INCLUSIVE STUDY OF BEAM DISSOCIATION INTO "LEADING CLUSTERS" AT FNAL ENERGIES

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ABSTRACT

Beam dissociation into "leading clusters" is studied in rapidity-ordered inclusive reaction events, and is shown to involve high-multiplicity, high-mass configurations.

Dissociation of π^- beam particles into "leading" clusters has been studied in 200 GeV/c $\pi^- p$ inclusive reactions. A hybrid arrangement of four dual wide-gap optical spark chambers downstream of the FNAL 30-inch bubble chamber was used to improve resolution for fast forward secondaries. The analysis is based on ~10,000 inelastic events of all multiplicities.

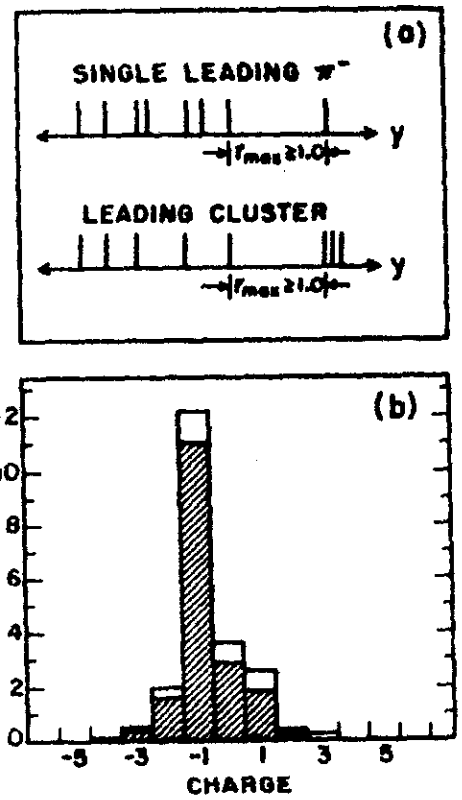

Fig. 1(a) Rapidity ordering. (b) Total charge forward of r_{max}, $r_{max} > 1$ events shaded.

We order in rapidity all secondaries from each event, Fig. 1a, and study pions produced forward of the maximum rapidity gap, r_{max}, with the further restriction that $r_{max} > 1$ to exclude gaps greater than the typical rapidity spread of a centrally-produced cluster. A subset of "single leading π^-" is expected to accompany target proton dissociation while higher multiplicity "leading clusters" with total charge $Q = -1$ (cluster multiplicity m must be odd) are produced in beam π^- dissociation.

Fig. 1b shows that the total charge of all secondaries forward of the maximum rapidity gap indeed peaks strongly at the charge of the beam pion, with or without the $r_{max} > 1$

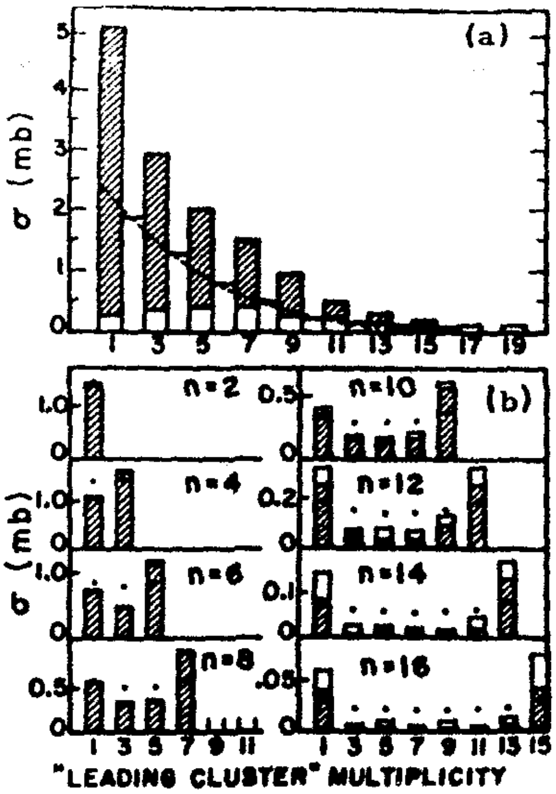

Fig. 2(a) Multiplicity m of charged particles forward of $r_{max} \geq 1$. Background curve is hand-drawn through even-m values. (b) Cluster multiplicity m by overall event multiplicity n, with $r_{max} \geq 1$ events shaded.

