

RESEARCH IN THE FIELD OF NUCLEAR PHYSICS IN UZBEKISTAN AND THE USE OF ITS RESULTS IN THE NATIONAL ECONOMY

Sattorova Nargiza

Physics Teacher, Kattaqo'rg'on District 1st Technical School

Annotation:

This article examines the development of nuclear physics research in Uzbekistan and highlights the practical application of scientific achievements in various sectors of the national economy. Particular attention is given to the activities of the Institute of Nuclear Physics of the Academy of Sciences of Uzbekistan, the operation of the WWR-SM research reactor, radioisotope production, radiation technologies, and their use in medicine, agriculture, industry, and environmental protection. The article also discusses the future prospects of nuclear science and technology in Uzbekistan.

Keywords:

Nuclear physics, Uzbekistan, Institute of Nuclear Physics, WWR-SM reactor, radioisotopes, radiation technology, nuclear research, agriculture, medicine, industry, scientific development, national economy.

Nuclear physics is one of the most advanced branches of modern science. It studies the structure of atomic nuclei, nuclear reactions, radioactive processes, and the practical applications of nuclear energy. The development of nuclear physics has contributed significantly to scientific progress, technological innovation, and economic growth throughout the world. Uzbekistan is among the countries that have established a strong scientific foundation in this field and continue to expand research activities for peaceful purposes. The history of nuclear physics research in Uzbekistan began during the twentieth century. A major milestone was the establishment of the Institute of Nuclear Physics under the Academy of Sciences of Uzbekistan. Over the years, the institute has become the leading center for nuclear research in Central Asia and has conducted both fundamental and applied



investigations in nuclear science. Research activities include nuclear spectroscopy, radiation physics, material science, neutron activation analysis, and radioisotope production. One of the most important scientific facilities in Uzbekistan is the WWR-SM research reactor located near Tashkent. The reactor has been operating for decades and serves as a key instrument for scientific research, education, and technological development. It provides neutron beams used in various experimental studies and supports numerous projects in nuclear physics and material science. The reactor has undergone modernization and safety improvements to ensure its continued operation and effectiveness. Research conducted using the WWR-SM reactor has contributed significantly to the study of material properties under radiation exposure. Scientists investigate how metals, semiconductors, and other materials behave when subjected to neutron irradiation. Such studies are essential for the development of advanced industrial materials, reactor components, and high-technology equipment. These investigations also help improve the reliability and durability of engineering structures used in various industries. Another important area of nuclear physics research in Uzbekistan is radioisotope production. Radioisotopes are radioactive forms of chemical elements used in medicine, industry, agriculture, and scientific research. The Institute of Nuclear Physics produces several radioisotopes required for diagnostic and therapeutic procedures in healthcare. These isotopes support modern medical technologies and improve the quality of patient treatment. Nuclear medicine is one of the most valuable applications of nuclear physics. Radioactive isotopes are used in medical imaging techniques such as positron emission tomography (PET) and single-photon emission computed tomography (SPECT). These technologies enable physicians to diagnose diseases at early stages and monitor treatment effectiveness. Radiation therapy is also widely used in the treatment of cancer, providing significant benefits for public health. The agricultural sector also benefits from nuclear technologies. Radiation methods are used to improve crop varieties, increase agricultural productivity, and control pests. Scientists apply radiation techniques to develop plant species with higher resistance to diseases, drought, and environmental stress. These innovations contribute to food security and sustainable agricultural development. Nuclear analytical techniques play an important role in environmental monitoring. Researchers use neutron activation analysis and other nuclear methods to determine the composition of soil, water, and air samples. Such studies help identify environmental pollution, monitor ecological conditions, and support environmental



