Hadro-chemistry in jets as a quark gluon plasma probe

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Hadro-Chemistry, i.e. the analysis of relative abundances and spectra of hadrons in high energy collisions, has long been a staple of heavy ion physics. Recently, we have suggested looking for signs of chemical equilibration for high momentum hadrons in high energy collisions between large nuclei. High momentum particles do not have enough time to equilibrate, but their relative abundance might be altered in nuclear collisions compared to elementary p+p collisions due to the presence of a chemically equilibrated medium.

The basic underlying idea is that the flavor of the leading parton of a QCD jet is not a conserved quantity. In fact, even in vacuum the identity of the leading parton can fluctuate between different quark flavors and gluons, or even change to a photon, due to QCD splitting functions. In a medium, induced bremsstrahlung, and annihilation and Compton processes with medium partons will alter the evolution of a jet and lead to a modified distribution of leading partons. Clearly, coupling a sample of ljet partons to a reservoir of particles in chemical equilibrium drives the jet sample toward equilibrium as well. Jet fragmentation will translate changes in the abundances of partons into changes in the abundances of hadrons. The merit of measuring flavor changing channels at high momentum lies in the fact that it can provide information complementary to that from jet quenching measurements. One can in principle infer the mean free path of fast partons in quark gluon plasma

In [1] we investigated the changes expected in the relative abundances and elliptic flow of protons vs pions, of photons, and of strangeness. We predicted an enhancement of kaons at high transverse momentum as a unique signal for flavor changing processes at RHIC energies. Such an enhancement is seen in preliminary data from the STAR collaboration presented at Quark Matter 2009. In [2] we expanded our predictions to heavy charm and beauty quarks at both RHIC and LHC. In [3] we discussed a new mechanism for elliptic flow of high momentum particles. We predicted that the enhancement of the yield of kaons and other strange hadrons at RHIC should be coupled with a suppression of the elliptic flow of the same particles.

[1] W. Liu and R. J Fries, Phys. Rev. C **77**, 054902 (2008).
[2] W. Liu and R. J. Fries, Phys. Rev. C**78**, 037902 (2008).
[3] W. Liu and R. J. Fries, arXiv:0805.3721