Fermilab Proposal No. 341

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INTERACTIONS OF π^+ MESONS AND PROTONS IN A HYDROGEN-NEON MIXTURE

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INTRODUCTION

We propose here to use the Fermilab 15-foot bubble chamber to study interactions of π^+ mesons and protons in a hydrogen-neon mixture, at an incident beam momentum of 150 GeV/c or greater. The use of a hydrogen-neon mixture coupled with the large geometric volume of the 15-foot chamber offers the possibility of detecting and measuring the γ-rays from π^0 decay or decays of other particles. Thus, direct measurement of the momentum of neutrals is possible, so there is no loss of kinematic constraints when such neutral particles are present. This condition makes possible the study of the following topics:

- neutral particle multiplicities by direct observation.
- inclusive distributions of vector mesons, including in particular ω^0.
- inclusive distributions of other neutral particles.
- heavy resonance mass spectroscopy, since all decay products, charged and neutral, can be measured.

Furthermore, the presence of neon in the operating liquid of the chamber opens the possibility of studying:

- beam diffraction on targets of two different radii; i.e. protons and neon nuclei.
- resonance-nucleon total cross sections, based on absorption of produced resonances within the nucleus.

EXPERIMENTAL CONSIDERATIONS

The Beam. The beam will be the enriched π^+ beam operating at a flux of at least two π^+ and no more than two protons per picture, at the highest momentum at which that flux can be achieved. The identity of the beam particle will be determined by Cerenkov counters and a tagging system in the beam line. The Davis group will undertake to provide a tagging system similar to that which it developed for the 30-inch chamber beam line, if such a system is not already provided (see reference).

(continued)

Event Rates. The experiment will be based on a total of 100 000 pictures, which, under the minimum beam conditions specified above, will yield about two events per μb of cross section. A 20% (atomic) neon mixture will yield about 40 000 events of π^+p interactions, and about 60 000 events of π^+Ne interactions, with similar numbers for the proton component of the beam. (Interactions on neon nuclei are distinguished by the odd number of charged outgoing prongs or by the presence of short evaporation protons resulting from nuclear break-up.) The exact percentage of neon in the mixture is not critical, but it should not be much in excess of 25%.

γ-Detection Efficiency. The single γ-ray conversion probability is about 0.8 for a mixture of 20% neon (atomic).

Data Processing. The photographs will be scanned and pre-digitized at Davis and LBL, and measured at LBL. The track reconstruction and fitting programs are presently being developed. In order to test and develop the analysis chain, we would like to receive a few hundred pictures of any hadronic interactions at the earliest date that such pictures become available.

REFERENCE

D. E. Pellett, et. al., "Gray Coded Hodoscope and Fast Buffer for Beam Particle Triggering", Nuclear Instruments and Methods, 115, 135.