ROLE OF CBM-FAIR IN MULTI-MESSENGER PURSUIT OF DENSE MATTER EOS

CBM aims to study heavy-ion collisions from high-intensity heavy-ion beams from SIS-100 at FAIR, providing unique conditions in lab to probe QCD matter properties at neutron star core densities, including the high-density EOS, and further the complementarity with astrophysical sources

EXPERIENCE: Established compatibility of EOS information at $\sim 1.5\rho_0$ from heavy-ion collisions at SIS-18 experiments (KaoS, FOPI, HADES, ASY-EOS) with multi-messenger astronomy, thereby establishing the need for experiments at SIS-100 (CBM, HADES) to probe EOS at neutron-star core densities $\sim 4\rho_0$

State-of-the-art fast and radiation hard detectors with trigger-less free-streaming readout, online event selection and 4-D event reconstruction → being tested within the FAIR Phase-0 framework

IDEAS: Use the unprecedentedly high beam-target interactions at CBM-FAIR to enable systematic, multi-differential measurements of following observables and their dependence on beam energy and system size

(i) Collective flow
(ii) Sub-threshold multi-strangeness production
(iii) Dilepton yield and fireball temperature
(iv) Femtoscopy and fireball space-time evolution
(v) Hypernuclei properties
(vi) Neutron-to-proton-like particle ratios

Forge exchange platforms to enhance both, technology collaborations to design next-generation heavy-ion experiments aimed at precise EOS inference and theory collaborations to lay the groundwork for comparison protocol between models and CBM data

QUESTIONS: Can we establish collaborations with transport modelists to allow testing of sensitivity of models and observables within the CBM analysis framework?

Are there new observables which can provide EOS sensitivity at higher densities?

What are the learnings for CBM-FAIR about EOS inference from AGS experiments and STAR-FXT?

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