

# Strange behavior of protons in the large hadron collider and cosmic detectors PAMELA and AMS–02

## Abstract

The behavior of relativistic protons in the Large Hadron Collider (LHC) and the PAMELA and AMS–02 space cannot be explained within the framework of the Standard Model (SM). Experiments are presented in the article, the analysis of which makes it possible to explain the strange behavior of relativistic protons both in LHC and both magnetic spectrometers PAMELA and AMS–02, through the participation of a quantum vacuum (dark matter).

**Keywords:** vacuum, dark matter, proton, electron, positron, resonance, mass, energy

Volume 2 Issue 4 - 2018

Konstantinov Stanislav Ivanovich

Department of Physical Electronics, Russian State Pedagogical University, Russia

**Correspondence:** Konstantinov Stanislav Ivanovich, Department of Physical Electronics, Russian State Pedagogical University, St. Petersburg, RSC Energy, Russia, Tel +8911-7159-176, Email konstantinov.s.i@yandex.com

Received: May 28, 2018 | Published: July 05, 2018

## Introduction

The behavior of relativistic protons in Large Hadron Collider (LHC) and cosmic detectors PAMELA and AMS–02 space cannot be explained within the framework of the Standard Model (SM). In colliders, this problem is especially evident in the case of strong interactions in the so-called soft hadronic processes. The most striking is that the interval of resonant proton energy in the LHC, at which the greatest probability of inelastic collisions of protons and the creation of new particles is observed, corresponds to the energy interval  $W_p \approx 10 - 100 \text{ GeV}$ ,<sup>1</sup> however, with increasing energy of relativistic protons, the effect of their stability after collision increases, that is, the probability of conservation of the proton as a single particle increases with increasing collision energy.<sup>1</sup> Noteworthy is the fact that in the alpha-magnetic spectrometer AMS–02, the resonance maximum of the total energy spectrum of the secondary electrons and positrons,<sup>2</sup> as well as the maxima of the energy spectra obtained separately for positrons<sup>2</sup> and electrons<sup>2</sup> also corresponds to the energy interval  $W_p \approx 10 - 100 \text{ GeV}$ . It can be assumed that the creation of new particles in this energy range is associated with the polarization of a quantum vacuum (dark matter) and are irrelevant to the integrity of the protons, that is, all collisions of protons in the LHC are elastic. It convincingly confirms the non-gravitational manifestation of dark matter (quantum vacuum) in near-Earth space and in Large Hadron Collider. Finally, oddities in the behavior of protons include the fact that in the PAMELA magnetic spectrometer, as the energy of relativistic protons increases, the probability of their registration as primary positrons increases.<sup>3</sup> I will try to explain the strange behavior of protons on based of the polarization of quantum vacuum in the theory electrodynamics (QED), and the theory of the Bayon (TB) of professor Yu.A. Baurov, and also on based on new discoveries obtained from the analysis of experiments at the Large Hadron Collider (LHC) and at the PAMELA and AMS–02 space detectors.

## The polarization of a quantum vacuum (dark matter)

In classical electrodynamics, vacuum is a “medium” with absolute dielectric and magnetic permeability ( $\epsilon_0, \mu_0$ ), which are equal to the dielectric and magnetic constant ( $\epsilon_0, \mu_0$ ). The electric strength of the vacuum is infinite, that is, theoretically the electric field of any

intensity cannot cause conduction currents in a vacuum due to the lack of charge carriers. In other words, the electric field strength  $E$ , the magnetic field strength  $H$ , as well as the density of electromagnetic energy in vacuum defined by them, can be infinitely large. It should be noted that these conclusions are obtained from the standpoint of the classical electrodynamics of Maxwell's linear field and, in the light of the latest achievements of quantum electrodynamics (QED), are incorrect. In QED, the instability of a physical vacuum under the influence of cosmic radiation, relativistic protons and electrons, peak electric fields, or high-intensity laser radiation is characterized by the avalanche formation of electron-positron pairs in a vacuum.<sup>4-6</sup> Experiments show that if an external field acts on the vacuum, then the creation of real particles is possible due to its energy.<sup>4-6</sup> Precisely because the vacuum is not a virtual but a real physical object (dark matter) and has a structure, the vacuum polarization leads not to virtual, but real radiation corrections to the laws of quantum electrodynamics. With the polarization of the vacuum and its transformation into matter, the change in the energy of the vacuum  $w$  can be represented as a sum:

$$w = w^p + w^{er} \quad (1)$$

where  $w^p$  is the vacuum polarization,  $w^p \ll E^2 / 8\pi$ ;  $w^{er}$  is the change in the energy of the substance at the production of particles.

