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Introducing WOM: The Wavelength-Shifting Optical Module

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Large-scale underground water-Cherenkov neutrino observatories rely on single photon sensors whose sensitive area for Cherenkov photons one wants to maximise. Low dark noise rates and dense module spacing will thereby allow to substantially decrease the energy threshold in future projects. We describe a feasibility study of a novel type of single photon sensor that employs organic wavelength-shifting material (WLS) to capture Cherenkov photons and guide them to a PMT readout. Different WLS materials have been tested in lab measurements as candidates for use in such a sensor and photon capture efficiencies as high as 50 % have been achieved. Based on these findings we estimate that the effective photosensitive area of a prototype built with existing technology can easily exceed that of modules currently used e. g. in IceCube. Additionally, the dark noise rate of such a module can be exceptionally low in the order of 10 Hz. This is of special importance when targeting low-energy neutrinos
that yield only few photons that need to be distinguished from noise hits

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