

# **Scintillator hodoscope array read** **by multi-pixel photon sensor (MPPC)**

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GPPU Experimental Point (GEP): 4

## ***Goal of Study***

In this lecture, we aim to obtain the knowledge and the experience of a pixelated photon detector (MPPC is the one of the pixelated photon detector produced by Hamamatsu photonics) which becomes very popular in the particle and nuclear experimental fields. By operating MPPCs for a scintillator hodoscope readout, we expect that students understand the basic features of MPPC and also learn how to operate multi MPPCs.

## ***Contents***

The new photon sensor, MPPC, has many pixels of avalanche photo diode (APD) in the sensitive area and the MPPC signal is the sum of all fired APD. By operating each APD in the Geiger mode, MPPC can have an enough large gain to detect a single photon. The sensitive area of MPPC is rather small (typical size is  $1 \times 1 \text{ mm}^2$ ). However, MPPC can be operated in the magnetic field and its cost is rather low. Therefore MPPC is one of the best photon sensors to read out fine segmented scintillation detectors such as scintillation fiber detector.

In this lecture, we obtain the skill to operate multi MPPCs by using the EASIROC board which was developed for this purpose. At first, we evaluate the basic performance and features of MPPC such as the relation between the operation voltage and signal gain. Then, we move to the readout of the scintillator hodoscope array with MPPC. In this detector, a wave length shifting (WLS) fiber is embedded in the hole made on the surface of the scintillator. The scintillator hodoscope array consists of 128 scintillators with WLS fibers and has a layer configuration of 8 segments for X direction and 8 segments for Y direction. We try to read out the 128 channels of MPPCs with EASIROC board. As an advanced course, by making the special trigger with FPGA module, we try to measure the angular distribution of comic ray or the life time of the cosmic ray muon.

**Textbook and References**

- [1] 次世代光検出器 Pixelated Photon Detector : 生出秀行、音野瑛俊、山下 了、日本物理学会誌 第 66 卷第 01 号 p.20.
- [2] A beam position fiber counter with scintillation fibers and multi-pixel photon counter for high intensity beam operation: R. Honda *et al.*, *Nucl. Inst. Meth A* **787** 157 (2015).

**Progress Schedule**

- ◇ Day 1  
Basics of MPPC and its readout (lecture)  
Readout of a single MPPC with EASIROC board (experiment)
- ◇ Day 2  
Readout of a single MPPC (check of MPPC feature) (experiment)  
Readout of a multi MPPC (gain adjustment, DAQ) (experiment)
- ◇ Days 3  
Analysis of data (photon yield, detection efficiency, etc.) (experiment)  
Make special trigger with FPGA module and accumulated data (experiment)
- ◇ Days 4  
Analysis of the accumulated date and summarize this course

**Other Details**

<b>Course Period</b>	Sep 2019
<b>Place</b>	Rm. 637, Science Complex B
<b>Number of Students</b>	1—8
<b>Evaluation method</b>	The evaluation method will based on the attendance (60 %), analysis results (40 %).

**In Addition**

Between Days3 and Day 4, we set data accumulation period of one day.