$$w^{er} = eET \wp \ddot{\wp} = \frac{e^2 E^2 T}{4\pi^3} \exp\left(-\frac{m^2}{2E}\right) \quad (2)$$

The creation of particles is the main reason for the change in the energy of the vacuum. The small value of the reverse reaction  $w^p$  implies the limitation on the electric field strength for a given time  $T$  ( $E_s \approx 10^{16} \text{ V} \cdot \text{cm}^{-1}$  is the critical Schwinger's field).<sup>4</sup>

In studies conducted in 1996–99 on the SLAC linear accelerator, only a few electron-positron pair creation events were detected at a laser pulse intensity of  $10^{17} \text{ W} \cdot \text{cm}^{-2}$ . Due to the fact that within the framework of the ELI and XCELS projects the laser radiation intensity available for experiments has increased to  $10^{23} \text{ W} \cdot \text{cm}^{-2}$  and higher, it has become possible to study the nonlinear vacuum effects that have so far not been experimentally studied. Thus, at the level of ultrahigh intensities  $10^{26} \text{ W} \cdot \text{cm}^{-2}$ , the effect of scattering of a laser pulse on an electron beam with an energy of 46.6 GeV (nonlinear Compton effect) causes such cascades of successive hard-photon

emissions that the creation of secondary electron–positron pairs in vacuum is a chain reaction that continues up to the moment of complete loss of energy by charged particles. This is very reminiscent of the extensive atmospheric showers generated by cosmic particles. They are called S–cascades (from the English shower–a shower).<sup>5,6</sup> In this comparison of space observations with the results of laboratory studies demonstrates deep analogies, evidencing, at a minimum, the unity of the physical principles of the behavior of matter in a wide range of densities and temperatures. Perhaps the creation of electron–positron pairs in a vacuum is a manifestation of the instability of dark matter. Today, according to the results of the experiments at CERN, many physicists believe that dark matter is connected with the study of the microworld at the smallest distances, and everything suggests that dark matter can act as a vacuum in experiments in near–Earth space and in Large Hadron Collider (LHC).<sup>7</sup> The quantum vacuum is a global field of oscillators' super–positions with the continuum of frequencies. In contrast to the field, a particle oscillates with the same fixed frequency. In front of us, there is an example of the non–integrable Poincare system. Resonances will occur whenever the frequency of the field and the particle coincide. The evolution of dynamical systems (field–particle) up to the self–organized matter depends on available resonances between degrees of freedom. This was a conclusion by I. Prigogine and I. Stenger in their monograph the “Time, Chaos, Quantum”.<sup>8</sup> They revived an idea by N. Tesla on a theory of global resonance. Nevertheless, if the Tesla's resonance theory of the matter birth in the ether had been based on an intuition of the ingenious experimenter, then in case of I. Prigogine, this theory acquired rigorous mathematical view. Proved by Poincare non–integrable dynamical systems and the theory of resonant trajectories by Kolmogorov–Arnold–Moser allowed Prigogine to conclude that the mechanism of resonance interaction of particles in large–scale Poincare a system (LPS) was “essentially” probable (binding). With increasing communication parameters, there is an increase in likelihood of resonance outcomes. It is such LPS dynamic systems, to which systems of particle interaction with the space environment and with each other belong. I. Prigogine wrote, “Should the systems be integrable, then for coherence and self–actualisation there would be simply no place as all dynamic movements would essentially be isomorphic movements of free (non–interacting) particles. Fortunately, the LPS in nature prevail over other systems.”<sup>8</sup> To describe the irreversible processes for the production of particles of baryonic matter in a quantum vacuum, of the professor Yu.A. Baurov proposed a new theory of the Bayon (TB).<sup>9</sup> The essential difference between TB and modern gauge representations of the Standard Model of classical and quantum theory is that the potentials of physical fields acquire exactly fixed values. The bayons are special nonobservable discrete objects, from which the three–dimensional physical space and the world of elementary particles arise as a result of minimization of the potential energy of their interactions. The definition of the bayon includes the cosmological vector potential  $\vec{A}_g = 1,95 \cdot 10^{11} \text{ Gs} \cdot \text{cm}$ . The base object for the formation of masses of leptons in TB is object 4B, which arises in the process of minimizing the potential energy of the bayon. The bulk of the potential energy passes into the energy of rotation (spin) of elementary particles. The residual part is treated as a mass of particles. For an electron, the minimum residual potential energy  $E = 33 \text{ eV}$ . Inside TB, the physical space without particles, from the bayon matter, is a quantum medium formed from bayons 4B having an uncertainty interval of Heisenberg. Smearing of objects 4B in the Universe creates the observed matter density in the Universe of  $\rho v = (0.721 \pm 0.025) \cdot 10^{-2} \cdot g \cdot cm^{-3}$  (dark energy and dark matter) and connects all objects of the universe in one information field.<sup>9</sup>

