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KM3NeT's sensitivity to the next core-collapse supernova

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Core-collapse supernovae (CCSNe), the collapse of supermassive stars, have a significant impact on the dynamics of galaxies but their underlying mechanism is still only partially understood. These phenomena, however, produce short and extremely intense neutrino bursts, which could be used to probe the dynamics of the CCSN cores. However, such neutrinos would be detected only for CCSNe occurring in the Milky Way or its satellite galaxies, which occur around twice per century. It is therefore necessary to maximise the detection potential of all sensitive neutrino experiments, including very-large-scale water Cherenkov detectors, primarily aimed at GeV-PeV neutrino detection. In this contribution, we present a new CCSN search using the KM3NeT neutrino detector. In this search, we consider KM3NeT's Digital Optical Modules (DOMs) as standalone detectors for MeV-scale CCSN neutrinos. We define observables that characterize the pattern of activated photomultipliers on a single DOM, and use them to distinguish CCSN neutrinos from radioactivity and atmospheric muon backgrounds. With this search strategy, KM3NeT could currently probe the majority of CCSN candidates in the Milky Way and, once finished, would achieve full galactic sensitivity.

Collaboration(s)

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