Anomalous magnetic moments as evidence of a pre-fermion lepton structure

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A pre-fermion hypothesis requires that fermions have structure. Pre-fermion particles, which have mass, spin and charge, will force their composite structures to move differently to structureless point particles with the same overall mass, spin and charge when in magnetic, electric or gravitational fields. The paper shows that g-2 experiments in cyclotrons which measure the muon anomalous magnetic moment can be interpreted as observing the distortion of the structure of the muons. The size of the distortion calculated to be required to produce the observed anomalous magnetic moment is shown to be physically feasible within a cyclotron beam.

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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 hypothesis of the pre-fermion framework is based on positive and negative meons chasing each other in a loop. The meons have adjusted-Planck sized mass $M_*$and charge Q_* properties, plus $\pm|q_e c^3/6\,|$ and $\pm|q_e/6\,|$ adjustments of each respectively, due to their spinning. The result will be that in a strong magnetic or electric field the positive or negatively charged meons will be affected differently which will result in the distortion of the normally-circular loop. It is this effect which is hypothesized here as the physical reason for the change in magnetic moment of the loop in a cyclotron.

As shown previously [3], the anomalous magnetic moment of a stationary electron loop is not as much as the currently acknowledged anomalous figure. The value in magnetic, electric or gravitational fields will depend on the properties of the loop and the fields and is not a fixed anomaly, as will be shown.

The paper sets out to show that that the distortion of the loops within a cyclotron is physically feasible, that is that the average distance by which each meon type is moved from the central path of the loop is within the observed beam in a cyclotron. This latter uses the muon loop as its example.

There is also the possibility of providing a source of explanation for some of the line shape broadening in a cyclotron [4].

The significance is in offering an alternative interpretation of why there are anomalous magnetic moments and why they take their observed values based on experimental parameters.

This paper sets out a theoretical hypothesis to explain physically the anomalous magnetic moments observed.

The conclusion is that structureless point particles should not have anomalous magnetic moments and that therefore the existence of anomalous magnetic moments is proof that charged leptons, and by implication all loops, have structure and thus that the pre-fermion hypothesis is the correct framework with which to work.

III. OUTLINE

Whilst the accuracy of QED, EW and Hadron radiative correction calculations appear unquestioned in relation to the anomalous magnetic moments of the electron and muon [5], the reason for the interactions and what they actually physically represent is not so certain.

The hypothesis proposed here includes that the interactions of loops with other particles take place in order to replace energy lost by the loops moving against the background viscosity of the local environment as previously detailed [6].

Thus the photons are not transmitting forces, which is the role of the background, but are transferring rotational frequencies between the loops in order to keep single fermion loops at their locked-in sizes, set by original inflation.

The amount of frequency needing to be restored will depend on the density of the local environment, which is proportional to the charge and mass densities in the local environment in which the loop sits.

This means that the 'stationary' loop in a weak external magnetic/electric/gravitational fields will require less frequency restoration than one in strong external fields or in motion.

The 'magic momentum'[7] supplied, for example, to muons in a cyclotron, that ensures cancellation of electric field contributions, leaves the muon in a strong magnetic field which requires additional interactions to maintain loop frequency.

However, since the lepton loops are composed of meons, each with large fundamental $\pm Q_*$ charges as well as $\pm q_e\ /6$ adjustments due to the spinning of the meons ('twisting' to differentiate from loop spin), there will be deflection away from the central path of the muons around the cyclotron. The negative muons will be subject to additional force in one direction radially, and the positive meons in the other direction.

This latter does not mean that the loops are broken, only that the average position of the negative meons will not be centred on the main path of the muon, and the same in the opposite direction for the positive meons.

In this analysis the individual velocities of the meons in the electron or muon loops is ignored as being very small compared to the circumferential velocity at which the loops in a Penning trap or cyclotron orbit. The meons still rotate as a loop, but distorted by the magnetic field. The precise path of each of the meons is complex and so only the average distortion of each type is considered. Thus the precision of the paper is not the most accurate and only provides an indication of the effects hypothesized.

For comparison, the meon velocities for the electron and muon loops are $2.0218x10^{-9}\ c$ and $2.0557x10^{-8}\ c$ respectively, confirming that v_e and v_μ are considerably smaller than v_r , the orbital velocity in a trap or cyclotron, usually around $0.999\ c$.

