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Understand Confinement from Deconfined Phase

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To understand the mechanism of confinement in QCD (and QCD-like theories) remains a great challenge. In the past decade an interesting new approach to this problem has emerged by studying the confinement mechanism from above". That is, one could probe how confinement occurs by first studying the finite temperature plasma phase above but close to the confinement transition temperature Tc. Important progress has been made along this direction, particularly driven by empirical findings about plasma properties from heavy ion collision experiments and lattice simulations as well as by theoretical developments on topological objects with nontrivial holonomy at finite temperature. In this talk, we report recent progress along this line on two interesting problems. We will first show how the confinement/deconfinement phase transition properties of the SU(2) Yang-Mills theory, as from first principle lattice computations, could be quantitatively described by a statistical ensemble of the so-called instanton-monopoles with particular short-range monopole-anti-monopole correlations. We will then examine the jet energy loss phenomenon, which provides highly informativeimaging" of the hot medium created in heavy ion collisions. In particular we will demonstrate how a unified description for the currently comprehensive sets of available data, from average suppression to azimuthal anisotropy, from light to heavy flavors, from RHIC 200GeV to LHC 2.76TeV as well as 5.02TeV collisions, can be achieved in a modeling framework called CUJET3, built upon a nonperturbative microscopic model for the hot medium as a semi-quark-gluon-monopole plasma (sQGMP) which integrates two essential elements of confinement, i.e. the Polyakov-loop suppression of quarks/gluons and emergent magnetic monopoles.

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