Volume 3, Issue 4, April - 2025 **ISSN (E):** 2938-3811

# ANALYSIS OF THE DEVELOPMENT OF PHYSICS IN THE XXI CENTURY

Туксанова Зилола Изатуллоевна
Преподаватель, Бухарский государственный университет
tuksanova@gmail.com

Назаров Эркин Садикович
Кандидат технических наук, доцент,
Бухарский государственный университет
nazarov.es68@mail.ru

Мусоева Гулрух Сирожиддин кизи
студент кафедры физики, Бухарский государственный университет

**Abstract**
In the 21st century, physics continues to occupy a key place in scientific progress and technological development of mankind. This article examines the main directions and achievements of physics over the past two decades, including nanophysics, quantum technologies, astrophysics, as well as the impact of the discovery of new particles and phenomena on our understanding of the universe.

**Keywords**: Quantum dot, atom, molecule, progress, matter, geology, mechanics, nucleus, photoelectric effect, thermonuclear fusion, nanosize, laser, superconductivity, multilayer elements.

## Introduction

Physics, as the basis of all natural sciences, continues to develop in the XXI century, expanding the boundaries of our understanding of the world around us. Scientists' aspirations are aimed at solving problems that previously seemed unattainable, and new technologies are opening the way for the study of unknown phenomena. The changes taking place in the development of mankind are striking. Literally before the eyes of one or two generations, the technical and even everyday landscape of our life has changed dramatically, which is completely based on discoveries in science. And if we compare the development of science itself as a separate branch during its history, which in fact has no more than 300-400 years, it becomes obvious that it is only accelerating. This acceleration became especially noticeable in the second half of the last century, and there is no doubt that in the near future it will at least not slow down. At the same time, the accumulation and need to process huge amounts of various information is taking giant strides.

If we compare the role of this or that natural science, it is quite easy to see that physics undoubtedly occupies a leading place among them. This conclusion follows from the fact that it is the most fundamental of all natural sciences, or the one that studies the deepest and most general laws of nature. The laws discovered by it (or, more precisely, by physicists) lie at the basis of chemical, biological, geological, and cosmological processes.

Quanta form the main element of the hypothesis, which leads to ultimate success in understanding a certain issue. Let me remind you in a little more detail that they were used to explain the spectrum of blackbody radiation. The first to take an important step was, as even schoolchildren know, the outstanding German theoretical physicist M. Planck. In an unrestrained desire to establish the key laws of blackbody radiation, he was forced to accept the hypothesis of the "portional" energy of elementary emitters, the spectrum of which in classical physics was always considered as continuous. The researcher showed scientific courage and assumed the exact opposite. By introducing a new fundamental constant - the now well-known Planck constant - he managed to achieve a perfect agreement between the developed theory and the experimental picture. The day of December 14, 1900, when Planck unveiled his theory of radiation to the members of the German Physical Society, is considered the birthday of quantum theory.

To describe the photoelectric effect, the idea of quanta was picked up and developed by A. Einstein. Subsequently, the Dane N. Bohr, the German W. Heisenberg, the Frenchman Louis de Broglie, the Austrian E. Schrödinger, the Swiss W. Pauli, the Englishman P. Dirac and others brought it to its logical conclusion, making quantum theory an integral and, in fact, the only working tool for calculating any measurable data of the microcosm.

Physics will continue to be the main force of scientific and technological progress. And if quantum theory, the foundation of physics, is indeed the pinnacle of modern knowledge, then in order to imagine or predict the way it will develop in the future, it is necessary to determine which events in physics had the greatest impact on the course of the twentieth century. Among the many possible events, let us single out three defining events.

*The first* was the discovery in 1938 of artificial nuclear fission made by the German chemist O. Gann, who measured the features of neutron scattering on uranium. From the data obtained on the decay of uranium nuclei, which became extremely important, researchers quickly realized the fundamental possibility of nuclear explosive processes, which, being super-powerful, formed the basis of nuclear weapons created soon after in an uncontrolled mode, and in a controlled mode determine the useful operation of nuclear technology.  The most famous creation of which is nuclear power plants. The presence of nuclear weapons or nuclear energy is now one of the main factors by which the military or industrial capabilities of a State can be assessed.

