A SEARCH FOR THE H PARTICLE (BNL EXPTS. E813/836)

J.J. Szymanski
Indiana University Cyclotron Facility, Bloomington, Indiana 47408

I am participating in an effort at Brookhaven National Lab to search for a strangeness=−2 dibaryon called the H particle. This state was predicted by Jaffe to have a mass 80 MeV less than the $\Lambda\Lambda$ mass of 2232 MeV (ref. 1). The H particle has the quark content 2u+2d+2s, all in singlet states. In several bag models this quark configuration results in predictions for the H mass near or below the mass of a $\Lambda\Lambda$ pair. Lipkin has argued that the general features of QCD and the known baryon mass splittings imply that the six-quark state with charge zero, spin zero, and strangeness=−2 would have the largest binding energy.[2] It is important to make an experimental verification of the existence of the H particle.

The search for H particles will be conducted in two ways. The first involves a novel, dual-target system shown in Fig. 1. A 1.8 GeV/c K^- beam produces Ξ^- particles in the liquid hydrogen via the reaction $K^- + p \rightarrow K^+ + \Xi^-$, where the outgoing K^+ is momentum-analyzed in a magnetic spectrometer. The Ξ^- particles are slowed with tungsten degraders and stopped in the liquid deuterium part of the target. H particles can then be produced with the reaction $\Xi^- + d \rightarrow H + n$ (see Fig. 2). The signal for H production is a K^+ (with momentum and angle appropriate for Ξ^- production), a large (i.e., much larger than minimum ionizing) signal in the silicon detectors located after the tungsten degraders and a monoenergetic neutron detected in the plastic scintillator neutron detectors located to the right and left hand sides of the target.

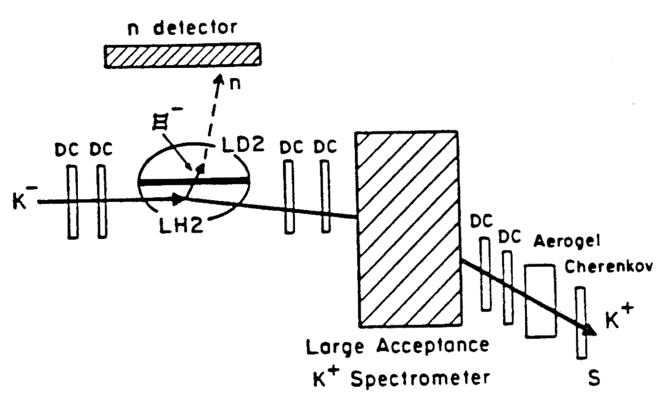

Figure 1. Schematic Layout of $(\Xi^- d)_{atom}$ experiment.

The experiment will also use the $K^- + {}^3He \rightarrow H + K^+ + n$ reaction to search for the H particle (see Fig. 2). This reaction is more sensitive to a lower mass (more bound) H particle than the dual-target experiment. Thus, we plan to do both measurements.

The IUCF contribution to this project is the second-level trigger system. The second-level trigger is designed to fast clear events before they are read into the main data aquisition computers. The events we wish to fast clear are background events such as $K^- + p \rightarrow K^- + p$ and $K^- + p \rightarrow K\pi p$, where the proton is detected in the K^+ magnetic spectrometer. The (K^+, K^-) events are quite rare, and estimates of the background proton trigger rates vary from 5 to 100 times the real trigger rate.

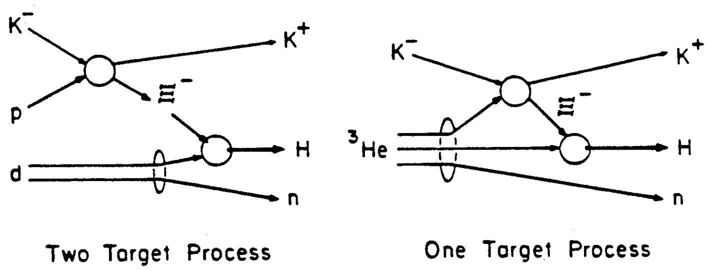

Figure 2. Comparison of $(\Xi^- d)_{atom}$ and ${}^3He$ target production mechanisms.

Protons can be differentiated from K^+ using time-of-flight scintillators located behind the magnetic spectrometer. However, the time-of-flight of the K^+'s and protons depends on the path length the particles follow through the magnetic spectrometer. The path length is determined by the element in the time-of-flight scintillators the K or p hits as well as the position measured with a drift chamber located within the magnetic spectrometer. Thus, it was decided to use a CAMAC auxiliary crate controller (Creative Electronic Systems model 2160) to read Fast Encoding and Readout ADC/TDC (FERA) modules and make a time-of-flight cut which depends on the time-of-flight scintillator hit and drift chamber position measurement. The auxiliary crate controller program is written and debugged. The response of the scintillator-photomultiplier-discriminator-tdc system needs to be closely monitored so that the measured time-of-flight does not change by more than a few hundred picoseconds. Studies are underway to determine the optimal time-of-flight cuts and to develop methods to calibrate and monitor the placement of the time-of-flight cut.

As of April 1990 all of the apparatus was in place and being debugged. Data will be taken during May and June, 1991 with subsequent runs scheduled for Spring 1992 and 1993.

1. R.L Jaffe, Phys. Rev. Lett. **38** (1977) 195 and 617.
2. H. J. Lipkin, in "Prospects for Strong Interactions at Isabelle," edited by D.P. Sidhu and T.L. Trueman (BNL, Upton, 1977).