

Measurement and Analysis of the ${}^6\text{Li}(n,t){}^4\text{He}$ Cross Section

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The reaction ${}^6\text{Li}(n,t){}^4\text{He}$ has important applications as a neutron flux monitor, and as a breeder of tritium. Surprisingly, although its cross section has been well measured in the region below a few hundred keV where it is used as a standard, it is not so well known at energies above one MeV. A high-priority measurement at the Weapons Neutron Research (WNR) facility has been to determine this cross section and its angular distributions in the MeV energy range.

Preliminary values of the measured angular distributions have been obtained recently from LANSCE-NS. The overall normalization of the data set is yet to be determined, but the relative information is almost final. This information has been included in a large, multichannel R-matrix analysis of reactions in the ${}^7\text{Li}$ system in order to obtain better information about the ${}^6\text{Li}(n,t)$ integrated cross section. The fits to some of the angular distribution data are shown in Fig. 1. The shape of the distribution around 2 MeV confirms the presence of the $J^\pi=3/2^-$ resonance that had been obtained earlier, and indicates that a pronounced “shoulder” in the integrated cross section due to that resonance is more than 5% higher than obtained from the previous data. This can be seen in Fig. 2.

The angular distributions in Fig. 1 also indicate that additional resonances may contribute in the energy range above 2 MeV. We will continue the analysis as the final data become available, with the

goal of providing a complete new evaluation of the $n+{}^6\text{Li}$ cross sections, including covariances, for NW applications.

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- [1] J.C. Overley, et al., *Nucl. Phys. A* **221**, 573 (1974).
- [2] M. Drosge, et al., *Nucl. Inst. Meth. B* **94**, 319 (1994).
- [3] R.L. Macklin, et al., *Nucl. Sci. Eng.* **71**, 205 (1979); ratio converted using revised ${}^{235}\text{U}(n,f)$ cross sections (2004).

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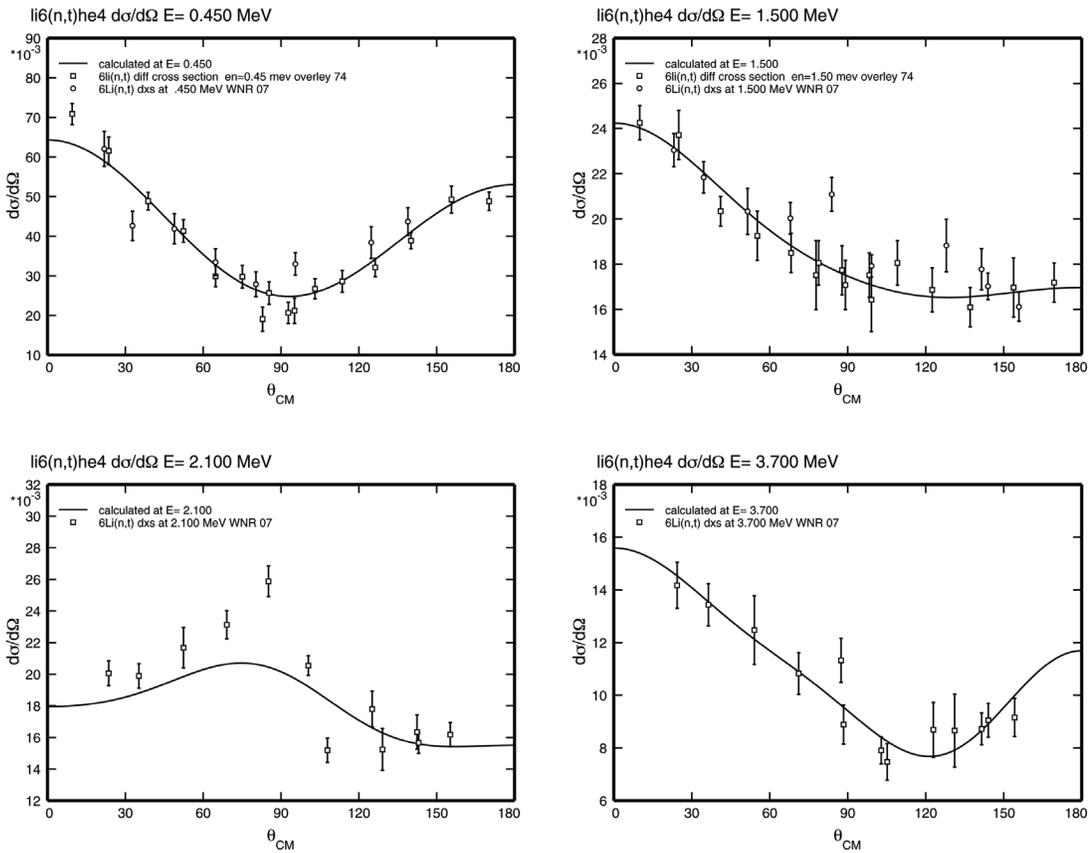


Fig. 1. Measured and calculated angular distributions for the ${}^6\text{Li}(n,t)$ reaction at energies between 0.45 and 3.7 MeV. The preliminary WNR measurement is shown with the data of Overlay et al. [1].

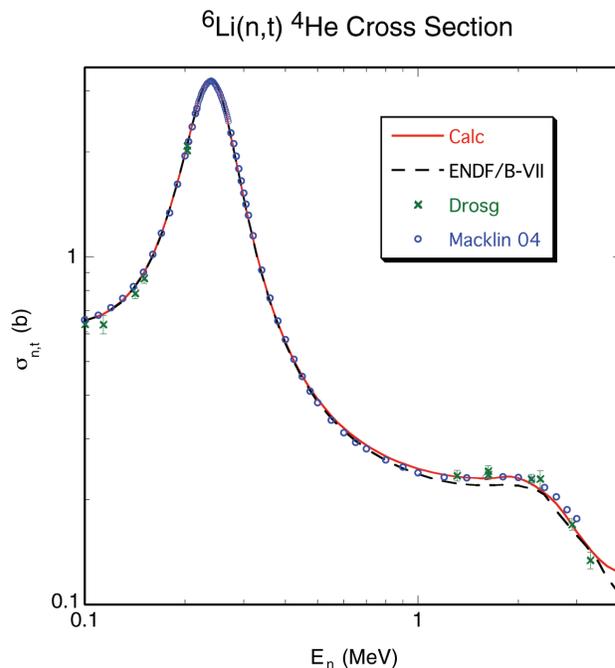


Fig. 2. Integrated cross sections for the ${}^6\text{Li}(n,t)$ reaction. The solid red line gives the calculation from the current fit. The dashed black line is the result from the recent ENDF/B-VII (and IAEA standards) evaluation. The measurements shown are from Drogg [2] (green crosses) and from Macklin [3] (blue circles).