Before examining the orbital cases of the electron and muon in Penning traps or cyclotrons, the 'stationary' case of an electron will be considered

The orbital system uses the same equations as the stationary system, with adjustment only for the orbital radius around which the meons are mainly in motion, the relativistic factor and that the orbital motion no longer links mass angular momentum through $h = mvr$.

IV. LOOP MASS-ENERGY BALANCING

This treatment follows a previous paper [3] but is included here for clarity as it also reflects the analysis of the orbital cases.

The balancing of mass energies within loops, to maintain $\pm h$ angular momentum for each meon regardless of sign of twist energy, is produced by balancing just the mass and twist energies themselves to have the same frequency as a the rest-mass of the electron, when considering a stationary electron loop.

The formulae for a meon pair, one third of an electron loop, with each meon having additional $-Q_* j$ charge, where $j\ =\ \sqrt{(\alpha/2\,\pi\,)}\ /6$ and $Q_* j\ =\ q_e\ /6$, and $+M_* j$ twist energy gives the set of mass energy formulae for a pair that is in a frame of reference where the loop is stationary, but the meons move, as

$$\begin{aligned} \mathrm{E_m} &= +(+M_* + M_* j)(\gamma_\mathrm{i} - 1)c^2 \\ &= -(-M_* + M_* j)\ (\gamma_o - 1)c^2 \\ &= (\gamma_e - 1)M_* \mathrm{c}^2 \\ &= \mathrm{m_e} c^2 \end{aligned}$$

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

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

$$\begin{aligned} E_m &= +½\ (+M_* + M_* j)\ v_i^2\ =\ -½\ (-M_* + M_* j)\ v_o^2 \\ &= +½\ M_*\ v_e^2\ =\ m_e c^2 \end{aligned}$$

This set of mass equations is the same for all pairs, adjusted for sign of $M_* j$ twist energy and $Q_* j$ charge. So all meons within a loop rotate at v_i or v_o velocities relative to their central velocity v_e , appropriate for the frequency 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

$v_i^2 = v_e^2/(1+j)$ and $v_o^2 = v_e^2/(1-j)$

This mass set of equations show that the velocity changes are not exactly equal inwards versus outwards.

The actual changes depend on the loop frequencies. For the electron at rest with mass 9.10938 x10^{-31} kg , frequency 2.47112 x10^{20} Hz , it can be shown that the velocity changes are +1.222 x10^{-3} ms^{-1} outwards and -1.212 x10^{-3} m s^{-1} inwards, leading to radius changes of +4.9466 x10^{-24} m outwards and -4.90465 x10^{-24} m inwards relative to central velocity and rotational radius of 0.42859 ms^{-1} and 3.46874 x 10^{-21} m respectively, based on the mutual adjustment of v_e and r_e parameters [8]. However, since they are very close to being equal, it will usually be simpler to use the same size change, equal to $\pm½jv_e$, or $\pm½jr_e$, since the outer is 0.50214 j , when related to the central velocity v_e or radius r_e , and the inner 0.49788 j. The same ratios will apply to all sized loops.

The same relative size changes apply to the muon loop where the meons have a central velocity and radius of 4.35786 ms^{-1} and 1.71575 x10^{-22} m respectively.

These values can be compared with a v_r of around 0.999 c in traps and cyclotrons.

V. CHARGE ENERGY CONSIDERATIONS

The radii at which each meon is mass-angular momentum-balanced means, in the case of the electron, that the larger size mass $(+M_* + M_*j)$ positive meon will rotate at a smaller radius than the negative meon with its smaller size mass $(-M_* + M_*j)$ The result is that the larger size negative charge $(-Q_* - Q_*j)$ of the negative meon rotates further out than the smaller positive charge $(+Q_* - Q_*j)$ of the positive meon. The net effect is overall negative charge energy. The total charge energy thus generated by the pair in an electron will be

$$E_Q = Q_p c^3 = +(-Q_* - Q_*j)(\gamma_o - 1)c^3 + (+Q_* - Q_*j)(\gamma_i - 1)c^3$$

