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Factorization for Subleading Power TMD Observables

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TMD distributions depending on the azimuthal angle provide a non-trivial example of observables that start at O(lambda) in the power expansion. They also have a long history, for example in 1978 Cahn showed that quark transverse momentum gives rise to an azimuthal cos(phi) asymmetry of the outgoing hadrons in semi-inclusive DIS (SIDIS). Such subleading distributions also are an interesting probe of the spin structure of hadrons. In this talk I study the full set of such subleading TMD distributions in SIDIS, Drell-Yan (DY), and e+e- to back-to-back hadrons. Under the assumption that leading power Glauber interactions do not spoil factorization at this power, I provide a complete derivation of factorization for these structure functions using SCET. At SCET 2021 I discussed the contribution of subleading power collinear operators for SIDIS, and this year I will extend the analysis of these contributions to DY and e+e-. A new analysis provided this talk is the full discussion of subleading soft effects, from both SCET II subleading operators, as well as contributions from the subleading dynamic Lagrangian. Interestingly, we show that all the possible subleading soft contributions vanish, and therefore the soft function remains the same as at leading power. Thus the only new distribution functions for these observables at subleading power are a set of the quark-gluon-quark correlators, which come along with only one new Wilson coefficient in SIDIS, DY, and e+e-.

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