Magnetic Moment of Leptons

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Considerable effort has been spent in order to estimate the "anomalous" magnetic moments of the leptons–electron, muon and the tau particle. There is a deviation from the unit expected values, which are generally corrected via perturbation theory or Feynman loop diagrams in the current theory of Quantum Electrodynamics (QED). This in general requires a number of constants, up to eight, in order to obtain the experimental values via theory. In addition, it is seen that due to the nature of the experiments, where the extrapolation is of mostly isolated systems via spectroscopic analysis, a high value of accuracy is able to be reached in experimental data.[1] Tests of any theory of physics must necessarily include this aspect into it.

Using the concepts of the Reciprocal System of theory[2] and the revisions by Prof. K. V. K. Nehru and B. Peret to include the concept of a bi-rotation,[3] we can reach an understanding of the value of this magnetic moment in terms of motion, and the effects of the distribution of that motion in various ways among the three dimensions of motion. To begin with, we have to consider the nature of the composition of motions which make up the leptons. As already highlighted by B. Peret in a communication regarding leptons[4]:

> Single bi-rotation: Positrons and electrons.
>
> Solid bi-rotation: A motion that LOOKS like a positron or electron, but is much heavier: the Muon.
>
> Double solid bi-rotation: A motion that looks like a bi-rotating electron pair, but extremely heavy: the Tauon.

We notice that the displacement[5] of all the three leptons is that of the electron 0-0-(1), if taken via notation. However, the difference comes in the way the 0's are distributed: single bi-rotations, or solid-bi-rotations, or double solid bi-rotations. Since the natural datum is unity, and unity is the same in all dimensions $1 = 1^2 = 1^3$, it follows that we can obtain a zero displacement by bi-rotational motion of one- or two-dimensional rotations at unity.

Note also, that since among the three dimensions of motion (which are the same as "scalar dimensions" mentioned in other works on the RS) only one (referred as the dimension of electric displacement) can be represented in the Euclidean Reference frame. Since the magnetic moment is the measurement of two-dimensional motion, it necessarily involves the effect of the motion in the other two "magnetic" dimensions than the one being observed. This has an effect on the magnitudes, as will be seen in the following discussion.

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1 Aoyama et al.; Hayakawa, M.; Kinoshita, T.; Nio, M. (2008). "Revised value of the eighth-order QED contribution to the anomalous magnetic moment of the electron." *Physical Review D.* 77: 053012. doi:10.1103/PhysRevD.77.053012

2 Larson, Dewey B., *Nothing But Motion*, Chapter 13, "Physical Constants."

3 KVK Nehru, "On the Nature of Rotation and Birotation," *Reciprocity* XX, Number 1 (Spring, 1991).

4 RS2 Theory forum post topic "Leptons."

5 Larson, Dewey B., *Basic Properties of Matter*, Chapter 26, "Atom Building", pg 279.

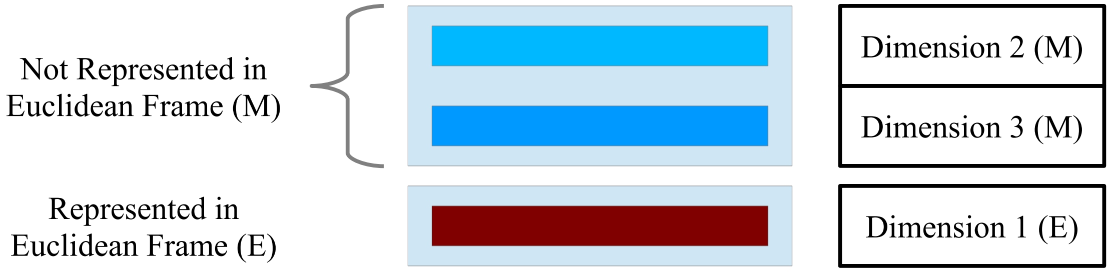

Figure 1: "Electric" and "Magnetic" Dimensions of Motion

The first contribution to the magnitude of the magnetic moment is due to the fact that the rotational value that we measure is always one unit for all leptons. The magnetic moment would just be the unity. However, as brought out in the reference,[2] the basic three-dimensional motion with magnetic and electric motion gives $4 \times 4 \times 8 = 128$ degrees of freedom in the electric frame of reference. The freedom in orienting the axis for the effective bi-rotation gives $3^2 = 9$ degrees of freedom. For the magnetic dimensions with the solid rotations, this would amount to $2^2=4$ of them being occupied. In addition, the net effect transmitted of the combination, across dimensions, gives a one third contribution to the electric dimensional measurement, which is what the physical experiment measures. As a result, the total effect of the magnetic moment in the lepton motion is the value unity plus the increment which we can signify as x, as shown:

$$\mu = 1 + \left(\frac{1}{3} \times \frac{4}{9} \times \frac{1}{128} \right) = 1 + x = 1.00115740740741$$

