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0 ' " (n, a) C^{13} Reaction at 14.1 MeV*

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Energy and angular distributions of alpha-particles in the $O^{16}(n,\alpha)C^{13}$ reaction have teen obtained at 14.1 Mev, by using a Wilson cloud chamber. The well resolved groups of alpha-particles leading to the states of 3.85 Mev, 3.68 Mev, 3.08 Mev and ground of C^{13} were obtained. The angular distributions for these states were analyzed. For the peak in the backward direction the heavy particle stripping process was applied. For the peak in the forward direction two reaction mechanisms were proposed: the knock-on process and pick-up process.

FOR the investigation of the (n, a) reaction mechanism in the region of light nuclei, the O^{16}(n, a) C^{13} reaction at 14.1 Mev has been recently studied by several authors.(1-5) They conclude that the direct interactions such as pick-up, knock-on or heavy particle stripping are important for this reaction, though the energy and angular distributions observed by them are in considerable inconformity.

For more accurate study of the (n, a) reaction in O^{16}, we used a Wilson clound chamber for the detection of alpha-particles. We expected that the most reliable energy and angular distributions of alpha-particles would be obtained, because there existed no isotope other than oxygen in the cloud chamber. The cloud chamber used the experimental procedures were the same as reported previously.(6)

Fig. 1 gives the energy distribution cf alpha-particles. The number of tracks was plotted against the alpha-particle energy in the C. M. system as well as the excitation energy of residual C^{13} nucleus. The ground state and the first excited state (3.08 Mev) are well resolved, while the 3.68 Mev and 3.85 Mev states are tao closed to be separated,

The angular distributions of alpha-particles leading to the ground and excited states of C^{13} nucleus are shown in Figs. 2, 3, 4 and 5. The simple Butler formula was used to fit the experimental distributions for the ground state and the 3.68 Mev and 3.85 Mev states.

The angular distribution for the ground state (Fig. 2) shows a strongly pronounced backward peak, which gives very larger values than the theoretical fitting far the heavy particle stripping process in the regian between 160° and 180" · The

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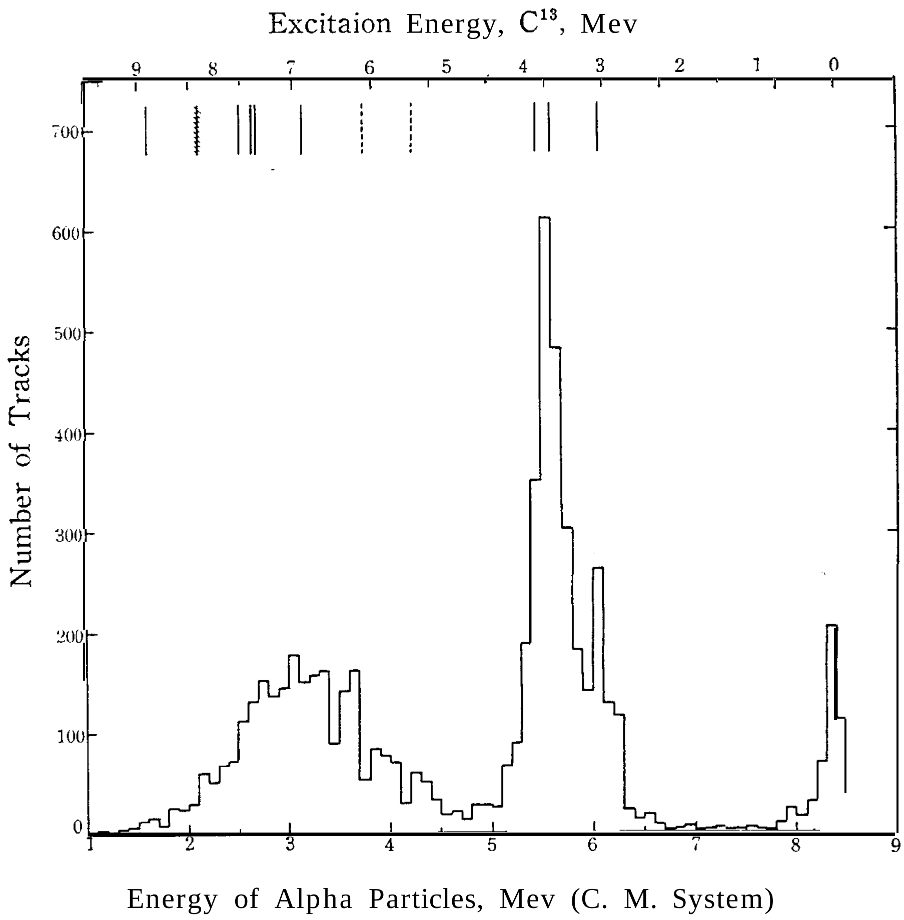

