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Enthalpic and entropic phase transitions in high energy density nuclear matter

Features of Gas-Liquid (GL) and Quark-Hadron (QH) phase transitions (PT) in dense nuclear matter are under discussion in comparison with their terrestrial counterparts, so- called ionization- and dissociation-driven PTs in warm dense hydrogen, nitrogen, xenon etc. Both, GLPT and QHPT, when being represented in widely accepted T-μ plane are often considered as equivalent PTs, i.e. amenable to one-to-one mapping by simple scaling. We argue that this impression is illusive and that GLPT and QHPT belong to basically different classes: GLPT is typical enthalpic (VdW-like) PT while QHPT ("deconfinement-driven") is typical entropic PT like many hypothetical "delocalization- driven"phase transitions in shock compressed hydrogen and nitrogen etc. in megabar pressure range. We compare and illustrate different properties of enthalpic and entropic PTs in topology of their binodals and spinodals (isothermal and isentropic ones) and in behavior of many thermodynamic isolines, when the latter cross two-phase region of enthalpic and entropic PTs. Another peculiarity of entropic PTs in contrast to enthalpic ones is their connection with significant anomalies for thermodynamic properties of matter within and in the vicinity of two-phase region of entropic PT, namely non-standard negative sign of a set of second thermodynamic derivatives, such as thermodynamic Gruneizen coefficient, thermal and entropic pressure coefficients and thermal expansion coefficient etc. We discuss hypothetical consequences of difference between enthalpic and entropic PTs with respect to GLPT and QHPT in high energy density nuclear matter in compact stars and supernovae explosions.

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