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Development of very low-threshold detection system for low-background experiments.

A concept of readout of noble gas two-phase emission detectors by means of multipixel avalanche Geiger photodiodes (MGPDs or SiPMs) and a THGEM structure is presented.
It is well known that a two-phase emission technique with noble gases is a very sensitive method of detection of very small ionisation signals (down to few or single ionisation electrons). Electroluminescent "amplification"provides the unique possibility to detect reliably even the single ionisation electron extracted from the liquid to the gas phase. Due to this reason such detectors are currently successfully used in the Dark Matter search experiments and are considered for the use in the neutrino experiments: for coherent scattering of reactor antineutrino off atomic nuclei.
To increase the capabilities of a two-phase detector a system of THGEM + WLS (wavelength shifter) +MGPD is proposed for its readout. Additional amplification of the charge in the THGEM holes gives the large light signal of electroluminescence detected with an array of SiPMs. This readout system provides the mm accuracy for the very low-energy events, that is important for the reliable separation of the rare physical events from the background ones caused by spontaneous emission of the electrons from the liquid noble gas surface.
"Blue sensitive"SiPMs has been tested in LXe with a wavelength shifter (WLS) to detect the VUV scintillation light from LXe. A wavelength shifter p-terphenyl was vacuum deposited on a sapphire window and specially protected from pollution to the LXe medium with a poly-para-xylylen film. It was found that the p-terphenyl has a strong absorption peak at a wavelength of ˜ 180 nm, very close to the peak of the LXe molecular continuum emission (175 nm). A Photon Detection Efficiency (PDE) of up to ˜ 10% has been obtained for the combination of WLS and SiPM.

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