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Multiplicity dependent hadron chemistry from dynamical core–corona initialisation

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Strangeness enhancement reported from the ALICE Collaboration [1] is referred to as an indication of the existence of quark-gluon plasma (QGP) in small colliding systems such as p+p and p+Pb collisions. Yield ratios of strange hadron show continuous increase as a function of multiplicity and saturation in averaged Pb+Pb events when the QGP is supposed to be formed. Motivated by this data, we develop a unified and phenomenological description of QGP formation under the "dynamical initialisation model [2]". We describe the formation of QGP fluids using the hydrodynamic equation with source terms. Just after the collision of nuclei, partons start traversing in vacuum and depositing their four-momentum dynamically. We generate the QGP fluids assuming the deposited four-momentum suddenly get thermalised, i.e. converted into the source of the QGP fluids.

In this work, we develop the dynamical initialisation introducing the core–corona picture:
Local equilibrium is likely to be achieved among highly populated partons due to multi-secondary scatterings, while partons tend to traverse without being QGP components when these are in low-density regions. Under this picture, we dynamically separate the initial partons into the QGP fluids (core: dense/soft components) and surviving partons (corona: dilute/hard components). We utilise the Cooper–Frye formula to obtain final hadron yield from the core, while we perform string fragmentation with PYTHIA [3] for the corona.

We show the (multi-)strangeness yield ratios monotonically increase with multiplicity due to the competition between core and corona components and successfully reproduce the tendency of experimental data [4]. We also calculate the fraction of fluidized energy as a function of multiplicity from small to large systems and find that if we try to describe the experimental data with our model, there should be sizable contributions from the QGP fluids even in averaged p+p collision events.

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Primary author: KANAKUBO, Yuuka (Sophia Univ.)

Co-authors: TACHIBANA, Yasuki (Wayne State University); HIRANO, Tetsufumi (Sophia Univ)

Presenter: KANAKUBO, Yuuka (Sophia Univ.)

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