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The QCD Phase Diagram - Theoretical Perspectives¹

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Unlike phase diagrams in condensed matter that can be probed in the laboratory, the QCD phase diagram can only be mapped out through both experiments and astrophysical phenomena. At low baryon densities and high temperatures it is explored both through the big bang and the little bangs produced in heavy-ion collisions. At large baryon densities, either low-energy heavy-ion experiments or neutron star mergers can be used to map out its potential phases. While the underlying theory - Quantum Chromodynamics - is known, due to the sign problem one cannot reasonably calculate the equation of state of QCD beyond small baryon densities. Here I will review the different approaches used in the description of hot and ultradense baryonic matter in and out of equilibrium, and discuss the regions in the phase diagram where heavy-ion collisions and neutron star mergers can overlap. Future perspectives are discussed to map out the phase diagram of strongly interacting matter from heavy ion collisions to neutron stars.

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