Or, in simplified form due to the meon's low loop velocity

$$E_Q = +½(-Q_* - Q_*j)c\, v_o^2 + ½(+Q_* - Q_*j)c\, v_i^2$$
$$= -½Q_*c[(1+j)v_o^2 - (1-j)v_i^2]$$

which can be adjusted using the mass set of equations relating v_i and v_o to v_e as

$$E_Q = -½Q_*cv_e^2[(1+j)/(1-j) - (1-j)/(1+j)]$$
$$= -½Q_*cv_e^2(4j/(1-j^2))$$

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

$$E_{Q3} = Q_t c^3 = -½Q_*cv_e r_e w_e(12j/(1-j^2))$$
$$= -6Q_*jc(M_*v_e r_e)w_e/(M_*(1-j^2))$$
$$= -q_e chw_e/(M_*(1-\alpha/(72\pi)))$$

Thus, using $M_*c^2 = hw_*$, the effective, but not the actual, charge Q_t in the loop will be

$$Q_t = -q_e w_e/(w_*(1-\alpha/(72\pi)))$$
$$= -q_e(w_e/w_*)(1-\alpha/(72\pi))$$

VI. MAGNETIC MOMENT OF LOOP MEONS

As mentioned earlier, the orbital system uses the same equations, with adjustment only for the size of cyclotron radius around which the meons are mainly in motion, the relativistic factor and that the orbital motion no longer links mass angular momentum through $h = mvr$ since the momenta are not quantised in the same way as in a loop.

The mass in the orbital case is the relativistic loop mass rather than the meon mass, the velocity and radius are relative to the orbital motion of the loop within the cyclotron.

No account is taken of any non-planar motion since the analysis here is only to show that the distortion of the loops within a cyclotron is physically feasible.

To turn the charge energy for an electron 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, uses the accepted standard equation $\mu_t = ½Q_t h/m_e$ to give

$$\mu_t = -½q_e(w_e/w_*)h/(m_e(1-\alpha/(72\pi)))$$

And since $m_e c^2 = ½hw_e$ and the standard definition of the electron magnetic moment is $\mu_e = ½q_e h/m_e$

$$\mu_t = -(½q_e h/m_e)(w_e/w_*)/((1-\alpha/(72\pi))$$
$$= \mu_e(w_e/w_*)/((1-\alpha/(72\pi))$$

which appears much smaller than could provide any measurable anomalous moment to the electron loop. The issue is that the mass of the electron loop m_e is used here as the basis for its magnetic moment, whereas each meon has a mass of $\pm M_*(1 \pm j)$. So it is the definition of the magnetic moment using the loop size which confuses here.

To arrive at the correct total magnetic moment requires using the meon masses, but as their frequency equivalent w_* to replace the loop frequency w_e. The result is

$$\mu_t = \mu_e/((1-\alpha/(72\pi))$$

This is the 'stationary' electron magnetic moment when in 'empty' space, which is really when the background is of minimal density. The reason for the increase in the magnetic moment is due to the orbiting of the loop, as explained below.

VII. ORBITING LOOP MAGNETIC MOMENTS

In the case of loops in cyclotrons, the same charge equations can be used, adjusted for the effect of relativity.

In the equations, the identity of the charged lepton is immaterial in terms of sign of charge or mass size. So use of electron includes positron with charges reversed, and the same for the muon.

What is considered is that the meons are shifted by a factor away from the central path of the loop. This is not examined precisely, but considers that the three negative meons are moved by a similar factor k_o outwards away from the centre of rotation in the cyclotron and the three positive meons inwards by a factor k_i. Reversal of the loop charge or the magnetic or electric fields will change the direction of each offset, but not the total offset for a pair of positive and negative meons with the same sign Q_*j charge.

Since the hypothetical system above is not exact, and the paths of the meons as they rotate in their now-distorted loop whilst travelling in a circular path in the cyclotron is uncertain, it is fair to use the assumption that

$$k_o k_i = 1 \qquad v_o = k_o v_r \qquad v_i = k_i v_r$$

where v_o is the average outer velocity for the negative meons, v_i the average inner velocity for the positive meons, both away from the central path where meons would travel at v_r and in each case $v = rw_r$, where w_r is rotational frequency at which the loop is orbiting in the cyclotron.

This method of adjusting the velocity or radius of rotation using a fractional factor is done to simplify the relativistic adjustments needed to the magnetic moment equation and because the effect is not mirrored across the central path.

