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Heavy Neutral Leptons in Ice, Water and Rock

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Heavy neutral leptons (HNLs) are well-motivated candidates for physics beyond the Standard Model. These heavy right-handed neutrino states can couple to their left-handed Standard Model counterparts through various portals, the simplest of which are mass-mixing and transition magnetic moments. This talk discusses searches for HNLs in two different experimental settings. First, neutrino telescopes such as IceCube and KM3NeT can search for mass-mixed and dipole-portal HNLs through a characteristic double cascade signature. We present the first attempt at an HNL-induced double cascade search in IceCube and discuss the status of upcoming improved double cascade searches. Second, far-forward experiments at the Large Hadron Collider can search for HNLs using the neutrino flux produced in proton-proton collisions. To this end, we introduce two new collider neutrino detector concepts leveraging the local natural environment: the Surface-based Integrated Neutrino Experiment (SINE) and the UNDERwater Integrated Neutrino Experiment (UNDINE). We discuss prospects for HNL searches at SINE and UNDINE using delayed event signatures and di-muon final states.

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