

Formulas for the g-factors of the Proton and Neutron

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This paper is a continuation of previous research [1], published in 2018. The approach is based on Ruđer Bošković's *Theory of Natural Philosophy* [2], the concept of *Unity of the Whole and the Parts* [3], and comparison of results with historical values from CODATA reports [4].

Due to limited opportunities for publishing research not originating from official institutions, the results are presented in the form of a brief communication. Detailed explanations of the methods will be provided on a future occasion. The concise format of the paper is considered an advantage in terms of clarity and focus on results.

Instead of using the magnetic moment, the *g-factor* is applied here, enabling direct comparison of dimensionless physical quantities. This substitution allowed for a theoretical determination of the neutron's *g-factor* with accuracy comparable to that of the proton.

LEGEND: Input values according to CODATA 2018:

- α – fine-structure constant (0,0072973525693)
- μ – proton-to-electron mass ratio (1836,15267343)
- $\beta = \mu * \alpha / 2\pi$ – ratio of the classical electron radius to the Compton wavelength of the proton
- $\Delta p = 2 - 1 / (\mu * \alpha + 2) = 1,9350609435$ – referred to as the “proton shift”
- $\gamma = [3 * e^{2\pi} / 4 + 3 * \log_2(2\pi) / 2 - \Delta p / 2] / [1 + \alpha^{-2} * \log_2(\mu)] = 0,0019872692$ – equivalent to the base-2 logarithm of the neutron-to-proton mass ratio
- g_{pn} – theoretically determined ratio of the proton and neutron *g-factors*
- g_{nt}, g_{pt} – theoretically determined *g-factors* of the neutron and proton

Formula for the g-factor ratio:

The formula was first introduced in [1]. The emergence of a volume-based structure represents just one link in the emergence of the material and spatial from Bošković's non-extended and massless. In other words, if the ratio of the proton and neutron g-factors obtained theoretically by this formula is denoted as g_{pn} , then:

$$g_{pn} = \sqrt{\frac{2 * \mu}{(1 + 4\pi * \alpha^{-1})}} * \left(1 + \frac{\alpha^2}{\sqrt{(2\pi)^3}} \right) = -1,45989806118 \quad (1)$$

Formulas for g -factors:

The formula yields results with a relative error an order of magnitude smaller than that reported by CODATA [4]. The negative square root sign aligns with the fact that the neutron's greater effective mass reduces the absolute value of g_{pn} .

Let's write in expanded form the "mass shift" Δg , which is the base-2 logarithmic value of the equivalent mass responsible for the neutron g -factor relative to a reference mass (similar to the "proton shift" in [3]):

$$\Delta g = \frac{\gamma}{(1 - g_{pn})} + 2 - \frac{1}{\mu * \alpha + 2^{\Delta p} * \alpha^{0.5} * (2\pi / \mu)^{1.5} + 2} = 1,935869086 \quad (2a)$$

Then the neutron g -factor is:

$$g_{nt} = -2^{\Delta g} = -3,826085427 \quad (2b)$$

And since from (1) it follows:

$$g_{pt} = g_{pn} * g_{nt} \quad (3a)$$

We also obtain the theoretical value for the proton g -factor:

$$g_{pt} = -g_{pn} * 2^{\Delta g} = 5,58569469653 \quad (3b)$$

The formulas provide predictions without additional fit parameters or complex calculations. To calculate both g -factors, it is sufficient to know only the constants α and μ , as is evident from the **LEGEND**, where all formulas are expressed in terms of these quantities.

For both nucleons, the relative error of the theoretical values is approximately 10^{-9} , which falls within the limits of experimental accuracy.

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