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Local equilibration and negative contributions: Investigating the transition interfaces in hybrid approaches

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Hybrid approaches are very successful in describing the dynamics of heavy ions collisions. The hot and dense medium is described well by fluid dynamic calculations whereas hadron transport accounts for particle rescatterings in the late stages of the reaction. The application of fluid dynamics requires rapid thermalization of the system. How and whether it is reached remains debatable. In this contribution we use the UrQMD hadron transport to study the early time dynamics of heavy ion collisions at $\sqrt{S_{NN}} = 3 - 20$ GeV. We consider the energy-momentum tensor of coarse-grained UrQMD events as a function of space and time to explore the degree of local equilibration of the system. In addition, to find out how well fluid dynamics can describe the system at these energies, we initialize UrQMD and viscous hydrodynamics in the same way and compare their $T^{\mu\nu}$ during the space-time evolution.

At the end of the fluid-dynamical evolution particles are generated on the transition hypersurface according to the Cooper-Frye formula. This description suffers from so-called negative contributions –particles flying from outside back to the fluid-dynamical region. We compare negative contributions obtained in the Cooper-Frye description to the actual particle trajectories across the hypersurface, again in a coarse-grained UrQMD evolution, where all the microscopic information is available. We show that results of these two calculations may significantly differ and the discrepancy becomes especially large, when the transition surface is not smooth, which may be the case in event-by-event calculations.

Author: OLIINYCHENKO, Dmytro (Frankfurt Institute for Advanced Studies, Germany; Bogolyubov Institute for Theoretical Physics. Kiev, Ukraine)

Co-authors: Prof. PETERSEN, Hannah (Frankfurt Institute for Advanced Studies, Germany; Institute for Theoretical Physics, Johann Wolfgang Goethe Universität, Frankfurt.); Dr KARPENKO, Iurii (Frankfurt Institute for Advanced Studies, Germany; Bogolyubov Institute for Theoretical Physics, Kiev, Ukraine); Dr HUOVINEN, Pasi (Institute for Theoretical Physics, Johann Wolfgang Goethe Universität, Frankfurt.)

Presenter: OLIINYCHENKO, Dmytro (Frankfurt Institute for Advanced Studies, Germany; Bogolyubov Institute for Theoretical Physics. Kiev, Ukraine)

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