PARALLEL SESSION
ON LARGE TRANSVERSE MOMENTUM PHENOMENA

RECENT RESULT ON SINGLE PARTICLE HIGH PRODUCTION AT FNAL

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We report on two experiments recently performed at Fermilab. The Brookhaven-CAL TECH-LBL [1] experiment measured high p_T π^0's produced in $\pi^{\pm} p$ and pp collisions at incident energies of 100 and 200GeV/c. The apparatus is shown in Fig.1. Cerenkov counters in the *incident* beam allowed π^+ and p data to be

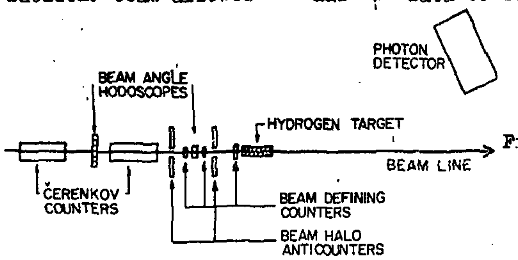

Fig.1.

taken simultaneously. The γ detector (Pb scintillator sandwich) covered a range in θ_{CM} from 50^0 to 110^0. They triggered on high p_T γ's by forming a weighted sum of signals from the scintillators within the γ detector. The position resolution ($\sim$ 1mm) as well as energy resolution ($\Delta E/E \sim 0.02 \cdot \sqrt{100\ GeV/E}$) gave them a very clean π^0 mass peak ($\Delta M^2/M^2 \approx 0.12$) with < 10% background beneath it. The principal objective was to measure $R(A/B)$ the ratio of the invariant cross sections for $Ap \to \pi^0 X$ and $Bp \to \pi^0 X$. In Fig.2 the results are shown.

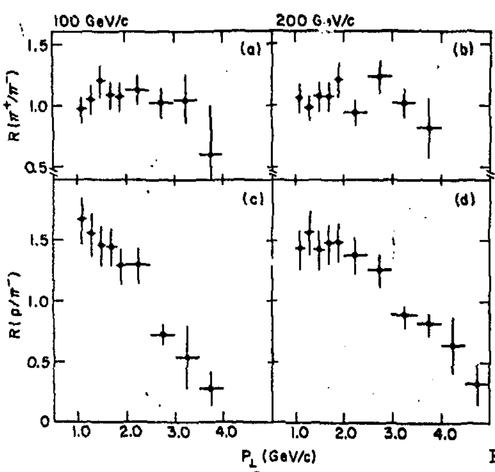

Fig.2.

$R(\pi^+/\pi^-)$ is consistent with 1 over the entire kinematic region covered, while $R(p/\pi^-)$ drops sharply with p_T from a low p_T value of $\sim$ 1.5, the value obtained from simple quark counting. They parameterize the invariant cross section as $(p_T^2 + M^2)^N (1-x_T)^F$ and find $N_p = -5.4 \pm 0.2$, $F_p = 7.1 \pm 0.4$, $M_p^2 = 2.3 \pm 0.3$ GeV^2, $N_\pi = -5.0 \pm 0.1$, $F_\pi = 5.5 \pm 0.3$, $M_\pi^2 = 1.8 \pm 0.2$ GeV^2. Since $N_\pi \approx N_p$ and $M_p^2 \approx M_\pi^2$, $R(p/\pi)$ is a function only of x_T. This is shown in Fig.3.

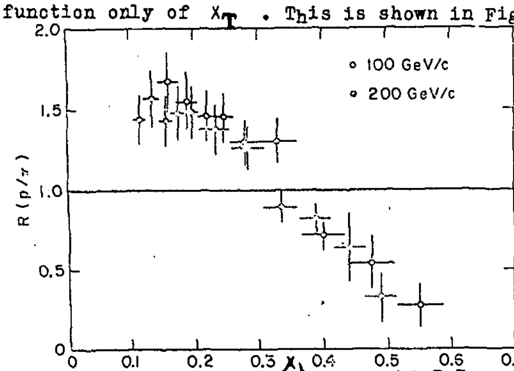

Fig.3.

