Center for High Energy Physics Colloquium

Light-Front Holography and Novel QCD Phenomena

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Awarded 2007 Sakurai Prize of American Physics Society
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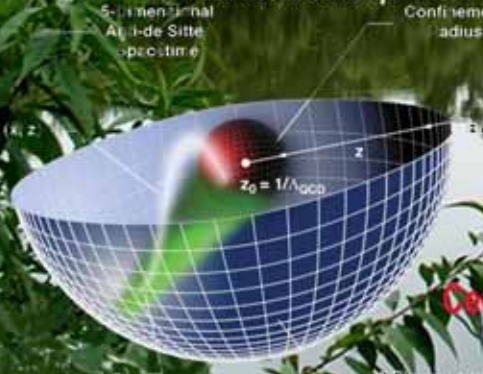
Brodsky's research areas span many areas of high-energy and nuclear theoretical physics, especially the quark -gluon structure of hadrons and novel effects in quantum chromodynamics; fundamental problems in atomic, nu clear, and high energy physics; precision tests of quantum electrodynamics, light-front quantization; nonperturb ative and perturbative methods in quantum field theory.

ABSTRACT

The AdS/CFT correspondence between theories in AdS space and conformal field theories in physical space-time leads to an analytic, semi-classical model for strongly-coupled QCD which has scale invariance at short distances and color confinement at large distances. "Light-Front Holography" is a remarkable feature of AdS/CFT: it allows hadronic amplitudes in the AdS fifth dimension to be mapped to frame-independent light-front wavefunctions of hadrons in physical space-time, thus providing a relativistic description of hadrons at the amplitude level. The resulting light-front Schrodinger equation can be extended to hadronic bound states of nonzero quark mass. Light-front wavefunctions are the fundamental process-independent entities which encode hadron properties, predicting dynamical quantities such as spin correlations, form factors, structure functions, generalized parton distributions, and exclusive scattering amplitudes. Novel aspects of QCD will also be discussed, including the effects of initial-state and final-state interactions, manifestations of color transparency at RHIC, the consequences of confinement for quark and gluon condensates, and the behavior of the QCD coupling in the infrared. A new method for computing the hadronization of quark and gluon jets at the amplitude level will also be presented.



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