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(G*) Ambient Background Modeling and Event Trigger Development for the Pacific Ocean Neutrino Explorer

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At energies over 100 TeV, the universe becomes opaque to photons limiting the range of high energy gamma ray observations to roughly within the Milky Way. Neutrinos on the other hand do not suffer from this drawback which makes them ideal messengers for studying extremely energetic astrophysical phenomena across the cosmos. Recent observations using neutrino telescopes have thoroughly cemented the research potential of neutrino astronomy. However, multiple neutrino telescopes are needed to expand the observable skyline and increase the detection rate of extraterrestrial neutrinos. The Pacific Ocean Neutrino Explorer (P-ONE) is a proposed initiative to construct one of the largest neutrino telescopes deep in the northern Pacific Ocean off the coast of British Columbia. The detector itself will consist of an array of strings lined with digital optical modules (DOMs) which detect Cherenkov light from secondary particles produced in neutrino interactions within the detector. To date, two pathfinder missions have been deployed for studying the optical properties of Pacific Ocean seawater including scattering and absorption lengths as well as the ambient undersea background. The background consists of stochastic noise spikes due to various undersea bioluminescence along with a baseline of Cherenkov radiation produced by β^- decay of radioactive isotopes, primarily ^{40}K, in sea salt. This presentation will discuss modeling the response of a pathfinder DOM to the ^{40}K background using Geant4 as well as the process of using this characterization of ^{40}K to develop event triggers for P-ONE. Verifying the undersea ambient background simulation against in situ measurements confirms the accuracy of measured optical parameters and solidifies the understanding of noise within the detector. Not only is this important step of the site characterization essential for event trigger development as will be discussed, but accurate modeling of ambient ^{40}K also proves to be useful for detector efficiency measurement and recalibration.

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