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Results from the RHIC energy scan and prospects for the future[1]

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Collisions between relativistic heavy-ions are energetic enough to vaporize the participating neutrons and protons creating an equilibrated plasma of quarks and gluons which is understood to be similar to the state of the universe about one microsecond after the big bang. This deconfined, partonic phase has been well established an the top energies available at the Relativistic Heavy Ion Collider (RHIC). Although progress has been made in understanding the nature of hot dense QCD matter, there are still important open questions about how the matter undergoes the transition between a quark-gluon plasma and a hot hadronic gas. If the plasma has an equal mix of quarks and anti-quarks, lattice QCD calculations now tell us that there will be a crossover transition. However, in heavy-ion collisions, systems are created with an excess of quarks. The degree of the quark excess (measured as baryon chemical potential) is determined by the collision energy. Under high baryon chemical potential conditions, we expect a first order phase transition. The termination of the first order phase transition boundary will be a critical point. RHIC has performed a scan of several beam energies in order to map the QCD matter phase diagram as a function of baryon chemical potential. Features of the phase diagram and becoming evident, however more data are needed to clarify the picture. Upgrades to both the collider and the detectors are being undertaken. These will allow a more focused and refined follow-up energy scan in 2019 and 2020.

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