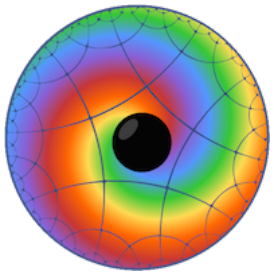

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Light-Front Holography and New Advances in Nonperturbative QCD

Monday, 13 April 2015 17:40 (30 minutes)

One of the most fundamental problems in Quantum Chromodynamics is to understand the origin of the mass scale which controls the range of color confinement and the hadronic spectrum. We show that a mass gap and a fundamental color confinement scale arise when one extends the formalism of de Alfaro, Fubini and Furlan to frame-independent light-front Hamiltonian theory. Remarkably, the resulting light-front potential has a unique form of a harmonic oscillator in the light-front invariant impact variable if one requires that the action remains conformally invariant. The result is a single-variable relativistic equation of motion for qq¯ bound states, a "Light-Front Shr\"odinger Equation", analogous to the nonrelativistic radial Schr\"odinger equation, which incorporates color confinement and other essential spectroscopic and dynamical features of hadron physics, including a massless pion for zero quark mass and linear Regge trajectories with the same slope in the radial quantum number and orbital angular momentum. The same equations with the correct hadron spin dependence arise from the holographic mapping of modified AdS5 space with a specific dilaton profile. A fundamental mass parameter ? appears, determining the hadron masses and the length scale which underlies hadron structure. Quark masses can be introduced to account for the spectrum of strange hadrons. This Light-Front Holographic approach predicts not only hadron spectroscopy successfully, but also hadronic form factors, the QCD running coupling at small virtuality, and the light-front wavefunctions of hadrons. Thus the combination of light-front dynamics, its holographic mapping to gravity in a higher-dimensional space and the dAFF procedure provides new insight into the physics underlying color confinement, chiral invariance, and the QCD mass scale.

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