Quark Matter 2015 - XXV International Conference on Ultrarelativistic Nucleus-Nucleus Collisions

Contribution ID: **172** Type: **Poster**

Quantifying deviations from local equilibration in a coarse-grained transport approach

Tuesday, 29 September 2015 16:30 (2 hours)

Event-by-event hybrid models construct the initial conditions for the hydrodynamic evolution from non-equilibrium approaches by matching the corresponding energy-momentum tensor. After splitting the obtained energy-momentum tensor and four-current into
ideal-hydrodynamics part and viscous correction, it often appears that the "correction" is large. However, all the existing models neglect viscous correction, assuming instant thermalization and violating angular momentum conservation.

Here we study the complete time evolution of heavy ion collisions within the coarse-grained UrQMD transport approach and quantify deviations from local equilibrium. Since these deviations are expected to be larger at lower beam energies and in more peripheral collisions, Au+Au collisions from $E_{lab} = 5 - 160A$ GeV at different centralities are investigated. At every position in space-time the energy-momentum tensor and net baryon four-current are determined in the Landau rest frame.

We find that the largest contribution to the deviation from local equilibrium is the pressure difference in the transverse and
longitudinal direction, while the off-diagonal components of the tensor and baryon charge flow play a minor role in most of the cases. In addition, for every considered energy and centrality there exists a rather sharp time t_0, after which energy-momentum tensor from UrQMD is close to ideal hydrodynamics in a vast space region. This time t_0 decreases with collision energy and slightly increases with centrality, being larger than the typical times of hydrodynamics initialization found in the literature. By comparing the result from single events to the average result we also investigate the effect of event-by-event fluctuations on t_0.

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Session Classification: Poster Session

Track Classification: Collective Dynamics