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# PHYSICAL AND MATHEMATICAL SCIENCES

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## MUON MAGNETIC MOMENT ANOMALY

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**Abstract** The article analyzes the results of experimental and theoretical studies of the value of the muon $g_\mu$-factor performed by an international group of scientists at the Fermilab facility as part of the Muon g-2 experiment. The analysis was carried out using both the Standard Model of the creation of the Universe and the model of the creation of the Universe with minimum initial entropy (UMIE). At the same time, it is shown that the Standard Model considers the Universe to be a three-dimensional space, the vacuum state of which contains only zero oscillations of electromagnetic waves. Such a model can explain the value of g-2 of an electron, which is different from zero exclusively due to the additional electromagnetic interaction. However, such a model contradicts the laws of physics, and therefore is unable to explain the g-2 value of the muon, even taking into account the interaction with all possible bosons.

On the other hand, UMIE does not contradict the laws of physics. She considers the Universe to be part of the Super-Universe, in which vacuum particles are the main state, and quarks and gluons are in a parallel two-dimensional space. From this it is clear that the g-2 value of the muon cannot be affected by gluons and bosons of weak interaction, and the main contribution is made by the interaction with electromagnetic oscillations and vacuum particles.

**Keywords:** Standard Model of the Universe, model of the Universe with minimum initial entropy, muon $g_\mu$-factor, vacuum particles.

Interesting and time-consuming scientific work was performed by an international group of scientists at the Fermilab facility as part of the Muon g-2 experiment [1]. A muon is a lepton. The lepton group includes the electron, muon, and tau lepton. All these particles have a negative electric charge. Sometimes, muon and tau lepton are called heavy electrons. Muon mass $m_\mu$ = 105.658369 MeV/$c^2$ = 206.768 $m_e$. The taon mass is 1.77686 GeV/$c^2$ = 3477.17 $m_e$. In addition to charged leptons, there are electroneutral leptons - electron neutrino, muon neutrino and taon neutrino. An electron is a stable particle, while heavy electrons are unstable. The average lifetime of a muon is $2.197 \cdot 10^{-6}$ s. The average lifetime of a taon is $2.9 \cdot 10^{-13}$ s.

All leptons have their magnetic moment (eħ/2mc), the magnitude of which is characterized by the g-factor (in units of e/2mc). The classical value of the g-factor is equal to 2. However, there are a number of interactions in nature, mainly with quanta of the electromagnetic field, which slightly increase the value of the g-factor. Therefore, the value of electron $g_e$ = 2.002319304386, and the theory within the Standard Model of the Universe fully describes the excess value of the $g_e$-factor.

Calculating the theoretical value of the muon's $g_\mu$-factor from the Standard Model is extremely difficult since its value is affected by interactions with particles in the quantum foam surrounding it. The calculations also consider the electromagnetic, weak, and strong nuclear forces, including photons, electrons, quarks, gluons, neutrinos, W and Z bosons, and the Higgs boson.

The last such prediction took place in 2020 [2]. Note that the results of such calculations will be affected by systematic errors of hadronic vacuum polarization and other factors. These results yielded the value $a_\mu^{SM}$ = 0.00116591810(43) for the muon's anomalous magnetic moment. Experimental results published in [1] give $a_\mu$ = 0.00116592059(22) (0.19 ppm), which is a twofold increase in accuracy.

The new experimental result for the $g_\mu$-factor is as follows:

g-2 = 0.00233184110 ± 0.00000000043 (stat.) ± 0.00000000019 (system).

The deviation of the experimentally obtained results from the prediction of the theory based on the Standard Model is interpreted as the existence of a window to study new physics beyond the Standard Model.

Of course, it is good that the article's authors [1] understand that it is necessary to work outside the Standard Model but remain its supporters.

First, you need to understand that the Standard Model of the creation of the Universe contradicts the laws of physics, and our three-dimensional Universe is only some of what there is to know. The three-dimensional Universe fully describes electromagnetic oscillations and waves. Therefore, in the case of an electron, the value of $g_e$-factor the theory correctly describes the experimental data. For a theoretical description of the muon's magnetic moment, corrections must be chosen based on the multidimensionality of the Super-Universe, of which our Universe is an element. Therefore, it is necessary to reject the Standard Model and switch to a new model that would not contradict the laws of physics.