## Experiments

### The pressure inside the proton

In May 2018 in the journal Nature, were published experiments by American scientists on measuring the pressure inside a proton.<sup>11</sup> Volker Burkert and his colleagues at the Jefferson Laboratory conducted a series of experiments on the accelerator CEBAF. After the collision of fast electrons with a mass of liquid hydrogen (a source of protons), the researchers registered the particles arising as a result of their interaction – an electron, a proton and two photons. This allowed for the first time to measure the pressure in the center of the proton, bombarding the proton with electrons whose energy reached 100 MeV or more, which allowed the electron to penetrate into the structure of the proton. Investigations in particle physics at the CEB–1 collider of the Novosibirsk Budker Institute of Nuclear Physics, Siberian Branch of the Russian Academy of Sciences have confirmed the validity of quantum electrodynamics at energies up to an energy of  $2 \times 160 \text{ MeV}$ . That is, they confirmed that the electron is a point formation in scales up to  $4 \times 10^{-14} \text{ cm}$  and, unlike the proton, does not have an internal structure.<sup>11</sup> At such a small value, the electrons penetrate into the proton. Then the researchers observed the scattering of the photons, comparing their characteristics with information about the proton and the accelerated electron. This scattering gave the scientists a scheme of energies and pulses that made it possible to describe the extreme pressure in the center of the proton. According to modern views the proton consists of three quarks – two u–quarks (upper quarks from the word up) and one d–quark (the bottom quark from the word down), hence the designation uud. The gluons bind quarks in a single particle. The maximum repulsion between quarks is observed at a distance of  $6 \times 10^{-13} \text{ m}$ , with the pressure reaching  $10^{35} \text{ Pascal}$ . This indicator is considered one of the key characteristics of the proton: colossal pressure is directed from the center outward, counteracting the pressure of the outer regions of the particle directed toward the center.<sup>10</sup>

### The effect of the stability of relativistic protons with increasing energy of their collision in the Large Hadron Collider (LHC)

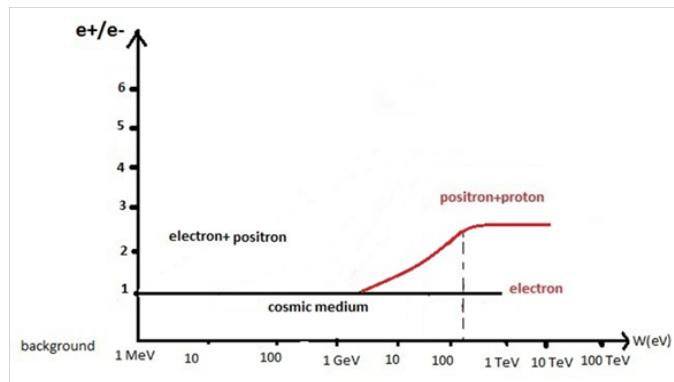
The experimental discoveries made recently in the LHC include an increase in the fraction of the processes of elastic scattering of relativistic protons as their collision energy increases, that is, an increase in the proton stability effect. The proton beams collide in the LHC with energies up to 13 TeV in their center of mass system. This energy should exceed the proton's own rest mass by more than four orders of magnitude ( $m_p \sim 9380000 \text{ MeV}$ ). The main goal of research at the collider is to study the forces that control the interaction of particles and clarify their internal structure. Although there are currently no indications of critical deviations from the predictions of the Standard Model (SM), which combines strong and electroweak interactions, a number of experimental facts that need to be explained are observed. This problem is especially evident in the case of strong interactions in the so–called soft hadronic processes. In particular, it is surprising that as the collision energy of relativistic protons increases, the probability of their integrity increases. Such a picture contradicts the notions of classical physics and goes beyond the framework of the SM. The author of the article<sup>1</sup> professor I.V. Dremin concludes that the probability of the survival of two protons with preservation of their integrity, with increasing collision energy, is related to the purely quantum nature of the structure of hadrons with quarks and gluons located inside. They manifest themselves in inelastic processes in the form of newly born ordinary particles

