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

Kosuke Ozaki
Master student at Nagoya University

2019/11/11-13
The organizers of Dark matter searches in the 2020s
- At the crossroads of the WIMP
@ Kashiwa Research Complex Conference hall

Introduction

Institute for
Space–Earth Environmental Research

- Experiments using LXe TPC are leading the search for WIMPs (XENON1T, LUX, PandaX)
- For future experiments such as DARWIN (～50 tons of LXe), ultra-low background (BG) environment is necessary. In XENON1T, PMT is one of the biggest origins of neutron BG, which mimics like WIMP.
- SiPMs have very low radioactivity and reasonable PDE for LXe scintillation light (λ～178nm).
- Current SiPM has ～2 orders of magnitude higher dark count rate compared with PMT used in XENON1T.

Photo Sensor	SiPM 13370-3050CN	PMT R11410-21
Dark Rate @LXe	**～1 Hz/mm²**	**～0.01 Hz/mm²**
PDE@178 nm	**～24%**	**～27%**

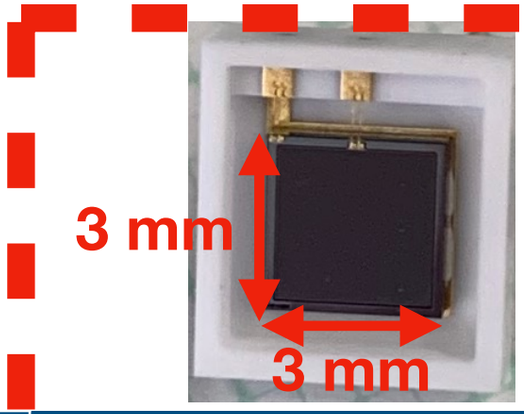
Newly developed SiPM

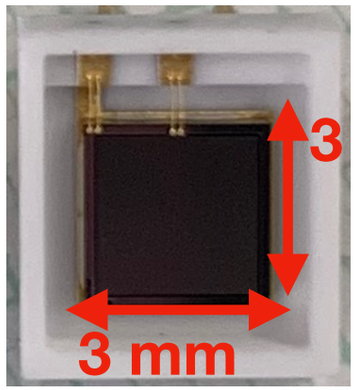
Institute for
Space–Earth Environmental Research

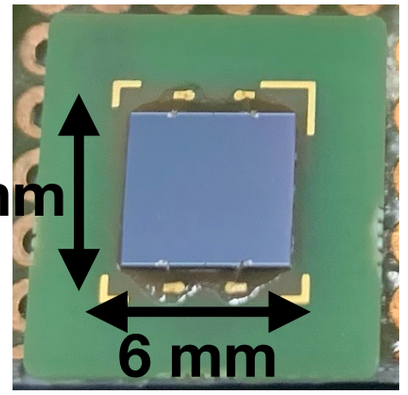
- To improve DCR property, we have cooperated with Hamamatsu, and a new SiPM (S12572-015C-SPL, SPL) has been developed.

- SPL is similar to commercially available SiPM (S12572-015C-STD, STD), but its internal electric field structure was optimized to reduce DCR.

- In this poster, we will report the current status of the performance measurements of SPL, STD, and FBK: VUV-HD-LF SiPM (low DCR SiPM)







	Hamamatsu S12572-015C-SPL	Hamamatsu S12572-015C-STD	FBK VUV - HD - LF
Operation Voltage	~100 V	~65 V	~33 V
Gain	~1.4×10^5	~2.3×10^5	~1.0×10^6
Sensitivity to VUV light	No	No	Yes