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Traces of the nuclear liquid-gas phase transition in the analytic properties of hot QCD

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The nuclear liquid-gas transition at normal nuclear densities, n~n0=0.16 fm−3, and small temperatures, T~20 MeV, has a large influence on analytic properties of the QCD grand-canonical thermodynamic potential. A classical van der Waals equation is used to determine these unexpected features due to dense cold matter qualitatively. The existence of the nuclear matter critical point results in thermodynamic branch points, which are located at complex chemical potential values, for $T > Tc$ 20 MeV, and exhibit a moderate model dependence up to rather large temperatures T 100 MeV. The behavior at higher temperatures is studied using the van der Waals hadron resonance gas˜(vdW-HRG) model. The baryon-baryon interactions have a decisive influence on the QCD thermodynamics close to μB=0. In particular, nuclear matter singularities limit the radius of convergence rμB/T of the Taylor expansion in μB/T, with rμB/T~2–3 values at T~140–170 MeV obtained in the vdW-HRG model.

Primary authors: Prof. GORENSTEIN, Mark (Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine, Kyiv); POBEREZHNYUK, Roman (Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine, Kyiv); STOECKER, Horst (FIAS Goethe Universitaet Frankfurt GSI); VOVCHENKO, Volodymyr (Goethe University Frankfurt); Mr SAVCHUK, Oleh (Taras Shevchenko National University of Kyiv)

Presenter: Mr SAVCHUK, Oleh (Taras Shevchenko National University of Kyiv)

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