The total energy of the magnetic moment of each of the three pairs of positive and negative meons the loop, using the appropriately adjusted equations from the loop case above, will now be

$$\mathrm{E}_{Q-1p} = +\tfrac{1}{2}\,(-Q_* - Q_*j)\; ck_o^2\, v_r^2 \,/\sqrt{(1-\,k_o^2 v_r^2/(c^2))}$$

$$+\tfrac{1}{2}\,(+Q_* - Q_*j)\; ck_i^2\, v_r^2 \,/\sqrt{(1-\,k_i^2 v_r^2/(c^2))}$$

$$= -\tfrac{1}{2}\,Q_*(1+j)\,k_o^{-2} c\, v_r^2/\sqrt{(k_o^{-2}-\,v_r^2/c^2)}$$

$$+\,\tfrac{1}{2}\,Q_*(1-j)\,k_o^2 c\, v_r^2/\sqrt{(k_o^2-\,v_r^2/c^2)}$$

$$= -\tfrac{1}{2}\,Q_* c\, v_r^2\Bigg[\frac{(1+j)k_o^{-2}}{\sqrt{\left(k_o^{-2}-\frac{v_r^2}{c^2}\right)}}-\frac{(1-j)k_o^2}{\sqrt{\left(k_o^2-\frac{v_r^2}{c^2}\right)}}\Bigg]$$

This equation multiplied by 3 for the three pairs, needs to be measured against the total charge energy of the loop on its path, at path velocity v_r, assuming that each meon is on the path, effectively a structure less point particle with total charge q , where that would be

$$\mathrm{E}_{Qr} = -\tfrac{1}{2}\,q\,c\,v_r^2\,/\sqrt{(1-\,v_r^2/c^2)}$$

This produces the unit-less energy factor F of

$$F = \,(Q_*/q)\sqrt{(1-\,v_r^2/c^2)}\,\Bigg[\frac{3(1+j)k_o^{-2}}{\sqrt{\left(k_o^{-2}-\frac{v_r^2}{c^2}\right)}}-\frac{3(1-j)k_o^2}{\sqrt{\left(k_o^2-\frac{v_r^2}{c^2}\right)}}\Bigg]$$

It would be useful to compare this to the magnetic moment by simply dividing the energy by c and w_r , but the relationship $h = mvr$ does not apply in this orbital case and the mass of the loop is not contained within the charge-energy equation. So the factor is used directly to adjust the magnetic moment where the comparison is with the standard model moment μ_L for a loop of mass m_L, charge q travelling at γ_L is

$$\mu_L = -\tfrac{1}{2}q\;h/(\gamma_L m_L)$$

producing the adjusted magnetic moment μ_{aj} for the electron or muon loop of

$$\mu_{aj} = -\tfrac{1}{2}Q_* h\Bigg[\frac{3(1+j)}{\sqrt{\left(k_o^{-2}-\frac{v_r^2}{c^2}\right)}}-\frac{3(1-j)}{\sqrt{\left(k_o^2-\frac{v_r^2}{c^2}\right)}}\Bigg]/m_L$$

When $k_o = k_i = 1$, the case where the meons are all travelling exactly along the path at v_r , effectively a point particle, then

$$\mu_{aj} = -\tfrac{1}{2}Q_* h[6j]/(\gamma_L m_L)$$

$$= -\tfrac{1}{2}qh/(\gamma_L m_L)$$

This applies only to the single-loop charged leptons which have all j factors the same sign. It is unphysical because each meon is affected differently in a strong magnetic field.

VIII. MAGNETIC MOMENT CONTRIBUTIONS

The part of the energy factor F that sets the numerical value of the multiplier acting on the expected loop magnetic moment, rather like the gyromagnetic ratio g, can be called the structure factor S_F and can be represented in two forms.

The first is in the style as shown above as

$$S_{F(M)} = -Q_*[\frac{3(1+j)k_o^{-2}}{\sqrt{\left(k_o^{-2} - \frac{v_r^2}{c^2}\right)}} - \frac{3(1-j)k_o^2}{\sqrt{\left(k_o^2 - \frac{v_r^2}{c^2}\right)}}]$$

and represents the contribution of each meon type, positive or negative, each in total. This will depend on the relative sign numbers of the j factors within the loop, here for the electron they are -3 and -3.

