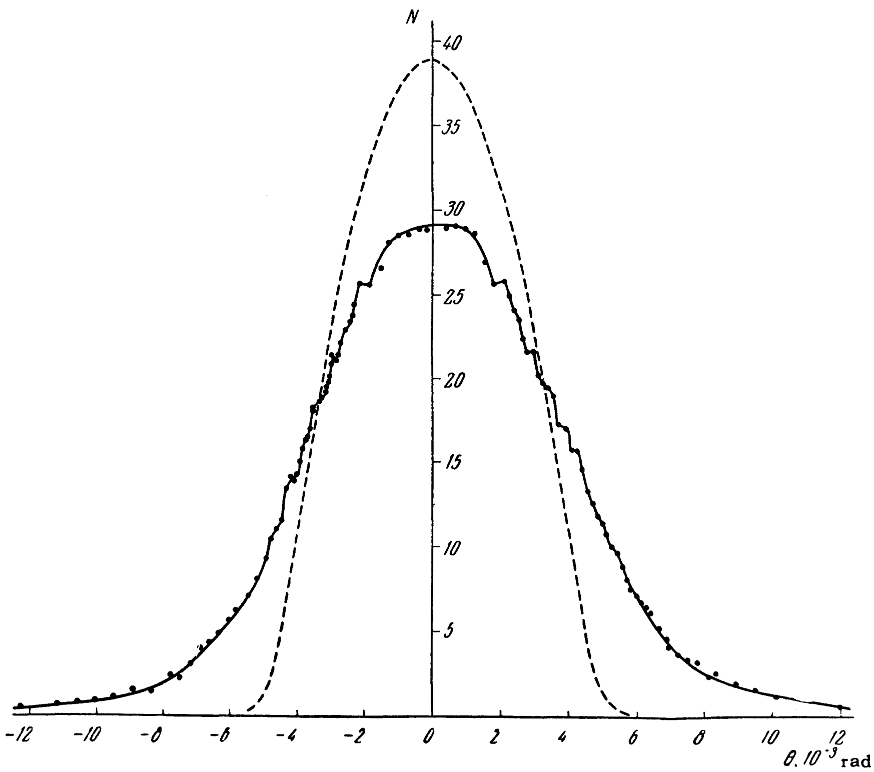

FIG. 1

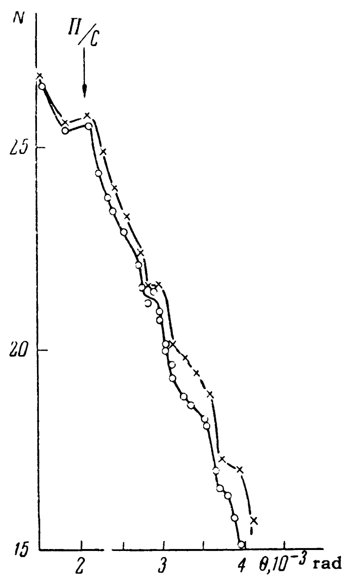

FIG. 2

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FORMATION OF FAST RESIDUAL NUCLEI

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IT was indicated in [1,2] that in any analysis of the formation of fast fragments upon interaction between nuclei and high-energy particles, it is necessary to take account of the possibility of intranuclear reactions in the diffuse region of the nucleus, that is, inelastic interactions between fast nucleons and nucleon clusters in the nucleus.

In this case the fragment emitted in the disintegration is a unique residual nucleus due to the destruction of nuclear substructure, and when a fragment unstable against decay is produced this can be the cause of some of the lighter products of the nuclear disintegration. (In the disintegration of light nuclei, in particular, this can be the high-energy components of the alpha particles, which cannot be explained within the framework of the cascade-evaporation mechanism [3]).