They find $R(p/\pi) \sim (1-x_T)^{1.6 \pm 0.5}$, consistent with the prediction of the Constituent Interchange Model [2] (CIM) of 2-4.

The Chicago-Princeton experiment [3] presented preliminary data on the production of high p_T particles from 200,300,400 GeV protons incident of H_2,D_2, Be, Ti and W targets. The apparatus consisted of a single arm magnetic spectrometer at $\sim 90^0$ in the center of mass which measured particle production in the range $0.8 < p_T < 7$ GeV/c. Two Cerencov counters allowed π , K and p data to be taken simultaneously.

Examples of the A dependence data are shown in Fig.4, which shows that the nuclear target data extrapolate well to D_2 . The H_2 data does not fit on these curves, there being an excess of positive pions and a deficit of negative pions. The invariant cross section data (H_2 excluded) are parametrized as A^n , where n can be a function of both p_T and $\sqrt{s}$. Results for π^--production at 400 GeV/c are shown in Fig.5. As observed previously, n increases with p_T from the low p_T value of $\sim 2/3$ to values

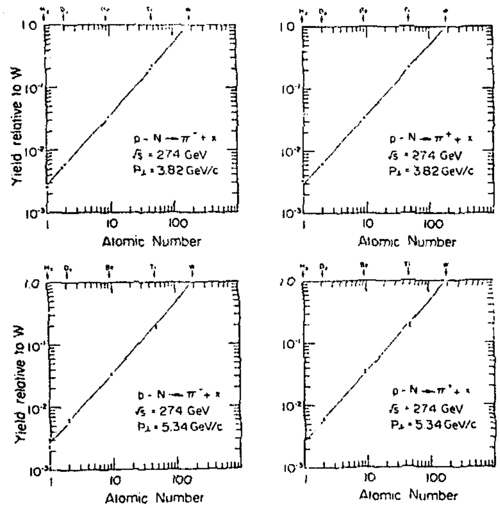

Fig.4.

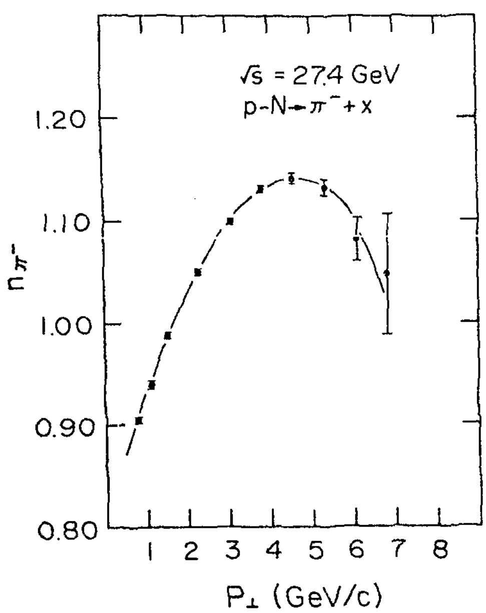

Fig.5.

significantly in excess of 1 at $p_T \sim$ 4-5 GeV/c. There is now an indication that n is dropping at very large p_T. Typical particle ratio data

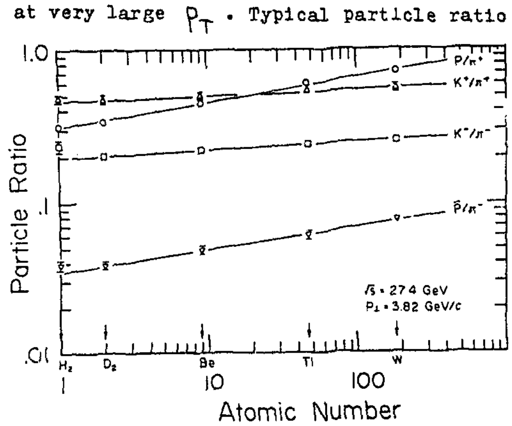

Fig.6.

