A STUDY OF THE Li(p,n) Be EXCITATION FUNCTION AT INTERMEDIATE ENERGIES USING RESIDUAL ACTIVITY

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The excitation function of the $^7\text{Li}(p,n)^7\text{Be}$ reaction was measured in the proton energy range of $E_p = 60$–200 MeV. Such a measurement was needed to determine the total reaction cross section which in the course of other $^7\text{Li}$ studies could be used for calibration purposes.

The total cross sections were determined using standard off-line γ-ray detection techniques by measuring the residual $^7\text{Be}$ (53d) activity. This method has been used at lower energies and at 120 MeV to calibrate large volume neutron detectors.

Typically at each energy a 10–20 mg/cm$^2$ enriched $^7\text{Li}$ target was irradiated with 20–100 nA·hr of protons. After bombardment the irradiated target was counted in a prescribed counting geometry with known γ-ray efficiency. The $^7\text{Be}$ was identified by its (10%) electron capture branch to the 477.4 keV level in $^7\text{Li}$. The samples were counted over several months to insure the 477.4 keV γ-ray decayed with the $^7\text{Be}$ half-life of 53.3d.

The results of these measurements at twelve energies between 60–200 MeV are shown in Fig. 1 along with the previous results of Schery, et al. The error of our measurements was typically 8–10%. A theoretical analysis of the striking $1/E$ dependence has been made by Prof. George Walker. Assuming the PWIA, an energy independent, very short range interaction (using harmonic oscillator wave functions and neglecting exchange effects), yields such a $1/E$ dependence for the summed inelastic scattering differential cross section to a particular state. This result implies that $\langle V^2 + 2.95 V^2_{\text{ST}} \rangle$ is independent of $E$, and that $\sigma(E) = 725.2869 \frac{1}{E} - 0.2952$ with $\sigma$ in millibarns, $E$ in MeV and a correlation coefficient of 0.99845.


Figure 1. Measurements of the $^7\text{Li}(p,n)^7\text{Be}$ total cross section as a function of energy from this work (dots) and Ref. 1 (triangles). The straight line represents a $1/E$ dependence.