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Interplay between core and corona from small to large systems

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Motivated by experimental results implying the possible QGP (quark-gluon plasma) formation in small colliding systems, we extend the hydro-based framework incorporating non-equilibrated components which play an essential role in small colliding systems. It has been widely accepted that relativistic hydrodynamics well describes the dynamics of the QGP at low p_{T} regimes in large colliding systems. Hence hydro-based frameworks are used to tease out properties of the QGP in high-energy heavy-ion collisions. In contrast, particle productions in small colliding systems have been studied through QCD-motivated phenomenological models such as perturbative QCD (semi-)hard processes followed by string fragmentation. As keeping these pictures in each regime, the "marriage" of relativistic hydrodynamics and QCD-motivated phenomenological framework is indispensable to explore the dynamics over wide ranges of colliding systems.

We realize this as the dynamical core–corona initialization framework (DCCI) [1-3]. In DCCI, QGP fluids are generated from initial partons obtained from PYTHIA/PYTHIA Angantyr [4-5] which reflects the total energy-momentum of incoming nuclei. We phenomenologically describe the fluidization of the initial partons with the dynamical aspects of the core–corona picture. Partons with sufficient secondary scatterings tend to generate QGP fluids (core) as equilibrated matter.
While partons with insufficient secondary scatterings tend to survive as non-equilibrated matter (corona). This framework is, so to speak, the hydrodynamic afterburner for PYTHIA. By treating both locally equilibrated QGP fluids and non-equilibrated matter, the DCCI, as a hydro-based Monte Carlo event generator, is capable of describing from low to high p_{T}, from backward to forward rapidity, and from small to large colliding systems.

In this talk, we investigate the interplay between core and corona components in high-energy nuclear collisions using DCCI. We reveal that the particle production from the core becomes dominant above $\langle dN_{\mathrm{ch}}/d\eta \rangle \sim 18$ regardless of the system size and the collision energy. Remarkably, the corona components turn out to dilute $\langle p_T \rangle$ and $v_2\{2\}$ obtained from the core components even in Pb–Pb collisions in which the entire system is often assumed to be locally equilibrated. These results suggest the importance of both equilibrated and non-equilibrated contributions in both small and large colliding systems towards an accurate understanding of the QGP properties.

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