrt{\boldsymbol{f_{es}}})(\boldsymbol{f_{es} w_t})$$

$$= (\boldsymbol{m_e})(\sqrt{\boldsymbol{f_{es}}}\boldsymbol{v_t})^{\boldsymbol{2}}$$

$$= \boldsymbol{f_{es}}(\boldsymbol{m_e})\boldsymbol{v_t}^{\boldsymbol{2}}$$

where again, the correct value for $\boldsymbol{f_{es}}$ = 0.50001997 rather than ½ . This difference is absorbed within the higher quantum number states in classical quantum energy equations.

XIV. ACTUAL LOOP SYSTEMS

Using the actual meon loop masses and charges with their sizes [3] of

Mass $\boldsymbol{M}_*(\pm 1 + \boldsymbol{s}/\boldsymbol{6})$

Charge $\boldsymbol{Q}_*(\pm 1 - \boldsymbol{q}/\boldsymbol{6})$

produces different velocities and radii for the positive meons versus the negative meons in order for each to maintain angular momentum $\boldsymbol{h}$.

What can now be concluded from the above analysis is that the mass kinetic energy in that referenced paper should now use $\boldsymbol{f_i}$, $\boldsymbol{f_o}$ and $\boldsymbol{f_e}$ rather than ½ throughout because the velocity of each meon is slightly different between inner $\boldsymbol{v_i}$ and outer $\boldsymbol{v_o}$ relative to the 'standard' velocity $\boldsymbol{v_e}$. Thus, using $\boldsymbol{j}$ instead of $\boldsymbol{s}/\boldsymbol{6}$ and $\boldsymbol{q}/\boldsymbol{6}$ for brevity, and considering only a pair of positive and negative meons, we have

$$\mathrm{E}_{Mmeons} = +\boldsymbol{f_i}\,\boldsymbol{M}_*(1+\boldsymbol{j})\boldsymbol{v_i}^{\boldsymbol{2}} = +\boldsymbol{f_o}\,\boldsymbol{M}_*(-1+\boldsymbol{j})\,\boldsymbol{v_o}^{\boldsymbol{2}}$$

$$= +\boldsymbol{f_e}\,\boldsymbol{M}_*\boldsymbol{v_e}^{\boldsymbol{2}} = \boldsymbol{m_e}\boldsymbol{c}^{\boldsymbol{2}}$$

From the formulae, simplifying the results, can be found

$$\boldsymbol{f_i}\,\boldsymbol{v_i}^{\boldsymbol{2}} = \boldsymbol{f_e}\,\boldsymbol{v_e}^{\boldsymbol{2}}/(1+\boldsymbol{j})$$

and

$$\boldsymbol{f_o}\,\boldsymbol{v_o}^{\boldsymbol{2}} = \boldsymbol{f_e}\,\boldsymbol{v_e}^{\boldsymbol{2}}/(1-\boldsymbol{j})$$

These do not have to be solved because they can be substituted into the similar charge energy equation, whose two component energies are not equal in size like the mass version, thus

$$\mathrm{E}_{Qmeons} = +\boldsymbol{f_i}\,\boldsymbol{Q}_*\boldsymbol{c}(1-\boldsymbol{j})\boldsymbol{v_i}^{\boldsymbol{2}} + \boldsymbol{f_o}\,\boldsymbol{Q}_*\boldsymbol{c}(-1-\boldsymbol{j})\,\boldsymbol{v_o}^{\boldsymbol{2}}$$

$$= +\boldsymbol{f_e}\,\boldsymbol{Q}_*\boldsymbol{c}[\frac{(1-\boldsymbol{j})}{\boldsymbol{1}+\boldsymbol{j}}]\boldsymbol{v_e}^{\boldsymbol{2}} + \boldsymbol{f_e}\,\boldsymbol{Q}_*\mathrm{c}[\frac{-1-\boldsymbol{j}}{1-\mathrm{j}}]\,\boldsymbol{v_e}^{\boldsymbol{2}}$$

$$= +\boldsymbol{f_e}\,\boldsymbol{Q}_*\boldsymbol{c}\boldsymbol{v_e}^{\boldsymbol{2}}\,[\frac{(1-\boldsymbol{j})}{\boldsymbol{1}+\boldsymbol{j}} + \frac{-1-\boldsymbol{j}}{1-\mathrm{j}}]$$

$$= -\boldsymbol{f_e}\,\boldsymbol{Q}_*\boldsymbol{c}\boldsymbol{v_e}^{\boldsymbol{2}}\,\frac{\boldsymbol{4j}}{\boldsymbol{1}-\boldsymbol{j}^{\boldsymbol{2}}}$$

