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Particle Radius versus Spin G-Factor (Empirical and Pharmaceutical Approach)

Janez Špringer

Cankarjeva cesta 2, 9250 Gornja Radgona, Slovenia, EU
info@lekarna-springer.si

Abstract: *In this paper the validity of the approximate formula* $g_{factor} \approx \frac{2}{spin^{-1}-1}$ *relating the electron spin and electron spin g-factor according to the pseudo-Heracletean dynamics on double surface is extended to other particles, too. Consequently the relation between particle radius and particle spin g-factor is revealed. And, for instance, muon radius* $r_{muon} = 1.37\ x\ 10^{-17} m$, *tau radius* $r_{tau} = 8.4\ x\ 10^{-19} m$ *as well as tau spin g-factor* $g_{tau} = 2{,}00242$ *is predicted.*

Keywords: *Particle radius, inverse spin or path-translation ratio, spin g-factor, pseudo-Heracletean dynamics on double surface, electron, proton, neutron, muon radi us, tau radius, tau spin g-factor*

1. The Theoretical Background

The subject of interest in this paper is to investigate the approximate relation between the fundamental particle (particle) spin and spin g-factor being observed at pseudo-Heracletean dynamics[1], [2] on double surface[2], [3]. The aim is to find out some relation between the particle-radius and spin g-factor.

1.1. Particle Inverse Spin on Double Surface

The particle inverse spin on double surface equals the path-translation ratio $\frac{s}{n}$ of that particle in on its own circumference concluded curved motion [2]:

$$spin^{-1} = \frac{s}{n} = 2 - \frac{1}{\sqrt{1+\frac{\pi^2}{n^2}}}. \qquad (1)$$

Here the path s, translation n and rotation π are expressed in the units of Compton wavelength $\lambda = \frac{h}{mc}$ of the spinning particle possessing mass m [2].

The relation can be written explicitly for the translation n:

$$n = \sqrt{\frac{\pi^2}{\left(\frac{1}{2-spin^{-1}}\right)^2-1}}. \qquad (2)$$

Or explicitly for the path s:

$$s = n\ x\ spin^{-1} = \sqrt{\frac{\pi^2}{\left(\frac{1}{2-spin^{-1}}\right)^2-1}}\ x\ spin^{-1}. \qquad (3)$$

1.2. Particle Inverse Spin Versus Spin G-Factor

Let us propose that the approximate relation between the electron spin and electron spin g-factor [2] is valid for other fundamental particles, too. Thus:

$$g_{factor} \approx 2\left(1 + \frac{2-spin^{-1}}{spin^{-1}-1}\right) = \frac{2}{spin^{-1}-1}. \qquad (4)$$

Here g_{factor} is a g-factor of some spinning particle and $spin^{-1}$ is the inverse spin of that particle.

The relation can be written explicitly for the inverse spin:

$$spin^{-1} = \frac{s}{n} \approx \mathbf{1}\frac{2}{g_{factor}}. \tag{5}$$

1.3. The Path s as the Circumference of the Spinning Particle Versus Particle Spin G-Factor

Applying relations (3) and (5) the explicit relation between path s (being the circumference of the spinning particle expressed in Compton wavelength of that particle) and the spin g-factor is given:

$$s = \frac{2\pi r_{particle}}{\lambda_{particle}} \approx \sqrt{\frac{\pi^2}{\left(\frac{1}{2-\left(1+\frac{2}{g_{factor}}\right)}\right)^2 - 1}}\; x\;(1 + \frac{2}{g_{factor}}). \tag{6}$$

Here g_{factor} is a g-factor of some spinning particle and $\lambda_{particle}$ is Compton wavelength of that particle.

1.4. The Radius of Spinning Particle Versus Particle Spin G-Factor

Rearranging the equation (6) the radius of spinning particle $r_{particle}$ is explicitly related to the spin g-factor of that particle as follows:

$$r_{particle} \approx \lambda_{particle}\; x \sqrt{\frac{1}{\left(\frac{1}{2-\left(1+\frac{2}{g_{factor}}\right)}\right)^2 - 1}}\; x\; \frac{1}{2}(1 + \frac{2}{g_{factor}}). \tag{7}$$

Here again g_{factor} is a g-factor of some spinning particle and $\lambda_{particle}$ is Compton wavelength of that particle.

2. The Radius of Electron, Proton and Neutron Related to the Particle Spin G-Factor

The strength of the relation between the radius of spinning particle and the particle spin g-factor (7) can be examined for the electron, proton and neutron with the help of data found in the literature [4], [5]. For the successful solution of the concerned task the CODATA values[4] and the values determined by the electron-nucleus scattering[5] are taken into account. The known and calculated values are collected in the Table 1.

