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Characterization of new photo-detectors for the future dark matter experiments with liquid xenon

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In the last three decades, numerous terrestrial experiments have been built to detect the faint interactions between WIMP dark matter and ordinary matter. Among them, experiments using dual-phase xenon time projection chambers (TPCs) are leading the search especially for high mass WIMPs. In these experiments, photomultipliers (PMTs) are used to detect the prompt primary scintillation and secondary electro-luminescence of ionized electrons. However, PMTs have several important shortcomings: the residual radioactivity levels, cost, bulkiness, and stability at cryogenic conditions. Therefore, several alternative technologies are under consideration toward the future dark matter experiments using ˜50 tons of liquid xenon (LXe). One of the such technologies is silicon photomultipliers (SiPMs). SiPM has very low radioactivity, compact geometry, low operation voltages and reasonable photo-detection efficiency for VUV light. However, current SiPM still has ˜two order of magnitude higher dark count rate compared with PMT, which significantly increases accidental coincidence background. In order to solve these problems, we are currently developing a new SiPM with the help of Hamamatsu and FBK. In this poster, we will report the current status of the performance measurements of the Hamamatsu VUV4 SiPMs (3mm×3mm), new SiPMs with less dark count and FBK VUV SiPMs (6mm×6mm).

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