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LHC Neutrino Physics at the FASER Experiment

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The Large Hadron Collider (LHC) is not only the most powerful particle accelerator ever built but also a unique source of an intense, high-energy beam of neutrinos spanning all flavors, predominantly collimated in the forward direction. After nearly 15 years of LHC operation, the first detection of collider-produced neutrinos was achieved by the dedicated FASER and SND@LHC experiments. This milestone marks the emergence of a new research frontier: collider neutrino physics. The TeV-energy neutrino beam produced in proton-proton collisions at the LHC enables the study of the highest-energy neutrinos in a controlled laboratory setting, providing novel opportunities to advance our understanding of neutrino interactions, explore strong interaction dynamics in previously uncharted kinematic regimes, and probe Beyond Standard Model (BSM) physics. Additionally, these measurements have significant implications for astroparticle physics, offering crucial input for addressing open questions about high-energy neutrino production in astrophysical environments. With initial results released in 2023 and 2025, ongoing and future neutrino experiments at the LHC will play a pivotal role in expanding our knowledge of QCD, neutrino properties, and new physics searches. This review presents the current status, first experimental results, and future prospects of collider neutrino studies at the LHC.

Collaboration you are representing

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