and resonances. It is the dynamics of internal fields in the process of elastic collision of protons that should be responsible for the observed increase in the probability of proton survival with increasing energy. However, new discoveries make it necessary to reconsider the nature of the resonances and the mechanism for the production of new particles. Since the middle of the last century, the study of the interaction of high-energy particles has made it possible to detect resonances that manifest themselves in the form of peaks on the general monotonic behavior of the cross sections of their interactions. Resonances were interpreted as a consequence of the presence of quantum levels in the systems themselves and identified in SM as newly generated unstable particles. Today, all resonances are classified and described within the framework of the Standard Model up to the Higgs Bosons. But the question arises whether it will be correct to interpret all the resonances only to the particles themselves. After determining the pressure in the proton  $P \sim 10^{35}$  Pascal,<sup>10</sup> it is naive to think that even the maximum energy of 13 TeV, reported to protons in a collision in the LHC, is capable of destroying the integrity of the proton as a particle. Then on what basis do researchers talk about inelastic collisions of protons at collision energies of the order of 10–500 GeV, their destruction and production of unstable particles. The creation of unstable particles in the LHC at proton energies of the order of 10–500 GeV is indeed observed, but this effect can be explained by the polarization of the quantum vacuum (dark matter), which is the third full participant in collisions of protons in the LHC and whose presence the apologists of the dominant 100 years in the physics of the Einstein's Special Relativity Theory (SRT) deny.<sup>12</sup>

### The Pamela experiment

The PAMELA magnetic spectrometer was launched aboard the Resurs-DK satellite to an elliptical near-polar orbit with a height of 350–600 km to study the fluxes of particles and antiparticles of cosmic radiation in a wide energy range from tens of MeV to hundreds of GeV. Since July 2006 to January 2016 continuous measurements of cosmic ray fluxes were carried out. The PAMELA device consists of a magnetic spectrometer based on a permanent magnet of  $\sim 0.4$  Tl, surrounded by anti-coincidence detectors, an electromagnetic calorimeter, a time-of-flight system, scintillation counters and a neutron detector. The magnetic spectrometer has six silicon strip planes that measure the coordinates of the track with an accuracy of 3 km, which allows us to determine the sign of the charge of the particle and their stiffness by the deviation in the magnetic field. The electromagnetic calorimeter makes it possible to separate the electromagnetic and hadronic cascades and measure the energy of electrons and positrons with an accuracy of not worse than 10% from several GeV to hundreds of GeV. The time-of-flight system has a resolution of about 300 ps and makes it possible to separate low-energy protons from positrons up to 0.8–1 GeV. The authors of the PAMELA device assert that “the use of a full set of criteria provides a proton–screening coefficient at the level of  $10^{-5}$ , which makes it possible to reliably isolate electrons and positrons against a background of protons.”<sup>13</sup> We draw attention to the fact that up to an energy of 0.8–1 GeV, low-energy protons were separated from positrons by means of a time-of-flight system with a resolution of about 300 ps, and then the separation of positrons and relativistic protons is carried out using other systems based on the behavior of charged particles in a constant magnetic field of 0.4 Tl of the PAMELA spectrometer. It is from this moment on that the “PAMELA Effect” begins to appear (Figure 1). Today there appeared a large number of works explaining the growth of positrons in the PAMELA effect, their number exceeded several hundred. The very number indicates that there is still no convincing explanation. At the

same time, researchers completely exclude the explanation of positron growth by the errors of experiments, however such a system error may exist, since all detectors are based on general physical principles, which use magnetic spectrometers to separate charged cosmic particles and measure their energy.



