Contribution ID: **14** Type: **not specified**

QCD Equation of State from effective Lagrangians and constraints from Relativistic Mean-Field Models

Thursday 2 October 2025 09:40 (20 minutes)

The finite-temperature equation of state (EOS) is analyzed within an effective Lagrangian framework, where the dilaton field encodes the breaking of scale symmetry in QCD. In the pure gauge $SU(3)_c$ sector, the gluon condensate dynamics are described through a dilaton Lagrangian: at low temperature the condensate is dominated by the dilaton, while above the critical temperature it evaporates into quasi-free gluons. Glueball excitations are included assuming a linear Regge trajectory, and the role of a string tension term on the spectrum is explored. To address thermal effects, we study the role of dilaton fluctuations, which has proven successful in reproducing lattice QCD results for thermodynamic observables such as pressure and energy density. Furthermore, a first-order phase transition is found, as expected from the results of lattice QCD. The analysis is extended using an effective Lagrangian that incorporates both broken-scale symmetry and explicit chiral symmetry breaking, including mesons (σ, π, ω, ρ) and nucleons at finite temperature and chemical potential, along with their thermal fluctuations. This approach enables the construction of an EOS over a wide range of temperature and chemical potential, providing a framework to study the nature of the QCD phase transition across different degrees of freedom.

In parallel, relativistic mean-field (RMF) models based on the exchange of σ, ω, and ρ mesons with non-linear nucleon-σ couplings and density-dependent ρ coupling are employed. A large set of models is generated via Bayesian methods and constrained by both nuclear physics and astrophysical observations, including GW170817 and NICER data, providing a tool to explore neutron star properties within present empirical limits.

Authors: PASSARELLA, Luca (Istituto Nazionale di Fisica Nucleare); LAVAGNO, Andrea (Politecnico di Torino and INFN Torino); DRAGO, Alessandro (Istituto Nazionale di Fisica Nucleare); PAGLIARA, Giuseppe (Istituto Nazionale di Fisica Nucleare)

Presenter: PASSARELLA, Luca (Istituto Nazionale di Fisica Nucleare)

Session Classification: Short contributions (III)