

**Stony Brook University  
The Graduate School**

Doctoral Defense Announcement

**Abstract**

Real-time dynamics of the confining string

By

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Quantum chromodynamics (QCD) describes the interaction of quarks and gluons, which are charged under the color group. Due to confinement of color charge, only colorless hadrons are observed in experiment. At very short distances (hard processes), perturbation theory is a valid tool for calculations and predictions can be made which agree well with experiment. Confinement, which is not yet understood from first principles, is important even for hard processes, because after the perturbative evolution is finished, the final colored particles combine to create the final state hadrons. There are many effective theories of confinement developed over the years. We will consider the Abelian projection; the gauge theory becomes Abelian-like and the theory contains magnetic monopoles. Confinement happens due to the dual Meissner effect, where dual in this case means the roles of the electric and magnetic fields are reversed. The field between charges resembles that of an Abrikosov-Nielsen-Olesen vortex or string. Based on the Abelian nature of the confining string, the fact that fermion zero modes are localized along the vortex and by considering very energetic jets, we assume that the dynamics along this string is described by massless quantum electrodynamics in 1+1 dimensions. This theory shares with QCD many important properties: confinement, chiral symmetry breaking, theta-vacuum, and is exactly soluble. We use the model to compute the fragmentation functions of jets in electron-positron annihilation and after fixing two adjustable parameters, we study the modification of fragmentation functions of jets in the QCD medium. We address an important puzzle in hadron scattering: the soft photon yield in processes with hadrons in the final state is much larger than what is expected from the Low theorem. We find that soft photons produced from currents induced during the real-time dynamics of jet fragmentation can contribute in the enhancement of photons. We compared the result with the recent DELPHI measurements and a reasonable agreement was found. Finally, assuming the QCD string to be thin, we address the observed phenomenon in recent lattice studies of partial chiral symmetry restoration along the string. Our result agrees well with the data.

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