The second way of describing the total of the structure factor splits the contributions of the large Q_* charges of the meons from the small $Q_* j$ charges, as

$$S_{F(Q)} = -Q_*[\frac{3k_o^2}{\sqrt{\left(1 - \frac{k_o^2 v_r^2}{c^2}\right)}} - \frac{3k_o^{-2}}{\sqrt{\left(1 - \frac{k_o^{-2} v_r^2}{c^2}\right)}}]$$

$$+(q_e/6)[\frac{3k_o^2}{\sqrt{\left(1 - \frac{k_o^2 v_r^2}{c^2}\right)}} + \frac{3k_o^{-2}}{\sqrt{\left(1 - \frac{k_o^{-2} v_r^2}{c^2}\right)}}]$$

At the 'magic' velocity for the muon, using the offset k_o=1.000006604 the contributions to the total magnetic moment in these two different ways will be

$S_{F(M)}$	-meons	+meons	Total
	-89.037840	87.035508	-2.0023318
$S_{F(Q)}$	Q_* charges	q charges	Total
	-1.0022833	-1.0000485	-2.0023318

The $S_{F(M)}$ shows that there are very large magnetic moments in action within a loop, even though the net action is much smaller.

The $S_{F(Q)}$ shows that the contribution of the fundamental meon charge Q_* is more than half the total, providing even more than the total j factors which represent the net electron charge q_e.

This latter Q_* contribution to the structure factor will be the same for all loops, although its actual size will depend on the orbital velocity of the loop and other parameters.

The 'magic' velocity for a charged lepton loop is when the relativity factor for the loop orbital velocity is equal to $(Q_* / q) = \sqrt{2\pi/\alpha}$. At that velocity, and with $k_o = 1$, the structure factor should equal -1 for a point particle of charge $-q$. This is managed in the equation by effectively setting the paths of all the meons to be on the central path.

That the muon does not have a non-zero anomalous magnetic moment at that velocity shows that there must be structure to the muon, and all loops, and that fermions are not point particles.

It is possible that, when ejected from a Pion, the muon is actually a stack of three loops – a muon-sized loop (the muon itself) adjacent to a muon anti-neutrino and electron neutrino.

Due to the presence of magnetic and electric fields and being in orbit, the latter two charge-neutral loops will also get distorted in their orbital paths, even though they have equal numbers of positive and negative j factors. Symmetric charge-neutral loops experience k effects as their positive and negative meon Q_* charges are larger than the j charges, although the net effect will be much lower than for charged loops.

It is the presence of strong magnetic and electric fields in a rotating system that strips the charge-neutral loops from the muon loop.

It could be that the differential k effects are what causes the change of size of the muon loop as the neutral-charge loops are stripped from the muon – swapping frequency with the electro-neutrino loop to become an electron loop, with the former becoming a muon-neutrino loop. The electron loop would no longer be held in the orbital path, nor would the muon anti-neutrino or muon neutrino.

It is unclear whether the experimental observation of muons in cyclotrons is observing the muon 3-loop stack or just the muon loop itself. However, for this paper the consideration will be that it reflects the distortion of the muon loop alone.

For a muon as observed in a cyclotron [7], the size of μ_{aj} at the estimated v_r and k_o=1.000006604 , equal almost exactly to $(1 + jq_e^2/Q_*^2) = (1 + \sqrt{\alpha/2\pi}^3/6)$, produces

$$\mu_{aj\mu} = -½qh[2.0023318]/(\gamma_\mu m_\mu)$$

$$= 2.0023318\mu_\mu$$

where μ_μ is the expected standard muon magnetic moment.

Although this result is approximate, because the energy used in the experiments [7] was insufficiently precise, and it was not possible to confirm the v_r to be exactly at its 'magic' value, it does give a measure of the required average offset necessary to produce that magnetic moment.

This then allows the estimation of whether the total offset in both directions away from the central muon path by the meons is reasonable. The offsets relative to the 7.11 m radius used in the relevant cyclotron are:

	Offset fraction	metres	mm
k_o	6.60358x10^{-06}	4.69515x10^{-05}	4.69515x10^{-05}
k_i	6.60354x10^{-06}	4.69512x10^{-05}	4.69512x10^{-05}

giving the total offset as 0.0939027 mm representing the average total distance by which the meons separate across the central path of the muon.

This is a reasonable amount since the normal beam width of muons in a cyclotron [7] is around 20 mm.

This total offset may be a source of some of the currently unexplained line shape broadening in a cyclotron.

In the case of the electron, since single electrons can be isolated for study and the size of the Penning trap cavity is around 10 mm, and the path radius smaller, a similar offset would be approximately 10^{-25} m - which is quite small. Since most experiments like the muon one referenced here concentrate on the easier to measure difference between the cyclotron and Lamour frequencies, little attempt is made to observe or measure the orbital radius of single muons or of electrons in their respective experiments.

