MULTIDISCIPLINARY AND MULTIDIMENSIONAL JOURNAL
ISSN: 2775-5118 VOL.3 NO.5 (2024) I.F. 9.1

SOME ISSUES OF TEACHING MODERN PHYSICS IN HIGHER TECHNICAL EDUCATION INSTITUTIONS

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ANNOTATION

The article is devoted to some important issues of implementation of modern physics education in higher technical educational institutions. It was noted that the reflection of new results and information obtained in the last years in the field of physics in educational programs and the implementation of physics education on this basis is one of the important factors in increasing the effectiveness of education. The directions of development of modern physics and some of the important results obtained in these directions are listed.

INTRODUCTION

Fundamental sciences taught in higher technical educational institutions are a source of basic knowledge for specialized sciences and provide a solid foundation for future specialists to acquire professional knowledge and skills. Among such sciences, physics occupies a leading place, because it studies the most general laws of the development of nature and serves as the theoretical basis of modern natural science. Knowing the basic laws of physics, and the ability to correctly explain natural phenomena determines the general cultural level of people and the scope of worldview. As a result of the teaching of physics, the students have an idea about the unique scientific picture of the Universe, which, in turn, plays an important role in the thorough acquisition of professional knowledge of the specialty and its application in practice. One of the urgent issues of today is to collect and generalize the achievements of physics science in recent years and the new information reflected in the relevant literature, and to include them in science programs and implement physics education based on the requirements of the time.

Keywords: bosons, quark, gluon, quantum chromodynamics, electroweak interaction, baryon asymmetry, synergetics, fullerenes, carbon nanotubes, quantum informatics

ISSN: 2775-5118 VOL.3 NO.5 (2024) I.F. 9.1

MAIN PART

In the second half of the last century, and especially in recent years, physical science developed very rapidly, and the methods and results of scientific fundamental research were rapidly applied to other natural sciences. As a result, new "hybrid" sciences appeared in adjacent fields of existing natural sciences. For example, astrophysics, biophysics, molecular biology, physical chemistry, and other sciences are among them.

As a result of fundamental research in physics and related sciences, a lot of scientific information has been collected, and scientific innovations have begun to find their application in practice. Science and technology, high technologies that determine the development of society appeared and began to develop.

Modern advances in science and technology have led to a new level of civilization in society and life. These processes are also reflected in the field of education.

Several great discoveries were made in physics between the end of the XIX century and the first half of the XX century, and these discoveries gave impetus to the formation of modern physics. During this period, radioactivity was discovered, and later this phenomenon was used in the study of atomic structure. The creation of the theory of relativity completely changed the old ideas about space and time. Attempts to study atomic structure led to the creation of quantum theory. This era, which completely changed the nature and scope of physical research, was called the era of new physics. During this period, the radio radiation of stars was observed, and the fission of neutrons and nuclei was discovered. Later, scientific research work was started on a large scale in solid bodies, elementary particles, and other fields of physics. As a result of this development of scientific research in the era of new physics, many discoveries, ideas, and imaginations appeared, all of which laid the foundation for the emergence of modern physics.

In the literature, the science of physics formed during the last 30-40 years is recognized as the modern science of physics. Modern physics is developing in the following directions. In the modern field of high-energy nuclear physics, the four fundamental mechanisms of the gravitational, weak, electromagnetic, and strong interactions that exist in nature have been studied. Scientific work was carried out to interpret them based on a single theory. A unified theory of electromagnetic and weak interactions was created. The existence of intermediate W^+, W^-, and Z^0 bosons with weak interaction quanta was experimentally confirmed. The quark structure of hadrons was proposed, and gluons, the strong interaction quanta between quarks,

ISSN: 2775-5118 VOL.3 NO.5 (2024) I.F. 9.1

were discovered. As a result of these studies, the science of quantum chromodynamics arose. The theory of the Grand Unification, which combines the electroweak and strong interactions, was founded. According to this theory, at very high energies, particles can be in the states of leptons and quarks, and they can rotate with each other. From this theory, it follows that there are 24 intermediate particles of the total field that provide quark-lepton spins.

