JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205

Volume 15 Issue 10, October 2025

Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

FUNDAMENTAL AND APPLIED PROBLEMS OF PHYSICS

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Abstract: Physics has always been a driving force for other sciences, stimulating new discoveries and new approaches to their problems, thus ensuring progress across science. Today, we must decide why the crisis has arisen and how to overcome it. Most scientists are locked into their own problems and are unwilling to delve into areas where they don't feel they have expertise. But experience is a matter of perseverance and desire. One reason is that physicists specialize in their own narrow field, and as science advances, this field rapidly narrows, thus losing the connection between different fields of science. Scientists are needed who work in various fields of science—this allows them not just to defend a doctoral dissertation, but to reach a fundamentally new, higher level.

Keywords: fundamental problems, applied problems, physics, theory, experiments, quantum mechanics, gravity, superconductivity, nanotechnology, quantum computing, energy.

Introduction.

Clearly, the time has come to fundamentally change the level of student training at universities by introducing new disciplines that would explore the connections between individual segments. Many proposals could be made here, but they don't fit the focus of this article. Let's return once again to 1976. Back then, I imagined physics was advancing at a breakneck pace. Indeed, computers had been created, rockets carrying astronauts had reached the Moon, the problem of thermonuclear fusion was about to be solved (theoretically, it had indeed been solved), new elementary particles were being discovered almost daily, new chemical compounds were being created using plasma chemistry; in particular, blood substitutes were created based on fluorine compounds. A little later, new particles—fullerenes—were discovered. It was expected that a whole cascade of discoveries of new chemical compounds would follow. Where are they today? Scientists continue to build molecules with various geometries based on fullerenes. Other scientists, attempting to add them to iron powders, are seeking to produce a material that transforms fullerenes into diamonds. (But this is an applied issue, and we will discuss them separately.) Newer and more powerful telescopes are being built, and our view of the UNIVERSE is changing. In this regard, it was proposed to call our Universe, which arose from a point, the Metagalaxy. That is, the Metagalaxy is that part of the Universe that we can not only observe today, but also imagine. Where the boundaries of our imagination end, there ends the Metagalaxy. It is known that our Metagalaxy is approximately 15 billion years old and arose from a point that has been called a singularity in scientific literature (by analogy with mathematics). Overall, it seemed to me then that science was blossoming.

So what happened today?

Biology has surged ahead with the study of various genotypes, cloning, DNA sequencing, and so on. Incidentally, the founder of molecular biology was E. Schrodinger. Fascinated by the problem of the origin of life, he even wrote a book on the origin of life, a collection of hypotheses. But biology has not been able, and without physics, will not be able, to answer the question of how life originated. The talk of evolution is empty. Evolution is only possible when there is something to evolve under. But we cannot understand how the simplest cell, if that word is even applicable to the problem of life, emerged from a non-racemic solution!

Computer science has become an independent and rapidly developing branch of theoretical and applied science. From this perspective, we can expect significant technological progress associated with the development of computer technology. In my opinion, this field cannot be classified as physics, as physics is the science of the nature of matter, and this must never be forgotten.

On the surface, physics was developing quite rapidly until the early 1990s. Indeed, nuclear processes had been studied quite thoroughly, and the focus was not on creating nuclear chain reactions, but on the compactness of nuclear devices. So many elementary particles had been discovered that few particle scientists could list them all. Numerous new quantum numbers, characteristic of elementary particles, were discovered. Cosmologists debated whether neutrinos possessed a rest mass and whether the Metagalaxy could collapse back to a "point." Then, suddenly, with the help of the American Hubble Space Telescope, dark matter was discovered in the Metagalaxy. It did not interact with the matter being studied, did not respond to electromagnetic interactions of any frequency, and did not emit any when interacting with high-speed particle flows. It interacted only gravitationally with the large masses of galaxies, forcing them to rotate around itself. (But I caution you—it's not a black hole.) I wouldn't risk equating Einstein's gravity with the gravity of dark matter. There's too little data. It's now known that dark matter makes up 95% of the mass of the Metagalaxy. We usually understand mass as a measure of inertia (the classical definition), but here it's more appropriate to say that mass is a measure of the gravitational influence of one body on another. However, this definition could also be incorrect. There are many questions here that remain unanswered for the foreseeable future, and naturally, we thought we couldn't conduct laboratory experiments. But this turned out to be untrue, and the very attempt at such experiments, despite the surprising results, met with strong resistance among many established physicists. However, young physicists were delighted with these results (they don't yet have scientific authority and have nothing to lose).

