Leptonic Decay of $\Lambda^0$ and $\Sigma^-$ Hyperons.

Analysis of photographs:

B. Aubert, B. Brisson, J. Hennessy, P. Mittner (*) and J. Six

Beam and Run:


Ecole Polytechnique - Paris

Summary. — A systematic search for leptonic decays of $\Lambda^0$ and $\Sigma^-$ hyperons has been carried out in a 1 meter heavy-liquid bubble chamber. 8$\Lambda^0_\beta$ and no $\Lambda^0_\mu$ or $\Sigma^-_\mu$ have been found. The total number of $\Lambda^0$ was $\sim 3200$. After correction for detection efficiency, this gives for the branching ratio $\rho = N(\Lambda^0_0)/N(\Lambda^0_\mu) = (0.29 \pm 0.06)$. This seems definitely in disagreement with the simple extension of the $V-A$ theory to this type of strangeness-nonconserving decay.

Introduction.

The Ecole Polytechnique heavy-liquid chamber (1) is specially adapted to the detection of electron tracks and therefore to a systematic search for leptonic decays.

Due to the chamber size ($100 \times 50 \times 50$ cm) and the running conditions ($B = 1.75$ Wb/m$^2$; 50% CF$_3$Br—C$_2$H$_5$ mixture of 0.9 g/cm$^3$ density and 21 cm radiation length), the bremsstrahlung probability is high enough to allow

(*) On leave of absence from the University of Padova.

for an easy identification of electrons on the scanning table together with fairly good momentum measurement.

From a theoretical point of view the study of leptonic decay of hyperons is particularly interesting in connection with a possible extension of the simple $V-A$ theory of weak interactions to the strangeness-nonconserving decays, with the same coupling constants ($^{(2)}$).

This theory predicts the following rates for $\Lambda^0$ and $\Sigma^-$ hyperon leptonic decays:

\[
\begin{align*}
\Lambda^0 \to p + e^- + \bar{\nu} & \quad 1.6\% \\
\to p + \mu^- + \bar{\nu} & \quad 0.3\% \\
\Sigma^- \to n + e^- + \bar{\nu} & \quad 5.6\% \\
\to n + \mu^- + \bar{\nu} & \quad 2.5\%
\end{align*}
\]

Until now the search for these decay modes in hydrogen ($^{(3)}$) and propane ($^{(4)}$) chambers has yielded very few events: two $\Lambda^0_\Sigma$ ($^{(3)}$), two $\Sigma^-_\Sigma$ ($^{(3,4)}$) and one $\Lambda^0_\Lambda$ ($^{(4)}$). These results seem to indicate that the actual branching ratios might be smaller than predicted, by an order of magnitude.

In the present experiment a systematic search was made for leptonic decay modes of $\Lambda$ and $\Sigma^-$ hyperons, produced in the chamber by a 1.15 GeV/c $\pi^-$ beam of the Saclay Saturne synchrotron. The experiment was carried out on a sample of 120 000 pictures.

1. Study of the mode $\Lambda \to p + e^- + \bar{\nu}$.

The lambdas produced in the chamber come mostly from the reactions

\[
\begin{align*}
\pi^- + p & \to \Lambda^0 + K^0 \\
& \to \Sigma^0 + K^0 \\
& \to \Lambda^0 + \gamma
\end{align*}
\]