These include 8 gluons, 3 W^+, W^-, Z^0 bosons, 1 photon and 12 colored x, y particles.

Advances in elementary particle physics are being used to solve the problems of cosmology. The stages of the evolution of the universe were interpreted based on the imagination of the present time. A logical answer was found to the current state and composition of the matter of the universe, baryon asymmetry, and other similar questions.

In the last decades of the last century, the science of nonlinear optics was formed. Many nonlinear optical effects have been observed in the interaction of high-intensity light with objects. First of all, the advent of lasers led to great changes in science.

One of the new fields of physics formed in recent years is the physics of open systems (thermodynamics). The science of synergetics emerged, which studies the spatial or temporal structures that exchange matter and energy with the external environment and self-organize in open systems far from equilibrium. A lot of new scientific information has been collected and great achievements have been made as a result of conducting research in the field of condensed media, especially solid-state physics. The synergetic approach to the study of the results of external effects on the physical properties of solid bodies is not only scientifically significant but also allows for obtaining materials with new properties and controlling their parameters in the future.

As a result of the research of small (nano) sized semiconductor structures and superconducting phenomena, new nano and superconducting electronics have appeared in physics. The emergence of nanotechnology is expected to cause huge positive changes and leaps in technology, medicine, society, and other fields. The study of atomic associates - clusters, which are intermediate links in the molecular and condensed states of matter, allows us to obtain new materials with unique properties, for example, fullerenes, carbon nanotubes, etc. The development of the main ideas of quantum mechanics led to the emergence of a new direction in physics - quantum informatics. In addition, modern physics is engaged in the study of life and thought processes at the molecular level and other problems of natural science. As a result of

ISSN: 2775-5118 VOL.3 NO.5 (2024) I.F. 9.1

such modern research in natural sciences, including physics and related sciences, high technologies have emerged and are rapidly entering our daily activities.

The current stage of scientific and technical development requires a new approach to the issue of personnel training. Specialists working with modern high technologies and new technical tools should have acquired modern knowledge and appropriate practical skills. However, the achievements of modern physics and the theoretical basis of high technologies are not sufficiently covered in the educational literature and are hardly reflected in educational programs.

First of all, the latest achievements of science and technology and modern fundamental research should be reflected in the curricula and manuals, and their teaching should be established. There are opportunities for doing these things in the current continuous education system. In our opinion, this issue can be solved in the following ways. The analysis of the existing curricula shows that there is a repetition of many subjects at the lower, middle, and higher levels of education. In addition, the number of hours of physical science in the technical higher education system is decreasing. To increase the effectiveness of education in such conditions, it will be necessary to coordinate the educational programs of fundamental subjects for the educational stages. If more of the weight of basic knowledge is transferred to the middle level, that is, if it is taught in academic lyceums or professional colleges, it will be possible to create educational programs of higher education based on modern natural science achievements. The secondary education system, which is equipped with modern educational equipment and technical means, has all the opportunities and conditions for imparting basic knowledge. As a result, there will be opportunities to further enrich and strengthen secondary education, and it will be possible to create modern educational programs that are highly effective.

If some time is required for such changes or problems arise, during this period it is appropriate to organize a separate course "Modern physics" at the bachelor's or master's level of education. One of the urgent issues that must be solved first is methodological supply, that is, the supply of modern teaching manuals, and equipment, and the issue of upgrading and retraining pedagogical staff.

The application of advanced pedagogical and information technologies and ideas to the educational process makes it possible to effectively solve the above-mentioned issues and problems.

CONCLUSION

In the history of physics, the science of physics formed during the last 30-40 years is recognized as the modern science of physics. Modern physics is developing in high-energy nuclear physics, physics of condensed media, nonlinear optics and physics of open systems, physics of nanomaterials, and other areas. One of the important factors in increasing the effectiveness of education is that the new information obtained and proven in these directions is reflected in the educational programs and the organization of modern physics education based on such programs. Due to the reduction in the number of hours allocated for physics in higher technical educational institutions, it is necessary to coordinate science programs at the lower, secondary, and higher education levels. It would be appropriate to organize special courses on modern physics in higher education. It is important to prepare educational and methodological manuals containing information about modern scientific achievements.

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