It is sensible to assume that the intranuclear reactions should be accompanied by production of a small number of nucleons, since excessive fractionalization of the energy of the cascade or incident nucleon among a large number of nucleons of a given group is hindered in the nucleus, in accordance with the Pauli principle. In this connection, great interest is attached to the question of the momentum distribution of the residual nuclei in the case of few-nucleon simple reactions of the type (p, 2p), (p, pn), etc., when high-energy particles interact with light nuclei, and particularly the possibility of the transfer of very large momenta, necessary to explain fragmentation by heavy nuclei, in such reactions.

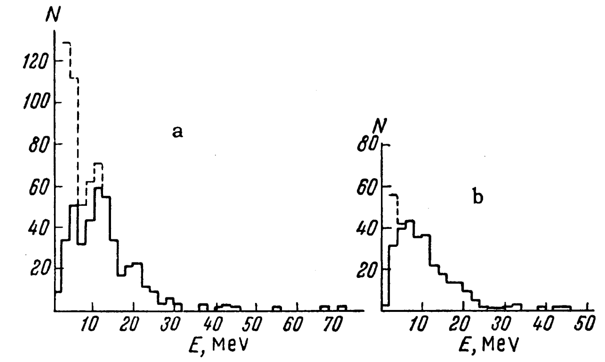
An experimental investigation of these questions was made using as an example the reaction $Be^9(p, 2p)Li^8$ with 660-MeV protons. This reaction, in addition to the convenience in registration of the residual Li^8 nucleus, makes it possible to study the momentum distribution of the residual nuclei which are practically in the same energy state.

The experiment was set up under conditions which were perfectly identical with those described earlier[1,2]. The 660-MeV protons were used to bombard a beryllium target approximately 30 mg/cm^2 thick. In order to monitor the appearance of extraneous T-shaped tracks in the nuclear emulsions, the reaction chamber was exposed for a long time without a target. Scanning of the control plates has shown that the background due to false Li^8 tracks is very insignificant.

A scanning of nuclear emulsions making different angles with the direction of the incident protons disclosed 1184 Li^8 tracks. The figure shows the energy spectra of Li^8 at angles 20.5 ± 3° and 90 ± 8°. To construct the spectra we selected cases in which one of the alpha particles from the Be^8 decay left the emulsion, and suitable corrections were introduced.

The table lists the ratios of the Li^8 yields in the reaction $Be^9(p, 2p)$ at angles that are symmetrical with respect to 90° (φ and $2\pi - \varphi$) at $E_{Li^8} > 2$ MeV.

The Li^8 energy spectra shown in the figure indicate clearly that large momenta are possible in reactions where one nucleon breaks away from a light nucleus.



Energy spectra of Li^8 nuclei from a thick beryllium target for angles 20° (a) and 90° (b). Solid line–histogram without corrections, dashed–with corrections for the Li^8 tracks with alpha particles leaving the emulsion. The spectra are cut off at 2 MeV energy.

φ, deg	$N(2\pi - \varphi)/N(\varphi)$
20.5	0,03±0.01
29	0.04±0.01
47.5	0.07±0.02
65.5	0.03±0.02

The maximum Li^8 momentum observed in the (p, 2p) reaction on Be^9 was approximately 1130 MeV/c. This is a very important result for the now developing theory of reactions of the (p, 2p) type, as well as for the use of the indicated hypothesis concerning the intranuclear reactions to explain fragmentation by heavy nuclei.

In spite of the fact that the mechanism of the transfer of large momenta can still not be explained within the framework of the existing theory of direct nuclear reactions, it can be regarded as proved that the detachment of one nucleon can be accompanied by the transfer of very large momenta to the residual nucleus (on the order of 1000 MeV/c).

In conclusion, the authors are indebted to Professor N. A. Perfilov for interest in the work and for useful discussions, to Professor V. P. Dzhelepov for support of the program on the study of the fragmentation process, of which the present investigation is a part, and to S. P. Tret'yakova and V. P. Perelygin for collaboration in the processing of the nuclear emulsions.

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