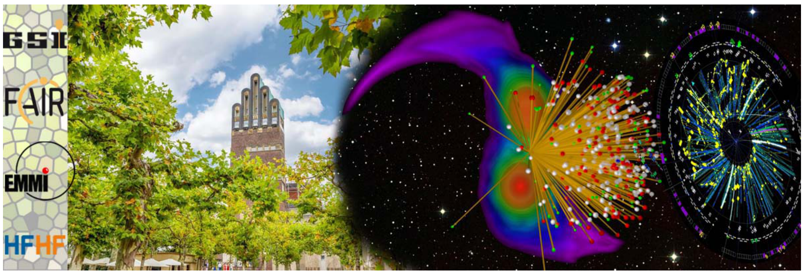

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Equation of state of nuclear matter from collective flows in intermediate energy heavy-ion collisions

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The equation of state of nuclear matter, momentum dependence of the effective interaction and in-medium modification of elastic nucleon-nucleon cross-sections are studied by comparing theoretical predictions for collective flows in intermediate energy heavy-ion collisions to experimental data. To that end, the dcQMD transport model [1] is upgraded by implementing medium modifications of differential elastic cross-sections guided by microscopical model calculations [2,3] and allowing for a medium modification factor of elastic cross-sections that depends on the local density, isospin asymmetry and isospin projections of the scattering particles. The description of final state multiplicities of emitted clusters is significantly improved by incorporating the coalescence afterburner into the transport model, allowing for identification of clusters at the local freeze-out time rather than the final moment of the simulation. The impact of potential energy corrections to the collision term, which proved crucial for pion production in heavy-ion collisions close to threshold [4,5], is also investigated. Finally, model predictions are compared to experimental data for rapidity dependent transverse flow of protons, deuterons, A=3 clusters and alpha particles and transverse momentum dependent elliptic flow of protons, deuterons and tritons at mid-rapidity in mid-central AuAu collisions of impact energy between 150 and 800 MeV/nucleon [6]. A multivariate analysis employing these combined experimental data sets that takes into account a systematic uncertainty induced on model predictions by the coalescence afterburner [7] leads to the following constraint for the equation of state at 68 percent confidence level: compressibility modulus of isospin symmetric matter K_0=183±11 MeV and slope of the symmetry energy L=62±12 MeV. The momentum dependence of the isoscalar potential is found to be similar to that of the empirical optical potential, with an effective isoscalar mass m^*=0.65±0.03, but slightly more repulsive at high momenta. The favored momentum dependence of the isovector potential is compatible with a positive neutron-proton effective mass difference Δm^*_{np}=(0.16±0.08)δ, close to the world average for this quantity [8]. An in-medium reduction of elastic cross-sections by about 25 percent in symmetric nuclear matter at saturation density is favored. The modification factor is reduced in isopin asymmetric nuclear matter of positive isospin asymmetry. Furthermore, a splitting of proton-proton and neutron-neutron elastic cross-sections $\sigma^*_{pp}>\sigma^*_{nn}$ is deduced, in qualitative agreement with microscopical model calculations [9,10].

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