Fig. 1. Energy distribution of alpha-particles in the $O^{16}(n, a)C^{13}$ reaction at 14.1 Mev.

peak in forward direction is fitted with theoretical curve for the knock-on process. A reasonable fitting for the pick-up porcess would also be obtained, but with a smaller radius R= 4.84 f m. The angular distribution of alpha-particles leading to the 3.08 Mev state (Fig. 3) gives a similar trend to that of the ground state. Fig. 4 shows the angular distribution for the unseparated 3.68 Mev and 3.85 Mev states. The theoretical curves for the knock-on and heavy particle stripping process, assuming $l=1$, well fitted to the experimental points. It was found that, for $l=2$, good fitting would be possible by choosing rather larger values for radii, $R=7.41$ fm for knock-on process and $R=6.91$ fm for the heavy particle stripping process. It is difficult to determine, from these results, whether this large peak in the energy distribution comes from 3.68 Mev or 3.55 Mev state. It seems that both states contribute to form this unseparated alpha-particle group. The theoretical fittings for the pick-up process were also studied to compare with that for the knock-on process, showing not so much difference from each other. Fig. 5 shows the angular distribution of alpha-particles leading to the excited states

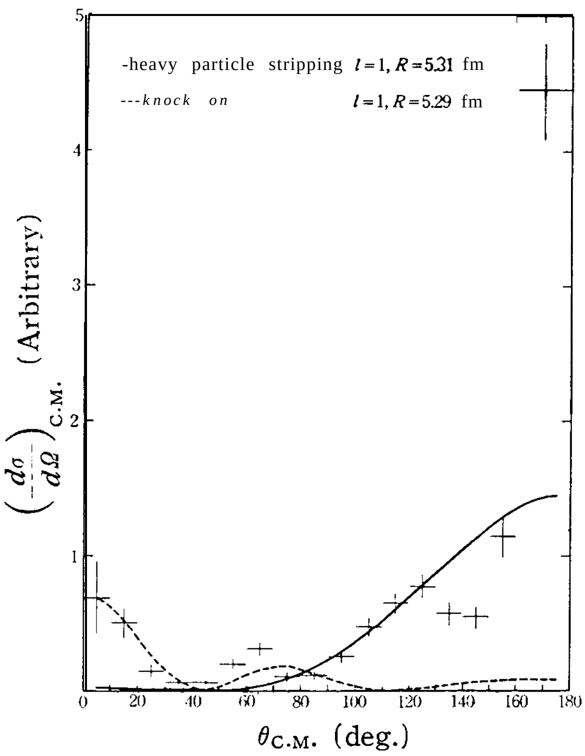

Fig. 2. Angular distribution of alpha-particles leading to the ground state of C^{13}

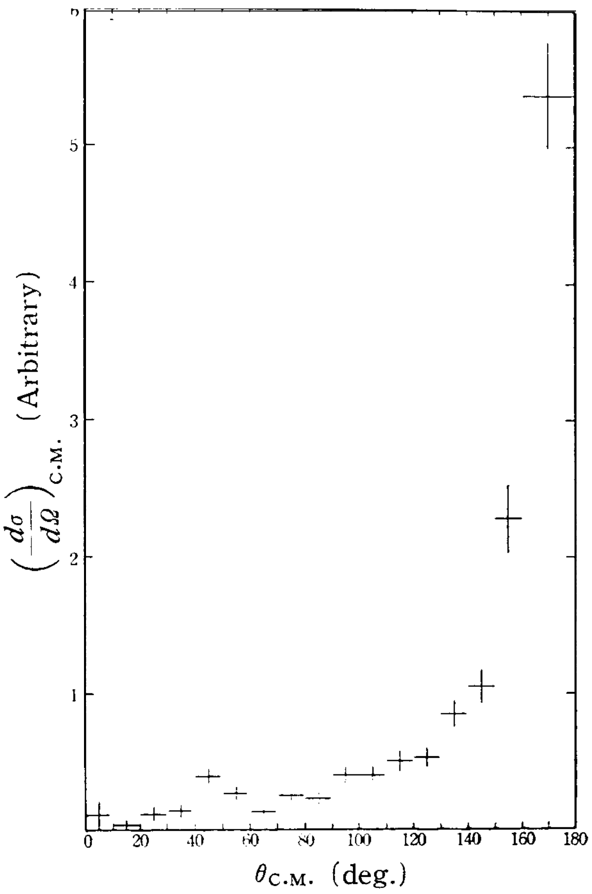

Fig. 3. Angular distribution of alpha-particles leading to the 3.08 Mev. state of C^{13}

