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Noise modeling for the multi-PMT digital optical modules of the IceCube Upgrade

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The IceCube Upgrade, to be installed in 2026, is a low-energy extension of the DeepCore detector part of the IceCube in-ice Cherenkov neutrino telescope at the South Pole. The Upgrade will improve the detection of neutrino interactions in the GeV range by deploying nearly 700 new multi-PMT digital optical modules in a high-density configuration. This allows for more precise measurements of fundamental physics phenomena such as neutrino oscillations and searches for beyond the Standard Model physics. In this talk, I will discuss an important background to consider for these low-level signals: the intrinsic noise caused by radioactive decays in the optical module's glass components. This background is modeled using GEANT4, which accounts accurately for correlated hits on short time scales across PMTs within a single module and can be calibrated against measurements of the module testing prior deployment. Also under investigation is the approach to model the noise with a neural network.

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