A Decay of an Anti-hyperon, $\bar{\Lambda}^0$, in Nuclear Emulsion.

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Summary. — An event which has been found in a stack of nuclear emulsion exposed to $10^6 \, 4.6 \text{ GeV} \pi^-$-mesons per cm$^2$, has been interpreted as an example of the decay in flight of an anti-hyperon, $\bar{\Lambda}^0$. The event and the interpretation are discussed in detail.

1. – Introduction.

The concept of particle and anti-particle is now well established and it received experimental confirmation a few years ago with the discovery of the anti-proton and anti-neutron (1,2). Up until now however it has not been extended to the realm of the hyperons. As distinct from the other group of strange particles, the $K^+$ and $K^-$-mesons which are particle and anti-particle, the presently known hyperons are expected to have anti-particles which have not yet been discovered. They are however expected to exist and will fit naturally into the present scheme of elementary particles. The main experi-

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mental difficulty in observing such particles lies in the fact that they must be produced in association with a baryon to conserve the baryon number or must be produced by an anti-baryon in such a way as to conserve strangeness, the threshold energy for production is therefore very high. The only hyperon-antihyperon pair whose threshold energy for direct production is within reach with accelerators presently working is that of the \( \Lambda^0 \)-hyperon. The reaction giving an anti-\( \Lambda^0 \) with protons is expected to be of the form:

\[
p + n \rightarrow \Lambda^0 + \Lambda^0 + p + n
\]

and with \( \pi^- \)-mesons of the form:

\[
\pi^- + p \rightarrow \Lambda^0 + \Lambda^0 + n.
\]

The threshold energy for production from a free nucleon by a proton is 7.10 GeV and for a \( \pi^- \)-meson, 4.73 GeV in the laboratory system; from a bound nucleon it can be considerably less if the struck nucleon is moving in a favourable direction. If a composite nucleus is used as a target however a fraction of \( \Lambda^0 \) will be absorbed before they can escape from the parent nucleus. When intense beams of \( \pi^- \)-mesons of \( \sim 5.0 \) GeV became available at the Bevatron, it was decided to attempt the detection of an anti-\( \Lambda^0 \)-hyperon in nuclear emulsion despite the numerous difficulties involved, of which the last mentioned is one. Because the beam energy is so little above the threshold, the particles produced are ejected in a narrow forward cone in the laboratory system. It is therefore necessary to search for these particles against a large background of beam tracks; it is thus highly desirable to have a pencil beam with a sharp cut-off in one dimension at least. The anti-hyperons are expected to have a short lifetime, \( \sim 10^{-10} \) s, and it is therefore necessary to detect them close to the point of production. A convenient way of doing this in nuclear emulsion is to use it as a target and as a detector, particles with lifetimes as low as \( 10^{-15} \) s can then be detected. If this technique is used however no separation of the secondary particles is possible either in momentum or mass, one is forced to detect all particles produced. There are hopes that very high fields which can be pulsed with the accelerator may eventually overcome these difficulties.

2. Exposure details.

The stack size was 150 plates 8 in. \( \times \) 7 in. \( \times \) 600 \( \mu \)m G.5 Ilford emulsion. The top edge of the stack was exposed to \( 10^6 \) \( \pi^- \)-mesons/cm\(^2\) which is a density which does not allow one to follow through near-minimum tracks although