are plotted in Fig.6, which shows that with exception of K^-/π^-, the nuclear data extrapolate well through H_2. Fig.7 shows the ratio for H_2 and D_2. While deuterium shows the same slow rise seen with the heavy nuclear targets, the hydrogen data shows rapid rise with the π^+/π^- ratio exceeding 2 at high p_T. If a H_2, D_2 subtraction is made, a naive result is obtained for pn scattering. The π^+/π^- ratio for p"n" interactions is seen to be flat or perhaps slightly decreasing.

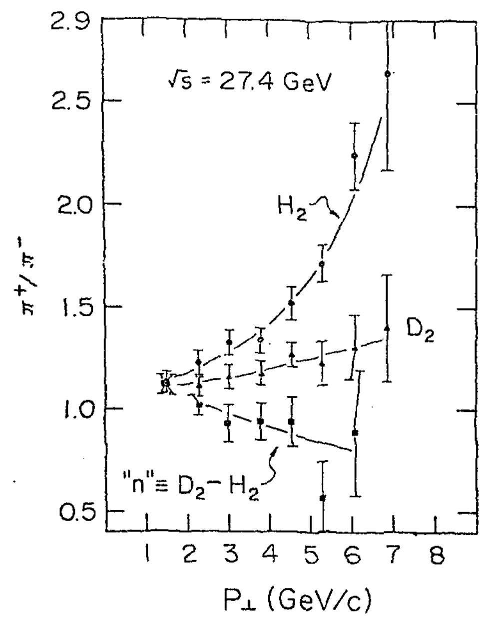

Fig.7.

There are also new results on the energy dependence of high p_T inclusive production in pp interactions. Data have been fit to the form

$$E\frac{d^3\sigma}{dp^3} = A\,p_T^{-n}(1-x_T)^f .$$

An example is shown in Fig.8, where $p_\perp^{8.5} E\frac{d^3\sigma}{dp^3}$ has been plotted vs x_T.

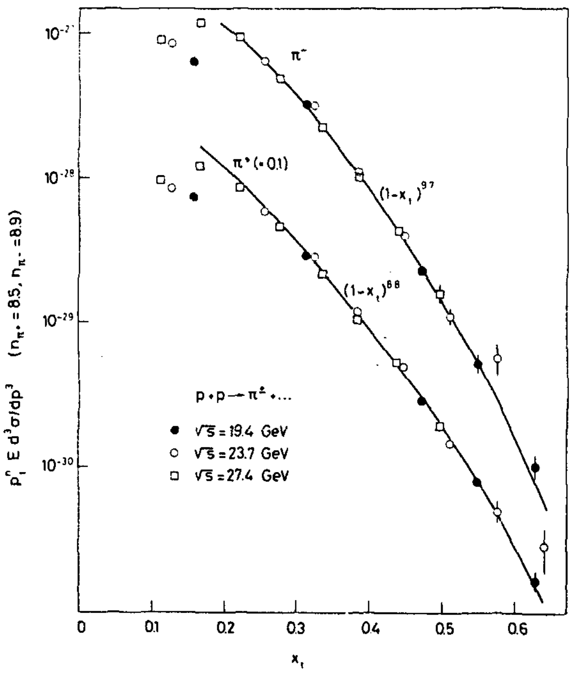

Fig. 8

In the scaling region $X_T > 0.3$ the data from the various energies all fall on the same curve. The results for the various final state particles are tabulated below together with the CIM predictions. The results are in general agreement with the CIM model.