**Figure 1** Graph of measurement of positron–electron ratio ( $e^+/e^-$ ) in PAMELA and AMS experiments.

### “PAMELA effect”

The “PAMELA effect” consists in an inexplicable increase in the number of positrons with respect to electrons detected by the PAMELA magnetic spectrometer, with an increase in the energy of cosmic radiation and relativistic protons starting from 5 GeV.<sup>13</sup> The same effect is observed in the registration of the electron–positron ratio in AMS-02 and FERMI- LAT but at higher energy values.<sup>3</sup> Primary high-energy electrons and protons in cosmic rays are formed during acceleration in supernova remnants. Secondary electrons and positrons are generated in the cosmic medium by relativistic protons and cosmic radiation and are within the boundaries of the Earth's magnetosphere, which is assumed to be 25,000 km. The generation of secondary particles under the action of relativistic protons is almost 100 times higher than from of cosmic radiation, and the energy spectrum of secondary positrons and electrons is very “soft” with a sharp drop above 100 MeV.<sup>13</sup> It was established that the generation of secondary particles increases with increasing altitude (by decreasing the magnetic field  $B$  below 0.215 G). The results obtained are difficult to explain in the framework of the model of inelastic interactions of the protons of the radiation belt with atomic nuclei of the residual atmosphere.<sup>13</sup> Another mechanism for the formation of secondary electron–positron pairs can be the collision of protons with protons and nuclei of the interstellar medium. In these collisions, pions and kaons are formed, which eventually decay into leptons.<sup>3</sup> The formation of electron–positron pairs excludes the PAMELA effect. However, an analysis of the results of observations shows that in the range 20–200 GeV, the electron spectrum decreases with increasing energy faster than the positron spectrum, that is, the electron spectrum is softer. This may indicate the primary nature of positron origin, which is difficult to explain in the framework of the traditional model of diffusion propagation of cosmic rays. The solution of the puzzle “PAMELA Effect” is at the intersection of three areas of physics: elementary particle physics, electrodynamics and astrophysics. Let us consider another way of producing electron–positron pairs in near-earth space by means of reconnection–explosive contact between two lines of the magnetic field in thin layers of the Earth's magnetosphere under the action of the solar wind at an altitude of up to 25,000 km. Four NASA probes within the framework of the

mission of Magnetospheric Multiscale (MMS) recorded a sharp surge of electrons and positrons in the thin layers of the Earth's magnetic field in the collision of the magnetosphere and the solar wind creating an extremely turbulent zone.<sup>8</sup> Fast particles and antiparticles are born and fly out of this zone in exactly the opposite directions. These jets of particles are typical for reconnection. Researcher Tan Fang from the University of California at Berkeley said that the resolution of previous measurements of the probes was not enough to detect reconnection in thin layers of the magnetic field. As part of the MMS mission, each of the four three-meter octagonal probes carries 25 sensors and all four probes rotate around the Earth from 2015, performing the main task: to investigate explosive short-term processes of reconnection.<sup>8</sup> The birth of electron-positron pairs in cosmic vacuum (dark matter) in the process of reconnection is one of the unexplored sources of particles and antiparticles in near-Earth space. However, this process also excludes the PAMELA effect, since an equal number of secondary electron-positron pairs is produced during the polarization of the quantum vacuum (dark matter).

Consider the probability that in the role of positrons in the PAMELA effect, relativistic proton can appear that are mistakenly summed in the PAMELA and AMS-02 detector with positrons. This can also be confirmed by the fact that the spectrum of secondary positrons becomes more rigid with increasing energy, while the spectrum of electrons varies little.<sup>2</sup> The mechanism of acceleration of cosmic rays in expanding non-relativistic shock waves during a supernova explosion predicts a law of spectrum with exponent of degree  $\gamma$  with cutoff at high energies for the energy spectra of protons:<sup>2</sup>

$$\Phi = C \left( \frac{E}{E_0} \right)^{-\gamma} \exp \left( -\frac{E}{E_0} \right), \quad (3)$$

It exactly corresponds to the spectrum of the "source" of primary positrons in the PAMELA effect in the energy range 20–200 GeV.<sup>2</sup> The spectral index  $\gamma$  is usually 2, although with great uncertainty. This fact confirms that together with positrons the detectors PAMELA and AMS-02 fix relativistic protons. Consider a possible mechanism for the failure of space detector equipment.

