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Joining hard thermal loops with soft deconfinement in the EoS

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The hard thermal (dense) loop (HTL) approach for the quark-gluon plasma

and the hadron resonance gas (nuclear statistical equilibrium) model for low-density hadronic matter are well-studied limits of the equation of state for strongly interacting matter. However, when investigating the transition between both phases of QCD in heavy-ion collisions or in Astrophysics, the question arises how to join these two limits, wishfully on the basis of quark and gluon degrees of freedom where hadrons emerge as bound states and condensates determine the phase structure.
I will elucidate the problem on two examples:
1) Compact star astrophysics, where the requirement to describe the high mass of 2M_sun for pulsars puts strong constraints on the construction of the junction between nuclear and quark matter [1], and
2) Heavy-ion collisions, where joining the hadron resonance gas and HTL quark-gluon matter directly results in too high transition densities [2].
I present a possible road to the solution within a generalized Beth-Uhlenbeck EoS that emerges from a cluster decomposition for the ϕ –derivable approach which is capable of describing a QCD phase diagram with a critical endpoint or also a crossover all over case [3].

[1] I. Tews et al., Astrophys. J. 860 (2018) 149
[2] A. Khvorostukin et al., Eur. Phys. J. C 48 (2006) 531
[3] N.-U. Bastian and D. Blaschke, arxiv:1812.11766 [nucl-th]

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