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Neutron Source for Boron Neutron Capture Therapy

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The accelerator-based epithermal neutron source based on tandem accelerator with vacuum insulation and lithium neutron producing target was proposed and created in the Budker Institute of Nuclear Physics for development of Boron Neutron Capture Therapy (BNCT). Stationary proton beam with 2 MeV energy, 1.6 mA current, 0.1% energy monochromaticity and 0.5% current stability has just been obtained. Neutron generation is realised through ^{7}Li(p,n)^{7}Be reaction. Neutron spectrum was measured by time-of-flight technique, neutron flux - by activation of lithium target and NaI scintillator. Acceleration and stripping of ion beam was investigated in details. Reason of ion beam current limit has been determined. The BNCT effect was demonstrated at neutron radiation of glioblastoma cell line U87 and normal human fibroblast cell line MRC-5 incubated in a medium with and without boron phenylalanine. Here we present and discuss the results of these investigations. The report also presents a work plan that being implemented will allow to start f BNCT at the nearest future. In order to increase the proton beam current up to 3 mA it is supposed to replace the source of negative hydrogen ions by a new one, and to improve the vacuum conditions at the beginning of the accelerating gap. To increase the energy up to 2.5 MeV the feed-through insulator was upgraded. The system under establishing will allow to provide the beam dose 1 RBE Gy per min, advanced depth of 12 cm and therapeutical ratio of 4. The facility, in addition to the formation of epithermal neutron beam for BNCT, will be able to generate powerful flow of fast neutrons through the ^{7}Li(d,n)^{8}Be reaction, monochromatic gamma-rays (0.478 MeV) due to inelastic scattering of protons in lithium or hard gamma-rays on the lithium fluoride target.