

Measurement of D-T Neutron-Induced Cross Section of $^{124}\text{Xe}(n,2n)^{123}\text{Xe}$

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Abstract: Nuclear reactions play an important role in understanding the inner dynamics of inertial confinement fusion (ICF) plasma. For various reasons, ^{124}Xe , which undergoes both $(n,2n)$ and (n,γ) reactions, is one of the most prominent nuclide for such research. The threshold of $^{124}\text{Xe}(n,2n)^{123}\text{Xe}$ reaction is about 10.6MeV, and its cross section is definitely important for the ICF plasma diagnose. Experimental measurements of the cross section have been completed by several institutions. However, the discrepancy of these results is rather evident. In order to provide more accurate experimental data, the $^{124}\text{Xe}(n,2n)^{123}\text{Xe}$ cross section was measured with monoenergetic neutrons at 14.6MeV by using the activation method. The experiment was carried out using the Cock-croft Walton Accelerator at China Institute of Atomic Energy. Monoenergetic neutron beams were produced via the $^3\text{H}(d, n)^4\text{He}$ reaction ($Q = +17.6\text{MeV}$). Typically, the deuteron beam current was about $250\mu\text{A}$, producing the neutron yield of $3\times 10^{10}/\text{s}$. The ^{124}Xe gas, enriched to purity of 99.5% , was contained in a PMMA cylinder with inner diameter of 20mm and height of 10mm, and the pressure was about 1atm, resulting in a ^{124}Xe mass of approximate 16mg which was weighted accurately. In addition, two high-purity thin ^{93}Nb foils of the same diameter were attached to the front and back faces of the ^{124}Xe gas cylinder for incident neutron flux determination. The distance between the ^3H target and the center of the ^{124}Xe cylinder was typically 10mm. After irradiation, the activity of ^{123}Xe and $^{92\text{m}}\text{Nb}$ was determined by using a high-purity germanium (HPGe) detector with calibrated efficiency in 10cm thick Pb shield. A Monte Carlo code was written to correct the neutron flux because of the short distance between the ^3H target and the ^{124}Xe gas. The cross section result is 1.00 b at 14.6MeV energy, and the uncertainty is about 5.0%. Our data is in excellent agreement with ENDF/B-VII.1 and the data of Sigg et al.

Keywords: ^{124}Xe , $(n, 2n)$, Neutron induced cross-section, ^{123}Xe , ICF

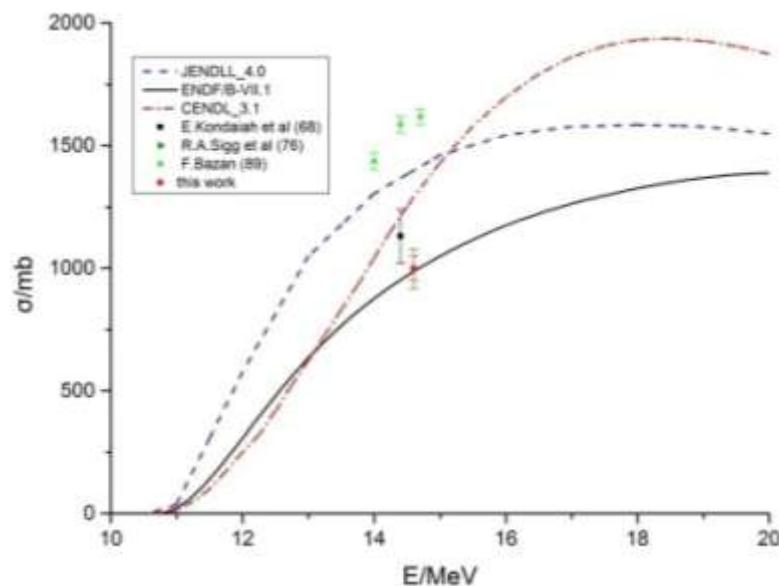


Fig.1 $^{124}\text{Xe}(n,2n)^{123}\text{Xe}$ cross section data of ours and others.