$\pi^- p \to \pi_F^-$ (FAST PION) + (FRAGMENTING TARGET)

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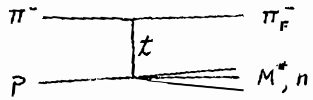
This experiment illustrates a trigger which should be useful for several other hadron projectiles provided the projectiles are suitably identified after the collision by Cerenkov counters. The stated purpose of the experiment is to study the inelastic vertex of the following diagram as a function of mass M*, momentum transfer t, and multiplicity n.



Energies below those at NAL do not allow one to observe a wide range of t (less than 1.0 $(GeV)^2$) and M* (less than 3.5 GeV/c^2). Bubble chamber experiments do not collect enough events, especially at the larger t values, and are unable to identify leading particles such as $K_F^{\pm}$ and $\bar{p}_F$. The spectrometer is the only way to do a satisfactory version of this experiment if the particle multiplicity of the inelastic vertex is to be one of the variables studied and the momentum transfer is to be greater than ~1 $(GeV)^2$.

The prime purpose of the trigger is to discriminate against events in which the projectile itself fragments, as in the diagram below.

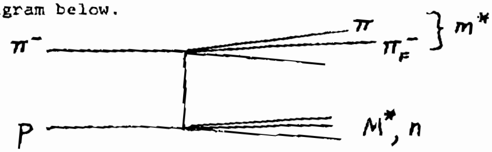
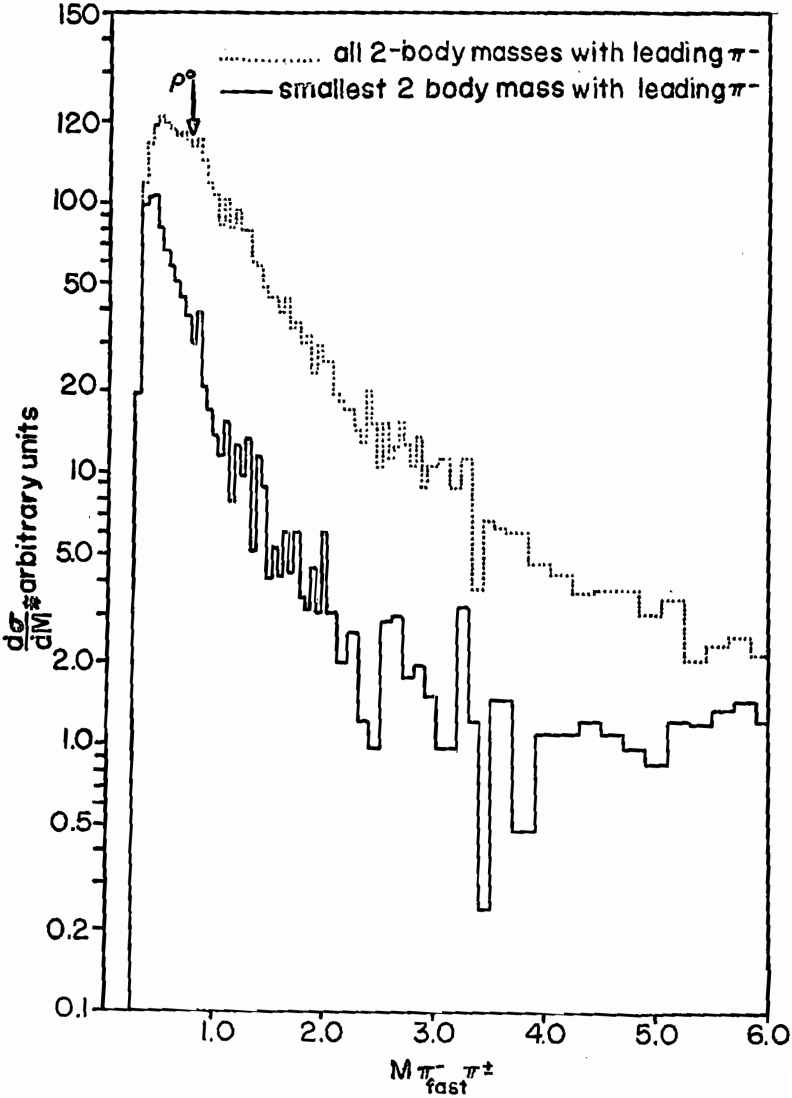


Figure 1 shows the strong tendency of another π of any charge to have a low effective mass m* with the fastest π^- in a multiparticle final state (this figure is for 25 GeV/c beam momentum). The peak occurs at ~500 MeV/c^2, well below the ρ mass. We wish to exploit this feature by triggering only on events which have no π-π effective mass, m*, with the fast

π^- less than some value, say 1.3 GeV/c^2. If no additional trigger restrictions are employed, we thus will record about one event in 10 and use it for further study.

