

sitions to the ground state of the daughter nucleus. In 20 out of 23 cases for which data on the parity are discussed, [1,2,9,10] these characteristics coincide.

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150

SEARCH FOR THE D^+ MESON

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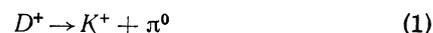
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THE first experimental indication of the possible existence of a particle with strangeness $S = \pm 2$, which decays into a K meson and a π meson (the so-called D meson), was found by Wang Kang-chang.^[1] An analysis of available "anomalous" strange particle decays from the point of view of the existence of such a particle was carried out by Yamanouchi.^[2] Eisenberg et al^[3]

analyzed a 300-MeV/c K^- beam obtained from the Berkeley Bevatron. The K^- mesons slowed down and came to rest in an emulsion stack; the ranges of the stopped K^- mesons were measured. In measuring the ranges of 6000 tracks, no particle was discovered with a mass close to the conjectured value of the D meson mass. It is thus concluded in the article that the admixture of D^- mesons in this K^- beam does not exceed 1/6000. A search for the D^+ meson in a beam of positive particles was made by Cook et al,^[4] who found that the number of D^+ mesons in the beam did not exceed a few thousandths of the number of K^+ mesons. It is necessary, however, to note that in the indicated experiments D mesons were sought in an extracted particle beam at a large distance from the target where they were produced. Thus, only long lived particles would have been observed in these experiments, whereas Pontecorvo^[5] points out that there are no reasons for expecting the D meson to have a lifetime comparable to the lifetime of charged K mesons. This is connected with the fact that, in contrast to K^\pm mesons, the $\Delta T = \frac{1}{2}$ rule does not lead to an additional prohibition with regard to the D meson. Consequently one can imagine that the D meson has a lifetime of the order of 10^{-10} sec, and thus we cannot observe it in K-meson beams.

In the present work, an attempt was made to observe the D^+ meson in the immediate vicinity of the place where it was produced.

Decays of K^+ mesons were looked for in an emulsion stack exposed to the internal 9 BeV proton beam from the synchrotron of the Joint Institute for Nuclear Research. The K^+ mesons (which came to rest and were found) were subsequently traced either to their place of production (star) or for a distance up to 15 mm from the decay point. With such tracking, we were in a position to observe a particle which decayed, for example, according to the scheme



or in any other fashion with a K^+ meson among the decay particles.

At the same time we recorded particles that decayed several centimeters away from the point of production, since the dimensions of the emulsion stack, in which the particles found in this way were produced, were $20 \times 10 \times 5$ cm. For the two-particle decay mode (1), the energy of the K^+ meson is determined by the mass of the D particle. Thus, a range of the K^+ meson in emulsion of up to 15 mm corresponds to values of the D^+ meson's mass from $M_D = 1230$ (the sum of the π^0 and K^+ masses) up

to $M_D = 1580 m_e$ (m_e denotes the electron mass). All told, the end points of 500 K^+ -meson tracks were found. The K^+ mesons were identified by the decay and by grain density. Out of the 500 K^+ -meson decays found, 470 were accompanied by the emission of one charged particle, i.e., they must be classed as $K_{\pi 2}$, $K_{\mu 2}$, $K_{\mu 3}$, and $K_{e 3}$ decays. Decay into three pions (τ decay) was observed in 30 cases (6%). Upon tracing the tracks of these K^+ mesons for about 15 mm, production stars were found in 98 cases, and in 402 cases the K^+ meson had a range greater than 15 mm. The energy spectrum of K^+ mesons with ranges ≤ 15 mm in emulsion is as follows:

T_K , MeV	0-10	10-20	20-30	30-40	40-50
Number of K^+ mesons	—	16	31	24	27

This spectrum has not been corrected for the edge effect due to the finite dimensions of the emulsion stack; the corresponding correction is small, since the stack was sufficiently large.

No cases of production of a K^+ meson in the decay of a heavier particle were observed. Thus, it follows from the results of the present work that the probability for the production of slow D^+ particles (which decay into K^+ mesons) by 9-BeV protons amounts to less than 1/500th of the probability for the production of slow K^+ mesons (which come to rest in an emulsion stack of the indicated dimensions). One can note for comparison that, under the conditions of the present experiment, the number of slow K^+ mesons amounts to approximately 1/300th of the number of charged pions stopped in the emulsion stack. It must be voted that if the D^+ meson decays into a K^+ meson according to the scheme (1), then in virtue of isotopic spin invariance and the $\Delta T = \frac{1}{2}$ rule the decay $D^+ \rightarrow K^0 + \pi^+$ also takes place with a probability twice that of decay (1); of course, we have not detected this decay mode of the D^+ meson in our experiment.

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151

TEMPERATURE DEPENDENCE OF THE EFFECT OF ISOTOPIC COMPOSITION ON THE SIZE OF THE LATTICE CONSTANT IN LITHIUM

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THE data available in the literature^[1] on the effect of isotopic composition on the size of the lattice constant in Li refer to a temperature of 300°K. At this temperature the lattice constant for the light isotope [$a(\text{Li}^6) = 3.5107 \pm 0.0009 \text{ \AA}$] is 0.0015 Å larger than the lattice constant of the heavy isotope [$a(\text{Li}^7) = 3.5092 \pm 0.0006 \text{ \AA}$], while the relative volume change $\Delta V/V \approx 0.1\%$.

As was shown for the Ni isotopes,^[2] the excess of the lattice constant of the light isotope over the lattice constant of the heavy one decreases with rising temperature and may even go to zero or change sign. Thus one can possibly expect to find a larger effect of the isotopic composition in Li at low temperatures than the one discovered for 300°K. To this end a series of x-ray photographs of the Li isotopes were produced at 20, 78, and 300°K. The low temperature runs were made in a cryostat where the sample as well as the film were immersed completely (for the runs in liquid hydrogen) or partially (for the runs in liquid nitrogen) in the liquid coolant. The x-ray beam entered the cryostat through beryllium windows in the form of flat slides^[3] sealed in the walls of the Dewar. The cell diameter equalled 57.3 mm. The precision with which the lattice constants were determined ($\Delta a = \pm 0.001 \text{ \AA}$) was insufficient to state confidently that a difference