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Lepton Number Violation at Colliders via Heavy Neutrino-Antineutrino Oscillations

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Collider-testable low scale type I seesaw models for neutrino mass generation generically feature pseudo-Dirac heavy neutrinos, composed of two Majorana states with nearly degenerate masses. These pseudo-Dirac heavy neutral leptons (HNLs) can oscillate between interaction eigenstates that couple to leptons and antileptons, and thus generate oscillations between lepton number conserving (LNC) and lepton number violating (LNV) processes. While it has been argued that for prompt processes LNV is strongly suppressed by the smallness of the light neutrino masses and practically unobservable, taking the oscillations into account can induce observable rates of LNV at the HL-LHC and future colliders. For long-lived heavy neutrinos, the oscillating pattern between LNC and LNV processes as a function of heavy neutrino lifetime may even be resolvable, which would allow for a deep insight into the neutrino mass generation mechanism. Only since recently, a public MadGraph patch exists that allows to include the oscillations in simulations of HNLs at colliders.

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