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The Phases of Nuclear Matter

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Over the past decade, the experiments at the Relativistic Heavy Ion Collider have produced tantalizing evidence for a new state of nuclear matter. The study of this phase presents to us the opportunity to study the strong force at high temperature. Much as the field of condensed matter has benefited through the study of collective phenomena based on Quantum Electro-Dynamics (QED), we are at the beginning of our study of the unique properties that matter possesses when interacting through Quantum Chromo-Dynamics (QCD). The quark-gluon plasma that has been observed in the collisions at RHIC showcases some intriguing properties. The bulk of the matter produced during the highest temperature phase exhibits near perfect liquid behavior. At the same time, the plasma is extremely opaque to the passage of high energy color-charged partons, a phenomenon christened "jet quenching." The density is large enough that even the massive quarks, charm and beauty, show evidence for a surprising amount of quenching. These findings attest to the success of the RHIC program in the past decade. As we look forward to another decade, we aim to study these exciting phenomena with increased precision in order to make quantitative assessments of the medium properties. In order to achieve this, a ten-fold increase to the RHIC collider luminosity, targeted detector upgrades, and advances in theory are envisioned. In this talk, we present an overview of current results, the key questions that we aim to address in the next decade, and how the planned new capabilities of accelerators and detectors can help us to answer them.