

Investigating the reach of LHC neutrino experiments

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The initiation of a novel neutrino physics program at the Large Hadron Collider (LHC) and the proposed Forward Physics Facility (FPF) motivate studies of the discovery potential of these searches. This requires resolving degeneracies between new predictions and uncertainties in modeling neutrino production in the forward kinematic region. Based on a broad selection of existing predictions for the parent hadron spectra at FASER ν and the FPF, we parametrize the expected correlations in the spectra of neutrinos produced in their decays, and use a Fisher information approach to determine the highest achievable precision for their observation. This allows for constraining various physics processes within and beyond the Standard Model, including neutrino non-standard interactions. We also illustrate how combining multiple neutrino observables could lead to experimental confirmation of the enhanced-strangeness scenario proposed to resolve the cosmic-ray muon puzzle during LHC Run 3.

Primary authors: KLING, Felix (T (Cosmology)); Dr TROJANOWSKI, Sebastian (NCBJ, Astrocent); MÄKELÄ, Toni (NCBJ)

Presenter: MÄKELÄ, Toni (NCBJ)

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