But let's return to W. Heisenberg's words in 1976, that physics took the wrong path at the beginning of the century. W. Heisenberg didn't explain his thought, substantiating this thesis over several pages; on the contrary, he seemed to encode it, turning it into something like Fermat's theorem. Apparently, his ideas were so orthodox that he was afraid of being misunderstood. Let's imagine a thought experiment. At the beginning of the 19th century, the French scientist A. J. Fresnel, speaking before the academicians of the French Academy of Sciences, brilliantly demonstrated the wave nature of light. Before this, Newton's idea of the corpuscular nature of light had dominated for 150 years. Newton's authority was so great that no one even tried to question his theory of the corpuscular nature of light. After A. J. Fresnel's discovery of the wave nature of light, he developed Maxwell's equations for the electromagnetic nature of light, then came Hertz's experiments (without this, the creation of radio and television would be impossible). In 1922-23, the American scientist A. Compton demonstrated the corpuscular nature of light by scattering electrons on photons. Since then, people have been talking about wave-particle duality. What's done is done. But let's imagine that before A. J. Fresnel's experiments, A. Compton had proven the corpuscular nature of light. What's happening? Maxwell doesn't write his equations, Hertz doesn't prove the propagation of electromagnetic waves in space, and, as a result, there's no radio or television at the right time. But there's no such thing as a vacuum. This means there had to be a different path for the development of physics. This isn't even science fiction; it's some kind of super-science fiction. Physics could probably cite many such examples, but physics typically solves the problems it was prepared to solve. But new theories make their way into science with great difficulty.

The greatest influence on the development of our views on the universe in the 20th century were discoveries related to cosmic factors. In the early 1970s, experiments were conducted to determine whether the solar neutrino flux corresponded to theoretical predictions. The experiments were conducted in the deepest mines in South Africa to isolate cosmic radiation. At a depth of approximately 5 km, a container containing a chlorine isotope was placed. This chlorine isotope interacts with neutrinos, and the fission process of the chlorine isotope nuclei was observed, with the decay fragments recorded by sensors. It turned out that the neutrino flux was 300 times lower than calculated. At the end of the century, this experiment was repeated with more sophisticated equipment at the same depth, but this time in India. The result was the same. In my opinion, the concept of stellar energy sources needs to be reconsidered.

Nevertheless, a comparative study of various thermonuclear reactions led Bethe, back at the dawn of the last century, to the conclusion that the energy of the Sun and main-sequence stars is produced by cyclic reactions in which the main role is played by the capture of a proton by nitrogen and carbon nuclei, followed by the formation of a helium nucleus [1]. This Bethe theory, which has recently gained widespread acceptance, still lacks direct astrophysical confirmation. I have no doubt that there will be astrophysicists who disagree with me. Then let them explain where the neutrinos go, or, conversely, why there are so few of them.

Let us remember in fond memory our famous compatriot, Professor Nikolai Alexandrovich Kozyrev. Here we will not talk about his recognized merits. In 1937, N.A. Kozyrev was placed in a prison camp for his commitment to the theory of the expanding Universe (as the Metagalaxy was then called) and was released from the camp only in 1948. Three months after his release from the camp, he defended his doctoral dissertation on the topic "Sources of stellar energy and the theory of the internal structure of stars". Through astronomical observations, N.A. Kozyrev proved the following. In the first part, two main patterns were investigated, establishing the "period - average density" of "Cepheids". The results obtained from the analysis of these patterns turned out to be different from the usual concepts of the theory of the internal structure of stars. The most important of them are the following: 1) in all stars, including even supergiants, radiation pressure does not play a significant role, and it can be neglected in comparison with gas pressure; 2) the inner regions of stars consist almost entirely of hydrogen (the average molecular weight is close to 1A); 3) the absorption of light is due to Thomson scattering of light by free electrons; 4) the stars have structures close to class 3/2 polytropic.

