A phenomenological magnetic description for the origin of mass for leptons and for the complete baryon octet

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Abstract

The theory developed by the author for the origin of mass in leptons and nucleons, in vixra 1511.0005, is now applied to the entire baryon octet. It is shown that mass for all these particles depends on two quantities (within a factor of two accuracy), namely, the number of magnetic flux quanta trapped in an intrinsic vibrational motion, and the magnetic moment of the particle.

Introduction

This paper builds upon the recent work by the author, vixra 1511.0005[1], which should be consulted for details. In that paper, beginning from the concept of gauge invariance and accepting as true the zitterbewegung intrinsic motion of fundamental particles, as discussed by Barut and Bracken[2] among others, we associated the magnetodynamic energy of the motion with the rest energy of a particle. The main result of such analysis was eq. (3) of [1]:

$$\frac{mR^2}{\mu} = \frac{nh}{2\pi ec} \tag{1}$$

In this equation *m* is mass, *R* is the range of the vibrational intrinsic motion of the particle, μ is the magnetic moment, *n* is the number of magnetic flux quanta(admitted as given by the nonrelativistic expression *hc/e*). The model adopts experimental values for *m* and μ. For the nucleons *R* was given by theoretical values calculated by Miller[3], and for the electron (and now the muon) this parameter was assumed as equal to the Compton wavelength $\lambda = \hbar/mc$[2]. Good agreement between model and experiment was obtained for that reduced group of particles.

However, the application of the model to other particles depends on the knowledge of the parameter *R*. In order to put the model to further test, in the present work we decided to simply try and eliminate the explicit dependence of the model upon *R*. For the leptons the following expression is known to be valid:

$$\mu = e\lambda/2 \tag{2}$$

Here $\mu = \mu_B$ is the magnetic moment in the case of the electron (μ_B is the Bohr magneton; here we consider no further corrections). Therefore, for the remaining members of the baryon octet considered in this work we will assume that in (2) λ can be directly replaced by *R*, so that *R* is eliminated from (1) in favor of μ. It is clear that such possiblity associates mass to only two parameters, namely, the number of flux quanta imposed by gauge invariance conditions and the charges of the quarks inside the baryons, and to the inverse of the experimental magnetic moment. As shown below we verify that such proposal is experimentally confirmed.

Inserting the definion for R into (1) and using the definition of the fine structure constant $\alpha = e^2/\hbar c$ (which we assume as 1/137) we can rewite (1) in the form:

$$\frac{4c^2\alpha}{ne^3} m = \frac{1}{\mu} \tag{3}$$

Table 1 shows the data utilized for the two leptons and the eigth baryons analysed. The nucleons are reconsidered (see [1]), but with R recalculated according to the rule given above. The values of n are calculated for each particle from their quarks compositions, according to the rule adopted in ref. [1]. The magnetic moment data are from [4].

Analysis

Figure 1 shows the plot of eq.(3) and the inclined straight solid line would indicate perfect agreement with theory. We observe the following:

1) Equation (3) describes all the data available within a factor of two precision, given by the dotted lines in the plot of Figure 1.

However

2) The quantization rules adopted in this model[1] clearly correspond to a nonrelativistic limit. Part of the deviations observed from the solid line in Fig.1 is certainly related to this point.
3) The way the paramer n is calculated is open to questioning, as stressed in [1]. An alternative way of calculation, considering an average over different spins configurations for the quarks would decrease n by a factor of about ½ , which would make the baryons data converge to the solid line in the Figure..

There exists a wealth of references in the literature in which scaling laws are proposed based[5-7] on experimental results, to associate mass for all particles with the inverse of α. We see from (3) that such relation indeed is part of our results. In particular, the results of [7] might be reproduced if the ratio n/μ in (1) is made part of the *free arbitrary* parameter N in ref. [7].

In resume, this paper has shown that if one properly inserts quantum conditions in a closed-orbit intrinsic motion for the fundamental particles (

even in a nonrelativistic limit), in order that gauge invariance is introduced in the treatment, the masses for these particles are directly dependent only upon the inverse of their magnetic moments and upon the number of magnetic flux quanta inside the orbits. No other parameters seem essential in order to obtain a fator of two accuracy between theory and experiment..

References

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Table 1: Data utilized in Figure 1. The magnetic moments are from ref. [4]. One needs to convert mass to grams, magnetic moments to erg/gauss (all CGS units). The numbers *n* of flux quanta are calculated according to ref. [1].

part	Rest energy(MeV)	n	(Abs)Magnetic moment(n.m.)
e	0.511	1	1836
muon	105.66	1	8.89
p	938.27	6	2.79
n	939.56	7.5	1.91
$\Sigma +$	1189	6	2.46
$\Sigma 0$	1192	3.5	0.85
$\Sigma -$	1197	3	1.16
$\Xi 0$	1314	7.5	1.25
$\Xi -$	1321	3	0.65
Λ	1116	3.5	0.61

Figure 1: Plot of eq. [3]. The dotted lines indicate a factor of 2 around the solid line. Triangles are leptons and circles are baryons.