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ABSORPTION OF SLOW π^- MESONS BY NUCLEI

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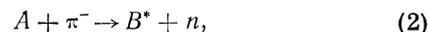
EXPERIMENTS on nuclear disintegrations induced by slow π^- mesons¹⁻⁶ so far do not permit drawing final conclusions with respect to the primary distribution of the rest energy of the π^- meson. In particular, the assumption that the meson rest energy is distributed primarily among a small group (2 to 4) of nucleons cannot be regarded as experimentally proven.

We have tried to explain the possible influence of collective interactions between nucleons in the nucleus on the above process. We have investigated nuclear disintegrations induced by the absorption of slow π^- mesons by light emulsion nuclei. The data are being reduced and the results will be published in a forthcoming article.

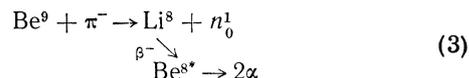
At present we shall limit ourselves to one specific example of a disintegration in which collective interactions are displayed especially prominently. The reaction in question is of the type



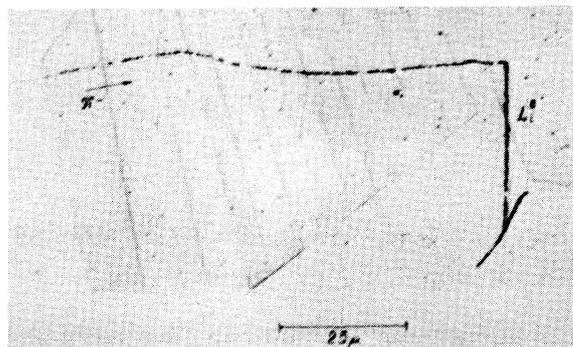
in which the absorption of a slow π^- meson by the nucleus A is accompanied by the production of a fast neutron and a residual nucleus in ground state (or a slightly excited state, leading to the release of a low-energy gamma ray). The attempt of finding a reaction of the above type was undertaken after a detailed study of disintegrations of a wider class. It was found that the absorption of a slow π^- meson by a nucleus leads often to a reaction of the type



in which the momentum of a fast (~ 80 to 100 Mev) neutron is compensated by an excited residual nucleus which disintegrates emitting several secondary particles. Reaction (1) can be evidently considered as a particular case of a more general reaction (2). After finding a considerable contribution due to disintegrations corresponding to reactions (2) we tried, therefore, to find also disintegrations corresponding to reactions (1). Unfortunately, identification of disintegrations corresponding to reactions (1) is in general difficult. However, in the special case of π^- -meson capture by the Be_4^9 nucleus, the reaction



can be easily detected in emulsion by means of characteristic "lithium hammers." Twelve stars corresponding to reaction (3) were found in nuclear emulsions NIKFI type 1a and NIKFI type K loaded with BeF_2 and irradiated by slow π^- mesons in the meson beam from the synchrocyclotron of the Joint Institute of Nuclear Research. A typical ex-



Microphotograph of a star corresponding to the reaction $\text{Be}^9 + \pi^- \rightarrow \text{Li}^8 + n_0^1$.

ample of such a star is shown in the figure. The range of Li^8 fragments was found to be equal to 34μ in all cases, with a spread of $\pm 1 \mu$. The mean value of the Li^8 fragment energy amounts to 14.4 ± 0.3 Mev.* The corresponding neutron energy, calculated from momentum conservation law, is 108 ± 2 Mev (accounting for relativistic correc-

tions). For the total energy free in the reaction (accounting the loss of 18.2 Mev for the binding energy) we have, therefore, the value 140.6 Mev, which corresponds very well to the π^- -meson rest energy (139.6 Mev). Consequently, in our case, Li^8 fragments are produced either in ground state or with an excitation energy less than 2 Mev. This follows also from the fact that, for excitation energies larger than ~ 2 Mev, Li^8 should disintegrate emitting a neutron. The yield of reaction (3), estimated under the assumption that the probability of π^- meson capture by any emulsion nucleus is proportional to the number of nuclei of a given type,⁷ amounts to $\sim 0.2\%$ of the total number of captures by beryllium.

The character of the observed disintegrations is clearly in disagreement with the assumption that the rest energy of the π^- meson is distributed, in the primary act, among a group consisting of a small number of nucleons. If such a group consisted even of 4 nucleons, the excitation energy of Li^8 should have amounted to not less than ~ 30 Mev. Consequently, the fast neutron obtains its energy as the result of an interaction in which take part all nucleons of the residual Li^8 nucleus.

The existence of disintegrations corresponding to reaction (3) indicates that collective interactions of nucleons in the nucleus can play an important role in the process of slow π^- -meson absorption.

A study of a wider class of stars confirms this conclusion.

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*Energy of the Li^8 fragments was determined from an experimental range-energy relation obtained by V. N. Maikov in a study of photonuclear reactions, *Приборы и техника эксперимента* (Instrum. & Instrum. Engg.) (in press).

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ENERGY DEPENDENCE OF THE ASYMMETRY COEFFICIENT IN $\pi^+ \rightarrow \mu^+ \rightarrow e^+$ DECAYS FOR THE LOW ENERGY PART OF THE POSITRON SPECTRUM

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WE have found earlier¹ that the asymmetry coefficient a in $\pi^+ \rightarrow \mu^+ \rightarrow e^+$ decays, taken over the whole positron spectrum in propane filling a bubble chamber, is -0.19 ± 0.03 .

Recently we studied the asymmetry coefficient a' for various parts of the positron energy spectrum. Positron energies were measured by multiple scattering.

The distribution function for positron decays, according to the four-component theory taking ac-

count of nonconservation of parity, has the form²

$$dN(\epsilon, \theta) = A \left\{ 3(1 - \epsilon) + 2\rho \left(\frac{4}{3} \epsilon - 1 \right) - \xi \cos \theta \left[(1 - \epsilon) + 2\delta \left(\frac{4}{3} \epsilon - 1 \right) \right] \right\} \epsilon^2 d\epsilon d\Omega,$$

where $\epsilon = E/E_{\text{max}}$ is the positron energy as a fraction of the maximum energy; ρ , ξ and δ are parameters of the theory which depend on the coupling constant. In the two-component theory $\rho = 0.75$; $-1 < \xi < +1$; $\delta = 0.75$.³

The existing experimental data mainly concern the determination of the constant ρ : $\rho = 0.68 \pm 0.02$;⁴ $\xi = 0.8 \pm 0.15$.⁵ Data on the determination of the parameter δ are few up to the present.⁶

The difference in the values of the quantity a'_{II} , calculated from the two-component theory (i.e., where $\delta = 0.75$) and the quantity a'_{IV} , calculated from the four-component theory (where $\delta > 0.75$) relative to the value a'_{II} (i.e., the quantity $|a'_{\text{II}} - a'_{\text{IV}}|/a'_{\text{II}}$) is much smaller in the high-energy part of the spectrum than in the low-energy part.