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Probing Soft-Hard Interactions in Heavy Ion Collisions

The large elliptic flow discovered at RHIC energies continuously increases also in the highest beam energy $\sqrt{s_{NN}}$=5.02 TeV in LHC. This was expected by calculations utilizing viscous hydrodynamics. These calculations also demonstrated that the shear viscosity to the entropy density ratio (η/s) of the created medium is close to a universal lower bound $1/4\pi$ in heavy ion collisions at LHC energies.

However there is still an open question if this upper limit of the η/s ratio is small enough to allow the formation of Mach shocks, induced by supersonic partons moving through the quark-gluon plasma (QGP).
Early studies expected that the Mach cone shock wave would be observed as a double-hump structure in the away-side of azimuthal correlations. However, it was found that the observed structure was explained by the odd harmonics of hydrodynamical flow that arise from initial geometry fluctuations rather than the Mach cone. This initiated a rapid development on flow observables and a series of precision flow measurements. The higher-order flow harmonics and their non-linear response to initial anisotropies can provide constraints to both the η/s and to initial fluctuations. Furthermore, correlations between different flow harmonics can provide strong constraints to the temperature dependence of η/s in the hydrodynamic calculations. These flow observables should reveal the details of the interaction between the constituents in the QGP and be sensitive to any angular distortion.

In this talk, a possible modification of various flow observables for the events where high energetic jets are produced by emphasis upon interactions of hard jets with the soft hydrodynamic components will be investigated with various available model calculations.
In particular, the individual flow coefficients and the correlations between different flow harmonics
are studied with various event section criteria to ensure that the event contains a very energetic jet to hinder the interaction between the jet and the medium.

Summary

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