Systematics of Radial and Elliptic Flows in High-Energy Heavy-ion Collisions

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The main goal of high-energy heavy-ion collisions is to understand the properties of hot and dense matter made of hadrons or quarks and gluons. Particularly at RHIC energies, formation of QGP is of great interest. Recent data at RHIC — jet energy loss, strong radial and elliptic flows — suggest the formation of QGP. For a clear understanding of QGP formation, it is necessary to elucidate when and where thermalized QGP is formed.

We analyze radial and elliptic flows from SIS to RHIC energies systematically in a realistic dynamical hadron-string cascade model including minijet production (JAM) [1]. We find that hadron m_T spectra up to SPS energies are well reproduced in JAM, but we cannot explain the very stiff proton and anti-proton spectra at RHIC observed by STAR and PHENIX collaborations [2]. For elliptic flows, the calculated value of v_2 in central rapidity region underesitmates the STAR and PHOBOS data. However, as shown in Fig. 1, elliptic flow data in the fragmentation region ($|\eta| \geq 3$) are well explained in JAM [3].

All of these observations imply the need of extra pressure in addition to the hadronic one in the early stage of reactions in the central rapidity region at RHIC. Together with the hydrodynamical analysis [4], this would be generated from the subsequent parton scattering after the initial minijet production, i.e. thermalized quark-gluon gas. In the presentation, we will also discuss the nuclear mean-field effects on radial and elliptic flows.

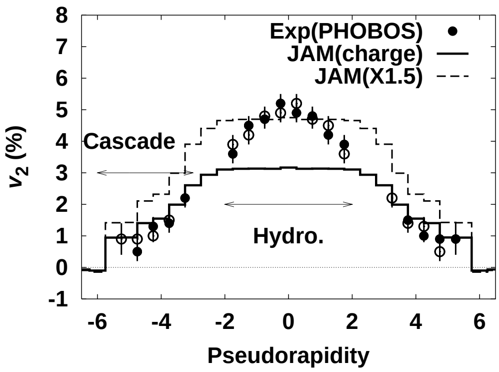

Figure 1: Pseudo-rapidity dependence of elliptic flow (v_2) in minimum bias events at $\sqrt{s_{NN}} = 130\mathrm{GeV}/c$ in comparison with PHOBOS data.

References

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