Light Cone 2017 (LC2017)
Frontiers in Light Front Hadron Physics : Theory and Experiment
18th - 22nd September 2017, University of Mumbai

Contribution ID: **38** Type: **not specified**

Supersymmetric Properties of Hadron Physics from Light-Front Holography and Superconformal Algebra and other Advances in Light-Front QCD

A remarkable feature of QCD is that the mass scale which controls color confinement and hadron mass scales does not appear explicitly in the QCD Lagrangian. However, de Alfaro, Fubini, and Furlan have shown that a mass scale κ can appear in the equations of motion without affecting the conformal invariance of the action if one
adds a term to the Hamiltonian proportional to the dilatation operator or the special conformal operator. Applying the same procedure to the light-front Hamiltonian leads to a unique confinement potential $\kappa^4\zeta^2$ for mesons, where ζ is the LF radial variable conjugate to the invariant mass. The same result, including spin terms, is obtained using light-front holography, the duality between the front form and five-dimensional anti-de Sitter space, if one modifies
the action by the dilaton in the fifth dimension z of AdS_5.
One obtains relativistic, Poincarè invariant, light-front quantum mechanical, bound-state wave equations which incorporate quark and gluon confinement and successfully predict many observed spectroscopic and dynamical features of hadron physics, such as form factors and linear Regge trajectories with identical slope in both the radial quantum number and the internal orbital angular momentum. Generalizing this procedure using superconformal
algebra, leads to a unified Regge spectroscopy of meson, baryon, and tetraquarks, including remarkable supersymmetric relations between the masses of mesons and baryons of the same parity. One also predicts observables such as hadron structure functions, transverse momentum distributions, and the distribution amplitudes defined from the hadronic light-front wavefunctions.
The pion is massless for zero quark mass, consistent with chiral invariance. The analytic behavior of the QCD coupling controlling quark and gluon interactions at large and small distances is also determined.
The mass scale κ underlying confinement and
hadron masses can be connected to the mass parameter Λ in the QCD running coupling $\alpha_s(Q^2)$ by matching the
nonperturbative dynamics to the perturbative QCD regime. The result is an effective coupling defined at all momenta and the determination of a momentum scale which sets the interface between perturbative and nonperturbative hadron dynamics. Applications to jet hadronization at the amplitude level will also be discussed.

Primary author: Prof. BRODSKY, Stanley J. (SLAC National Accelerator Laboratory, Stanford University)

Presenter: Prof. BRODSKY, Stanley J. (SLAC National Accelerator Laboratory, Stanford University)