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BASIC DIRECTIONS OF MODERN PHYSICS AND ASTRONOMY AND THEIR ROLE IN THE DEVELOPMENT OF INNOVATIVE DEVELOPMENT

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Abstract.*In this article bases of formation of the purposes of modern physics are discussed. Literally translated from Greek, the word "physics" means "nature", therefore, physics is the science of nature, studying the simplest and at the same time the most general properties of the material world. Physics is the main of the natural sciences, since it reveals truths that are valid for the entire universe. The laws of physics are the basis of knowledge about the structure and functioning of the Universe, they underlie the scientific comprehension of reality. Two circumstances make it difficult to understand modern physics: the use of the most complex mathematical apparatus and the inability to create a visual model of modern physical concepts are associated with the gradual rejection of direct visibility. This is due to the fact that some aspects of reality are invisible to superficial observation and visibility can be misleading. It turned out to correspond to reality simply because it was not noticed that the reason for the body to stop is friction. In order to draw a correct conclusion, an experiment was required, which was not a real experiment, impossible in this case, but an ideal experiment.*

Keywords: *modern physics, science of nature, physical concepts, real experiment*

Основные направления современной физики и астрономии и их роль в развитии инновационного развития

Аннотация. *В данной статье обсуждаются основы формирования целей современной физики. В дословном переводе с греческого слово «физика» означает «природа», следовательно, физика — это наука о природе, изучающая простейшие и в то же время самые общие свойства материального мира. Физика является главной из естественных наук, так как она открывает истины, действительные для всей Вселенной. Законы физики являются основой знаний об устройстве и функционировании Вселенной, они лежат в основе научного осмысления действительности. Два обстоятельства затрудняют понимание современной физики: использование сложнейшего математического аппарата и невозможность создания наглядной модели современных физических представлений связаны с постепенным отказом от прямой видимости. Это связано с тем, что некоторые аспекты реальности невидимы для поверхностного наблюдения и видимость может ввести в заблуждение. Оно оказалось соответствующим действительности просто потому, что не было замечено, что причиной остановки тела является трение. Чтобы сделать правильный вывод, требовался опыт, причем не реальный, в данном случае невозможный, а идеальный.*

Ключевые слова: *современная физика, естествознание, физические понятия, реальный эксперимент*

Zamonaviy fizika va astronomiya fanining asosiy yo‘nalishlari va ularning innovatsion rivojlanishdagi o‘rni

Annotatsiya. *Ushbu maqolada zamonaviy fizikaning maqsadlarini shakllantirish asoslari ko‘rib chiqiladi. Yunon tilidan so‘zma-so‘z tarjima qilingan "fizika" so‘zi "tabiat" degan ma'noni anglatadi, shuning uchun fizika tabiat haqidagi fan bo‘lib, moddiy dunyoning eng oddiy va ayni paytda eng umumiy xususiyatlarini o‘rganadi. Fizika tabiiy fanlarning asosiysidir, chunki u butun koinot uchun amal qiladigan haqiqatlarni ochib beradi. Fizika qonunlari koinotning tuzilishi va faoliyati to‘g‘risidagi bilimlarning asosi bo‘lib, ular haqiqatni ilmiy tushunishga asoslanadi. Ikkita holat zamonaviy fizikani tushunishni qiyinlashtiradi: eng murakkab matematik apparatdan foydalanish va zamonaviy fizik tushunchalarning vizual modelini yaratishning iloji yo‘qligi to‘g‘ridan-to‘g‘ri ko‘rinishni asta-sekin rad etish bilan bog‘liq. Buning sababi shundaki, voqelikning ba'zi jihatlari yuzaki kuzatish uchun ko‘rinmaydi va ko‘rinish noto‘g‘ri bo‘lishi mumkin. Bu haqiqatga to‘g‘ri keldi, chunki jismning to‘xtashiga ishqalanish sabab bo‘lganligi sezilmagan. To‘g‘ri xulosa chiqarish uchun eksperiment talab qilindi, bu haqiqiy tajriba emas, bu holda mumkin emas, balki ideal tajriba edi.*

Kalit so‘zlar: *zamonaviy fizika, tabiat fani, fizik tushunchalar, haqiqiy tajriba*

1. Innovative teaching methods using new achievements in modern physics and astronomy.

Modern physics singles out three structural levels of the Universe: microcosm, macrocosm and megaworld. The study of the microworld is carried out by microphysics, the macroworld by macrophysics and the megaworld by astrophysics. The microcosm is the world of directly unobservable objects with spatial dimensions from 10^{-10} to 10^{-18} m. The lifetime of these objects can be only 10^{-24s}. The movement of objects in the microworld obeys the laws of quantum mechanics and electrodynamics. The macroworld is a world of objects, the dimensions of which are comparable to the scale of human experience, the laws of movement of objects in it are formulated by classical mechanics and electrodynamics. Megaworld is the world of cosmic distances and speeds, the distance in which is measured in light years. The time of existence of these objects reaches millions and billions of light years. The movement of mega-world objects is described by the laws of special and general relativity. In modern physics, a number of new directions have arisen, unknown to classical physics. We restrict ourselves to listing only a few and outline the range of tasks facing them.

