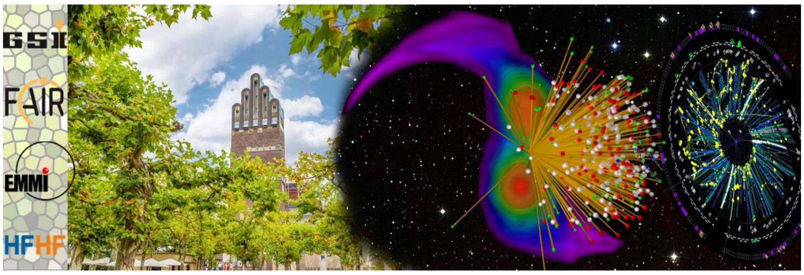

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Impact of Symmetry Energy on Sound Speed and Spinodal Decomposition in Dense Neutron-Rich Matter

Tuesday, 19 September 2023 15:00 (30 minutes)

Using a meta model for nuclear Equation of State (EOS) with its parameters constrained by astrophysical observations and terrestrial nuclear experiments, we examine effects of nuclear EOS especially its symmetry energy \esym term on the speed of sound squared $C_s^2(\rho)$ and the critical density ρ_t where $C_s^2(\rho_t)$ vanishes (indicating the onset of spinodal decomposition) in both dense neutron-rich nucleonic matter relevant for relativistic heavy-ion collisions and the cold $n+p+e+\mu$ matter in neutron stars at β-equilibrium. Unlike in nucleonic matter with fixed values of the isospin asymmetry δ, in neutron stars with a density dependent isospin profile $\delta(\rho)$ determined consistently by the β equilibrium and charge neutrality conditions, the $C_s^2(\rho)$ almost always show a peak and then vanishes at ρ_t. The latter strongly depends on the high-density behavior of \esym if the skewness parameter J_0 characterizing the stiffness of high-density symmetric nuclear matter (SNM) EOS is not too far above its currently known most probable value of about -190 MeV inferred from recent Bayesian analyses of neutron star observables. Moreover, in the case of having a super-soft \esym that is decreasing with increasing density above about twice the saturation density of nuclear matter, the ρ_t is significantly lower than the density where the \esym vanishes (indicating the onset of isospin-separation instability and pure neutron matter formation) in neutron star cores.

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