Particle leaking, cross-sections ratio ^{10}B(n,α)/^{238}U(n,fission), and excitation function of the reaction ^{10}B(n,α)^{7}Li at MeV energies

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The neutron-reaction standard ^{10}B(n,α)^{7}Li has been studied in the energy range between 1 MeV and 5 MeV at the 7 MV Van de Graaff accelerator of IRMM by using a gridded ionisation chamber (GIC) and signal digitisation. The aim was to obtain accurate data for the recently started IAEA Coordinated Research Project on the improvement of standard cross sections for light elements. The effect of particle leaking has been discovered and its implications investigated. Particle leaking arises from the simultaneous emission of reaction products in forwards angles and the inability of the detector to resolve multiple particles. It is an inherent property of all GIC spectrometers used for the study of (n, charged particle) reactions on light-element solid targets. The measurement of the cross section strongly benefits from it but the determination of other measurables is negatively affected. Forward angular distributions are truncated at large emission angles and look like depleted of reaction products in a region between a kinematically determined angle θ_0 and 90°. The branching ratio α_0/α_1 can not be determined in the depleted region. The cross-sections ratio ^{10}B(n,α)/^{238}U(n,fission) has been measured and the excitation function of ^{10}B(n,α)^{7}Li determined by simultaneously detecting the charged particles from the boron disintegration emitted in the forward and the fission fragments emitted in the backward emission hemispheres respectively. Compared to the most recent versions of well known evaluations the IRMM cross sections show the best overall agreement with the data of JEF-2.2, are close to the values of JENDL-3.3, and strongly deviate from predictions of ENDF/B-VI.8 and JEFF-3.0.

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