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Heavy Neutral Leptons Search in a Realistic Neutrino Oscillation Model at FCC-ee

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The Standard Model predicts neutrinos to be massless but the observation of neutrino flavor oscillations implies that they are massive particles.
The type I see-saw mechanism has been extensively studied as a promising model of neutrino mass generation in which the existence of right-handed heavy neutrinos (also called heavy neutral leptons, HNLs) is needed to counterbalance the mass of the observed left-handed neutrinos. Precedent studies considered one HNL as a benchmark phenomenological model but at least two HNLs are needed to explain neutrino oscillations and, simultaneously, the baryon asymmetry of the Universe and dark matter generation, thus being able to give a solution to the main open problems of the Standard Model. The case of two generations of HNLs is considered, with a non-diagonal mixing matrix in all three lepton flavors. The analysis is conducted in the context of exploration proposed by the Future Circular Collider (FCC) in its e+e- stage at the Z-pole. The discovery region accessible at FCC-ee has not been previously excluded by other experiments and allows the HNLs to attain long-lived properties. The search is then focused on displaced vertices, and other reconstructed variables, as an indication of HNL interactions in the IDEA detector. From these properties, an excellent background suppression is achieved. The signal significance is evaluated in a wide range of HNL parameter space. This expected sensitivity is compared with the current experimental constraints as well as the expectations from other future projects. The impacts of detector performance on the HNL sensitivity is also discussed.

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