*The second* of the three most important physical events of the century took place in December 1947, when American specialists who conducted research in one of the Bell laboratories J. Bardeen, W. Brattain and W. Shockley discovered the transistor effect. The fact is that at that time radio engineering and radar were significantly developed, where tube amplifiers were replaced by crystalline amplifiers, the basis of which was semiconductor media.  that the goal of the researchers who studied the possibilities of using these crystals was a fundamental test of the performance of quantum theory in solids, primarily semiconductors. However, as history decreed, the main result of the group's work was something different: the invention of the



Web of Scientists and Scholars: Journal of Multidisciplinary Research

germanium amplifier, or point transistor. And after it was experimentally proven that the main thing in this case is the injection, or injection, of carriers to germanium, physicists guessed what principle should be used as the basis for the creation of semiconductor technology.

*The third* decisive physical event of the 20th century was the creation of the laser. It all began in 1917, when A. Einstein, who, intending to explain the distribution of radiation density by heated bodies (and, most likely, not imagining lasers at all, but knowing about the Bohr atom), suggested the presence of stimulated optical atomic transitions along with the so-called spontaneous ones. when in 1957-58 researchers and future Nobel laureates O.M. Prokhorov and his student M. Basov were able, relying on the idea of stimulated (sometimes they say stimulated) radiation, to theoretically formulate the principle of amplification of electromagnetic waves and invented such an amplifier in the radiofrequency wave range - maser.

Later, in the United States, based on the same principle, the first amplifier in the optical range, or laser, was launched. Since then, masers and lasers have been widely used - scientific, technological, medical and military. Now such laser multilayer elements made of a wide variety of components have become the heart of fiber-optic communications, which provides millions of telephone conversations at the same time. About 100 million optical cables encircle the globe, their number is constantly growing, and the quality - especially noise immunity - is improving.

One of the newest devices of recent times is a laser based on the so-called quantum semiconductor dots. Quantum dots are very non-standard formations. They can be constructed atom-to-atom, or they can be grown by molecular beam epitaxy. It is the dots, according to some experts, that are the prototype of a new type of transistors. The fact is that the main action of the latter is based on the transition from one stable state to another. There are more quantum points of state in the collective, and the energy barriers between them are lower. This means that the corresponding transitions can be initiated by the electrons read. The creation of such transistors, of course, requires a new level of technology, which will determine the development of semiconductor electronics, which is increasingly approaching the limit set by Nature itself. At the same time, the operation of any device, which can be a single molecule, will be determined by single-electron processes, which means exclusively quantum regularities. They will make laser and computer components work, the power consumption of which will also become negligible, which is identical to extremely economical.

The development of these branches of physics in the 21st century, as it happened in the 20th century, will continue to determine the real progress of mankind. At the same time, much of the choice of scientific research began to be dictated by the market and the urgent needs of mankind, and more and more attention is paid to the development of such largely applied areas as, for example, the fight against the threat of global warming, urban infrastructure, water purification technologies, prevention of coal mine methane emissions, etc., as well as high-yield high-speed information electronics, wireless communications, network technologies and nanoindustry.







Web of Scientists and Scholars: Journal of Multidisciplinary Research

Modern science is not and cannot be reduced only to research, which pays off quickly and many times over, and the natural curiosity of man will prompt him to new and new searches, the only self-sufficient consequence of which will be exclusively knowledge. Despite significant successes, physics of the XXI century faces a number of challenges. This includes a lack of funding for basic research, the need for an interdisciplinary approach to solving complex scientific problems, and the ethical and safety issues associated with new technologies. It is important to formulate clear strategies to ensure the sustainable development of physics as a science and its role in society. The development of physics in the XXI century continues to inspire scientists to new discoveries and achievements. It is important to understand that physics not only explains the laws of nature, but also serves as a basis for the development of technologies that change people's lives. Current trends in science create not only new opportunities, but also require a responsible approach to their use.

**References**

1. Nóva F., Ghosh A. Nanophysics: The Building Blocks of Nanostructured Materials. Oxford University Press. 2020.
2. Nazarov E.S., Khamrokulova Sh.A. Effective use of energy resources. Modern Scientific Solutions to Current Problems. International Scientific and Practical Conference. Rostov-don. Russia. 2022. P. 15-17.
3. Nazarov Sh., Ravshanov N., Model and numerical algorithm for investigation of the transfer and diffusion of aerosol particles in the atmosphere taking into account the capture of particles by vegetation elements. ICISCT 2023. International Conference On Information Science And Communications Technologies-Applications, Trends And Opportunities. 28-30 September, 2023. Tashkent, Uzbekistan. pp.624-628.
4. Ravshanov N., Nazarov Sh., Nazarov E., Boborakhimov B. Development of a mathematical model of aerosol particles' distribution process in the surface layer of the atmosphere taking into account the earth's heterogeneous surface. International scientific and practical conference on 'modern problems of applied mathematics and information technology. Bukhara. Uzbekistan. Volume 3004. Issue 1. 11 March 2024.