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Simulating Heavy Neutral Leptons at Forward Collider and Fixed Target Experiments

Heavy Neutral Leptons (HNLs) are among the leading examples of long-lived particles. For masses in the MeV to GeV range, HNLs are light enough to be produced at many collider and accelerator facilities, but also heavy enough to decay to visible particles on length scales that can be observed in particle detectors. We discuss the FORESEE simulation package to include the production and decay of HNLs, providing a user-friendly, relatively fast, and highly flexible tool to evaluate the prospects for HNL discovery at ongoing and proposed experiments. The framework accommodates a large range of HNL masses and arbitrary couplings to e, μ, and τ leptons. As examples, we present sensitivity reaches for five benchmark scenarios with coupling ratios $U_e^2 : U_\mu^2 : U_\tau^2$ = 1:0:0, 0:1:0, 0:0:1, 0:1:1, and 1:1:1 for FASER and proposed experiments at the Forward Physics Facility.

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