High Energy Physics - Phenomenology

Factorization and Resummation for Dijet Invariant Mass Spectra

Christian W. Bauer, Frank J. Tackmann, Jonathan R. Walsh, Saba Zuberi

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Multijet cross sections at the LHC and Tevatron are sensitive to several distinct kinematic energy scales. When measuring the dijet invariant mass m_jj between two signal jets produced in association with other jets or weak bosons, m_jj will typically be much smaller than the total partonic center-of-mass energy Q, but larger than the individual jet masses m, such that there can be a hierarchy of scales m << m_jj << Q. This situation arises in many new-physics analyses at the LHC, where the invariant mass between jets is used to gain access to the masses of new-physics particles in a decay chain. At present, the logarithms arising from such a hierarchy of kinematic scales can only be summed at the leading-logarithmic level provided by parton-shower programs. We construct an effective field theory, SCET+, which is an extension of Soft-Collinear Effective Theory that applies to this situation of hierarchical jets. It allows for a rigorous separation of different scales in a multiscale soft function and for a systematic resummation of logarithms of both m_jj/Q and m/Q. As an explicit example, we consider the invariant mass spectrum of the two closest jets in e+e- -> 3 jets. We also give the generalization to pp -> N jets plus leptons relevant for the LHC.

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