	Data		CIM prediction	
Process	n	f	n	f
$pp \to \pi^+ X$	8.5	8.8	8	9
$pp \to \pi^- X$	8.9	9.3	8	9
$pp \to K^+ X$	8.4	8.8	8	9
$pp \to K^- X$	8.9	11.7	8	11,13
$pp \to p X$	11.7	6.8	12	5
$pp \to \bar{p} X$	11.9	8.0	12	11

Fit to $E d^3\sigma/dp^3 = A\, p_T^{-n} (1-x_T)^f$

References

1. G. Donaldson et al. Phys.Rev.Lett., to be published.
2. S. Brodsky, invited talk in this session.
3. L. Kluberg et al. Submitted paper to the Conference 753/A4-17.

CORRELATIONS IN COLLISIONS WITH A HIGH-$p_\perp$ PARTICLE PRODUCED

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In order to study the mechanism responsible for the production of secondaries with large transverse momenta we have to analyse the high-$p_\perp$ collision as completely as possible. The Split Field Magnet detector (SFM) installed at the CERN Intersecting Storage Rings offers such a possibility for high-energy proton-proton collisions. In this review we will discuss the data obtained by three experimental groups which analysed collision at 26 + 26 GeV with a high transverse momentum secondary using the SFM detector.

The CERN group was dealing with the collisions in which a high-$p_\perp$ *neutral pion was emitted at 90° c.m. production angle. The analysed* sample contained ~ 8000 events [1].

The British-French-Scandinavian Collaboration [2] has studied events with a high-$p_\perp$ charged particle emitted also at 90° c.m. angle. This particle has been identified with a Cerenkov counter as being K, π or a proton. The data are preliminary. The sample analysed so far contains 38 000 events from which 8700 have a charged particle with the transverse momentum above 2 GeV/c.

The CERN-Collège de France-Heidelberg-Karlsruhe Collaboration [3] has presented the data based on about 270 000 events with a charged secondary of transverse momentum bigger than 2 GeV/c. The production angle of high-$p_\perp$ secondaries was equal to about 45° (80 000 events) and about 20° (190 000 events).

It has been found in all three experiments that whenever a high-$p_\perp$ particle is detected the probability to observe another particle(s) emitted roughly in the same direction increases. This is shown in fig. 1 where a clear peak in the rapidity distribution is observed at rapidities close to that of the high-$p_\perp$, triggering particle. In this figure are plotted only those particles which are emitted at azimuthal angles similar to that of the high-$p_\perp$ particle. In the same figure the rapidity distribu*tion for normal events (without a high-$p_\perp$ secondary) is shown as a dashed* curve.

The observed excess of secondary particles above the distribution for normal collisions increases with the transverse momentum of secondaries which is shown in fig. 2. It increases also with the transverse momentum of the high-$p_\perp$ particle what can be seen in fig. 3.

However the correlation for same charged particles is weaker than for different charges. This can be seen in fig. 4 where the average multiplicities of particles in the region around a high-$p_\perp$ particle are plotted for different charge combinations of the high-$p_\perp$ and low-$p_\perp$ particles. The average multiplicities are about twice as big for opposite charges than for the same ones. This effect depends weakly on the nature of a high-$p_\perp$ particle. Nevertheless there is an indication that for the *same charge the multiplicity associated with a high-$p_\perp$ pion is higher than* that associated with a high-$p_\perp$ kaon or a proton (antiproton). One of the possible explanation of this fact could be the Goldhaber effect.

Finally, the excess of particles in the region around the high-$p_\perp$ particle decreases with the increase in the rapidity of the high-$p_\perp$ particle. This is illustrated in fig. 5.

The excess of particles around a high-$p_\perp$ particle is often considered as a manifestation of a jet of hadrons originated, for example, in the hard scattering of two partons. We can then ask what is the distribution of the momentum component perpendicular to the jet axis. The corresponding data are shown in fig. 6. It can be seen that the transverse momentum distribution in respect to the jet axis is similar to that observed in ordinary soft hadron-hadron collisions as expected from the jet concept.

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