In this expression, the unit value is what is always present, when we reckon with things in the natural units. The fraction is the increment due to there being a two-dimensional motion in the magnetic dimensions. The total value μ, is hence the basic magnetic moment of the leptons. We now have to take into consideration the resulting effect on each of the individual leptons separately.

The Electron

Measurement of the magnetic effect is necessarily indirect, and the contribution for the electronic magnetic moment is further modified due to this aspect. Primarily, what this means is that not only does the effect of the basic magnetic moment be measured in the electric dimension, but the magnetic moment is also modified by the effect of the electric motion increment *back* onto the magnetic dimensions. We would not have this situation in cases where the necessary physical quantity is a combination of all three dimensions, but in this instance, the measurement is of a quantity which is totally on the other side of the Euclidean frame of reference. In other words, the magnetic moment is, by definition, a completely two-dimensional (magnetic) quantity, and hence exceeds the capacity of direct representation by the reference system.

So, there would be a contribution from the degrees of freedom (DOF) of one-dimensional motion of the electron (+1 or -1, hence 2), the indirect effect of the two-dimensional motion in two dimensions onto itself (2^3), and the indirect effect of the full electric and magnetic motion as a combination (128). The effect is reduced by the appropriate 1/3 factor due to the motion distribution in three dimensions. As we have called the basic increment of 0.00115740740741 as x, we shall have the net effect as:

$$\mu_e = 1 + x + \underbrace{\left(2 - \frac{1}{3}\right)}_{I} x^2 + \underbrace{\left(8 - \frac{1}{3}\right)}_{II} x^3 + \underbrace{\left(128 - \frac{1}{3}\right)}_{III} x^4 = 1.00115965217649$$

Figure 2 shows the way the contributions occur. It is to be kept in mind that the contributions are only with respect to the third (red) dimension, which is what is relevant for us at the moment. Hence, only three possible increments can be obtained over and above the basic $1+x$. The effect of the unit moment, is followed by the net effect of the motion in the other two dimensions acting as a modification on 1, and the thick black line represents this value (x). Since this is the "new value" of the electric rotation, it changes the value of the increment due to the one-dimensional DOF of the electric motion as well, but to the next power, as the boundary is crossed twice. Similarly, for the two-dimensional DOF, $2^3=8$, we have the next power and finally for the total magnetic and electric motion conjunction, the three dimensional increment is 128, modified accordingly by a total of four crossings of the boundary.

