would provide Λ hyperons of energies down to approximately 30 Mev (laboratory), an energy not too high to be useful. Unfortunately, at this incident momentum, a large number of alternative channels are competing.

Although not yet known (to us) to be polarizing, the in-flight reaction

$$K^- + p \to \pi^0 + \Lambda^0 \qquad (7)$$

is quite favorable kinematically, providing, for example, Λ hyperons of (laboratory) kinetic energy of from 9 Mev to 72 Mev over the cone of production (in addition, of course, there is a much higher energy component), at an incident K-meson momentum of 2 Bev/c. Should reaction (7) prove polarizing at moderate production energies, it would be more useful as a source of low-energy Λ hyperons for scattering than is reaction (4). A third alternative which is kinematically favorable (and which may well prove polarizing)[15] is associated photoproduction of Λ hyperons:

$$\gamma + p \to K^0 + \Lambda^0. \qquad (8)$$

If reactions (7) and (8) turn out to be polarizing (information important within itself), then the feasibility of a useful study of Λ-hyperon–nucleon scattering as outlined above would be considerably enhanced.

One of us (C.G.G.) wishes to thank G. R. Satchler of the Oak Ridge National Laboratory for instructive conversations.

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POSSIBLE EVIDENCE FOR A NEGATIVE HEAVY MESON*

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Following the report of the High-Energy Conference at Kiev in which evidence was presented for the existence of a heavy positive meson decaying into a π^+ and a K^0,[1] we decided to see if there was any additional evidence relating to the existence of such particles. If such a particle should exist it presumably has strangeness +2 and it would seem reasonable that its antiparticle with strangeness -2 might exist. To this end we re-surveyed the scanning of an emulsion stack exposed to the 300-Mev/c Berkeley K^- beam[2] for stars which might indicate anomalously high-energy release.

We found two events of interest. The first and the one which gives evidence for the possible existence of a new negative meson is shown in Fig. 1 in a schematic sketch. It has a total of 8 prongs, one of which labelled P is the primary particle initiating the event; it lies in the beam direction and the grain density measurements at 0.5 mm and 8.5 mm from the star yield the values 2.89 ± 0.12 and 2.58 ± 0.11 times the minimum, respectively, indicating that the particle is indeed moving in the direction of the star. Of the prongs emitted two are of particular interest. Prong No. 7 is a "picture book" Σ^+ hyperon decaying at rest by the protonic mode; it has an energy at emission of 23.2 Mev and the decay proton an energy of 18.8 Mev. Prong No. 6 is the one which, in conjunction with No. 7, gives the event its pe-

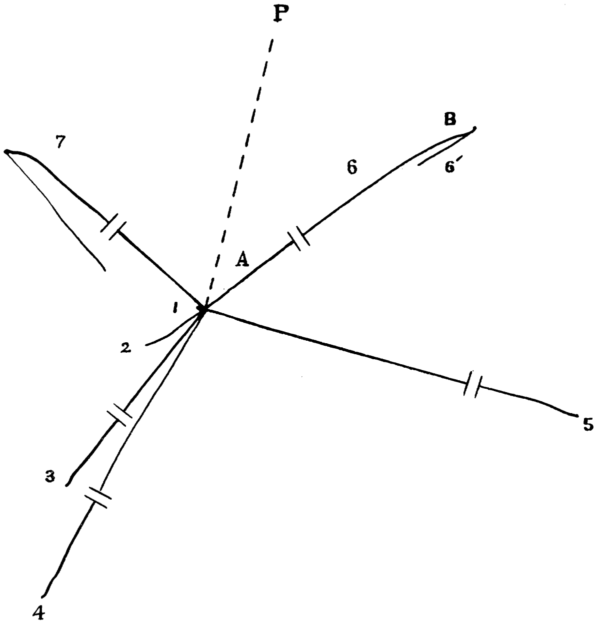

FIG. 1. Schematic drawing of the star, which includes two hyperons. Prong No. 6 is most probably a He hyperfragment decaying by the π^0 mode. Prong No. 7 is a Σ^+ decaying into $p+\pi^0$ at rest.

culiar nature. It appears to come to rest after traversing 628 μ and at this point there is associated with it a singly charged particle (6′) of 101μ range and a recoil of a few grains. Profile measurements made on Prong No. 6 indicate that its charge is $\leqslant 2$ and that its direction of motion is most probably from A to B; its width at A is 10% less than at B. If one assumes this, then the question arises as to the nature of the event of B. One might say that it is a low-energy nuclear interaction of an α particle; however, a direct comparison of the gap density of 6′ and 6 shows that 6 has an ionization $I_6 \geqslant 5I_6'$, and thus its velocity is $\leqslant 0.08c$. To make the star at B it should supply at least 4 Mev of kinetic energy which implies a velocity $\geqslant 0.12c$. In addition, the existence of the strong Coulomb barrier would make such an interaction highly improbable.

The other possibilities are that it is the decay of an excited nuclear state which is immediately rejectable, or that it is an event involving a hyperon. The capture of a Σ^- seems unlikely in view of the gap density measurements, and only the decay of a He hyperfragment by π^0 mode seems to be compatible with the observation. Assuming that this represents the event, then the lower limit to the total visible prong energy emitted from A is 565 Mev. Since this represents a production of strangeness -2 in a strong interaction, the incident particle must also have strangeness -2. A lower limit to its mass is obtained by making allowance for the binding energy needed to supply the prongs, allowing for neutrons and subtracting the kinetic energy of the incident particle; this yields an estimate of the lower limit to the mass of 650 Mev. Some supporting evidence for this is the mass as determined by multiple scattering and ionization which yielded 640^{+120}_{-100} Mev.

One could also consider the possibility that prong 6 is in reality travelling from B to A and by coincidence stops just at that point. The probability for this is $\sim 10^{-10}$. If we accept the reality of this event, one can reasonably ask how such a particle was able to pass through the magnetic selection. We have discussed this with W. Barkas who is of the opinion that it is quite difficult to see how such a particle could survive the experimental arrangement. On the other hand, we do have in the same stack an event in flight made by an incident particle in the beam direction which has 17 visible prongs, one of which is an identified π meson. The lower limit to the total visible prong energy in this star is 600 Mev and the incident particle has a velocity $= 0.55c$. This is clearly incompatible with a K^- meson and only barely with a meson as massive as 750 Mev (due to the large amount of energy $\geqslant 210$ Mev which must be attributed to neutrons). On the other hand, a mass measurement yields a value of 1020^{+220}_{-140} Mev indicating that this is an antiproton annihilation in flight. Since the prongs of this event traversed many different emulsions of our stack, they could not have been traced unless it occurred during the exposure as the emulsions are shuffled otherwise. We quote this to illustrate that it is possible for a particle of the wrong mass to survive the focussing arrangement.

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[1]Private communication from Professor C. Goebel.

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