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On Schwinger-Dyson equations for QCD in Coulomb gauge from local action

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Summary

An intuitive picture of confinement was first proposed by Gribov in which the color-Coulomb potential provides the long-range confining force. This picture has been successfully studied by Hamiltonian methods. We propose here to develop a non-perturbative calculational scheme adapted to local Lagrangian quantum field theory in Coulomb gauge. We are encouraged to do so because of the theorem, "No confinement without Coulomb confinement," which asserts that if the gauge-invariant Wilson potential $V_W(r)$ is confining, then the color-Coulomb potential $V(r)$ is more strongly attractive than $V_W(r)$ at large r, $V(r) > V_W(r)$. The color-Coulomb potential is the instantaneous part of the time-time component of the gluon propagator $D_{00}(x) = V(r)\delta(t) + P(x)$, where $V(r)$ is the instantaneous color-Coulomb potential and $P(x)$ is non-instantaneous.

Starting from the local Lagrangian of quantum gauge field theory in Coulomb gauge, we develop a truncation scheme for a closed set of Schwinger-Dyson (SD) equations that involves only one time. The propagators that appear are either instantaneous, such as $V(r)$, or at equal time, such as the space-space components of the gluon propgator $D^{ET}_{ij}(\vec{x}-\vec{y}) \equiv D_{ij}(x-y)|_{x_0=y_0}$. The local Lagrangian in Coulomb gauge may be either of Yang-Mills type or of the type developed by Gribov and Zwanziger.

Primary author: Prof. ZWANZIGER, Daniel (New York University)

Presenter: Prof. ZWANZIGER, Daniel (New York University)

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