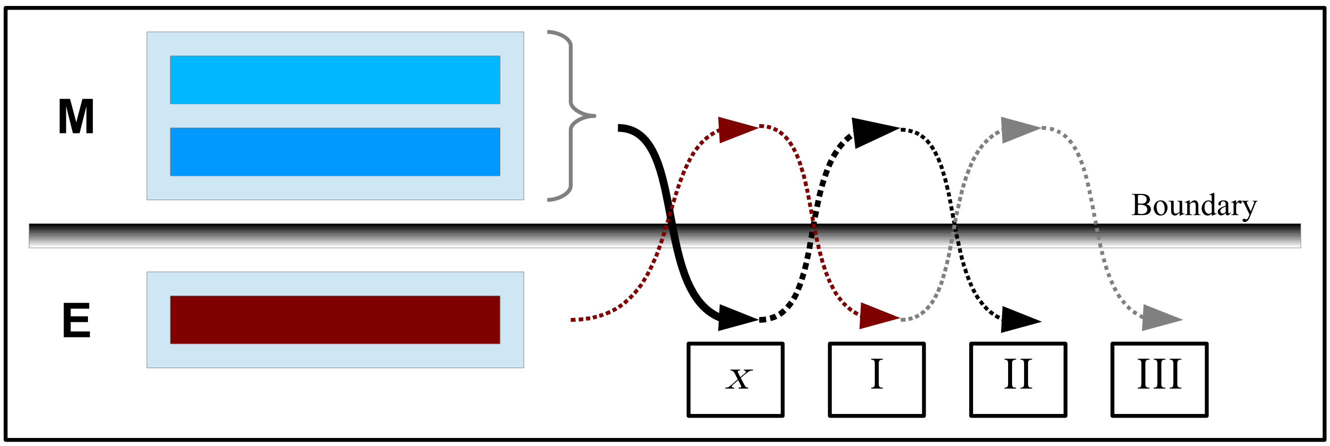

Figure 2: Contributions and their Interchange

The Muon

The situation for the Muon is similar, however, the number of terms reduces by one, as we have a basic solid rotation to start with, and hence the corrections only occur for the dimensions greater than two. Another factor which enters the relations is the fact that the reduction in the contributions of the overlap, which were a uniform 1/3 in the one dimensional case, now become two-dimensional (2/3). And the contributions of the specific terms also get multiplied by 2. The resulting expression is as shown below, with reference to Figure 3:

$$\mu_m = 1 + x + 2 \times \underbrace{\left(4 - \frac{2}{3}\right)}_{I} x^2 + 2 \times \underbrace{\left(128 - \frac{2}{3}\right)}_{II} x^3 = 1.00116673286897$$

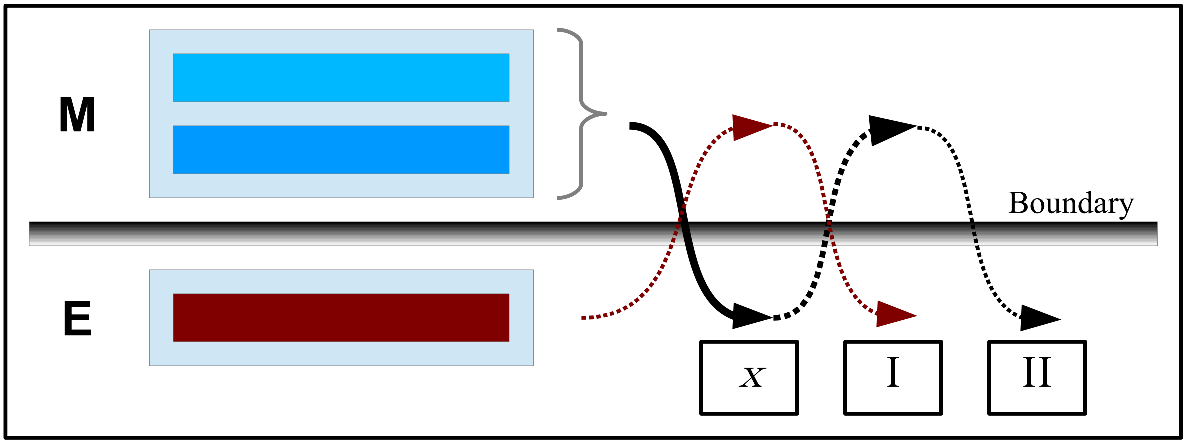

Figure 3: Muon Magnetic Moment Increments

The Tau Lepton

The experimental situation is a bit difficult in the case of the tau lepton, due to large uncertainties in measurement, hence our comparison may not be with accurate data. Nevertheless, we can identify what the addition in this case would be, where the entire 3 dimensional motion effect gets transmitted across the boundary of the electric dimension, resulting in 32=9 degrees of freedom for the indirect effect of the motion. There are no further 3 dimensional equivalents for the increment, and hence there is only one additional term, as shown:

$$\mu_\tau = 1 + x + 2 \times \underbrace{\left(9 - \frac{3}{3}\right)}_{I} x^2 = 1.00117616169410$$

With this, we are now in a position to compare with experimental data. It is seen that theoretically there can only be three further indirect increments for the one dimensional case, two for the two dimensional case, and one for the three dimensional case, due to the finite number of dimensions, and there are no infinite order corrections. It must also be noted that since we are essentially dealing with time region phenomena in their own domain (via frequencies and resonance spectroscopic measurements) we are hence not required to take into account the irrational number connection between the space/time region and the time region. The data for the electron and muon are taken from CODATA values.

Anomalous Magnetic Moment	**RS2 Theory**	**Experimental**	**Difference**
Electron	1.00115965217649	1.00115965218111[6]	-0.00000000000462
Muon	1.00116673286897	1.00116592069[7]	+0.000000812
Tauon	1.00117616169410	1.00117721[8]	+0.000001

6 CODATA: http://physics.nist.gov/cgi-bin/cuu/Value?muemsmub
7 CODATA: http://physics.nist.gov/cgi-bin/cuu/Value?amu
8 http://arxiv.org/PS_cache/hep-ph/pdf/0701/0701260v1.pdf