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First Measurement of Muon Neutrinos as a Function of Energy and Rapidity with the FASER experiment

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The Forward Search Experiment (FASER) at the CERN Large Hadron Collider (LHC) provides access to TeV-scale neutrinos produced in the far-forward region of proton-proton collisions. Using the electronic detector components of FASER and an integrated luminosity of $186 \pm 4 \text{ fb}^{-1}$ collected during LHC Run 3 at $\sqrt{s} = 13.6 \text{ TeV}$, charged-current muon neutrino interactions are measured in bins of neutrino rapidity and muon charge-over-momentum. The observed event yields are unfolded using a likelihood-based fit including detector efficiencies, migration matrices, and background constraints. After subtraction of the expected backgrounds, 766.8 ± 29.6 interaction events are observed. The resulting double-differential distributions probe both the angular and energy structure of the forward neutrino flux and provide sensitivity to neutrino production from light-hadron and charm decays, as well as to TeV-scale neutrino interaction cross sections. These results extend previous collider neutrino measurements by providing the first double-differential characterization of TeV-scale neutrinos produced at the LHC.

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