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Impact of mini-jets in bulk observables within a concurrent evolution approach

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Mini-jets, created by perturbative hard QCD collisions at moderate energies, can represent a significant portion of the total multiplicity of a heavy-ion collision event. Given the fact that their transverse momenta are initially larger than the typical saturation scale describing the bulk of the equilibrating QGP, they ought to be described through the physics of parton energy loss. Indeed, their typical stopping distances are larger than the usual hydrodynamization time, so they do not in general hydrodynamize at the same pace than the bulk of the collision. Therefore, in general mini-jets cannot be described solely by a unique pre-equilibrium stage that bridges the initial, over-occupied glasma state, with the hydrodynamical evolution.

In this work we make use of a new concurrent mini-jet+hydrodynamic framework in which the properties of the hydrodynamically evolving QGP are modified due to the injection of energy and momentum from the mini-jets. We study the system for different choices of the minimum transverse momentum associated to mini-jet production. In order to achieve a realistic description of charged particle multiplicity, the amount of entropy associated to the low-x initial state needs to be reduced. Moreover, the fact that the injected momentum from the randomly oriented mini-jets is not correlated with the spatial gradients of the system reduces overall flow, and the value of the QGP transport coefficients needs to be reduced accordingly in order to describe the measured flow coefficients in experiments. They are, in effect, an important new source of fluctuations, resulting in a spikier, notably modified hydrodynamical evolution when compared to the scenario in which the presence of mini-jets is ignored. We avow that their abundance makes it necessary to include their physics in holistic descriptions of heavy-ion collisions. We will discuss the potential impacts of this modified hydrodynamical evolution on a number of observables, and also propose ways in which the currently unknown relevant scale for mini-jet production can be constrained by data.

Primary authors: Dr PABLOS, Daniel (University of Bergen); SINGH, Mayank (School of Physics and Astronomy, University of Minnesota, USA); GALE, Charles; JEON, Sangyong (McGill University)

Presenter: Dr PABLOS, Daniel (University of Bergen)

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