protection programs. Accurate measurements obtained through nuclear techniques provide valuable information for decision-makers and environmental agencies. Industrial applications of nuclear physics are equally important. Radiation technologies are used for quality control, material testing, and industrial process optimization. Non-destructive testing methods based on radiation allow engineers to examine the internal structure of materials without causing damage. These techniques improve safety standards and reduce production costs in many industrial sectors. The mining industry in Uzbekistan also utilizes nuclear technologies. The country possesses significant uranium resources, making it an important participant in the global nuclear fuel market. Nuclear analytical methods assist in mineral exploration, resource evaluation, and geological investigations. These applications contribute to the efficient use of natural resources and support economic development. Education and human resource development represent another important aspect of nuclear physics advancement in Uzbekistan. Scientific institutions collaborate with universities and international organizations to train highly qualified specialists. Students and researchers gain access to modern laboratories, research reactors, and advanced scientific equipment. Such educational initiatives strengthen the country's scientific potential and prepare future experts in nuclear science and technology. International cooperation has become a key factor in the progress of nuclear research in Uzbekistan. The Institute of Nuclear Physics actively collaborates with foreign scientific organizations, research centers, and international agencies. Participation in international projects allows Uzbek scientists to exchange knowledge, access advanced technologies, and contribute to global scientific developments. Recently, Uzbekistan joined the international MBIR research reactor consortium, expanding opportunities for advanced nuclear research and technological innovation. The peaceful use of nuclear energy is receiving increasing attention in Uzbekistan. National programs aim to strengthen energy security and diversify energy resources. Scientific research in reactor technology, nuclear safety, and radiation protection supports these long-term objectives. The development of nuclear infrastructure is expected to contribute to sustainable economic growth and technological modernization. Safety remains a fundamental principle of all nuclear activities. Uzbekistan cooperates closely with the International Atomic Energy Agency (IAEA) to ensure compliance with international safety standards. Regular safety assessments, modernization projects, and personnel training programs help maintain the safe operation of nuclear



facilities. International experts have recognized the country's commitment to the responsible management of nuclear technologies. Research in radiation materials science continues to generate valuable results for industrial development. Scientists investigate the effects of radiation on advanced materials, semiconductors, and engineering components. These studies support the creation of innovative technologies used in electronics, aerospace engineering, and energy production. The practical outcomes of such research contribute directly to economic modernization and industrial competitiveness. The future of nuclear physics in Uzbekistan appears promising. Continued investment in scientific infrastructure, international cooperation, and human capital development will strengthen the country's position in the global scientific community. Advances in nuclear science are expected to provide new solutions for energy production, healthcare, environmental protection, and industrial innovation. In conclusion, nuclear physics research in Uzbekistan plays a vital role in scientific and technological development. The achievements of the Institute of Nuclear Physics and related organizations have found practical applications in medicine, agriculture, industry, environmental monitoring, and education. The effective use of nuclear technologies contributes significantly to the national economy and improves the quality of life of the population. Through continued research and international collaboration, Uzbekistan is well positioned to expand the peaceful applications of nuclear science for future generations.

References:

- 1 Institute of Nuclear Physics of the Academy of Sciences of Uzbekistan – Research Activities and Reactor Operations.
- 2 International Atomic Energy Agency (IAEA). Research Reactor Safety and Nuclear Applications in Uzbekistan.
- 3 World Nuclear Association. *Uranium in Uzbekistan and Nuclear Research Infrastructure*.
- 4 Rosatom and Institute of Nuclear Physics Cooperation Reports.
- 5 Institute of Nuclear Physics Participation in the MBIR International Consortium.
- 6 Hayes, A.C. *Applications of Nuclear Physics*. arXiv, 2017.
- 7 Radiation Physics and Chemistry. *Material Radiation Property Studies on the VVR-SM Reactor*.



8 Academy of Sciences of the Republic of Uzbekistan. Nuclear Science Development Programs.

9 International Atomic Energy Agency. *Peaceful Applications of Nuclear Technology*.

10 OECD Nuclear Energy Agency. *Nuclear Science and Technology for Sustainable Development*.