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Infrared-finite amplitude for $e^+e^- \to q\bar{q}g$ in the light front coherent state formalism

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The Light Front (LF) formulation of quantum field theories has been used in the study of hadron physics since the last few decades. However, like in the conventional equal-time formulation, LF field theories too are fraught with infrared (IR) divergences in the presence of massless particles. The coherent state formalism can be employed to cancel IR divergences at the amplitude level. We consider the amplitude for the process $e^+e^- \to q\bar{q}g$ at $\mathcal{O}(g^3)$ in LF time-ordered Hamiltonian QCD. We then show the occurrence of infrared divergences in the form of vanishing energy denominators in this amplitude. Using the coherent state approach, we prove that these divergences cancel, thus providing an IR-finite scattering amplitude.

Authors: Prof. MISRA, Anuradha (Centre for Excellence in Basic Sciences (UMDAE-CEBS), University of Mumbai); Dr BHAMRE, Deepesh (Universidade Cruzeiro do Sul / UNICID); GOGIA, Shrey (Indian Institute of Technology Kharagpur)

Presenter: Dr BHAMRE, Deepesh (Universidade Cruzeiro do Sul / UNICID)

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