Since this is for one pair and there are three pairs in a loop, the total charge energy for the electron loop will be

$$\mathrm{E}_{Qeloop} = -2\boldsymbol{f_e}\,\boldsymbol{q}\boldsymbol{c}\boldsymbol{v_e}^{\boldsymbol{2}}\,/(\boldsymbol{1}-\boldsymbol{j}^{\boldsymbol{2}})$$

Changing this to a magnetic moment by dividing by $\boldsymbol{c}$ and the appropriate loop frequency $\boldsymbol{f_e}\boldsymbol{w_e}$ produces

$$\boldsymbol{\mu_{eloop}} = -2\,\boldsymbol{f_e}\boldsymbol{q}\boldsymbol{h}/[\boldsymbol{M}_*(\boldsymbol{1}-\boldsymbol{j}^{\boldsymbol{2}})]$$

As before, this is based on the meon masses whereas it should be based on the loop mass, in this case $\boldsymbol{m_e}$. This would produce, where $\boldsymbol{\mu_{eacc}} = -½\boldsymbol{q}\boldsymbol{h}/\boldsymbol{m_e}$ is the accepted definition of the electron magnetic moment, the actual intrinsic spin magnetic moment to be

$$\boldsymbol{\mu_{eme}} = -4\,\boldsymbol{f_e}\boldsymbol{q}\boldsymbol{h}/[\boldsymbol{m_e}(\boldsymbol{1}-\boldsymbol{j}^{\boldsymbol{2}})]$$

$$\boldsymbol{\mu_{eme}} = 4\,\boldsymbol{f_e}\boldsymbol{\mu_{eacc}}/(\boldsymbol{1}-\boldsymbol{j}^{\boldsymbol{2}})$$

A calculation of $\boldsymbol{f_e}$ uses the recast equation from earlier as

$$\mathbf{w}_{\boldsymbol{e}}/\boldsymbol{w}_* = 1 - (\boldsymbol{1} + \mathbf{m}_{\boldsymbol{e}}/\boldsymbol{M}_*)^{-2}$$

producing $\boldsymbol{f_e} = 0.5$ as close as can be calculated because the velocity of the meons is so low.

Utilising this value for $\boldsymbol{f_e}$ gives the magnetic moment value

$$\boldsymbol{\mu_{eme}} = 2\,\boldsymbol{\mu_{eacc}}/(\boldsymbol{1}-\boldsymbol{j}^{\boldsymbol{2}})$$

$$\boldsymbol{\mu_{eme}} = 2\,\boldsymbol{\mu_{eacc}}/(1-\boldsymbol{\alpha}\,/(72\,\pi))$$

$$\boldsymbol{\mu_{eme}} = 2.000064525\,\boldsymbol{\mu_{eacc}}$$

This is the same as the paper [3] and is still well short of the observed anomalous magnetic moment of the electron.

XV. EQUATIONS RECONCILED

It is now possible to write the momentum and energy equations of a rotating system in a form that reconciles the velocity $\boldsymbol{v}$ and radius $\boldsymbol{r}$ properties

Momentum

Mass $\boldsymbol{h} = \boldsymbol{M}_*(\sqrt{\boldsymbol{f}}\boldsymbol{v})(\boldsymbol{r}/\sqrt{\boldsymbol{f}})$

Charge $\boldsymbol{H} = \boldsymbol{Q}_*\boldsymbol{c}(\sqrt{\boldsymbol{f}}\boldsymbol{v})(\boldsymbol{r}/\sqrt{\boldsymbol{f}}) = \boldsymbol{h}$

Kinetic Energy

Mass $E_{MKE} = \boldsymbol{M}_*(\boldsymbol{f}\boldsymbol{v}^{\boldsymbol{2}})$

Charge $E_{QKE} = \boldsymbol{Q}_*\boldsymbol{c}(\boldsymbol{f}\boldsymbol{v}^{\boldsymbol{2}})$

XVI. CONCLUSION

This analysis has shown clearly that the spin quantum number of a fermion is $\boldsymbol{h}$ and not ½ $\boldsymbol{h}$. The ½ factor is a relativistic effect that is linked to the velocity, radius and angular frequency of the meons as they rotate about a loop.

It is also clear that the energy of the intrinsic spin of an electron is exactly equal and opposite to the mass energy of the electron, which is itself the kinetic energy of the meons in the electron loop.

The analysis also shows that by including the relativistic $\boldsymbol{f}$ factor in both the angular momentum and energy equations, the two can be better understood and reconciled.

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