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# Rapidity scan with DCCI at LHC energy

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In recent years, analyses using RHIC-BES data have been actively conducted to explore the high baryon number density region in the QCD phase diagram. Meanwhile, even in high-energy collisions, such as RHIC and LHC energies, the presence of high baryon number density matter in the forward rapidity region has been suggested [1]. This implies that, in addition to the analysis of BES data, a rapidity scan—analyzing data along the collision axis in such high-energy collisions—could serve as complementary ways to explore the high baryon number density region in the phase diagram. However, a model that provides a comprehensive description of the collision, from low $p_T$ to high $p_T$ and from midrapidity to forward rapidity, is essential for precise studies of the rapidity scan. Furthermore, since it is not at all trivial whether the produced matter has reached equilibrium in the forward rapidity region, a model capable of describing the dynamical evolution of both equilibrium and non-equilibrium components is required.

The state-of-the-art dynamical core-corona initialization (DCCI) model [2] is a novel framework that dynamically describes the space-time evolution of both equilibrium and non-equilibrium components including their interactions. Consequently, it has a great success in comprehensively describing experimental data of high-energy collisions from low $p_T$ to high $p_T$ at midrapidity. Thus, the DCCI model would be a strong candidate for rapidity scan studies. In this study, we extended the DCCI model by including baryon number current within the ideal hydrodynamics and modeled the dynamical deposition of baryon number into the fluid, enabling us to describe a gradual thermalization process of baryon number alongside the fluid formation through the dynamical initialization. Using this model, we aimed to clarify the baryon number distribution of each core (equilibrium) and corona (non-equilibrium) component across the entire system at the LHC energy. Specifically, we determined which regions of the QCD phase diagram are accessible with the rapidity scan at the LHC energy and showed which rapidity regions of high-energy collisions are comparable to the baryon number densities achieved in low-energy collisions. This study strongly supports the existence of high baryon number density as equilibrated matter in the forward rapidity region at the LHC energy.

[1] M. Li and J. I. Kapusta, Phys. Rev. C 99, 014906 (2019).
[2] Y. Kanakubo et al., Phys. Rev. C 105, 024905 (2022).

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