**Model of the creation of the Universe with minimum initial entropy (UMIE)**

Forming the most important concept of modern physics is difficult - physical vacuum (PV). Before the creation of relativistic theories of the Special theory of relativity (STR) and General theory of relativity (GTR), the basis of almost all physical theories was the idea of mechanical ether as an all-pervading material substance. The ether was replaced by absolute emptiness after the emergence of STR and GTR. Although P. Dirac introduced the concept of special ether, which corresponds to a microcosm filled with particles with negative energy, the idea of space as a curved void continued to prevail in physics. The experimental discovery of corrections to the electron's magnetic moment forced physicists to endow PV with "vacuum corrections." PV is considered only as the lowest state of quantum fields. However, it continues endowed with more unexplained but rigidly postulated properties. There is no hint of the mechanisms of birth and destruction of particles. At the same time, the existence of virtual states (quantum foam) of elementary particles in PV is postulated.

In the fundamental work of I. Gerlovin [3], it was shown for the first time that during the annihilation of a particle-antiparticle pair, they are not eliminated, as is currently believed but are combined into a system called an elementary vacuum particle (EVP). In EVP, in the unexcited state in our laboratory space, all quantum numbers are equal to zero. These are the main virtual particles that make up the entire PV. Such an idea of PV corresponds to all experimental data and allows I. Gerlovin to correctly describe the whole spectrum of elementary particles even before their discovery in experiments.

The author showed, developing the UMIE model [4, 5], that our Universe is a component of the layered Super-Universe, which consists of 4 layers: zero-dimensional (fundamental 12-dimensional spatial sphere), one-dimensional (two spatial coordinates folded into rings of fundamental size), two-dimensional (one spatial coordinate is collapsed into a ring of fundamental size) and three-dimensional layer - our Universe, which has 3 collapsed coordinates and 3 unfolded coordinates. Time and information coordinates are common for all layers. The Scalar Field continuously enters through the zero-dimensional prime, which carries the fundamental code according to which the Universe and layers with reduced dimensions are formed [6, 7]. In one-dimensional space, the Scalar Field creates Planck particles, which have the properties of dyons. In the two-dimensional world, the Scalar Field creates quarks, and the dimension of space provides a 3-fold reduced quantum value of the electric charge. In our three-dimensional space, the Scalar Field creates the entire palette of elementary particles, atomic nuclei, atoms and molecules, planets, stars, galaxies and clusters of galaxies. Being common to different layers of the Super-Universe, the Scalar Field provides information communication between particles of different spaces and certain physical properties. The Scalar Field is present near every particle, providing it with mass, charges, spins, etc. The Scalar Field itself is responsible for the particle-antiparticle annihilation process. At the same time, vacuum particles are created, all of which quantum numbers (including mass) are equal to zero. It creates virtual particles by exciting vacuum particles. The polarization of a vacuum particle in the field of an atomic nucleus allows it to be excited by electromagnetic radiation with the formation of a real particle-antiparticle pair.

As shown by I. Gerlovin [3], the basis of the physical vacuum is a proton-antiproton ($p^+p^-$) vacuum. The EVP concentration in this type of vacuum is $n_w(p^+p^-) = 1.54541 \cdot 10^{39}$ cm$^{-3}$, while the EVP concentration in the electron-positron vacuum closest to it is $n_w(e^+e^-) = 1.73009 \cdot 10^{29}$ cm$^{-3}$, i.e. 10 orders of magnitude lower. Therefore, the main properties of the physical vacuum are determined by the parameters of the proton.

It is clear that the magnitude of the muon's magnetic moment will be influenced by the interaction with polarized particles not only of the proton PV but also of the muon PV. If the muon were a stable particle, the concentration of the corresponding vacuum particles would be intermediate between the concentration $n_w(p^+p^-)$ and $n_w(e^+e^-)$. Muon instability significantly lowers the concentration of the corresponding vacuum particles. Nevertheless, they will significantly affect the magnitude of the muon's magnetic moment.

The interactions of the muon with weak and strong nuclear forces, with quarks, gluons, neutrinos, W- and Z-bosons, and the Higgs boson considered in [2] are most likely insignificant. The Scalar Field in the UMIE model is responsible for the mass of elementary particles, so the influence of the Higgs boson must be removed. The weak interaction is manifested only in the case of the creation of W- and Z-bosons by corresponding quarks in the presence of a pair or several pairs of neighbouring quarks due to the Scalar Field. The virtual particles that surround the muon cannot detect the weak interaction. And therefore, there is no influence of neutrinos. A strong interaction in a virtual pair of nucleons is also not manifested. The interaction of the muon with quarks and gluons, with which a virtual pair of nucleons interacts, will be significantly reduced.

Thus, this publication shows a real way to describe the anomalous magnetic moment of the muon adequately.

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