It must be noted that the difficulty of producing the perfect environment in a trap or cyclotron to enable v_r to be at the 'magic' velocity without complicating issues like balancing the electric field means that the 'magic' velocity may be only a future target to achieve. Thus far it has been frequencies that have been targeted.

IX.OTHER LOOPS

Using the analysis above, it is possible to predict the magnetic moments of some other loops.

The tau electron will have an anomalous magnetic moment in the same region as the electron and muon since it has the same structure and total $Q_* j$ charges both when stationary and when at its 'magic' velocity in a cyclotron.

The neutrino, whilst having total zeros for both Q_* and Q_*j components when $k_o = 1$, does have a magnetic moment at other velocities. At the 'magic' velocity for the neutrino, set at the relativity factor equal to $(Q_* / q) = \sqrt{2\pi/\alpha}$, the neutrino has ± 1.000385 structure factor, positive or negative depending on loop orientation up or down and whether the loop is a neutrino or an anti-neutrino. Since the assumption here is just of the relativistic factor, there is no need to consider whether the neutrino has a mass or not and whether it is a muon or electron neutrino.

This calculated result is for symmetric neutrinos, whose $\pm Q_*j$ factors are symmetrically place around the loop. For asymmetric neutrinos, the structure factor will be larger, for example, $\pm$ 1.002283 for the maximum asymmetry.

For quark loops, there is a need to consider the asymmetry of the Q_*j charges. This means averaging over the two mirror offsets that are possible, where one opposite sign pair of Q_*j charges on one side of the central path cancels out their joint effect.

An up quark at $k_o = 1$ and at its 'magic' velocity will have a structure factor of +2/3 and when offset by the same factor as, for example, the muon will have Q_* and Q_*j contributions respectively of +0.664801and +1.002283 totaling +1.667084.

A down quark at $k_o = 1$ and at its magic velocity will have a structure factor of -1/3 and when offset by the same factor as the muon will have Q_* and Q_*j structure factor contributions respectively of -0.333349 and -1.002283 totaling -1.335632.

Interestingly, if two up quarks are in a stack with spin -½ together with one spin +½ down quark and two spin +½ neutrinos, so that total stack is spin +½, the total structure factor would be +2.669030, which is not far away from the observed proton magnetic moment value of 2.792847 nuclear magnetons.

However, that would require that such a stack was sufficiently held together to avoid being separated within a cyclotron and all loops were at the same loop size in the stack.

This stack analysis is possible because neutrinos, as well as appropriately sized muons or electrons, can exist within the nucleus – indeed within nucleons. The only real particles that are present are of adjusted-Planck mass M_* , plus or minus the M_*j twist energies. The size of the loop does not exclude its constituent meons from becoming part of a nucleon.

The only loops that have locked-in sizes are single loops, but they can be altered by frequency transmission from other loops like photons, whose sizes are not fixed, or by swapping frequencies with other loops.

X. QED – EW – HADRON CALCULATIONS

What does this analysis say about the many theoretical calculations on radiative corrections that match the experimentally observed anomalous magnetic moments of the electron and muon to such high levels of accuracy?

It says that in the perfect situation of a loop rotating at relativistic factor $(Q_* \,/\, q) = \sqrt{2\pi/\alpha}$, there is a background density of magnetic, electric and gravitation fields at that velocity that requires all possible interactions in order to keep the loop at its locked-in frequency, and that these interactions are another mathematical representation of the increased moment.

Looking back at the single loop calculations of magnetic moment of the electron, it has an anomalous moment even when stationary. The 'magic' velocity in a cyclotron produces a special anomalous figure. But between the two, and beyond, will be a continuous range of anomalous moments. The anomalous magnetic moment of the electron is not a physical constant, but a point of inflection that can be accurately set by repeated experiment and is more like the point at which a phase change in a liquid is repeatedly observable.

XI. CONCLUSION

Since stationary loops have anomalous magnetic moments and charged leptons in cyclotrons have different anomalous magnetic moments, it follows that anomalous magnetic moments are not fixed, but vary with velocity within the local environment of magnetic, electric and gravitational fields.

That there is an anomalous magnetic moment at all in loops is evidence that they have structure and are not point particles. The pre-fermion hypothesis proposed in this and previous papers deserves acknowledgement that it is a valid potential overall description of the physical structure of matter and should be investigated further,

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