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High-energy hadronic processes and parton distribution functions in the presence of Lorentz symmetry violation

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Hadron-lepton and hadron-hadron interactions at large momentum transfer are studied in the presence of Lorentz-violating background fields affecting quarks. Connections are made with the operator-product expansion and leading-twist parton distribution functions are derived. Cross sections for deep inelastic scattering and the Drell-Yan process are calculated at leading order for minimal and nonminimal Lorentz violation using the Standard-Model Extension, an effective field theory characterizing general Lorentz-violating effects for the Standard Model fields and General Relativity. Estimated bounds are placed using sidereal-time analyses of existing HERA, LHC, and future US-based electron-ion collider data.

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