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Energy-Energy Correlations on Tracks: Factorization and Resummation

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To do experimentally clean measurements, one of the proposed strategies is to use track-based observables, which means working exclusively with final-state charged hadrons (tracks). A field-theoretic framework, the so-called track function formalism, for calculating track-based observables has been introduced. Although the case of most experimental interest is tracks, this framework is based on the factorization and universality of collinear divergences, and thus can be applied to measurements on any subset of final-state hadrons with a set of particular quantum numbers. While the track function formalism has existed for eleven years, it's just in the past few years that we've extended it beyond leading order, making it practical in higher-order calculations comparable to experimental data. We illustrate its power by calculating the energy-energy correlation (EEC) on charged hadrons in e^+e^- in QCD at two-loop order and achieving its first resummation both in the collinear limit at next-to-next-to-leading logarithmic (NNLL) accuracy and in the back-to-back limit at next-to-next-to-next-to-leading (N^3LL) logarithmic accuracy. This makes the track EEC a prime candidate for precision QCD studies. We also believe that our study in the Sudakov region is crucial for understanding the non-perturbative effects of EECs and those in transverse-momentum-dependent observables.

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