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Non-dipolar Wilson links for parton densities

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We propose a new definition of a transverse-momentum-dependent wave function with simpler soft subtraction. 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. The non-dipolar Wilson links are also introduced to the quasi-parton distribution function (QPDF) with an equal-time correlator in the large momentum limit, which can remove the involved linear divergence, and allow perturbative matching to the standard light-cone parton distribution function. The latter can then be extracted reliably from Euclidean lattice data for the QPDF with the non-dipolar Wilson links.

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