Brief Communications

ANGULAR CORRELATION BETWEEN MULTIPLY PRODUCED FRAGMENTS

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THE purpose of this work was to plot the excitation function of the multiple emission of fragments and to carry out a detailed analysis of the angular correlation between a pair of fragments in one disintegration.

Pellicle stacks with P9ch and NIKFI-K emulsions were exposed in the internal beam of the proton synchrotron of the Joint Institute for Nuclear Research to 2, 3, 6, and 9 GeV protons. The absolute values of the cross sections were determined in terms of the cross sections for star production in the emulsion. Figure 1 shows the experimentally obtained dependence of the cross section for the production, on the Ag and Br nuclei, of disintegrations with two and three fragments of $Z \geq 4$, having a range $\geq 15\,\mu$ in emulsion, as a function of the energy of the incident protons. As in the case of the production of one fragment, the excitation functions show a noticeable increase in the region of ~ 1 GeV, which goes over into saturation at high energies.

To analyze the angular correlation of fragments produced in pairs, we selected 309 stars with two fragments having $Z \geq 4$, and 46 stars in which a Li^8 fragment was observed simultaneously with a fragment having $Z \geq 4$.

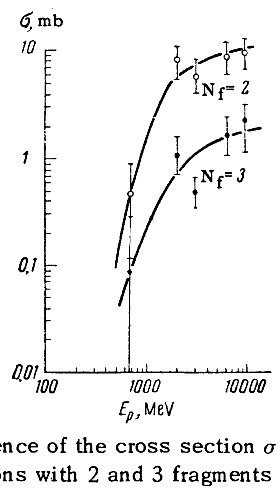

FIG. 1. Dependence of the cross section σ for the production of disintegrations with 2 and 3 fragments on the energy of of the incident protons E_p: N_f – number of fragments in one disintegration.

All the fragments were separated into two parts: slow—with energy $1.5 \leq E_f < 5$ MeV/nucleon, and fast—with energy $E_f \geq 5$ MeV/nucleon. As a result, the disintegrations with two fragments formed three groups: group I—two slow fragments, group II—one fast and one slow, and group III—two fast fragments. Figure 2 shows the distribution of the cosines of the angles ψ between the fragments for all three disintegration groups. It is seen from the figure that the character of the angular correlation is plainly different in the different groups: whereas in stars having one fast and one slow fragment all the angles between fragments have equal probability, in the group with two slow fragments we observe a clear-cut angular correlation at 120–140°. At the same time, in stars with two

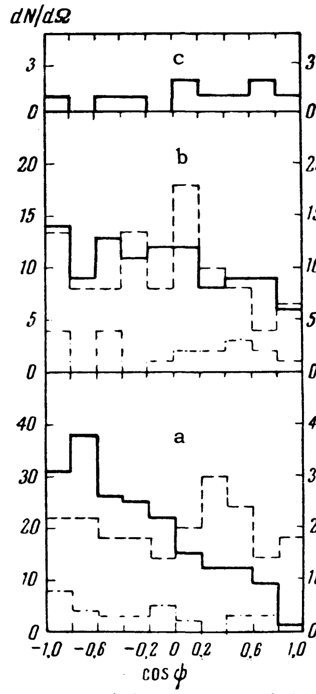

FIG. 2. Distribution of the cosines of the angles ψ between two fragments in one disintegration. Continuous curve – experiment; dashed curve – calculation for fragments with $Z \geq 4$; dash-dot line – for disintegrations containing at least one Li^8 fragment. a – group I, $1.5 \leq E_f < 5$; b – group II, $E_{f1} \geq 5$, $1.5 \leq E_{f2} < 5$; c – group III, $E_f \geq 5$ (energies in MeV/nucleon).

fast fragments there is a preference for angles < 90°. By assuming independence of the production of the two fragments and by knowing the form of the angular distributions of single fragments, we can calculate the form of the angular correlation for all groups. Comparison with experiment (Fig. 2) shows that for groups II and III the assumed independence of the formation of each of the fragments is correct. For group I, this assumption is not sufficient. Our analysis has shown that to explain the angular correlation in this group it is necessary to assume that the fragment pair is produced simultaneously in one disintegration.

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INELASTIC SCATTERING OF DEUTERONS BY SEVERAL EVEN TIN ISOTOPES

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MEASUREMENTS were made, at a deuteron energy of 13.6 MeV, of the differential cross-sections of inelastic scattering on the isotopes $Sn^{116,118,120,122,124}$ with excitation of the first 2^+ levels ($Q \approx -1$ MeV) and also of the states which form a gross-structure peak at $Q \approx -2.5$ MeV. The deuterons were recorded by a selective scintillation spectrometer[1].

The method used to determine the absolute cross-sections was similar to that described previously[2]. The angular distributions for the excitation of the quadrupole 2^+ levels are shown in Fig. 1, where the curve is drawn through the points corresponding to Sn^{120}. The position of the extremal points of all the angular distributions is described by the Huby-Newns theory[3] for $L = 2$ and $R_0 = 8.2 - 8.5$ F. The angular distributions of the deuterons which form a gross-structure peak for $Q \approx -2.5$ MeV do not, on the whole, possess a clear enough structure, because several levels contribute to the peak. As the example of Sn^{120} clearly illustrates (Fig. 2), several of these levels give angular distributions which fluctuate partly in phase with the curve for the 2^+ level, and partly in anti-phase to it. The latter phenomenon indicates the presence of levels with negative parity in the gross-structure peak. At the same time, the position of the $Q \approx -2.5$ MeV peak coincides with that of the 3^- level in the region of $A \sim 120$, and so it is natural to assume that it is these levels which make the greatest contribution to the gross-structure peak, since in inelastic scattering the collective states are excited the most intensely.

In a previous investigation carried out by us on the excitations of the collective and single-particle states of the isotopes $Sn^{118,120}$ in (d, p) reactions [4,5], it was shown that in this reaction the single-particle states are excited more intensely than the

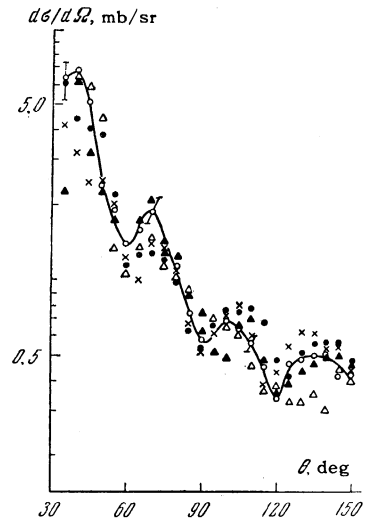

FIG. 1. Angular distributions of deuterons inelastically scattered by tin isotopes: ● = Sn^{116}; × – Sn^{118}; ○ = Sn^{120}; △ = Sn^{122}; ▲ = Sn^{124}. Abscissa: laboratory angle of scattering. Ordinate: differential cross-section in mb/sr.

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