

Iowa State University

Thesis Abstract

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Thesis Title: Extraction of jet properties from two particle azimuthal correlations in pp and AuAu collisions at $\sqrt{s_{NN}} = 200$ GeV

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Two particle azimuthal correlation functions measured in pp and $AuAu$ collisions at $\sqrt{s_{NN}} = 200$ GeV at midrapidity with the central arms of the PHENIX detector are analyzed in order to extract the properties of hadronic jets produced in QCD vacuum and highly excited QCD media.

Already, the published results on hadron spectra at high transverse momentum (p_T) in pp , dAu and $AuAu$ collisions at RHIC energies gave definitive proof for the discovery of hadronic jet quenching.

We use the method of two particle azimuthal correlation functions to gain more detailed information about this phenomenon, by extracting quantities like the jet shape parameters j_T and k_T , the jet conditional yields (number of associated hadrons per high p_T trigger hadron) and the jet fragmentation function.

The analysis of pp data starts with the measurement of the vacuum fragmentation function from which the p_T dependence of the mean fragmentation momentum fraction $\langle z \rangle$ is extracted. We obtain a constant value of $\langle z \rangle = 0.74 \pm 0.02$ for p_T above 3 GeV/c. Soft (non-perturbative) parton fragmentation becomes significant below 3 GeV/c and the slope of the fragmentation

function is p_T dependent in this region. Gaussian fits to jet induced azimuthal correlations are employed to measure the mean jet fragmentation transverse momentum $\langle |j_{Ty}| \rangle = 359 \pm 11$ (stat) ± 6 (syst) MeV/c and the mean partonic transverse momentum $\langle |k_{Ty}| \rangle = 964 \pm 49$ (stat) ± 16 (syst) MeV/c.

The analysis of $AuAu$ data is based on azimuthal correlation functions between charged hadrons in the 1.5-3 GeV/c and 3-5 GeV/c p_T regions in five classes of collision centrality. The mean jet fragmentation transverse momentum $\langle |j_{Ty}| \rangle$ is centrality independent and consistent with the value in pp data mentioned above. A strong broadening with the centrality of the extracted mean partonic transverse momentum $\langle |k_{Ty}| \rangle$ (multiplied by $\langle z_{trigg} \rangle$) is observed. This is an important finding because hadronic jet quenching through energy loss is expected to be accompanied by a broadening effect.

Another important finding is that the jet conditional yields in both the near ($\Delta\phi \sim 0$) and away ($\Delta\phi \sim \pi$) regions exhibit a slightly raising trend with centrality. This was also expected to accompany the jet quenching found at higher p_T based on simple energy conservation considerations.

This detailed study of hadronic jet properties is another piece of the Quark-Gluon Plasma puzzle that RHIC is trying to solve.