## A technique for measuring the energy of charged particles in a magnetic spectrometer and their separation with the participation of the Lorentz force

The most common instruments for the accurate measurement of the energy spectrum of constant and pulsed beams of charged particles are magnetic spectrometers. This method is based on the dependence of the radius of the cyclotron orbit on the kinetic energy of the particle. The equality of the Lorentz's force and the centrifugal force when the particle moves around the circumference in a homogeneous magnetic field leads to the equation:

$$qvB = \frac{mv^2}{r} \quad (4),$$

where  $q$  is the particle charge,  $v$  is its velocity,  $B$  is the magnetic field induction,  $r$  is the radius of the cyclotron orbit,  $m = m_0 / \sqrt{1 - v^2 / c^2}$ ,  $m_0$  = rest mass &  $c$  is the speed of light.

From the known  $q$ ,  $r$ ,  $B$ , we can calculate the kinetic energy of a particle:

$$W = m_0 c^2 \left\{ \sqrt{\frac{q^2 \mathbf{B}^2 r^2}{(m_0 c^2)^2} + 1} - 1 \right\} \quad (5)$$

In modern spectrometers, an approximate relation is used to estimate the kinetic energy of ultrarelativistic charged particles in a magnetic field when  $qBr \gg m_0 c^2$ .<sup>15</sup>

$$W \approx qBr \quad (6)$$

where  $q$  is the particle charge,  $\mathbf{B}$  is the induction of a homogeneous magnetic field,  $r$  is the radius of a circle described by a particle.

It can be seen from expression (6) that the kinetic energy of a charged particle in a magnetic spectrometer is directly proportional to the charge value, which in classical electrodynamics does not depend on the velocity of the particle, and the radius of the cyclotron orbit, which is determined experimentally in the spectrometer. However, as the velocity of the particle approaches the speed of light, the effectiveness of the action of the magnetic field on the charged relativistic particle and, correspondingly, the radius of the cyclotron orbit of the ultrarelativistic particle, described by it under the action of the Lorentz force, decreases. To estimate this, it is necessary to isolate of the ultrarelativistic particle, to turn the energy into other forms—and this requires the interaction of a fast particle not with fields, but with matter. The first honest measurements of the brake losses of fast particles – in proportional counters<sup>16</sup> and photographic emulsions<sup>17</sup> – showed: the energy of the particle does not grow into relativistic infinity, but goes to saturation. In the CEBB-4M collider of the Novosibirsk Budker Institute of Nuclear Physics, Siberian Branch of the Russian Academy of Sciences, for measuring the energy (mass) of particles was developed and tested, a unique technique of resonant depolarization with a record high absolute accuracy of measurement of  $10^{-6}$ .<sup>11</sup> The final clarification of this question was made by the Chinese physicist Fan Liangjia in 2010 after three experiments on a linear accelerator at the Shanghai University each of them clearly indicates the absence of relativistic growth the mass in infinity for fast electrons at  $v \rightarrow c$ .<sup>18</sup> Particularly impressive is the fact that when the accelerating voltage increases several times the radius of curvature of the trajectory of a relativistic electron in a magnetic field instead of increasing remains constant. In the framework of relativistic ideas (formula (5)) this cannot be, however, taking into account the presence of a quantum vacuum (dark matter), the increase in particle mass with velocity occurs for other reasons. When the frequency of oscillations

arising when a particle moves in dark matter  $\omega_B = \frac{mv^2}{\hbar r}$  close to the

