The submitted manuscript has been authored by a contractor of the U. S. Government under contract No. W-31-109-ENG-38. Accordingly, the U. S. Government retains a nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or allow others to do so, for U. S. Government purposes.

Fermilab Library
0 1190 0021482 9

ANL-HEP-CP-92-121

NUCLEAR RESCATTERING EFFECTS IN $pA \rightarrow$ DIHADRONS*

T. FIELDS[a] and M.D. CORCORAN[b]
[a]*Argonne National Laboratory*
[b]*T.W. Bonner Nuclear Laboratories, Rice University*

ABSTRACT

Based upon recent dijet angular correlation measurements, we point out that the parameter α in the A^{α} cross section parameterization can be substantially affected by the angular acceptance of the two-arm spectrometer apparatus used to measure dihadron production from nuclear targets. Correction for this acceptance effect could well bring the results of some published 400 GeV dihadron experiments into better agreement with each other.

Fermilab experiments E609 and E557 studied the process $pA \rightarrow$ dijets at 400 GeV and 800 GeV respectively. Results from both experiments[1,2] show that: 1)the fact that a parton has traversed nuclear matter hardly affects the angular width of its hadron jet; 2)nuclear scattering dramatically broadens the azimuthal back-to-back correlation between the two hard scattered partons. This broadening is shown in Fig. 1 for E609 data at 400 GeV, and a similar large effect can be seen at 800 GeV in Fig. 5a of Ref. 2.

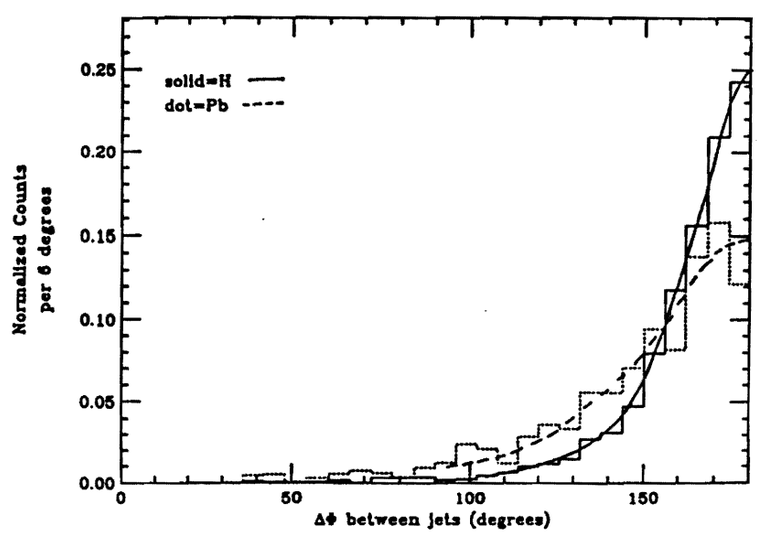

Fig. 1 Experimental data from ref. 1 on the distribution of azimuthal opening angle for dijet events from H and Pb targets, with $p_{beam} = 400$ GeV/c, $\theta_{cm} \approx 90°$, and $< p_T > = 5$ GeV/c. Both experimental histograms are normalized to the same number of events. The curves are drawn to guide the eye.

*This work supported by the U.S. Department of Energy, High Energy Division under Contract No. W-31-109-ENG-38.

We shall call $k_T\phi$ the azimuthal component of the net transverse momentum ($\vec{k}_T$) of the dijet system. It is usually assumed that nuclear scattering contributions to k_T will combine in quadrature with the value for a nucleon target:

$$k_T{}^2\,(\mathrm{pA}) = k_T{}^2\,(\mathrm{pp}) + k_T{}^2\,(\text{nuclear rescattering})$$

The broad dijet azimuthal correlation seen in Fig. 1 for Pb corresponds to a nuclear-rescattering contribution to $k_T\phi$ of 1.8 GeV/c for the dijet system. We have described elsewhere[1,3] how this surprisingly large value of k_T can be attributed to rescattering of the final-state (not initial-state) partons, and how the measured anomalous nuclear enhancement ($\alpha > 1$) in inclusive single hadron production at large p_T can arise from this rescattering.

Turning now to $pA \rightarrow$ massive dihadrons at 400 GeV, we first note that the azimuthal correlation behavior for dihadron production is expected to be very similar to that for dijets. That is, large p_T hadrons will measure jet azimuthal angles with a precision comparable to that of a jet calorimeter ($\sim 5^\circ$ per jet). Thus, the $\Delta\phi$ distribution for dihadrons produced at, say, $p_T = 4$ GeV/c should be quite similar to Fig. 1.

