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The Collins-Soper kernel from a vacuum soft function

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We present the results of the first lattice calculation of the Collins-Soper (CS) kernel from a vacuum soft function, which is constructed from space-like Wilson lines with complex direction vectors. Employing three ensembles of pure SU(3) gauge configurations at fine lattice spacings, we achieve high statistical precision in computing the soft function, whose rapidity dependence is well described by CS evolution across a wide range of rapidity differences. Although the uncertainties in the extracted CS kernel are dominated by perturbative matching systematics, they are comparable to those achieved in state-of-the-art lattice calculations based on hadronic observables. Notably, the kernel exhibits saturation at large transverse Wilson-line separations, which provides an important constraint for TMD phenomenology.

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