Accelerator based neutron sources VITA

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The Budker Institute of Nuclear Physics has developed a neutron source VITA [1, 2], consisting of an electrostatic tandem accelerator of charged particles of an original design (vacuum insulated tandem accelerator) to produce a beam of protons or deuterons with energy up to 2.3 MeV and with current up to 10 mA, a thin solid lithium target for generating neutrons and set of beam shaping assemblies for producing a neutron beam. The facility produces powerful neutron fluxes in a wide energy range: from cold to fast.

The facility at the BINP site is used for the development of boron neutron capture therapy (BNCT), including the development of methods and tools of dosimetry, testing of new boron delivery drugs, and treatment of domestic animals with spontaneous tumors [3]. Also the facility is used for 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; seeds modifications; neutron diffraction, etc. The facility is currently being prepared to repeat the Stern-Gerlach experiment in order to give it a correct description and then to design a neutron storage ring [4].

Thanks to the neutron source VITA-IIα made for a clinic in Xiamen (China), China became the second country in the world to begin treating patients with BNCT. Now the neutron source VITA-IIβ is currently being commissioned at the National Medical Research Center of Oncology in Moscow to begin clinical trials of the BNCT technique in Russia since November 2025. Currently, the neutron source VITA-III is being developed, featuring a number of innovative solutions with the aim of improving and simplifying it [5]. The compact neutron source VITAmin is also being developed as a powerful source of fast neutrons, which has the potential to create a very compact neutron source for BNCT.

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

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