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Abstract

During the period February 1973 - March 1974 100,000 photographs of the NAL 30-inch HBC were taken during its exposure to a mixed beam of π^+ mesons and protons at 100 GeV/c. Analysis of 50,000 photographs showed that for both π^+p and pp interactions the charged particle multiplicity distribution is of Poisson form for all but the lowest multiplicities. These occur more frequently than required to complete the Poisson distribution and may result from a second (diffraction dissociation) component.

A small sample of 200 GeV π^+p and pp interactions was also obtained. This sample is under analysis.

A proposal to study π^-d interactions at 200 and 400 GeV in the NAL 30-inch hybrid chamber was approved. A proposal to study $hi P_T$ interactions was submitted to NAL. Also a proposal to study $K\bar{K}$ and $KK\bar{K}$ resonant structure was submitted to SLAC.

Two other papers were published. One involved the observation of structure in the s-wave component of $K\pi$ scattering. The other described a high resolution scintillator hodoscope using binary coding.

During the period 1 February 1973 - 31 March 1974, the following progress has been made:

Preparations for the 100 GeV/c π^+p and pp bubble chamber run at NAL were carried out during February - June. Cerenkov pressure curves were taken and beam tuning and tagging studies advanced. UCD participated in this work at NAL. Scan table modifications to accommodate NAL film were completed and programs developed to correlate the proportional wire chamber (PWC) tagging information and the bubble chamber (BC) tracks. The first batch of film was run off in July and August, 1973, with UCD participating. UCD and LBL modified MATCH to handle 100 GeV interactions. This program now matches tracks automatically in 3 views with about 80% probability on a single pass.

Scanning and measuring of the first batch of film was completed. We demonstrated that the PWC tagger successfully located $\sim 80\%$ of the BC tracks with negligible ambiguity. The remaining 20% were either "lost" or were ambiguous.

The multiplicity distribution for charged particle secondaries from 100 GeV π^+p collisions was compared to that from 100 GeV pp collisions. Both were found to be consistent with a Poisson distribution except for the lowest multiplicities, and the average value of the higher multiplicities was found to be identical in the two cases. A similar situation was found to hold for 200 GeV π^-p and pp collisions using published data. Our results are published in Phys. Rev. Letts. 32, 254 (1974).

Preliminary study of the first batch of 100 GeV π^+p film also showed that total π^+p cross section to be much larger than expected. The second 50,000 photographs were run off with additional checks on possible biases

that could be affecting the cross section results. In particular UCD personnel performed absorption measurements on the beam at the BC to measure the meson content. These photos were taken in Jan./Feb. 1974 and are undergoing analysis now. A cross section value is expected by late April.

Neutral particles, gamma rays and V^0 's, were measured in the first 50,000 photos. A paper on the degree to which scaling has been reached at 100 GeV for π^0 and Λ^0 production is in preparation. The average number of π^0 's produced per π^- produced will also be reported. Preliminary results were given at the August 1973 meeting of the Division of Particles and Fields.

Under the reasonable assumption that the measuring biases for backward c.o.m. hemisphere π^- tracks will be similar for pp and π^-p events, a comparison was made of $d\sigma/dy$ for π^+p and pp reactions. The ratio $(d\sigma/dy)_{\pi^+p} \div (d\sigma/dy)_{pp}$ was constant and nearly unity for y values in the backward c.o.m. hemisphere. This result suggests strongly that the amplitude for π^- production factorizes^Z. Preliminary results were reported at the August DPF Meeting, as were our initial results on the elastic π^+p scattering cross section and slope parameter.

Other results during this period involved K^+d interactions at 9 GeV/c. This work was done in collaboration with a group at Purdue University and appeared in Nuclear Physics B54, 109 (1973).

A publication describing our binary coded hodoscope appeared in Nuclear Instruments and Methods 115, 135 (1974).

During January a fortuitous combination of circumstances allowed us to take a few thousand photographs of 200 GeV π^+p interactions. The main ring proton energy was 400 GeV for this work. This film will be analyzed in the next year, but the knowledge of the π^+ content of the beam (20%) already shows that enrichment methods are needed. NAL is testing certain

possibilities for such enrichment.

A proposal to measure 200 and 400 GeV π^-d interactions in the NAL 30-inch BC was approved for 50,000 photos at 200 GeV. The energy for the second 50,000 is to be determined later. This work is to be done in collaboration with Lubatti's group at the University of Washington and two Polish groups.

Another proposal, this one in collaboration with two University of Washington groups and a French group, was also submitted to NAL in March. This proposal describes how the entire rapidity distribution could be observed in high P_T collisions using the University of Washington's Streamer Chamber. Action on this proposal is not expected until July, 1974.

During this working period, design studies for an experiment using the SLAC 40-inch BC in conjunction with auxiliary triggering equipment were carried out in collaboration with SLAC personnel. The studies resulted in a UCD proposal to SLAC to use the hybrid BC facility to study $K\bar{K}$ and $KK\bar{K}$ resonance structure. If approved, this run would occur about February 1974. UCD would provide PWC's and readout hardware for upstream beam tagging.