The combination of the obtained results allowed him to calculate, as a first approximation, the physical conditions inside stars, based on the observed characteristics of L, M, R. For example, for the center of the Sun, the temperature is approximately 6 million degrees, apparently insufficient for thermonuclear reactions. [2]

N.A. Kozyrev hypothesized that the primary source of stellar energy is the current time. However, for some reason, he didn't go any further. This begs the question: where are the combustion products and what are they? The simplest answer is that the continuous flow of time in our world is emitted as time quanta, like combustion products, in another world. Or in another universe—everything must be different there: there is no continuous space-time, and the structure of matter there is also different. We have experimentally detected such particles (time quanta with mass). They penetrate the nuclei of radioactive elements, altering their activity and half-life due to their quantum number, and possibly due to their mass defect, but they do not participate in nuclear transformations. It should be noted that, apparently, they do not possess either the weak or strong interaction. This interaction is of a fundamentally different type and can reach neighboring nuclei of a body-centered crystalline lattice, also altering their activity, but to a lesser degree. Of course, it would be interesting to isolate these particles in accelerators and study their properties. Irradiating a radioactive element with such particles reduces radioactivity by approximately 20%, with a measurement error of 1%. Two institutes independently conducted such a test and obtained these figures.

Conclusion

Eighteen years ago, we built a pilot plant with a capacity of over 20,000 times greater than the original, but we made a small mistake during startup, and within 20 seconds, the plant had turned into a pile of molten metal, quartz, and so on. But most importantly, it demonstrated the correctness of the chosen method. Equipping nuclear power plants with such plants and launching them in the event of an accident would immediately stop all chain reactions and prevent a catastrophe. They could also be used to decontaminate radiation-contaminated areas. Further work was impossible, as the scientific section was closed in 1990-1991.

But most importantly, the development of New Physics, built on different principles, will make it possible to reach virtually all the stars in our galaxy within 20 years. Modern spacecraft use the energy of the electron shell of an atom, or, in other words, the energy of chemical bonds, for their flights. Clearly, humanity won't be able to explore even the Solar System with such rockets. Meanwhile, there's a risk of collisions between Earth and massive celestial bodies, and today we have no countermeasures, which would mean the end of civilization. However, why speculate about what New Physics will be if we don't have the ability to conduct laboratory experiments?

We won't discuss all physics topics in this article, but only those that will provide us with new insights into the nature of matter and influence other areas of physics. These include the construction of Takamak spacecraft, ground-based lasers, and the like. Theoretically, this area has already been exhausted.

However, there is one problem that will likely be perennial. As technology advances, more and more new materials with new properties will be required. These issues are addressed by materials science and solid-state physics.

Somewhere around the late 1970s, the theory and practice of small particles and ultradispersed systems emerged and began to develop rapidly. These would later become widely known as nanosystems. We will not discuss superconducting nanoceramics, as they emerged long ago and their development can be considered quite successful. The situation is different with nanoceramics for structural and functional purposes.

The issues under consideration relate to applied physics. Ultradisperse systems cannot be classified as solid-state physics. They are likely developing into a separate field of physics. For those interested in this topic in more detail, I recommend the journal "Advances in Physical Sciences."

There are many methods for forming ultrafine systems with particle sizes and narrow histogram widths of approximately 10 nm. However, they share a common drawback: they have high surface energies and, therefore, tend to clump together. The goal is to create compact materials with 100% density. Yttria-stabilized zirconia has been considered the most promising material of the past 20 years. In other words, one atom in the zirconia crystal lattice is replaced by a stabilizer atom, allowing zirconia to avoid phase transformations. The expected properties of the material include superplasticity and retention of physical and mechanical properties at temperatures of approximately 3000 K. Other high-temperature materials are also possible. Stabilizers, molding, pressing, and sintering conditions are selected for them. Each stage represents an entire study. Currently, only laboratory samples have been obtained worldwide, and no one can say whether nanoceramics will ever be introduced into production. This direction is the most promising of all that exist within the framework of solid state physics.

In the same way, we created ceramic nanomembranes with an open porosity of 10 nm and a histogram half-width of 1 nm. Continuous nanocrystalline fibers with high bending resistance (0.5 mm) were used to create composite materials with special properties. Many studies on the development of structural deformation diagnostic methods have been translated into other languages. These are all applied issues, and we will not discuss them in detail.

The main question is whether we can convince the scientific community to begin work in the field of New Physics.

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