SIGNIFICANCE OF UNIVERSAL LAWS OF PRESERVATION IN INTERDISCIPLIC COMMUNICATION

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ABSTRACT

This article describes the meaning of the laws of conservation of energy, impulse and moment impulse in particle physics.

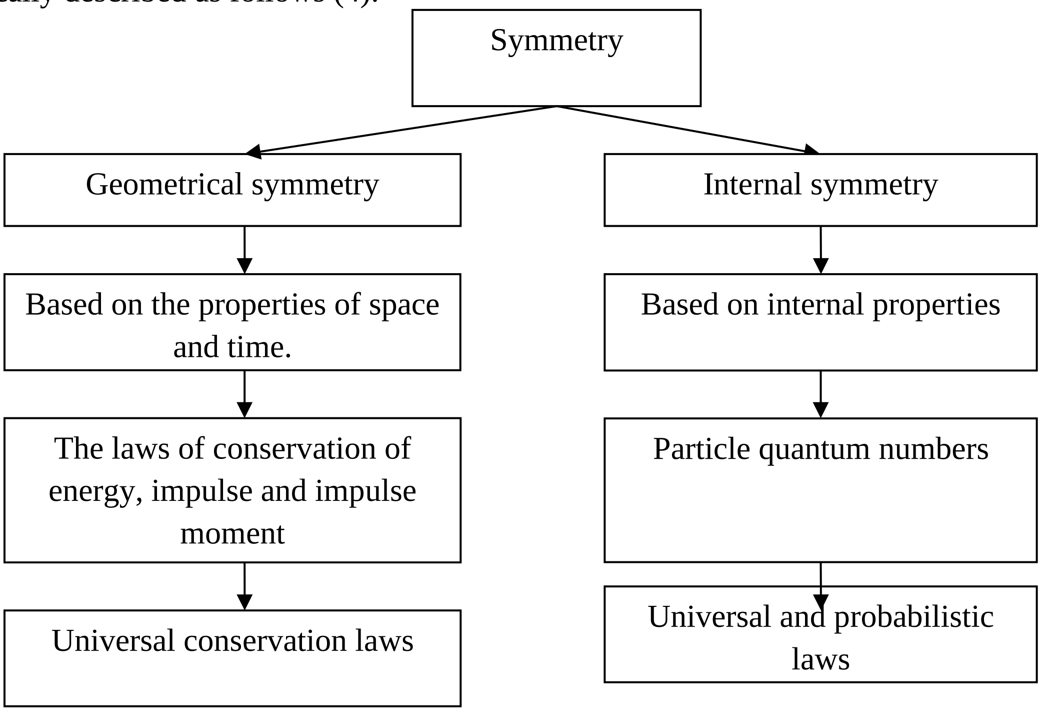
Keywords: Elementary particle physics, the principle of interdisciplinary connection, energy, impulse, impulse momentum, conservation laws.

INTRODUCTION, LITERATURE REVIEW AND DISCUSSION

Large-scale research is carried out aimed at improving the quality of students' assimilation of the elementary particle physics section by teaching it on the principle of intersubject communication. For this purpose, the parties were studied related to the observance of the laws of conservation of particle physics in other branches of physics and chemistry, as well as the place of the object of study of this section in comparison with other sciences. It is known, unlike other branches of physics, the conservation laws of elementary particle physics are universal and have a probabilistic nature, i.e. part of them is performed in all types of interaction and have a universal character, and part - is performed in some types of interaction, while in others it is violated, i.e. has a probabilistic nature. In the initial work [1-2], the law of conservation of electric, baritone, and lepton charges in intersubject communication was studied. In this paper, we consider separately those laws of a universal nature that conserve energy, momentum, and angular momenta, taking into account their importance. It is known that at the end of the 19th and beginning of the 20th centuries a new physics was formed - quantum physics. The subject of her study is very small objects - processes taking place in the world of particles and these processes, requiring an approach that is different from the ideas and techniques that existed in classical physics until then, led to a sharp turn in science. That is why the formation of quantum physics as a science has come a long and difficult path. For example, processes such as blackbody radiation, Rutherford’s experiments, Bohr's postulates, Frank-Hertz’s, Devisson-Germer’s and Stern-Gerlach’s experiments, de Broglie’s idea, emission spectra of the hydrogen atom, Moselle’s law, combinatorial principle, Compton effect, deducing by a new stage of ideas, became the basis of human thinking in a new way and revolutionary changes in worldview. As emphasized above, the processes of the particle world cannot be described by the laws of classical physics, which has caused many confusion. Such inexplicable situations were primarily associated with the laws of conservation of energy and mass in the microworld, i.e. with violation, non-conservation of them in the processes of particles.

Initially, from the point of view of classical physics, the transformation as a result of the annihilation of a particle and an antiparticle, for example, an electron and a proton, into a photon was considered as a “disappearance” of matter. This led to the advancement by N. Bohr, one of the founders of quantum physics, of the hypothesis of non-conservation of mass and energy in processes in the particle world. (5). But, as a consequence of deep reasoning, he wrote in his article about the incorrectness of this hypothesis. The situation that fundamentally changed the ideas of classical physics was the adoption of discontinuous values by quantities characterizing quantum-mechanical systems as an atom and a nucleus in quantum physics. A striking example of this is the quantization rule proposed by N. Bohr for the hydrogen atom.

