First observation of jets at RHIC

David Hardtke, Kirill Filimonov, Peter Jacobs,
Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720
and the STAR Collaboration

In hadronic collisions, it is expected that at sufficiently high transverse momentum particle production is dominated by the hard scattering of quarks and gluons. The scattered partons fragment into jets of hadrons nearly aligned with the direction of the scattered parton. At RHIC energies, jets are expected to account for a significant fraction of the total multiplicity. In nucleus-nucleus collisions, however, these jets are superimposed upon a large background and cannot be fully reconstructed on an event-by-event basis.

We have searched for jet activity on a statistical basis using data from the STAR detector. For this analysis we have used 400,000 central Au+Au events at nucleon-nucleon center-of-mass energy of 130 GeV. We concentrate on the 20,000 events with a large transverse momentum particle (p_T>4 GeV/c). We use this trigger particle to estimate the location of the jet axis, and look at angular correlations of other particles relative the trigger particle. Jet activity will show up as an enhancement of near-angle (Φ<30°) correlations.

In addition to jets, however, there is a strong two-particle angular correlation due to elliptic flow at high p_T [1]. The elliptic flow, however, represents a long range correlation and should be roughly constant in the pseudorapidity (η) range covered by STAR. In order to eliminate the elliptic flow contribution to the two-particle angular correlation, we subtract the large $\Delta\eta$ contribution ($|\Delta\eta|$ > 0.5) from the signal in order to isolate the enhancement due to jet activity.

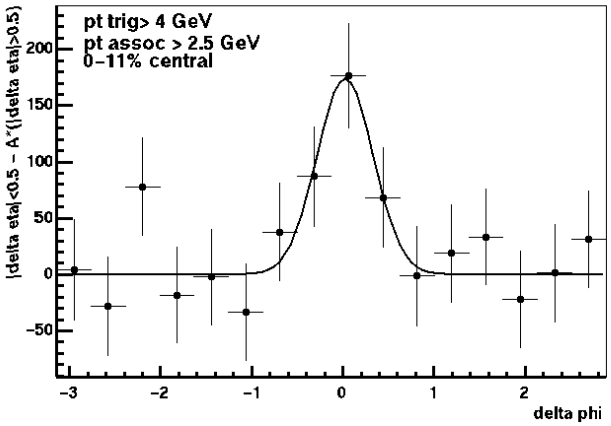

Figure 1. Background subtracted angular correlation for central Au+Au collisions at RHIC

Figure 1 shows the background subtracted angular distribution of p_T>2.5 GeV/c particles relative the trigger particle. We see a clear enhancement near ϕ=0 that we attribute to jet activity. The width of this signal is consistent with jet measurements in UA1 [1] and predictions of the Hijing model. We find that 3% of charged particles with transverse momentum>4 GeV/c have an associated particle with transverse momentum>2.5 GeV/c. This is in quantitative agreement with the predictions of the Hijing model, and indicates that the signal is indeed due to jet activity.

We thus conclude that above 2.5 GeV/c we can identify a hard component in the particle spectra using two-particle angular correlations. With the greatly enhanced statistics available from the year 2 STAR data we will measure high p_T angular correlations for several centrality and p_T bins. These data can then be used to look for modifications of the parton fragmentation functions in nucleus-nucleus collisions.

Footnotes and References

2. K. Fillimonov, et al., this report.
2. G. Arnison, et al., Phys Lett. B 118, 173 (1982).