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Strongly Coupled QCD Matter

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ABSTRACT

Quantum Chromodynamics predicts a transition from normal hadronic matter to a phase where the quarks and gluons are no longer bound together and can move freely. Quark gluon plasma is now produced regularly in collisions of heavy nuclei at very high energy at both the Relativistic Heavy Ion Collider (RHIC) in the U.S. and at the LHC in Europe.

Quark gluon plasma exhibits remarkable properties. Its vanishingly small shear viscosity to entropy density ratio means that it flows essentially without internal friction, making it one of the most “perfect” liquids known. It is also very opaque to transiting particles including heavy charm quarks, though the exact mechanism for this is not yet understood. Recent data suggest that even very small colliding systems may produce a droplet of plasma. The similarities to strongly coupled or correlated systems in ultra-cold atoms and condensed matter are striking, and have inspired novel theoretical descriptions growing out of string theory. It remains a mystery how this plasma emerges from cold, dense gluonic matter deep inside nuclei within 1 fm/c. I will discuss how a future electron-ion collider can help address this question.