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Cool QCD: Hadronic Physics and QCD in Nuclei

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QCD is the only strongly-coupled theory given to us by Nature, and it gives rise to a host of striking phenomena. Two examples in hadronic physics include the dynamic generation of mass and the confinement of quarks. Indeed, the vast majority of the mass of visible matter is due to the kinetic and potential energy of the massless gluons and the essentially massless quarks. QCD also gives rise to the force that binds protons and neutrons into nuclei, including subtle effects that have historically been difficult to understand. Describing these phenomena in terms of QCD has represented a daunting task, but remarkable progress has been achieved in both theory and experiment. Both CEBAF at Jefferson Lab and RHIC at Brookhaven National Lab have provided unprecedented experimental tools for investigating QCD, and upgrades at both facilities promise even greater opportunities in the future. Also important are programs at FermiLab as well as the LHC at CERN. Looking further ahead, an electron ion collider (EIC) has the potential to answer whole new sets of questions regarding the role of gluons in nuclear matter, an issue that lies at the heart of the generation of mass. On the theoretical side, rapid progress in supercomputers is enabling stunning progress in Lattice QCD calculations, and approximate forms of QCD are also providing deep new physical insight. In this talk I will describe both recent advances in Cool QCD as well as the exciting scientific opportunities that exist for the future.