If we choose to do the experiment for 200 GeV/c incident π^-, Fig. 2 shows the laboratory angle another π of a given momentum must have with the fast (assumed to be 200 GeV/c for the figure) π^- to produce a specific m^*. A simple trigger might be constructed as follows. Particles entering the aperture of M3 have to first order the same angle with respect to the beam direction as they did at the vertex since the bending of M1 and M2 tend to cancel. To reach the entrance aperture of M2, assuming M1 runs at 15 kG, a particle must have momentum in excess of 8 GeV/c. By insisting that one and only one particle reaches the entrance aperture of M3, we eliminate most events with $m^* \gtrsim 800$ MeV/c^2 ($p > 8$ GeV/c, $\theta < 30$ mr). Even if the mass distribution is no sharper at high energy than that shown in Fig. 1, this trigger will eliminate 75% of the events. Rates will further be reduced by the built in requirement that a leading particle with $p > 8$ GeV/c exists at the entrance to M3.

One may seek to impose additional requirements in the trigger to reduce the data collection rate such as requiring the leading particle to have the same charge as the beam particle. A hardwired trigger might conceivably limit t to values greater than ~ 1.0, reducing the data rate by another 10^2, but otherwise the trigger discussed so far will probably not discard more than 90% of the events.



150
120
100
50
20
10
5.0
2.0
1.0
0.5
0.2
0.1
all 2-body masses with leading π⁻
smallest 2 body mass with leading π⁻
ρ°
dσ/dM = arbitrary units
1.0
2.0
3.0
4.0
5.0
6.0
M π⁻fast π±

Figure 1

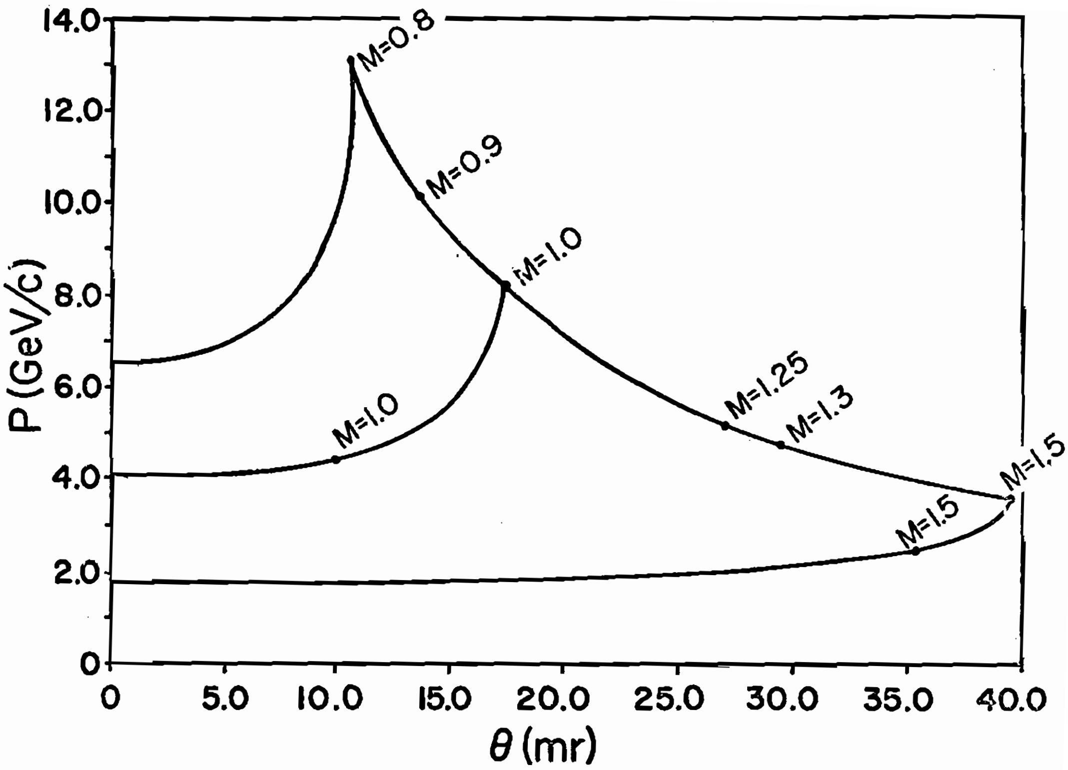

P (GeV/c)
θ (mr)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
M=0.8
M=0.9
M=1.0
M=1.0
M=1.25
M=1.3
M=1.5
M=1.5

Figure 2