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Power Corrections in Resummation-based Subtraction Schemes

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Power corrections to leading-power factorization formalisms have been under extensive study recently [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16]. They have considerable impacts on phenomenological applications such as α_s extractions from event shapes, and on the stability of the resummation-based subtraction schemes such as q_T-subtraction [17] and N-jettiness subtraction [18, 19, 20]). Particularly in the latter case, the power corrections can be understood completely perturbatively. Given a resolution parameter τ, the power corrections have the form

$$\mathrm{NLP} = \sum_{k=0} \alpha_s^n \, C_k \, \tau \, \ln^{2n-1-k} \tau. \tag{1}$$

Although this expression is suppressed linearly by the resolution parameter τ, the size of the power correction is enhanced by the logarithm $\ln \tau$ and can be numerically important [1, 2, 4, 5, 12, 8, 9]. It is therefore important to quantify the effect of these corrections on resummation-based subtraction schemes.

Like their leading-power counterparts, the logarithms in these power corrections arise from soft and collinear singularities, and thus can be studied systematically using either QCD or SCET. Until recently, most studies focused on cases with no final-state jets, such as Drell-Yan and gluon-fusion Higgs production. In general, for a given cross section $\sigma = \int \mathrm{d}\Phi[\tau] \, |\mathcal{M}|^2(\tau)$, the power correction can be obtained by expanding the phase-space integral and the matrix element in terms of τ. In practice, the subleading power matrix element can be constructed using SCET power-suppressed building blocks [15, 16]. The phase space integral could be complicated especially in the presence of final state jets.

An initial work towards understanding the $\mathcal{O}(\alpha_s)$ power corrections for jet-production processes in the N-jettiness subtraction was given in [8] using the method-of-regions approach. It will be important to extend this result to allow for predictions of the dominant power corrections at $\mathcal{O}(\alpha_s^2)$. In order to expand the phase space $\Phi[\tau]$ in powers of τ, a phase space parametrization directly in terms of the resolution parameter τ may be helpful to make the expansion more tractable. Such a phase-space parametrization may itself help to stabilize the numerics.

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