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Pre-Synopsis Presentation on

"Study of Light-Front Field Theory Methods and their Application to Quantum Chromodynamics"

for the partial fulfillment of PhD Degree in Physics
by
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Light-Front (LF) Field Theory, which is a Quantum Field Theory with the quantisation surface being the light-front, has emerged as a very useful formalism for studying particle physics, especially the non-perturbative regime of strong interaction. Hadronic phenomena can be studied from first principles using LF Quantum Chromodynamics (QCD). Thus, it has become necessary to show the equivalence of LFFTs with the conventionally used covariant field theories. We show the equivalence of covariant and LF Quantum Electrodynamics (QED) at one loop level by starting with the standard covariant expressions for all the three fundamental corrections in QED viz. electron self-energy, vacuum polarisation and vertex correction, and establishingtheir equivalence with the LF expressions calculated using time-ordered Hamiltonian perturbation theory in the light-front formalism. We resolve the important issue of the form of the gauge boson propagator to be used in such proofs of equivalence.

Infrared divergences arise in higher order calculations of gauge theories when loop momenta in Feynman diagrams vanish, or equivalently, when the massless propagators in the theory go on-shell. In time-ordered Hamiltonian perturbation theory, this is equivalent to the energy denominators in the perturbation expansion of S-matrix elements tending to zero, which result from the massless particles in the theory being soft. This issue is further complicated in theories like QCD which contain interaction vertices involving all massless particles, since these can lead to collinear divergences. In conventional calculations, infrared divergences cancel between real emission and virtual diagrams at the cross-section level. We discuss an alternative approach to infrared problem in LFQED and LFQCD based on a coherent state approach which addresses cancellation of IR divergences at amplitude level. We construct the S-matrix elements using the LF formalism in the coherent state basis instead of using the conventional Fock basis, and investigate the cancellation of infrared divergences at the amplitude level. We also mention briefly the advantages of our methods over the conventional techniques.

Time and Date: 13.08.2021, 11.00 am
Venue: Google Meet
Pre-synopsis viva notice
Friday, August 13 · 11:00am – 12:00pm
Google Meet joining info
Video call link: https://meet.google.com/mic-daut-irg
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