

Applications within particle accelerators

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Summary

Particle accelerators are used for fundamental scientific research aimed at expanding our understanding of matter, for a variety of socio-economic applications related to human health, environmental monitoring, food quality, energy and aerospace technologies, and other areas. We will consider applications of a particle accelerator using the example of accelerator VITA developed at BINP (Russia). This accelerator is an electrostatic tandem accelerator of charged particles of an original to produce beam of protons or deuterons with energy up to 2.3 MeV and with current up to 10 mA.

This accelerator is actively used for the development of boron neutron capture therapy (BNCT), including the development of methods and instruments of dosimetry, testing of new boron delivery drugs, and treatment of domestic animals. The second neutron source was made for the treatment of patients in clinic in Xiamen (China) and China became the second country in the world to begin treating patients with BNCT. The third neutron source made for Oncology Center in Moscow to begin clinical trials in Russia from 2025. The fourth neutron source is currently being developed for Biological Center in Moscow.

The facility VITA in BINP produces powerful neutron fluxes of various energy ranges (from cold to fast), and powerful fluxes of monoenergetic α -particles and photons. For this purpose, a thin lithium target and a number of beam shaping assemblies are used. The facility is used for applications such as radiation testing of promising materials, including for ITER and CERN, measurement of the cross-section of nuclear reactions, development of lithium-neutron capture therapy; creation of quantum dots in crystals, determination of elemental composition of thin films, study of the luminescence of substances under the influence of neutrons; seed modifications; neutron diffraction, etc.

The report describes the created facilities, presents the results of the conducted research and declares plans.