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Photon detection in nEXO

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The nEXO experiment is being designed to achieve unprecedented sensitivity to the neutrino-less double beta decay of 136Xenon. nEXO background rejection strategy includes in particular self-shielding, interaction site counting and energy resolution. Efficient light detection is critical for achieving the desired energy resolution of 2% (FHWM) or better. Simulations show that such an energy resolution can be achieved if at least 5% of the scintillation photons are detected, which requires mirroring most inactive surface and at least 4m2 of single photon detectors. So-called silicon photo-multipliers (SiPMs) are the only viable option as Photo-multiplier tubes are too radioactive and Avalanche Photo-Diodes yield too much electronics noise due to their low gain and are difficult to produce in mass quantity. The development of SiPMs for nEXO has already produced promising results: 1) measured limits for the radio-isotope content of SiPMs (produced by Foundation Bruno Kessler, FBK) are consistent with requirements, 2) the photo-detection efficiency exceeds 15% for FBK and Hamamatsu Photonics SiPMs at the liquid Xenon scintillation wavelength, 3) dark noise and correlated avalanche rates are within specifications. The nEXO collaboration is continuing to work with the SiPM vendors to further improve performances. The nEXO collaboration is also investigating solutions for reading out m2 of SiPMs, which has not been done before. In addition to conventional analog electronics solutions, the nEXO collaboration is investigating using the 3-dimensionally integrated technology (3D-SiPMs) that completely avoid any analog electronics and provide a mean of tagging every photon with minimum power dissipation. In this poster we will report the development of solutions for light detection in nEXO highlighting the technology that are pioneered by the collaboration, for example VUV sensitive SiPMs and 3D-SiPMs.

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