High-p_T Hadron Spectra, Azimuthal Anisotropy and Back-to-Back Correlations in High-energy Heavy-ion Collisions *

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The degradation of high-p_T partons during their propagation in the dense medium can provide critical information necessary for detection and characterization of the strongly interacting matter produced in high-energy heavy-ion collisions. Because of radiative parton energy loss induced by multiple scattering, the final high-p_T hadron spectra from jet fragmentation are expected to be significantly suppressed. Such a phenomenon, known as jet quenching, was observed for the first time in $Au+Au$ collisions at the Relativistic Heavy-ion Collider (RHIC). One also observes the disappearance of back-to-back jet-like hadron correlations and finite azimuthal anisotropy of high-p_T hadron spectra. These three seemingly unrelated high-p_T phenomena are all predicted as consequences of jet quenching. Together, they can provide unprecedented information on the properties of dense matter produced at RHIC.

In this Letter, we will study these three high-p_T phenomena simultaneously within a lowest order (LO) pQCD parton model that includes initial nuclear k_T broadening, parton shadowing and medium induced parton energy loss. We point out that an enhanced $(K+p)/\pi$ ratio leads naturally to different suppression of $h^{\pm}$ and π^0 spectra at intermediate p_T range. We will also show that the suppression of back-to-back correlations is directly related to the medium modification of hadron-triggered FF's similar to a direct-photon triggered FF.

We have studied simultaneously the suppression of hadron spectra and back-to-back correlations, and high-p_T azimuthal anisotropy in high-energy heavy-ion collisions within a single LO pQCD parton model incorporating current theoretical understanding of parton energy loss. Experimental data of $Au+Au$ collisions from RHIC can be quantitatively described by jet quenching in an expanding medium. With HIJING (EKS) parton shadowing, the extracted average energy loss for a 10 GeV quark in the expanding medium is $\langle dE/dL\rangle_{1d} \approx 0.85(0.99) \pm 0.24$ GeV/fm, which is equivalent to $dE_0/dL \approx 13.8(16.1) \pm 3.9$ GeV/fm in a static and uniform medium over a distance $R_A = 6.5$ fm. This value is about a factor of 2 larger than a previous estimate because of the variation of gluon density along the propagation path and the more precise RHIC data considered here .

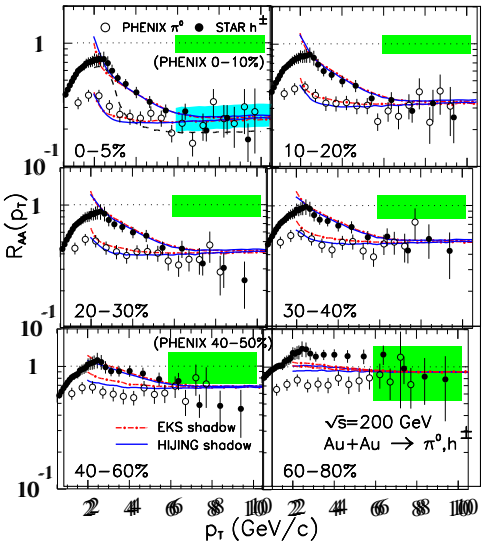

Figure 1: Nuclear modification factors for hadron spectra in $Au+Au$ collisions as compared to data from STAR [2] and PHENIX [3].

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‡C. Adler *et al.*, Phys. Rev. Lett. **89**, 202301 (2002); arXiv:nucl-ex/0305015