Di-hadron correlation shapes in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV from STAR

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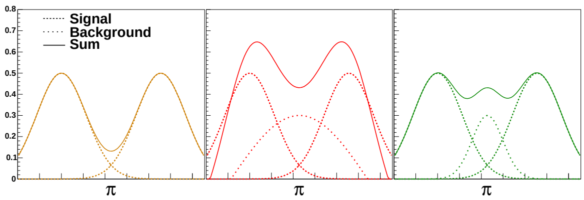

FIG. 1: Graphical illustrations of the 3 different functional forms used to fit the away-side shape. In the leftmost panel only symmetric identical Gaussian distributions (Symmetric Gaussians) are used. In the middle panel (Gaussian + Cosine) a central background contribution in the form of a $\cos\Delta\phi$ distribution is added. The rightmost panel uses a Gaussian distribution as the background distribution (Gaussian + Gaussian).

Relativistic heavy-ion collisions at RHIC have produced a hot and dense colored medium exhibiting collective, flow-like phenomena[1].

It has been shown at RHIC that there is absorption of the fast moving hard partons from initial state hard scatterings [2]. This absorption is interpreted as the hard partons losing energy via gluon bremsstrahlung as they interact in the dense, colored medium.

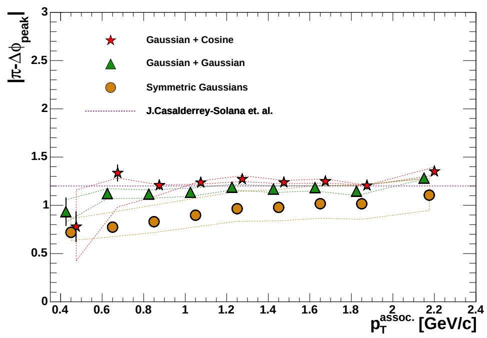

FIG. 2: The deviation of the mean value of the symmetric Gaussian distributions away from $\Delta\phi = \pi$ on the away-side. The lines show the systematic uncertainty from v_2 while the errors are the statistical errors from the fit.

The technique applied in this analysis is the same as in [2] and allows the reconstruction of the direction of one of the hard partons from a hard trigger particle, giving a frame for the hard scattering. We can then construct azimuthal di-hadron correlations with respect to the trigger particle (hard parton). In this technique the hard trigger particle is attributed to one of the hard partons forming near the surface and not undergoing significant energy loss in the medium as its in-medium path length is small. The hadronic fragments of this parton make up the small angle correlation peak (near-side). The partner parton, on average, traverses the medium at π radians (away-side) from the trigger particle where it has a much greater path length in the medium than the near-side parton and loses much more of its energy. A soft correlated yield on the away-side is expected as a consequence of energy and momentum conservation. Softened correlated products have been reconstructed [3] by using associated particles with the lowest p_T. The away-side structure for certain associated p_T ranges has exhibited a doubly-peaked structure, possibly consistent with the idea of a shock wave (for example see [4]) being created in the medium by the away-side parton.

To characterise the away-side shape, we have fitted the away-side distribution with several functional forms based on the idea that there is significant yield in a cone around π in $\Delta\eta$-, $\Delta\phi$-space. The projection of this cone on $\Delta\phi$ gives rise to peaks on both sides of $\Delta\phi = \pi$. This part of the yield is parameterised by a pair of identical Gaussian distributions symmetric about π. In addition some jet contribution may still exist which is centered at π and we have characterised this using a $\cos\Delta\phi$ or Gaussian distribution. These parameterisations are referred to as Symmetric Gaussians, Gaussian + Cosine and Gaussian + Gaussian respectively and are demonstrated in Fig. 1.

In Fig. 2, for 0-10% most central collisions, we plot the displacement of the cone peaks from the centre of the away-side as a function of p_T for the different phenomenological descriptions of the away-side shape for trigger particles with p_T in the range 4.0 to 6.0 GeV/c.

The cases where a central contribution is included show a behaviour which is consistent with a constant angular separation between the symmetric Gaussians representing the cone contributions. It is consistent with being constant at the value from [4], about 1.2 as expected in a model for a Mach cone. For the case of no central contribution, only symmetric Gaussians, a slow increase with p_T is observed.

Our phenomonological description of the away-side shape is consistent with the picture of Mach cone generated by the away-side parton.

[1] J. Adams *et al.* nucl-ex/0501009.
[2] J. Adams *et al.* Phys. Rev. Lett. **90** (2003) 082302.
[3] J. Adams *et al.* nucl-ex/0501016.
[4] J. Casalderrey-Solana *et al*, hep-ph/0411315.
[5] I. Vitev, hep-ph/0501255.