

Measurements of nuclear reaction cross-sections at VITA

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At the Budker Institute of Nuclear Physics (Novosibirsk, Russia) the accelerator based neutron source VITA was proposed and developed initially for the boron neutron capture therapy (BNCT), a promising cancer treatment method. VITA consists of the vacuum insulated tandem accelerator for producing a proton/deuteron beam with energy of 0.3-2.3 MeV and current of 1 nA to 10 mA, lithium target for neutron generating in the ${}^7\text{Li}(p,n){}^7\text{Be}$ reaction and the beam shaping assembly for neutron flux forming.

Knowing the reaction cross-sections is certainly important for many applications from BNCT and proton therapy of cancer to aneutronic fusion and astrophysics. At first it was necessary to measure the ${}^7\text{Li}(p,p',\gamma){}^7\text{Li}$ cross-section as this is the source of undesirable accompanying photon dose for BNCT, and the open data in literature vary significantly. For the measurement, the thin lithium target was manufactured by thermal evaporation of lithium in a vacuum and irradiated with the protons of 0.65-2.225 MeV energy. The intensity of γ -radiation was measured by a HPGe γ -ray spectrometer (Institute of Physical and Technical Problems, Dubna, Russia). Then with the lithium target the following reaction cross-section were measured: ${}^7\text{Li}(p,\alpha){}^4\text{He}$, ${}^7\text{Li}(d,n\alpha){}^4\text{He}$, ${}^7\text{Li}(d,\alpha){}^5\text{He} \rightarrow \alpha + n$, ${}^6\text{Li}(d,\alpha){}^4\text{He}$, ${}^6\text{Li}(d,p){}^7\text{Li}$, ${}^6\text{Li}(d,p){}^7\text{Li}^*$, $\text{Li}(d,n)$. The intensity and energy of α -particles and protons were measured by the α -spectrometer with silicon semiconductor detector (Institute of Physical and Technical Problems, Dubna, Russia). The successful results in measuring the cross-sections with lithium encouraged to measure the cross-section of ${}^{11}\text{B}(p,\alpha)\alpha\alpha$ reaction. For this the thin boron target was manufactured by magnetron sputtering

This work presents the developed complex for measurement the nuclear reaction cross-sections, the features of the measurement procedure, the detailed description of the investigated targets and the results of experimental data for cross-sections compared with the data from literature.

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