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1.6 # Resonance Energy Dependence of Analyzing Power for ^{12}C + n Elastic Scattering near 16 MeV

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Observation of the intermediate structure of neutron cross-sections due to the exitation of doorway states[1,2] in energy region 10 - 20 MeV is on the verge of experimental accuracy. Such states may be more prominent in the exitation functions of analyzing power of nuclei for scattering of fast polarized neutrons due to the sensitivity of the polarization to the interference of scattering mechanisms. However the manifestation of doorway states has not yet been observed in this way. The amount of experimental neutron polarization data in this energy region is very limited and some of them are contradictory. In particular, the discrepancies existed for ^{12}C near 16 MeV[3-6].

We have measured the analyzing power for $^{12}C(n,n_o)^{12}C$ with lesser neutron energy spread then in ref.[3-6]. Neutrons with a polarization from -0.14 to -0.18 were obtained from $^{3}H(d,n)^{4}He$ reaction on the thin tritium - titanium solid target at 65° to a 1.8 - 2.3 MeV deuteron beam. The experimental arrangement used was described in ref.[7,8]. Experimental asymmetry values and errors were obtained by averaging of the results of about 300 measurements of asymetry for each data point. False asymmetry values were periodically measured using unpolarized 14.3 MeV neutron beam. Our data on angular distribution of analyzing power $A(\Theta)$ measured between 30° and 90° lab at neutron energy 16.34 MeV are in a good agreement with data[3-5] measured at 14.2 - 16.35 MeV energy region. Data[6] at 16.1 MeV are much more positive over the whole angular range investigated. We also carried out the measurements of the exitation functions A(En) for the angles 45° and 34° lab for isotropic scattering. Taking into account the angular dependence of differential cross section $d\sigma/d\Omega(\Theta)$ and finite geometry it corresponds to 41° and 31° with angular resolution of 7.5°. The analyzing power data obtained are shown in fig.1. Our results for 41° indicate the exitation of a rather narrow resonance at the neutron energy about 16.1 MeV. They are in a good agreement with the data measured by the other groups, which seemed to disagree, because the data[6] were obtained near the maximum of the resonance, and data[4,5] outside it. In our data for 31° the resonance effect was not visible within the limits of experimental analyzing power errors of about ±0.07. An analysis has been made based on an optical or diffraction model plus Breit-Wigner resonance permitted to provide a good fit to all available experimental data in common with the following parameters of the resonance: E_o=16.1 MeV, Γ =0.1 MeV. Elastic neutron width Γ_{no} is quite large and similar to the total width: $\Gamma_{no}/\Gamma \approx 1$. Exitation energy of the ^{12}C+n system is $\mathcal{E}_x$=19.9 ± 0.1 MeV, lifetime $\tau \sim 7 \cdot 10^{-21}$ sec corresponds to a doorway state. The correlation between the values of resonance effects at the angles 41° and 31° point out the most probable value of L_{res}=1.

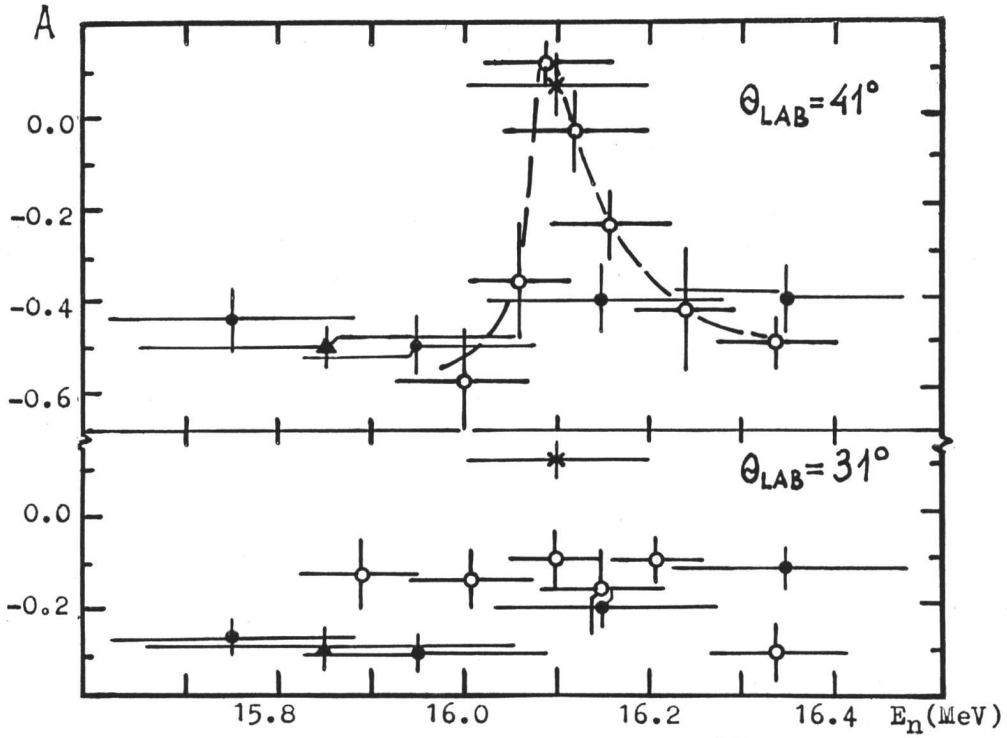

Fig. 1. Analyzing power in elastic ^{12}C + n scattering at laboratory angles 41° and 31°. The data of this work are shown by the open circles; the rest of the data points is the interpolation of values measured at the neighbouring angles in ref.[4] - triangles, ref.[5] - solid circles, ref.[6] - crosses. Horizontal error bars represent the energy resolution. The dashed curve is a guide to the eye.

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