This means that requiring $\Delta\phi$ (dihadrons) $= 180^\circ$ would lead to an underestimate of the Pb/H dijet cross-section ratio by about a factor of 2. A factor of 2 in cross-section ratio corresponds to $\Delta\alpha = 0.13$ in the A^α behavior of the cross-section. Therefore, making accurate comparisons of α measurements from different experiments will require that differences in the azimuthal acceptance of each experimental setup be corrected for.

To make such corrections accurately would require knowledge of k_T (pp) and k_T (nuclear rescattering) as well as of the apparatus acceptances. Lacking knowledge of these, it is nevertheless interesting to consider the three main measurements of α (dihadron) at 400 GeV, which are shown in Fig. 2. The large $\Delta\phi$ acceptance

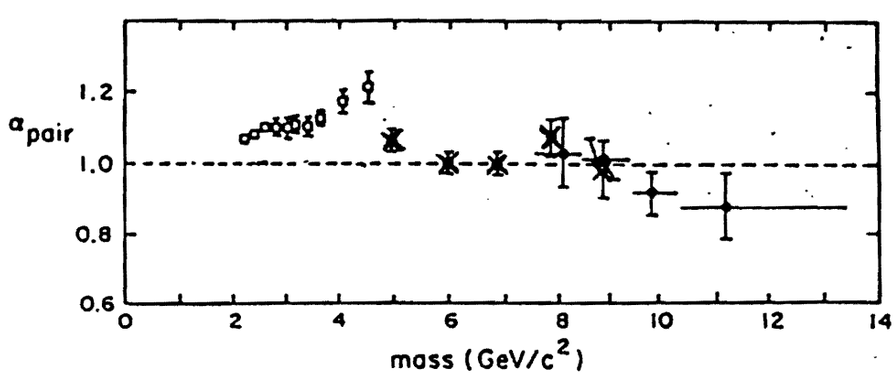

Fig. 2 Experimental data on the A dependence of massive dihadron production by 400 GeV/c protons. Squares (below 4.7 GeV/c^2) are from Finley *et al.* (ref. 4) The X's are from McCarthy *et al.* (ref 5) and the filled circles are from Hsiung *et al.* (ref. 6).

experiment of Finley *et al* ($\Delta\phi$ acceptance per arm $\sim \pm 17^o$) gives α values which are larger than those of the small $\Delta\phi$ acceptance ($\sim \pm 4^o$ per arm) data of McCarthy *et al.* A precise estimate of the differences in α is difficult to make since the dihadron mass ranges of the two experiments do not quite overlap. Nevertheless, it does seem likely that much of the difference may be due to the $\Delta\phi$ acceptance effect which we are describing.

Another experimental demonstration of the great sensitivity of α to the $\Delta\phi$ acceptance can be seen in data from the dihadron experiment of Hsiung *et al*[6] as shown in Fig. 3. In that figure, p_{out} $(=k_{t\phi})$ = 2 GeV/c corresponds to $\Delta\Phi \approx = 156^o$.

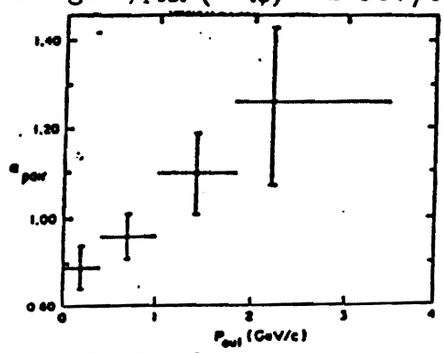

Fig. 3 Experimental dihadron data of Hsiung *et al.* (ref 6) showing the dependence of α upon p_{out} for a 400 GeV/c proton beam.

From Fig. 3 alone, it is clear that the measured value of α (dihadron) can be substantially affected by the azimuthal acceptance of the apparatus. To achieve the full potential experimental accuracy in α (dihadron) of about ± 0.01 will require that this acceptance effect be taken into account.

This work was supported in part by the U.S. Department of Energy.

References

1. M.D. Corcoran *et al.*, *Phys. Lett.* B259, (1991) 209.
2. C. Stewart *et al.*, *Phys. Rev.* D42, (1990) 1385.
3. T. Fields, *Nucl. Phys.* A544, (1992) 565c; T. Fields and M. Corcoran, *Preprint ANL-HEP-PR-92-76.*
4. D.A. Finley *et al.*, *Phys. Rev. Lett.* 42., (1979) 1031.
5. R.L. McCarthy *et al.*, *Phys. Rev. Lett.* 40, (1978) 213.
6. Y.B. Hsiung *et al.*, *Phys. Rev. Lett.* 55, (1985) 457.