The main directions of modern science.

Physics of elementary particles. Its main problem was and remains the study of matter at the level of elementary particles. Not all theoretical provisions of this section of physics have been directly confirmed by experiments. There are

only attempts to build a theory that combines all types of interactions: gravitational, electromagnetic, weak and strong.

Physics of the nucleus. In the 30s. 20th century a proton-neutron model of the nucleus was created, great progress was made in understanding the structure of nuclei, and great success was achieved in the practical application of nuclear reactions. One of the most important tasks in this area is the solution of the problem of controlled thermonuclear fusion. Work in this direction is being carried out by the joint efforts of researchers from a number of countries. Relatively recently, with the invention of structural neutronography, it was possible to "see" the shape of the atomic lattice of a crystal and even follow the behavior of each atom.

Astrophysics. The development of the physics of elementary particles and the atomic nucleus made it possible to get closer to understanding such complex problems as the evolution of the Universe at the early stages of its development, the evolution of stars, and the formation of chemical elements. However, despite the impressive achievements of modern astrophysics, it remains unclear what the structure of matter is at huge densities inside neutron stars and "black holes". The nature of quasars and the cause of supernova explosions have not been clarified. In general, we can assume that only the beginning of solving the problem of the evolution of the Universe has been laid.

Optics and Quantum Electronics. On the foundation of the quantum theory of radiation, laid down by A. Einstein, a new science arose - quantum electronics. Advances in this field are associated, first of all, with the creation of supersensitive receiving systems and fundamentally new light sources - lasers or optical quantum generators. The almost strict monochromaticity of laser radiation makes it possible to obtain a three-dimensional image of an object - a hologram. Work is underway on the use of lasers in controlled thermonuclear reactions. The development of this area is associated with a further increase in the power of lasers and with the expansion of the range of operating frequencies.

Plasma Physics The importance of studying plasma is related to two circumstances. First, the vast majority of matter in the universe is in the plasma state. Secondly, it is in high-temperature plasma that it is possible to carry out a controlled thermonuclear reaction. Obtaining such reactions will provide mankind with an almost eternal environmentally friendly source of energy. This problem is very urgent, because in the near future humanity will face the problem of energy hunger.

Solid State Physics. Progress in computer engineering is entirely based on the achievements of solid state physics. An important area of research is the study of the phenomena of the tunnel effect and superconductivity. The tunnel effect is a phenomenon from the field of quantum physics, which consists in the ability of elementary particles to penetrate a barrier that a classical particle cannot pass in principle. On the basis of the tunnel effect, special devices have been created - tunneling microscopes, which make it possible to observe individual atoms. Superconductivity is a special state of some substances, discovered a long time ago. It lies in the fact that at temperatures of the order of 5-200 K, the electrical resistance completely disappears. Current can circulate in such a conductor for years. At present, materials have been synthesized in which superconductivity occurs at temperatures of 100~1500 K. Such materials can be widely used in science and technology.

2. The connection of nanotechnology with academic subjects and its role in teaching physics.

Nanotechnology today can be called one of the stages and at the same time directions in the development of technology. Technique is a set of means of labor and production, as well as techniques that serve to create material values. At the present stage, the rate of development of technology is so great that it is difficult to predict the direction of its development, as well as whether new and new technical inventions will be used for good or for evil. And one of the new directions for improving technology is the development of nanotechnology. Nanotechnology is a special area based on the synthesis of knowledge of fundamental and applied science and technology, which is a set of methods for the production and use of products with a given atomic and molecular structure through controlled manipulation of individual particles - atoms and molecules.

Nanotechnologies are used today in medicine, construction, industrial production, and the field of nanotechnology research itself is one of the most intensively developing at the present stage. For the first time the term "nanotechnology" was used by Norio Taniguchi in 1974, denoting the production of products whose dimensions are comparable to a nanometer. One nanometer is one billionth of a meter (the prefix "nano" - 10^{-9}). The first scientist who measured in such units was Albert Einstein, who proved that the size of a grain of sugar is one nanometer. One of the key directions in the development of nanotechnologies is the creation and production of products with completely new properties - nanomaterials and its application.

