

Excess of Tau events at SND@LHC, FASER ν and FASER ν 2

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During the run III of the LHC, the forward experiments FASER ν and SND@LHC will be able to detect the Charged Current (CC) interactions of the high energy neutrinos of all three flavors produced at the ATLAS Interaction Point (IP). This opportunity may unravel mysteries of the third generation leptons. We build three models that can lead to a tau excess at these detectors through the following Lepton Flavor Violating (LFV) beyond Standard Model (SM) processes: (1) $\pi^+ \rightarrow \mu^+ \nu_\tau$; (2) $\pi^+ \rightarrow \mu^+ \bar{\nu}_\tau$ and (3) $\nu_e + \text{nucleus} \rightarrow \tau + X$. We comment on the possibility of solving the $(g-2)_\mu$ anomaly and the τ decay anomalies within these models. We study the potential of the forward experiments to discover the τ excess or to constrain these models in case of no excess. We then compare the reach of the forward experiments with that of the previous as well as next generation experiments such as DUNE. We also discuss how the upgrade of FASER ν can distinguish between these models by studying the energy spectrum of the tau.

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