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Fermion number violation with heavy neutrinos

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Three mysteries stand after the discovery of the Higgs boson: (i) the origin of the masses of the neutrinos; (ii) the origin of the baryon asymmetry in the universe; and (iii) the nature of dark matter. High energy colliders provide an exciting opportunity to resolve these mysteries with the possible discovery of heavy neutral leptons (HNLs), both at the HL-LHC from neutrinos produced in semi-leptonic decays, or at a later stage using the large sample (510ˆ12) of Z bosons with 20% neutrino decay fraction, produced in circular e+e- Higgs factories running at the Z pole.

The mixing between light and heavy neutrinos is expected to be very small, resulting in very long lifetimes for the HNL, and in spectacular signal topology. Even from Z decays, although the final state in this reaction appears to be charge-insensitive, it is possible to distinguish the Dirac vs Majorana nature of the neutrinos, by a variety of methods that will be discussed. A Majorana nature could have considerable implication for the generation of the Baryon Asymmetry of the Universe.

Scientific topic

Symmetries

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