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Four-dimensional QCD equation of state at finite chemical potentials

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Exploration of the QCD phase diagram is pivotal in particle and nuclear physics. We construct a full four-dimensional equation of state of QCD as a function of the temperature and the chemical potentials of baryon (B), charge (Q), and strangeness (S) by extending the NEOS model [1] beyond the conventional two-dimensional approximation. Lattice QCD calculations based on the Taylor expansion method [2] and the hadron resonance gas model are considered for the construction. We also develop an efficient numerical method for the application of the four-dimensional equation of state to relativistic hydrodynamic simulations, which can be used for the analyses of the nuclear collisions at beam energy scan energies and of different nuclear species at the BNL Relativistic Heavy Ion Collider.

[1] A. Monnai, B. Schenke, and C. Shen, Phys. Rev. C 100, 024907 (2019); Int. J. Mod. Phys. A 36, 2130007 (2021)
[2] A. Bazavov et al., Phys. Rev. D 90, 094503 (2014); H.-T. Ding et al., Phys. Rev. D 92, 074043 (2015); A. Bazavov et al., Phys. Rev. D 95, 054504 (2017)

Primary author: Prof. MONNAI, Akihiko (Osaka Institute of Technology)

Co-authors: PIHAN, Grégoire (Wayne State University); SCHENKE, Björn (Brookhaven National Laboratory); SHEN, Chun (Wayne State University)

Presenter: Prof. MONNAI, Akihiko (Osaka Institute of Technology)

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