

## Discovery potential of FASERnu with contained vertex and through-going events

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The FASER $\nu$  detector is a newly proposed detector whose main mission is to detect neutrino flux from the collision of the proton beams at the ATLAS Interaction Point (IP) during run III of the LHC in 2021-2023. We show that this detector can also test certain beyond standard model scenarios, especially the ones in which the neutrino interaction with matter fields can produce new unstable particles decaying back into charged leptons. Such scenarios are also motivated by the MiniBooNE anomaly. The detector will be located 480 m away from the interaction point such that neutrinos have to cross 10 meters of concrete and 90 meters of soil before reaching the detector. We show that if the new physics involves multi-muon production by neutrinos scattering off matter fields, including the neutrino flux interactions in the rock before the detector in the analysis (i.e.) accounting for the through-going muon pairs) can significantly increase the effective mass of the detector to search for new physics. We develop a model that can give rise to such multi-muon signal.

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