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Search of Heavy Neutral Leptons with KM3NeT-ORCA

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KM3NeT is a next-generation neutrino telescope currently under construction in the Mediterranean Sea. The detector comprises two components, ARCA and ORCA, each equipped with optical sensors that detect Cherenkov light emitted by charged particles resulting from neutrino interactions in the surrounding medium. ARCA, sensitive to interactions in the TeV–PeV energy range, is designed to observe cosmic neutrinos, while ORCA focuses on studying atmospheric neutrino oscillations in the GeV range.

In this work, we investigate the potential signal produced by a Beyond Standard Model (BSM) particle commonly and generically referred to as the Heavy Neutral Lepton (HNL). This signal is particularly distinctive, as HNLs are expected to generate two spatially separated showers of light, an event topology not anticipated from any known particle within the same energy range. Using a novel simulation based on the SIREN lepton injector to model HNL signals in KM3NeT/ORCA-18, we evaluate the capability of Deep Learning algorithms such as ParticleNeT or DYNEDGE in combination with Boosted Decision Trees (BDTs) to reconstruct and isolate this unique signature.

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