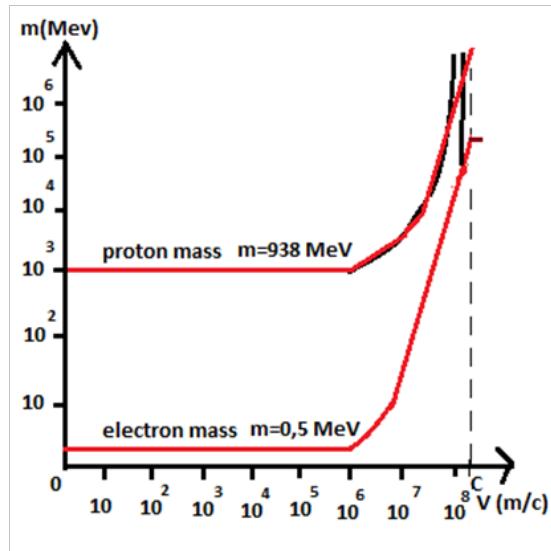
natural frequency of oscillation of the particle  $\omega_S = \frac{mc^2}{\hbar}$ , resonance occurs. Resonance is accompanied by an increase in the additional mass of the particle:

$$\Delta m = \hbar \omega_r / c^2 \quad (7)$$

The standard graph of the dependence of the particle's mass on its speed is now simply half the amplitude-frequency characteristic of the forced oscillations of a harmonic oscillator with no dissipation, and the mass growth is absolute.<sup>19</sup>

It is seen from Figure 2 that at a particle velocity of less than  $10^7$

$m \cdot s^{-1}$ , the value of the mass calculated from the equation (7) and from Einstein's formula ( $m = m_0 / \sqrt{1 - v^2 / c^2}$ ,  $m_0$ =rest masses), coincide, and, further, the values of the calculated masses begin to differ.



**Figure 2** The standard graph of the dependence of the particle's mass (energy) on its speed at  $v \rightarrow c$ . Red color denotes the limitation of the mass (energy) of the particle as  $v \rightarrow c$  (experiments Dr. Fan Liangjia on a linear accelerator at the Shanghai University in 2010). Black color means infinite growth of mass (energy) of a particle as  $v \rightarrow c$ . (Einstein's theory).

This indicates a complete inapplicability of the magnetic spectrometer in the region of relativistic measurements. Thus, the reliability of the conclusions about the complete elimination of relativistic protons from the flux of secondary electrons and positrons in the PAMELA magnetic spectrometer is doubtful.<sup>3</sup>

## Conclusion

The main goal of the study at the Large Hadron Collider (LHC) is to study the forces controlling the interaction of particles and to clarify the internal structure of the surrounding matter. The theory of such forces is now known as the Standard Model (SM), which combines strong and electroweak interactions. To explain new experimental facts require for of the original theoretical hypothesis, allowing to go beyond the SM.<sup>9,19,20</sup> According to UQT, multi-particle production in LHC after the collision of high-energy protons (with large amplitude of the packet) with some periodical structure of another protons is simply the diffraction process of the interaction of non-linear waves one on another, and the jets of the resulting particles are diffraction maxima.<sup>19</sup> According to another hypothesis is expected the presence of a quantum medium (dark matter) in the physical space of the LHC and its influence on the behavior of colliding beams of relativistic protons.<sup>3,9</sup> In this connection, it is possible to revise the statistical properties of many short-lived particles found in the LHC. Indeed, the products of their decay, judged by which statistics they correspond (Bose-Einstein or Fermi-Dirak), are fixed at a considerable distance from the course of the reaction itself.

Thus, strange and inexplicable the behavior of relativistic protons in the Large Hadron Collider and PAMELA and AMC-02 cosmic

detectors, can be explained by the non-gravitational manifestation of dark matter participating in all interactions in nature. When the protons achieve energy in the LHC providing a resonance frequency for the production of different particles and antiparticles in the quantum vacuum (dark matter) for example electron-positron pairs:

$$W_r \approx 20 \text{ GeV} = 33 \cdot 10^{-10} J, v_r = 4.7 \cdot 10^{24} \text{ Hz}, \omega_r = 2.82 \cdot 10^{25} \text{ Hz}, \lambda_r = 6.39 \cdot 10^{-17} \text{ m},$$