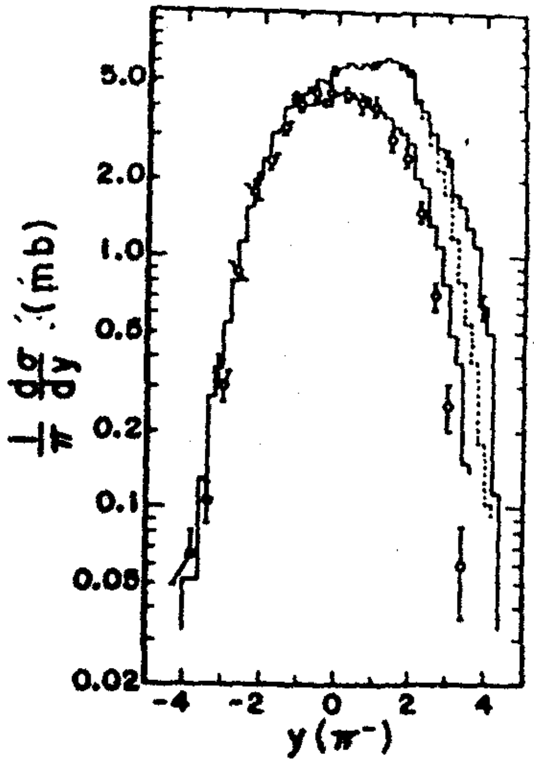

Fig. 3 Rapidity distribution for (outer) all π^-, (dashed) excluding single leading π^-, (inner) excluding leading clusters. 205 GeV/c pp data, normalized to $\sigma_{in}(\pi^- p)$ are shown as open circles for comparison.

restriction. Fig. 2a shows that odd cluster multiplicity and Q = -1 (shaded) predominate out to surprisingly high values of the cluster multiplicity. In Fig. 2b we plot distributions of the leading cluster multiplicity m for different multiplicities n of charged secondaries in each event. For all topologies, there is a strong signal for single forward π^- emission (mainly target dissociation), and an even stronger signal for beam dissociation into the largest number of charged secondaries allowed, m = n - 1. The surprising dominance of beam and target dissociation phenomena out to the highest multiplicities is reflected in the fact that the "leading particle asymmetry" in the single-particle rapidity distribution extends back into the "central region" as shown in Fig. 3.

The question remains, to what extent are "leading clusters",

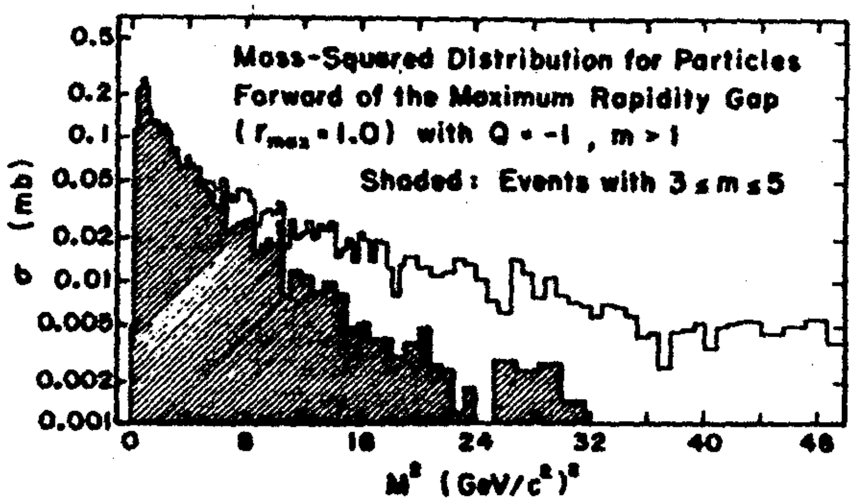

Fig. 4 Mass-squared distribution for leading clusters.

produced with zero charge exchange across the maximum rapidity gap, diffractively excited? In a previous study[1] of pion diffraction dissociation at this energy, an analysis of M^2 distributions for various n has indicated a diffractive component of 1.8 mb for $M^2 \leq 32$ in events with $n \leq 6$. Above $n = 6$ the diffractive peak becomes more difficult to recognize in this analysis. Beam dissociation is clearly indicated in Fig. 2b above, where the $m = n - 1$ cross section is consistent with the previous diffraction results[1] up to $n = 6$, and shows a continuation of diffractive behavior out to quite high multiplicities. This implies higher M^2 values, as shown in Fig. 4. The extent to which the observed beam dissociation into leading clusters is diffractive would seem to depend on the operational definition of "diffraction" that is applied. The total beam dissociation cross section for the $m = n - 1$, $n > 2$ events (ignoring the small amount of $n = 2$ beam dissociation) is 2.5 ± 0.15 mb.

REFERENCES

1. F.C. Winkelmann et al., Phys. Rev. Letters 32, 121 (1974).