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Probing QCD Matter with the Integrated Hydrokinetic Model at RHIC

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One of the main goals of relativistic heavy-ion experiments in the GeV range is to explore the QCD phase diagram, particularly at high baryon chemical potential, where critical features may emerge. At very high energies, such as at the LHC, the matter created is extremely hot with low net baryon density, and lattice QCD indicates a smooth crossover from quark–gluon plasma to hadronic matter. At lower collision energies, a significant fraction of baryon charge is stopped at midrapidity, producing matter with high baryon chemical potential. Models suggest that here the QCD transition may shift from a crossover to a first-order phase transition, with a critical point separating the two regimes. This could affect observables through the softening of the equation of state, enhanced fluctuations, and modified collective flow. Energy scans provide a unique opportunity to search for such signatures.

I will present results from the integrated hydrokinetic model (iHKM) [1] at RHIC BES energies using two equations of state: one featuring a first-order phase transition and another with a smooth crossover. Our analysis focuses on bulk hadronic observables, including transverse momentum spectra, elliptic flow, and femtoscopy [2-3]. The calculated observables are compared with experimental data, indicating that lower collision energies may favor a phase transition, while higher energies are more consistent with a crossover scenario.

Authors: ADZHYMAMBETOV, Musfer (Bogolyubov Institute for Theoretical Physics); NABOKA, Vladislav (Bogolyubov Institute for Theoretical Physics); SINYUKOV, Yuri (Bogolyubov Institute for Theoretical Physics)

Presenter: ADZHYMAMBETOV, Musfer (Bogolyubov Institute for Theoretical Physics)

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