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Massive thermal loop integrals and bulk viscosity in quark matter

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Observations of neutron stars and their mergers have opened a new avenue and motivation for studying QCD matter at very high densities. When studying neutron star mergers in particular, it is vital to understand effects of both the temperature and, for transport quantities such as the bulk viscosity, the quark masses.

Unfortunately, in loop calculations at finite density and/or temperature, taking into account the masses of constituent particles generally leads to analytically intractable and often numerically cumbersome expressions.

By introducing an approximation scheme valid in regions of the phase diagram where a mass m scales numerically with a power of the coupling, $m \propto g^r T$ or $m \propto g^r \mu$, such integrals can be expanded to what is often a much more efficient form, while sacrificing little accuracy.

The approximation has been applied to the thermodynamics of dense pQCD at finite density and temperature with a finite strange quark mass to NNLO, showing excellent agreement with full mass effects.

Moreover, in an ongoing work the scheme is used to study the bulk viscosity, with applications to neutron star mergers in mind. The perturbative values will be combined with results from holographic models, extendable to lower baryon densities, in order to find a prediction for the bulk viscosity valid at densities down to those of realistic merger scenarios

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