Table1. *The known* [4], [5] *as well as calculated values of the electron, proton and neutron radius given with the help of the radius-spin g-factor relation* (7)

Particle	$Spin\ g_{factor}$	$Radius^{CODATA}$ x 10^{-15} m	$Mean\ radius^{(5)}$ x 10^{-15} m	$Calculated\ radius$ x 10^{-15} m
Electron	2.00231930436182(52)	2.8179403227(19)	/	2,8084
Proton	5.585694702(17)	0.8751(61)	0.77	0,75
Neutron	3.82608545(90)	/	0.6	0,55

The calculated values of the particle radii in the Table 1 are due to approximate mathematics (7) a little underestimated but nevertheless show that the concerned relation has essence.

3. The Muon Radius Predicted from the Muon Spin G-Factor

The results from the chapter 2 encourage one to predict the muon radius with the help of CODATA value of muon spin g-factor $g_{muon} = 2.0023318418(13)$ [4]. Applying the relation (7) the next prediction is given:

$$r_{muon}^{predicted} = 1.366\; x\; 10^{-17} m. \tag{8}$$

4. The Muon Radius Versus Electron Radius

The values of muon and electron radius r_{muon} , $r_{electron}$ and mass m_{muon} , $m_{electron}$ are collected and related in the Table2.

Table2. *The relation between the muon and electron radius and mass*

Particle	*Mass m* (MeV/c^2)	*Radius r* $(10^{-15}m)$	*Mass x radius* $(MeV/c^2)\ x\ 10^{-15}m$	$Spin\ g_{factor}$
muon	105.6583715(35)	0.01366	1.4430	2.0023318418(13)
electron	0.5109989461(31)	2.8179403227(19)	1.4400	2.00231930436182(52)

According to the data given in the Table2 the muon and electron radius and mass is in approximate inverse proportion: $m_{muon}\ x\ r_{muon} = m_{electron}\ x\ r_{electron} = 1.44\ x\ 10^{-15}\ \frac{MeV}{c^2} m.$ (9)

It is evident in the above Table(2) that the approximate constant (9) mirrors the approximate equality of the electron and muon spin g-factor.

5. THE TAU RADIUS PREDICTED

The approximate inverse proportion (9) between radius and mass could be extended for the tau particle, too since we have deal with the same kind of non-composed particle which mass $m_{tau} = 1776.82(16)\mathrm{MeV}/c^2$ [**4**] only slightly alters the spin g-factor as well as proportion factor. Indeed, extrapolating values from the table2 the next proportion factor for tau particle is expected:

$$m_{tau}\ x\ r_{tau} = 1{,}44 + \frac{1776.82-0.51}{105.66-0.51} x\ (1.443 - 1.440) \frac{MeV}{c^2} x\ 10^{-15} m = 1.49 x\ 10^{-15}\ \frac{MeV}{c^2} m. \quad (10)$$

Consequently the next prediction for the value of tau radius is given:

$$r_{tau}^{predicted} = \frac{m_{tau}\ x\ r_{tau}}{m_{tau}} = 8.4\ x\ 10^{-19} m. \quad (11)$$

6. THE TAU SPIN G-FACTOR PREDICTED

Knowing the tau radius (11) and applying the relation (7) the next value of tau spin g-factor is predicted:

$$g_{tau}^{predicted} = 2{,}00242. \quad (12)$$

7. THE FALSE PREDICTION OF PROTON AND NEUTRON RADIUS

The validity of approximate inverse proportion (9) between radius and mass should not be extended for composed particles, i.e. proton and neutron. Taking into account their mass $m_{proton} = 938.27\ \frac{MeV}{c^2}$ and $m_{neutron} = 939{,}57\ \frac{MeV}{c^2}$ [4] such a prediction would give a false result:

$$r_{proton}^{predicted} \approx r_{neutron}^{predicted} = 1.6\ x\ 10^{-18} m \ll 0.8\ or\ 0.6\ x\ 10^{-15} m. \quad (13)$$

8. CONCLUSION REMARKS

Empirical approach looks for the difference between mathematics and physics. Pharmaceutical approach estimates the significance of that difference.

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Dedication

This fragment is dedicated to my dear uncles: godfather Mihael† and sponsor Peter†.

AUTHOR'S BIOGRAPHY

Janez Špringer, a pharmacist by his profession, is an independent scientist who has been publishing papers in opened accessed scientific journals – i.e. Progress in Physics, GJSFR, IJARCS and IJARPS - quite often lately.