Secondly, the introduction of quantities characterizing the properties of particles not found in classical physics, such as baryon charge, leptonic charge, spin, isospin, strangeness, charm, charm, truth, paired enriched the originality of quantum physics. This peculiarity is schematically described as follows (4):



According to this scheme, such quantum numbers as electric, baryonic, and lepton charges, spin, and the third projection of isospin, having a universal character, are preserved during any interactions and depend on the properties of internal hidden spaces. From these, we studied the conservation laws of electric, baryonic, and lepton charges [1-2]. But the magnitude of the quantum number of spins, despite the characteristic of the world of particles, i.e. quantum physics, depends on the geometric space, and not on the hidden inner space, this is the impulse moment that arose as a result of the rotational movement of the particle around its axis [6].

Now, before dwelling on the laws of conservation of energy, momentum, and impulse moment, based on the properties of homogeneity and isotropy of homogeneous and geometric space, it is necessary to emphasize the difference in the expressions of these quantities in classical and quantum physics. Due to the occurrence of speeds of processes in the world of particles close to the speed of light, that is, $\vartheta > 0{,}1c$

all physical quantities are expressed in relativistic form. The known relativistic expression of energy has the form

$$E = \frac{mc^2}{\sqrt{1 - \frac{\vartheta^2}{c^2}}}$$

At the particle velocity $\vartheta = 0$, the expression has the form $E_0 = mc^2$. In this case $m = m_0$, if we take into account that the particle mass is equal to the rest mass, the rest energy of the particle will have the form

$$E_0 = mc^2$$

In relativistic physics, for energy, momentum and mass, the expression

$$E^2 = p^2c^2 + m^2c^4.$$

If in this expression we accept $m = 0$, come to mind $E = pc$ A from this expression we arrive at the following expression

$$p = \frac{E}{c} = \frac{mc^2}{c} = mc$$

This expression is appropriate for the photon and neutrino whose rest mass $m_0 = 0$, *here m is their gravitational mass.*

As can be seen, due to the high speed of particles in quantum physics, expressions of energy and momentum are expressed in a relativistic form and, unlike classical physics, have a wide judgment. In addition, a certain relationship between energy, momentum and mass is appropriate. This dependence makes it possible to interpret the process of annihilation of a particle and antiparticle in a different way. Those. in the collision of a particle and an antiparticle, for example, an electron and a positron, they turn into a virtual photon, and after a while this virtual photon again decays into an electron and a positron. In such cases, the above relationship between energy, momentum and mass will be appropriate. Initially, such processes were observed that could not be explained by the known laws of physics. One of these processes is the conversion of the beryllium core to the polonium core

$$^{210}_{83}Bi \rightarrow ^{210}_{84}Po + e^-$$

in which there was a non-conservation of energy and the momentum of the private impulse-spin. This problem led to the hypothesis of the existence of a neutrino particle unknown in science by the Austrian physicist Wolfang Pauli (1900-1958). Because in this process, the spins of the nuclei are equal to 1 and 0, respectively, and the electron -$\frac{1}{2}$ and in this process the transition is impossible $1 \rightarrow \frac{1}{2}$. In this process, one neutron of the nucleus turns into a proton, i.e.

$$n \rightarrow p + e^-.$$

Here, depending on the directions of the spins of the p-proton and the e-electron in one direction or the opposite, the transition or is possible $\frac{1}{2} \rightarrow 0$ or $\frac{1}{2} \rightarrow 1$. But due to violation of the law of conservation of impulse moment, this process is impossible. As a result, Pauli put forward the idea of the existence of a neutral particle with extraordinary properties - neutrinos. That is, the process of converting neutrinos into a proton occurs as follows:

$$n \rightarrow p + e^- + \overline{\nu}_e$$

Moreover, due to the equality of the spins of the electron and the antineutrino ½ and flying out in the opposite direction, the law of conservation of spin is not violated, i.e. a transition occurs $\frac{1}{2} \rightarrow \frac{1}{2}$. At the same time, the missing part of the energy is explained by the consumption of antineutrinos and the law of conservation of energy is also not broken.

Now, using the above relationship between energy, momentum and mass, we can verify that the laws of conservation of energy and momentum in all processes occurring among particles are fully satisfied. The sum of the masses and kinetic energies of each particle resulting from the collision is equal to the sum of the masses and kinetic energies of the colliding particles. For example, the following processes are relevant.

$$\pi^- + \rho \to K^+ + \Sigma^-,$$
$$\pi^- + \rho \to K^0 + \Lambda^0,$$
$$\pi^- + \rho \to K^- + K^+ + n,$$
$$\pi^- + \rho \to \Omega^- + K^+ + K^0 + K^0,$$
$$\pi^+ + \rho \to K^+ + \Sigma^+,$$
$$p + p \to K^+ + p + \Lambda^0,$$
$$p + p \to K^- + K^+ + p + p.$$
$$n \to p + e^- + \overline{\nu}_e$$

Or the sum of the masses when decaying into light particles is less than the sum of the masses of decaying particles. The difference between the masses is spent on the kinetic energy of the particles.

$$\Lambda^0 \to p + \pi^-,$$
$$\Lambda^0 \to n + \pi^0,$$
$$\Sigma^+ \to p + \pi^0,$$
$$\Sigma^+ \to n + \pi^+.$$

As well as the law of conservation of impulse moment, which depends on the isotropic properties of ordinary space, the impulse moment-spin is also conserved for all interactions. These conservation laws are fulfilled in all processes occurring with particles and have the ability to control all processes in the particle world. When studying particle physics, analyzing with a specific example of processes the fulfillment of these conservation laws will undoubtedly increase the quality of assimilation of this area. To study the fundamentals of particle physics, the next task is to create developments that incorporate various processes involving particles, providing intersubject communication, test tasks to strengthen the material, a database of mass, back and other particle characteristics.

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