eration regions. However, any further discussion of the problem of the cosmic-ray electron sources requires a better knowledge of the shape of the primary negatron spectrum which at low energies depends critically on the residual modulation and hence must await future positron measurements.

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SIMPLE SYSTEMATIC BEHAVIOR IN MULTIPLE PION PRODUCTION IN 25-BeV/c π^-p COLLISIONS*

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In studying high-energy multiple production events it has long been customary to investigate the transverse momentum distribution of the final-state particles. The invariance of this distribution when transformed from the center of mass to the laboratory system makes it one of the few directly observable physical quantities of significance at very high energies. Below several hundred BeV incident energy the dominant feature has been the constant and relatively small value of the average transverse momentum.

More recently experiments have been performed at zero-gradient-synchrotron and alternating-gradient-synchrotron energies with a capability for good statistics. Using 12-BeV/c p-p collisions, Ratner et al.[1] have shown that for a fixed center-of-mass component of momentum along the beam direction the transverse momentum distribution per unit of "phase space"[2] drops off according to a very precise exponential in the square of the transverse momentum. For p-p collisions up to 30 BeV/c, Anderson and Collins[3] have presented evidence that the average multiplicity is linearly related to the "transverse momentum" of one of the final-state protons.

In the experiment discussed here we have noticed a significant correlation between the multiplicity of events and the distribution of both longitudinal and transverse momentum. Events were produced by 25 BeV/c π^- mesons in the 80-in. Brookhaven hydrogen bubble chamber. An arbitrary division of data limits our analysis to events with 6 to 16 visible outgoing prongs.

All events were used without benefit of kinematic fitting and mass identification. To minimize the number of incorrect mass assignments we consider only tracks that transform into the forward hemisphere of the center-of-mass system whenever a pion mass is assigned to them.[4] Obvious strange particles are not included.

The procedure adopted was to fit the forward distribution of the center-of-mass longitudinal momentum p_L to the form

$$dN(p_L) = B_L \exp(-ap_L) dp_L.$$

To obtain a reasonable fit to the distribution in transverse momentum p_T, it was found necessary to use the form

$$dN(p_T) = B_T p_T^{3/2} \exp(-bp_T) dp_T.$$

Again only particles in the forward hemisphere of the center of mass were used. $dN(p)$ is the number of tracks observed in a momentum interval dp, and B is a normalization constant. The constants a and b were obtained separately for each multiplicity of visible prongs. Our results give values of $b \gtrsim 1/m_\pi c^2 \approx 7\ \mathrm{BeV}^{-1}$. The need for the factor $p_T^{3/2}$ has been anticipated by statistical models.[5]

Figure 1(a) shows how the slope a changes on a log plot of the p_L distribution as the number of visible prongs changes. As one might

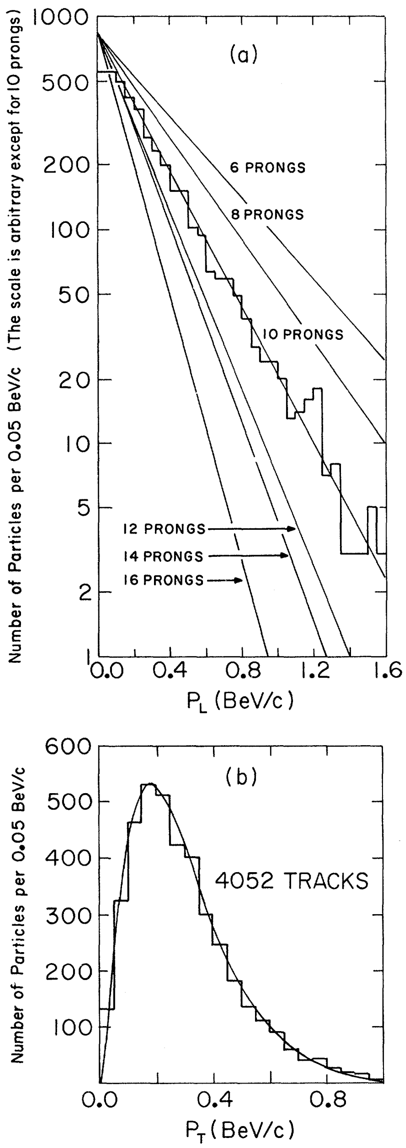

FIG. 1. (a) The curves obtained by a chi-squared fit to the longitudinal momentum of particles in the forward hemisphere defined by the direction of the incident π^- in the π-p center-of-mass system. Fits were made separately for events of different charged multiplicities. The histogram for the ten-prong data is displayed. (b) The distribution of the observed magnitude of transverse momenta in the forward hemisphere is plotted as a histogram for the ten-prong events. The smooth curve is a best fit to the data.

