TO: E.L. Goldwasser/T. Groves

FROM: L. Pondrom

SUBJECT: Measurements of $\pi^- Cu \rightarrow K^\circ_s$, Λ°, and neutron inclusive cross sections for proposal P-36o (Nauenberg) with the E-8 apparatus in the M-2 beam line

1.) Motivation

Proposal P-360 discusses the construction of a high intensity K°_L beam which is relatively free of high energy neutrons by using π^- rather than protons as the incident particles. This beam would be built in the Proton Lab, where a pion flux of $\sim 10^8$/pulse may become available. Inclusive strange particle yields from pion bombardment of a copper target have physics interests as well as furnishing engineering data needed for the construction of the desired K°_L beam. A strange particle and neutral V detector system (E-8) is operational in the M-2 beam at the Meson Lab. Although fluxes in the M-2 line are too low to produce the K°_L beam required by P-360, they are sufficient to measure the yields and test the feasibility of the construction of a more intense facility. These measurements can be done with the E-8 hardware and software with no changes other than switching from protons to π^- in the M-2 beam. A collaboration between the E-8 group and the authors of P-360 is proposed to carry out this work. It is estimated that 100 hours of π^- beam time will suffice.

2.) Expected Yields

At a π^- momentum of 200 GeV/c, a flux of $5 \times 10^5 \pi^-/3 \times 10^{12}$ protons can be obtained in the M-2 beam line. Using this flux, the known acceptance of the E-8 apparatus for $K^\circ_s \rightarrow \pi^+\pi^-$ and $\Lambda^\circ \rightarrow p\pi$,

and the spectra calculated by Nauenberg based on scaling as discussed in P-360, the detected yields shown in the first two rows of the Table were obtained. E-8 can handle 220 events/pulse.

The method of E-305, in which neutrons produce N^*'s in a carbon target, can be exploited to measure the neutron momentum spectrum. The $N^* \rightarrow p\pi^-$ decay would be detected by the spectrometer much like the decay of a Λ°. The process is essentially independent of neutron energy, and the overall neutron flux produced by π^- can be readily compared with the neutron flux produced by protons measured in the same way. These measurements require the insertion of a thin (2 gm/cm^2) carbon target in the neutral beam. The third row in the Table was obtained using Nauenberg's predicted $\pi^- + Cu \rightarrow n$ flux, and yield data for $n \rightarrow N^* \rightarrow p\pi^-$ in carbon from E-305, kindly furnished by J. Rosen.

Table

	Detected Yield per 5×10^5 π^-	Mean Momentum Detected
$\pi^- + Cu \rightarrow K^\circ_S$	23	110 GeV/c
$\pi^- + Cu \rightarrow \Lambda^\circ$	3	110 GeV/c
$\pi^- + Cu \rightarrow n$	.1 (1/2" carbon inserted)	50 GeV/c

3.) Requested Running Time

It would be straightforward to reverse the polarities in the M-2 line and re-tune for 200 GeV π^- at the end of a regular E-8 run with 300 GeV protons. This would be most efficient,

because all of the E-8 spectrometer apparatus would be in working order. Under these conditions, 50 hours of data on $K_s^\circ \to \pi^+\pi^-$ and $\Lambda^\circ \to p\pi^-$ should give 700,000 and 90,000 events respectively, sufficient for a good determination of the K_s° momentum spectrum. A second 50 hour run with 1/2" carbon target in the neutral beam will give about 3,000 neutrons if the neutron yield is as low as anticipated. A previous brief run with 300 GeV protons on the hyperon target will serve to normalize the neutron flux, and show if the pion production technique has the desired properties of high K_s° flux with very few high energy neutrons.

We request 100 hours of 200 GeV/c π^- time, in collaboration with the authors of P-360, to make these measurements.