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Non-dipolar Wilson links for transverse-momentum-dependent wave functions

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We propose a new definition of a transverse-momentum-dependent (TMD) wave function
with simpler soft subtraction for k_T factorization of hard exclusive
processes. The un-subtracted wave function involves two pieces of non-light-like
Wilson links oriented in different directions, so that
the rapidity singularity appearing in usual k_T factorization is regularized,
and the pinched singularity from Wilson-link self-energy corrections is alleviated
to a logarithmic one. In particular no soft function is needed, when the two
pieces of Wilson links are orthogonal to each other. We show explicitly at one-loop
level that the simpler definition with the non-dipolar Wilson links exhibits the same
infrared behavior as the one with the dipolar Wilson links and
complicated soft subtraction. It is pointed out that both
definitions reduce to the naive TMD wave function as the
non-light-like Wilson links approach to the light cone. Their equivalence is then
extended to all orders by considering the
evolution in the Wilson-link rapidity.

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