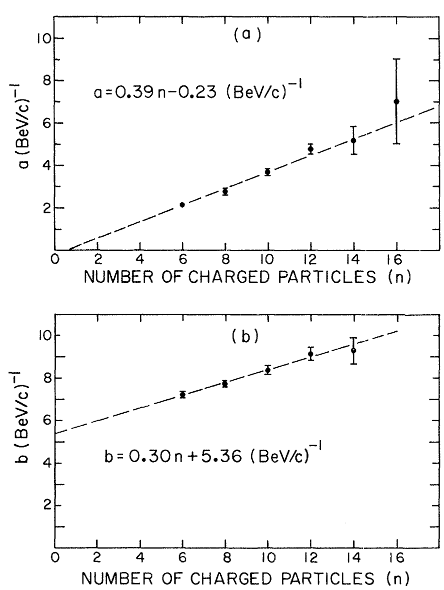

FIG. 2. (a) The values of a for which the longitudinal momentum spectrum achieved the best fit with the form $dN/dp_L = B_L \exp(-ap_L)$. (b) The values b for which the transverse momentum spectrum achieved the best fit with the form $dN/dp_T = B_T p_T^{3/2} \exp(-bp_T)$. In (a) and (b) the dashed lines and equations represent the best fits of the parameters a and b to linear functions of n, the charged multiplicity.

expect, large values of p_L are less likely with increasing multiplicity. A typical plot of a transverse momentum spectrum and its fitted curve is shown in Fig. 1(b).

Figure 2 shows the systematic trends observed in both a and b as the visible multiplicity changes. In order to plot true multiplicity, one would have to increase the values along the abscissa to reflect the number of neutrons and π^0's that were not included in this presentation.

The analytic form used to parametrize the data here should not be considered unique. It is also observed that the experimental angular distribution is not reproduced especially well if it is calculated from the product of the fitted distributions in p_L and p_T. When cut and presented in similar manner,[6] the data appear within statistics to agree with the distributions obtained by Ratner et al.[1] in p-p collisions.

We wish to express our gratitude to Dr. W. Fowler, Dr. H. Foelsche, Dr. R. Louttit, Dr. D. Rahm, and Dr. R. Shutt for their cooperation and help with the 80-in. chamber and beam at Brookhaven. We would also like to thank Dr. C. Goebel and Dr. M. Firebaugh for some interesting discussions regarding this data.

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[2]"Phase-space" is a terminology used by the authors of Ref. 1 to describe the product $\Delta\Omega\Delta p$ where $\Delta\Omega$ and Δp refer, respectively, to the center-of-mass solid angle and the center-of-mass momentum bite accepted by their spectrometer.

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[4]We thus rely on these reactions to favor relatively small momentum transfer to the baryon. Baryon pair production which might produce forward protons is probably small, since hyperon pair production in this experiment is 20 μb. In any case the percentage of proton contamination becomes small in high multiplicity events.

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[6]The bubble-chamber data as presented in this paper represent all momenta and angles available in the forward hemisphere of the center-of-mass system. However, with considerable loss in statistical accuracy, $d^2\sigma/dPd\Omega$ can be obtained by cutting on certain intervals of P_L and $P_T{}^2$ and compared with the results of the counter experiment described in Ref. 1.

STUDY OF ELECTRON-POSITRON ANNIHILATION INTO $\pi^+\pi^-$ AT 775 MeV WITH THE ORSAY STORAGE RING

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The recent achievement of higher luminosity[1] (counting rate per unit cross section) in the Orsay storage ring (ACO) made possible the investigation of the electron-positron annihilation

$$e^+ + e^- \rightarrow \pi^+ + \pi^-$$

in the region of the ρ^0 resonance. In this Letter, we present a preliminary measurement of the cross section $\sigma_{\pi\pi}$ of this reaction at the energy of 775 MeV.

Electron-positron pairs from large-angle Bhabha scattering and $\pi^+\pi^-$ pairs were detected in the same experimental setup (Fig. 1). We were thus able to monitor the $\pi^+\pi^-$ events by the e^+e^- scattering, assuming quantum electrodynamics, and to deduce an absolute value of $\sigma_{\pi\pi}$. The accepted solid angle around a vertical axis had a constant value of 2×1.6 sr over 22 cm along the beam line. The interacting length of the colliding beams was only 12.6 cm (full width at half maximum).

Our experimental setup was comprised of two identical arrays of scintillation counters and spark chambers. In each array, a 4-gap thin plate chamber C_1 (or C_1') was used to determine particle trajectories. Then two thick plate chambers C_2 and C_3 (C_2' and C_3') were used as shower and range chambers in order to identify electron and pion tracks.