

**PRELIMINARY RESULTS FROM EXPERIMENT UA6 ON
INCLUSIVE π^+ , η AND γ PRODUCTION FROM $\bar{p}p$
COLLISIONS AT $\sqrt{s} = 24.3$ GeV**

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ABSTRACT

We present preliminary results on the invariant cross section for inclusive π^+ production, the η/π^+ production ratio, and the ratio of direct photons to π^+ production in $\bar{p}p$ collisions at $\sqrt{s} = 24.3$ GeV in the range $2.5 < p_T < 4.5$ GeV/c. These results are from data collected during a start-up run of the experiment in the fall of 1984 with an integrated luminosity of $4.0 \cdot 10^{34}$ cm⁻².

The aim of experiment UA6 [1] is to study, in $\bar{p}p$ and pp collisions at $\sqrt{s} = 24.3$ GeV, inclusive electron, π^+ , η and γ production in the central region at large values of $x_T = 2p_T/\sqrt{s}$, and low- t elastic scattering and diffractive dissociation. We report here preliminary results on detected electromagnetic showers from pp collisions.

The experiment, shown in Fig. 1, is situated in the main ring of the SPS. It consists of an internal hydrogen cluster-jet target followed by a double arm spectrometer. Both arms are identical, each arm with a conventional magnetic spectrometer with multiwire proportional chambers before and after a 2.4 Tm dipole magnet, a lead/proportional tube gas sampling calorimeter, an ionization (dE/dx) chamber, and a transition radiation detector. The acceptance of each arm is 20 to 100 mrad in the polar angle θ and about 75° in azimuth for an integrated geometrical acceptance of 1.8 sr. At full jet intensity with $5 \cdot 10^{10}$ antiprotons in the main ring the luminosity is $5.2 \cdot 10^{29} \text{cm}^{-2}\text{s}^{-1}$. The luminosity is monitored by measuring the elastic cross section using a set of four silicon detectors set near $\theta = 90^\circ$ in the laboratory frame.

The electromagnetic calorimeter [2] consists of 30 lead plates, each 4.0 mm thick, interleaved with alternating planes of horizontal and vertical gas filled proportional tubes for a total of 24 radiation lengths and 0.75 nuclear interaction lengths. The transverse dimension of each tube is 1.0 cm. The calorimeter is longitudinally divided into three identical modules each containing 5 horizontal and 5 vertical planes of tubes. In each module the analog signals are summed in depth providing a longitudinal sampling of the shower every 8 radiation lengths in both horizontal and vertical views. A hodoscope of seven horizontal scintillation counters placed between the first two modules was used to trigger on electromagnetic energy deposited in the calorimeter.

Test beam results show the energy resolution of the calorimeter to be $\sigma(E)/E = 33\%/\sqrt{E}$ with the response linear to within 3% from 10 to 100 GeV/c. Hadron rejection is approximately 10^4 . The shower position resolution is $\sigma = 2\text{mm}$. The calorimeter was calibrated in a test beam, the calibration being monitored and updated on a run to run basis by centering the π^+ mass peak on $0.135 \text{ GeV}/c^2$.

A simple clustering algorithm is used to identify showers and to reconstruct their energy and position. In each view and module clusters are first identified and then required to be associated in depth from module to module requiring that a line through the cluster centers extrapolate back to the target. Two clusters in the horizontal and vertical views are matched to form a shower if their energies are equal. Fig. 2 shows the mass distribution of all two cluster combinations with a total $p_T > 2.5 \text{ GeV}/c$. There are clear peaks from the two-photon decays of the π^+ and η mesons. All two-cluster combinations with an invariant mass between zero and $0.3 \text{ GeV}/c^2$ were used for the π^+ cross section measurement. These candidates also were required to have a cluster separation at the face of the calorimeter greater than 3.0 cm and both showers were required to have an energy greater than 7 GeV.

The acceptance was calculated with a hybrid Monte Carlo using calorimeter test beam data to model the electromagnetic showers. Fig. 3 shows the invariant cross section for inclusive π^+ production as a function of p_T . The errors are statistical. For comparison the same cross section measured by the CCRS collaboration from pp collisions at $\sqrt{s} = 22.5$ GeV is plotted [3]. Within our present normalization uncertainty we see no difference between the π^+ invariant cross section in $\bar{p}p$ and pp collisions.

To measure the ratio of η to π^+ production the background under the η peak was subtracted by fitting a Gaussian plus a polynomial function to the data. The observed η production rate was then corrected for the $\eta \rightarrow 2\gamma$ branching ratio, and the acceptance. The resultant η/π^+ cross section ratio is shown in Fig. 4. The ratio has a value of about 0.5. This is consistent with other measurements made in $\bar{p}p$ and pp collisions. Errors are statistical.

The fine transverse segmentation of the calorimeter makes it well suited for the study of direct photons where the background from π^+ and η decays can dominate. For a 100 GeV/c π^+ the minimum separation of the two photons is 2.8 cm at the calorimeter face which produces two showers readily distinguishable from a single shower. Higher energy π^+ 's have showers which begin to overlap but which can be separated from single showers by their width. An electromagnetic shower was considered to be a direct photon candidate if it could not be paired with another shower to form either a π^+ or an η and if the shower radius was consistent with that produced by a single photon. Fig. 5 shows the ratio of these direct photon candidates to π^+ 's corrected for acceptance. These data are very preliminary. In particular no systematic errors are included. For comparison we have plotted the theoretical expectations obtained from a computation of the expected $(\bar{p}p \rightarrow \gamma X)/(pp \rightarrow \gamma X)$ ratio by Contogouris and Mebarki [4] and direct photon measurements in proton-proton collisions of experiment R-806 [5].

REFERENCES

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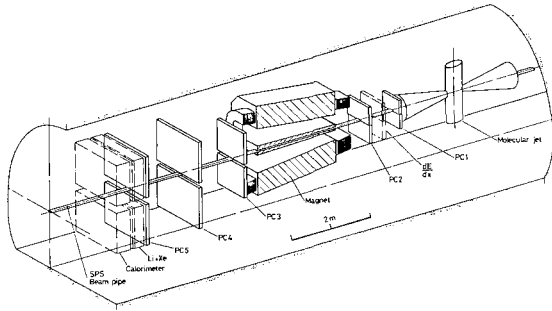


Fig. 1

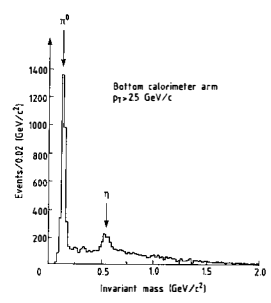


Fig. 2

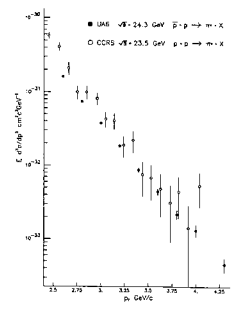


Fig. 3

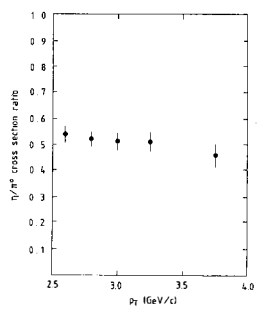


Fig. 4

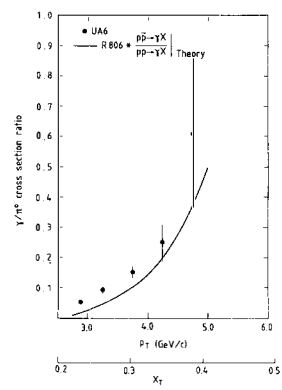


Fig. 5