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Bayesian constraints on the high density QCD EoS from Heavy-ion collision data

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The Equation of State (EoS) of QCD matter for baryon densities ranging from 2 to 6 times saturation densities (n_0) is explored using a Bayesian framework [1]. A novel method [2] is employed to introduce any density-dependent EoS in UrQMD, allowing inference on a parameterizable EoS within the molecular dynamics part of the transport model. Au- Au collision data from different heavy-ion collision experiments in the beam energy range of $\sqrt{s_{\rm NN}}$ =2 - 10 GeV are used to construct the posterior distribution for the density dependence of the EoS. The techniques, challenges and solutions involved in the analyses will be outlined.

It is found that the proton observables used in the study tightly constrain the EoS from 2- 4.5 n_0. However the constraints on the EoS beyond 3 n_0 are highly sensitive to the choice of observations. I will also show new results on how the UrQMD+CMF framework allows us to also study the effect of hyperon interaction, with hyperon flow measurements, which is important for the understanding of the role of strange matter in neutron stars. This highlights the need for accurate measurements by experiments in the collision range of $\sqrt{s_{\rm NN}}$ = 2 - 10 GeV which can be achieved through the RHIC BES run and in the HADES+CBM @FAIR Experiments.

[1] Omana Kuttan, M., Steinheimer, J., Zhou, K., & Stoecker, H. (2023).
QCD Equation of State of Dense Nuclear Matter from a Bayesian Analysis of Heavy-Ion Collision Data. **Physical Review Letters, 131(20), 202303**.

[2] Omana Kuttan, M., Motornenko, A., Steinheimer, J., Stoecker, H., Nara, Y., & Bleicher, M. (2022). A chiral mean-field equation-of-state in UrQMD: effects on the heavy ion compression stage. **The European Physical Journal C, 82(5), 1-12.**

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