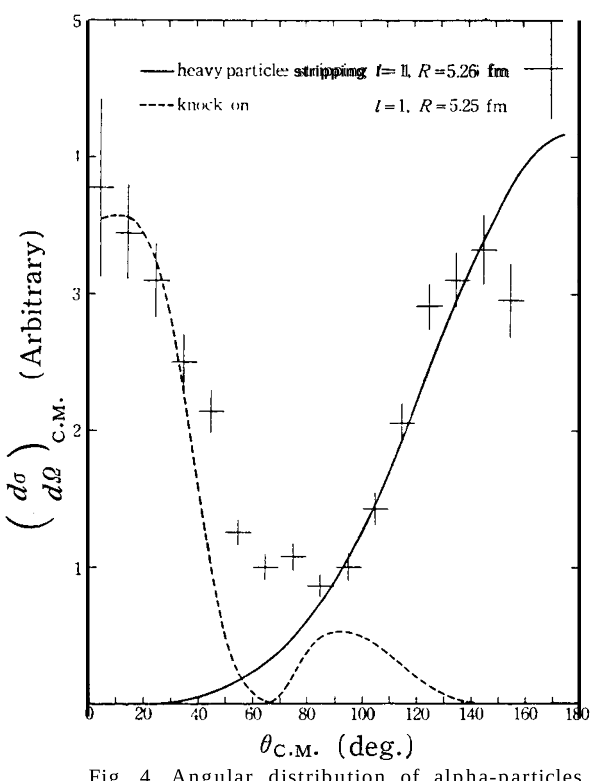

Fig. 4. Angular distribution of alpha-particles leading to the 3.68 Mev and 3.85 Mev states of C^{13}

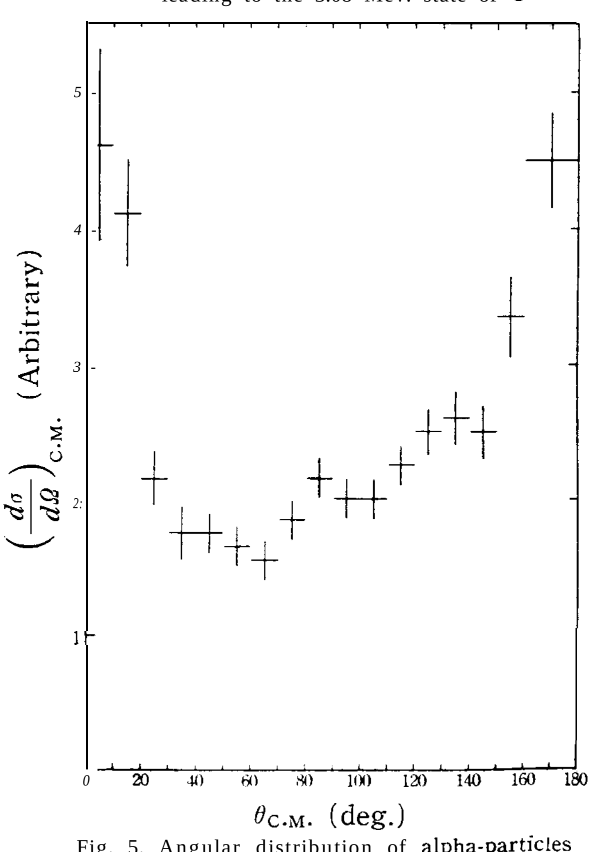

Fig. 5. Angular distribution of alpha-particles leading to the excited states of C^{13} between 4.5 Mev and 8.5 Mev

between 4.5 Mev and 8.5 Mev, which are not resolved. Comparing with Fig. 4, similar peaks in both forward and backward direction are clearly absorved.

From these angular distribution studies, it is difficult to specify which particular reaction mechanism, knock-on or pick-up, is opearative for producing forward peak. The backward peak oberved in the present work indicates that the heavy particle stripping process is of importance for the reaction studied.

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