Researchers observe a whole legion of particles, but collisions of protons can remain elastic. Direct experimental determination of the resonance dependence of elementary particle- antiparticle pair's birth, under the influence of frequency  $v$  of external radiation and of relativistic protons in the quantum vacuum (dark matter) is almost completely rejects by modern physics. Following the deceptive logic of the modern theory, this dependence is drawn as a monotonically increasing curve, which contradicts the experimental discoveries made recently in the LHC.<sup>1</sup> It turned out that the number of resonances with a variety of quantum characteristics for the polarization of a quantum vacuum is so great that it is necessary to create special tables, similar to the tables published by the collaboration Particle Data Group (PDG), in which all properties of resonances are described. Addendum to the review on Higgs Bosons: On 2012, the ATLAS and CMS collaborations simultaneously announced observation of a new particle produced in pp collision data at high energies. Cosmology reviews updated to include 2013 Planck and cosmic detectors PAMELA and AMS-02 2011–2015. It's time to revise and expand the scope of the Standard Model.

## Acknowledgements

The author thanks for discussions to of professors Leo Sapogin and Yu. Baurov.

## Conflict of interest

Author declares there is no conflict of interest.

## References

1. Dremin IM. Some new discoveries at colliders. *Physics-Uspekhi*. 2018;61(4).
2. Galaktionov Yu V. Search for antimatter and dark matter, precision studies of the cosmic rays fluxes on the international space station. AMS experiment. Results of four year exposure. *Physics-Uspekhi*. 2017;60(1).
3. Konstantinov SI. Dark matter and generation of secondary electrons and positrons in the near-Earth space environment from the data of experiments PAMELA, FERMI and AMS. *The Global Journal of Science Frontier Research*. 2017;17(2A).
4. Adornov TK, Gavrilov SP, Gitman DM. Peculiarities of the production of particle pairs in a peak electric field. *Russian Physics Journal*. 2017;60(3).
5. Quantum-electrodynamic cascades with ionization of atoms. *Physics - Uspekhi*. 2017;60(11):1271.
6. Narozhniy NB, Fedotov AM. Quantum-electrodynamic cascades in an intense laser field. *Physics-Uspekhi*. 2015;58(1):103–108.
7. Hunting the mysterious dark photon: the NA 64 experiment (CERN)
8. Prigogine I, Stengers I. *Time, Chaos, Quantum*. Russia: Progress; 1994.
9. Baurov Yu A. Standard leptons and the following lepton in the theory of the Bayon. *Bulletin of the Russian Academy of Sciences: Physics*. 2016;80(5).

10. Burkert VD, Elouadrhiri L, Girod FX. The pressure inside the proton. *Nature*. 2018;557:396–399.
11. Levichev EB, Skrinsky AN, Tumaikin GM, et al. Electron–positron beam collision studies at Budker Institute of Nuclear Physics. *Physics–Uspekhi*. 2018;61(5).
12. Brusin LD, Brusin SD. Basis of Structure of the material world. *International Journal of Applied and Fundamental Research N8*. 2016.
13. Mikhailov VV, Adriani O, Bazilevskaya GA, et al. Secondary electrons and positrons in the near Earth space in the PAMELA experiment. *Bulletin of the Russian Academy of Sciences: Physics*. 2017; 81(2): 222–224.
14. Fang T. Mission of Magnetospheric Multiscale (MMS). *Nature*. 2018.
15. Kudasov Yu B. *Electrophysical measurements*. Russia: Fizmatlit; 2010.
16. Deich M, Kofed–Hansen O. *Experimental nuclear physics*. In: Segre E, editor. USA: Publishing house of foreign literature; 1961.
17. Barashenkov VS, Toneev V. *Interaction of high–energy particles and atomic nuclei with nuclei*. Russia: Atomizdat; 1972.
18. Fan L. *Three experiments challenging Einstein's relativistic mechanics and the traditional electromagnetic acceleration theory*. Series Problems of the study of the universe, Issue. 34. USA: Proceedings of the Congress–2010, Fundamental Problems of Science and Technology; 2010. p. 5–16.
19. Sapogin LG, Dzhanibekov VA, Mokulsky MA. About the Conflicts between the Unitary Quantum Theory and the Special and General Relativity Theories. *Journal of Modern Physics*. 2015;6:780–785.
20. Sapogin LG, Ryabov YA, Boichenko VA. *The Unitary Quantum Theory and a New Source of Energy*. USA: Science Publishing Group; 2015.