Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

High p_T Azimuthal Anisotropy in Au+Au Collisions at $\sqrt{s_{NN}}$ = 200 GeV

By

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A novel state of nuclear matter, in which quarks and gluons are de-confined, yet strongly coupled to each other, is created in Au+Au collisions at the Relativistic Heavy Ion Collider (RHIC). This matter, which displays strong collective flow, and large opacity to the fast moving partons, are commonly referred to as the strongly-coupled quark gluon plasma (sQGP). Many efforts are ongoing to understand the microscopic properties of the strong interaction and the relaxation process leading to the rapid thermalization. The PHENIX experiment has measured the azimuthal anisotropy of π^0 at mid-rapidity ($|\eta|<0.35$) in Au+Au collisions at $\sqrt{s_{NN}}$= 200 GeV in RHIC 2007 run (Run-7). The results show good agreement with previous PHENIX measurement in Run-4, but with four times more statistics and much improved reaction plane determination. It allows for detailed study of the anisotropy as a function of collision centrality and transverse momentum p_T in the range of 1-18 GeV/c. In addition, the anisotropy of π^0 at mid-rapidity is measured with respect to the reaction planes reconstructed by four different reaction plane detectors located at forward region ($|\eta|>1.0$), for the first time that the detailed study of the influence of non-flow due to jets on the measured v_2 are presented. The observed anisotropy shows a gradual decrease up to p_T of 7-10 GeV/c and remains significantly above zero at p_T>10 GeV/c. The comparisons with v_2 of identified charged particles confirm the recently observed general trend of v_2 of identified particles at RHIC: constituent quark number scaling at transverse kinetic energy KE_T<1 GeV and the breaking of the scaling thereafter. The $\Delta\varphi$ dependent nuclear modification factors show a large split between the in-plane and out-of-plane directions. Such large difference exceeds the expectation from the energy loss models. A jet absorption model is employed to study the influences of initial geometry and path length dependence on the jet energy loss. An estimate of the increase in anisotropy expected from initial-geometry modification due to gluon saturation effects and fluctuations is insufficient to account for this discrepancy. Calculations that implement a path length dependence steeper than what is implied by pQCD energy-loss models show reasonable agreement with the data.

Date: Aug 6th, 2010
Time: 10AM
Place: Physics C-133

Program: Physics
Dissertation Advisor: Jiangyong Jia