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Energy-energy correlators in Deep Inelastic Scattering

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The energy-energy correlator (EEC) is an event shape observable which probes the angular correlations of energy depositions in detectors at high energy collider facilities, which it has been extensively investigated in the context of precision QCD. In this work we introduce a novel definition of EEC adapted to the Breit frame in deep-inelastic scattering. In the back-to-back limit, the observable we propose is sensitive to universal transverse momentum dependent (TMD) parton distribution functions and fragmentation functions. In this limit, it can be studied within the traditional TMD factorization formalism for single hadron production in deep inelastic scattering. We show that, in this limit, the new observable is insensitive to experimental pseudorapidity cuts, often imposed in the Laboratory frame due to the detector acceptance in the forward region. In this work the singular distributions for the new observable are obtained in soft collinear effective theory up to $\mathcal{O}(\alpha_s^3)$ and are verified by the full QCD calculations up to $\mathcal{O}(\alpha_s^2)$. The resummation in the singular limit is performed up to next-to-next-to-next-to-leading logarithmic accuracy. After incorporating non-perturbative effects, we present a comparison of our predictions to PYTHIA 8 simulations.

Primary authors: LI, Haitao (NU & ANL); MAKRIS, Yiannis (INFN PAVIA); VITEV, Ivan (LANL)

Presenters: LI, Haitao (NU & ANL); MAKRIS, Yiannis (INFN PAVIA)

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