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Tracing early time dynamics through high energy probes

Jets are essential hard probes for investigating the early-time dynamics and structure of the quark-gluon plasma in heavy-ion collisions. We develop an analytical framework for radiative energy loss in evolving media using resummation techniques, capturing both rare and multiple scattering regimes. Our results highlight the sensitivity of jet observables to early-time medium properties, showing that strong quenching requires the medium's equilibration time to exceed its mean free path. Next, we apply our understanding of jet-medium interactions to γ+jet correlations at forward rapidities, incorporating initial-state gluon saturation via the small-x Improved Transverse Momentum Dependent (ITMD) factorization. We present results for azimuthal correlations and nuclear modification factor with parameters tuned for upcoming forward calorimeter acceptances in experiments, in particular the ALICE FoCal detector. To further understand the signatures of pre-equilibrium phase, we explore with diffractive dijet production in pp and pA collisions at large rapidity gaps, offering a complementary perspective on QCD dynamics in dilute systems.

Secondary track

T05 - QCD and Hadronic Physics

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