

Neutrino measurements and short-lived particle searches with FASER

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The FASER experiment at the LHC is designed to study all three flavors of neutrinos at TeV energies and to search for new long-lived particles. The FASER detector, a one-ton-scale emulsion-electronic hybrid neutrino detector, is located 480 m downstream of the LHC proton-proton interaction point, directly along the beam collision axis. Data taking began with the start of LHC Run 3 in 2022.

In 2021, the FASER Collaboration reported the first neutrino interaction candidates produced at the LHC [1]. In 2024, the first cross-section measurements of electron and muon neutrinos at around 1 TeV were published [2]. Updated results on high-energy electron and muon neutrino interactions in the FASER's emulsion detector were presented in 2025 [3]. In 9.5 fb^{-1} of data with a target mass of 314.7 kg, five electron-neutrino candidate events and twenty muon-neutrino candidate events have been observed. This analysis marks progress toward an extended physics program focused on neutrino studies, providing valuable insights not only into neutrino and electroweak physics but also into quantum chromodynamics, through investigations of forward hadron production and deep inelastic scattering involving high-energy neutrinos.

In this talk, we will present updated neutrino interaction rates, and their interpretation in terms of both neutrino cross sections and hadron production at $\sqrt{s} = 13.6 \text{ TeV}$. We will also discuss the development of decay search methods for short-lived particles such as tau and charm. Figure 1 shows event displays of simulated neutrino interaction vertices for a charm-associated neutrino interaction and for a tau neutrino interaction in the emulsion detector. Algorithms have been developed to detect the small angular differences between short-lived particles and their daughter tracks, and the decays shown in Fig. 1 are successfully reconstructed.

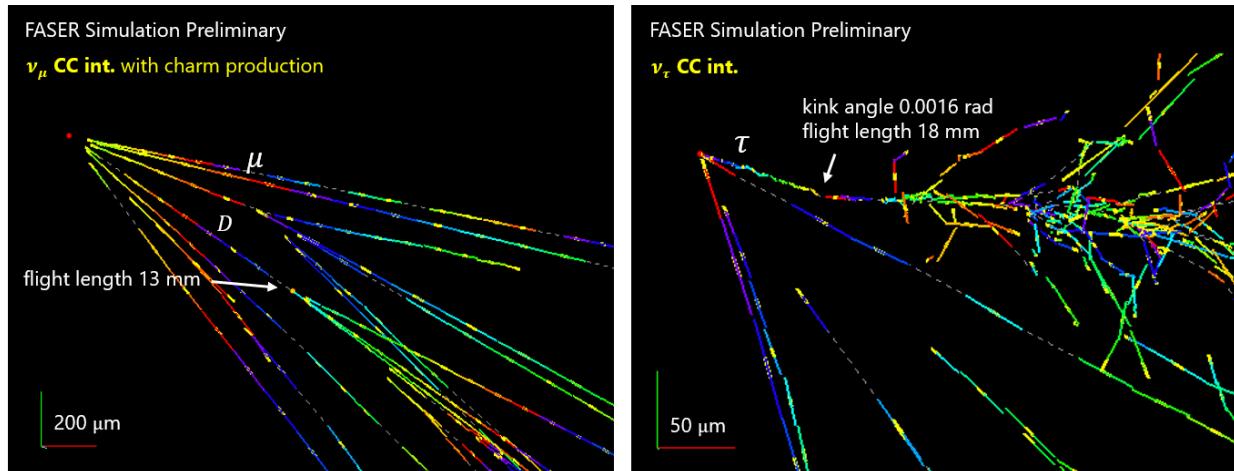


Fig. 1. Event displays of simulated neutrino interaction vertices for a charm-associated neutrino interaction (left) and a tau neutrino interaction with the tau decaying into an electron (right) in the emulsion detector.

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References

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