Nanomaterials are materials created on the basis of or using nanoparticles and/or through the use of nanotechnology, which have unique properties due to the presence of these particles. Nanomaterials include objects whose sizes range from 1 to 100 nm. The most popular objects of research in the field of nanotechnology include nanoparticles, nanofibers, nanopowders, nanofilms. Nanoparticles is a general term for ultradispersed isolated objects, denoting particles of a substance up to 1 nanometer in size.

Often, nanoparticles form clusters arranged according to a certain pattern. The most characteristic example is fullerenes - structured carbon compounds. In fullerene molecules, carbon atoms are located at the vertices of hexagons and pentagons that make up the surface of a sphere or ellipsoid. The most fully studied representative of the fullerene family is C_{60} fullerene, in which carbon atoms form a truncated icosahedron resembling a soccer ball. On the basis of fullerenes, carbon nanotubes are synthesized. A carbon nanotube is an allotropic modification of carbon atoms, in the form of an empty cylindrical structure with a diameter from ten to several tens of nanometers and a length from a micrometer to several centimeters. Carbon nanotubes are applicable in various fields - in engineering, as durable materials, current superconductors, the basis of cables, in medicine - as artificial muscles and nerves, in information technology - as components of computer matrices, etc.

The main directions in the development of nanotechnology are:

- obtaining durable and lightweight materials that are used in engineering, biotechnology, medicine, environmental protection, space;
- creation of sensors and indicators in production;
- creation of drugs and new means of their delivery to the body;
- formation of new means and methods of research and monitoring in various fields;
- development of methods for cleaning the environment - water, air, soil, etc.;
- development of miniature spacecraft for launching and deep space exploration.

In the field of nanochemistry, reagents based on ordered nanoparticles are used to create various composite and sensor materials, solid electrolytes.

3. Nanotechnologies and their application.

The use of nanotechnologies in the field of communication makes it possible to improve the quality of communication channels and information display systems. In practical medicine, nanoparticles are used as drugs, containers for their delivery, medical nanorobots, artificial genomes, and regeneration of body tissues.

Nanomaterials play a special role in the field of energy, especially at the present stage, when it is necessary to develop alternative energy sources. Nanotechnologies in the field of energy are aimed at improving fuel construction materials, protecting the natural environment during energy generation (creating thin nanofilters), developing safe nuclear energy, and developing monitoring using nanosensors. Nanostructured metals, polymers and ceramics are of great importance in construction and industry. In computer technology, nanochips are being developed today. Nanofibrous materials are now used in the creation of various types of small arms, missiles and aircraft.

Modern man in everyday life is faced with the use of nanotechnology. For example, modern samples of dirt-repellent clothing are created by spraying a special layer of polymer nanoparticles onto the fabric, which does not allow dirt to settle on the fabric. Today, adhesive plasters are being created with the spraying of silver nanoparticles, which have an antibacterial effect. A special paint for cars is gaining significant popularity today - the paint consists of particles-balls, less than a nanometer in size. When scratched on the car, these particles-balls settle in the cracks, filling them, due to which the damage on the surface of the car is “rubbed out”. This paint allows the car to maintain a perfect surface for a long time, protecting it from rust.

At the present stage, a number of problems in the development of nanotechnology can be identified, in particular:

- ❖ Relatively high cost of nanomaterials in comparison with "conventional".
- ❖ "Unpredictability" in relation to the potential harm that nanomaterials in industrial use can cause to the environment.
- ❖ The need to determine the range of nanomaterials that should be transferred to the scale of industrial production is the most commonly used, most in demand materials.
- ❖ Identification of a certain range of areas of research in the field of nanotechnology, which are priorities, requires funding, development of programs and state support.
- ❖ The complexity of working with nanomaterials is the study of nanomaterials, their creation is possible using special scanning microscopes that allow you to visually magnify objects thousands of times.

The solution of these problems lies at the intersection of research in many sciences - physics, chemistry, biology, technical disciplines, etc.

Conclusion

In this article bases of formation of the purposes of modern physics are discussed. Physics is the main of the natural sciences, since it reveals truths that are valid for the entire universe. The laws of physics are the basis of knowledge about the structure and functioning of the Universe, they underlie the scientific comprehension of reality. Two circumstances make it difficult to understand modern physics: the use of the most complex mathematical apparatus and the inability to create a visual model of modern physical concepts are associated with the gradual rejection of direct visibility. This is due to the fact that some aspects of reality are invisible to superficial observation and visibility can be misleading. It turned out to correspond to reality simply because it was not noticed that the reason for the body to stop is friction. In order to draw a correct conclusion, an experiment was required, which was not a real experiment, impossible in this case, but an ideal experiment.

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