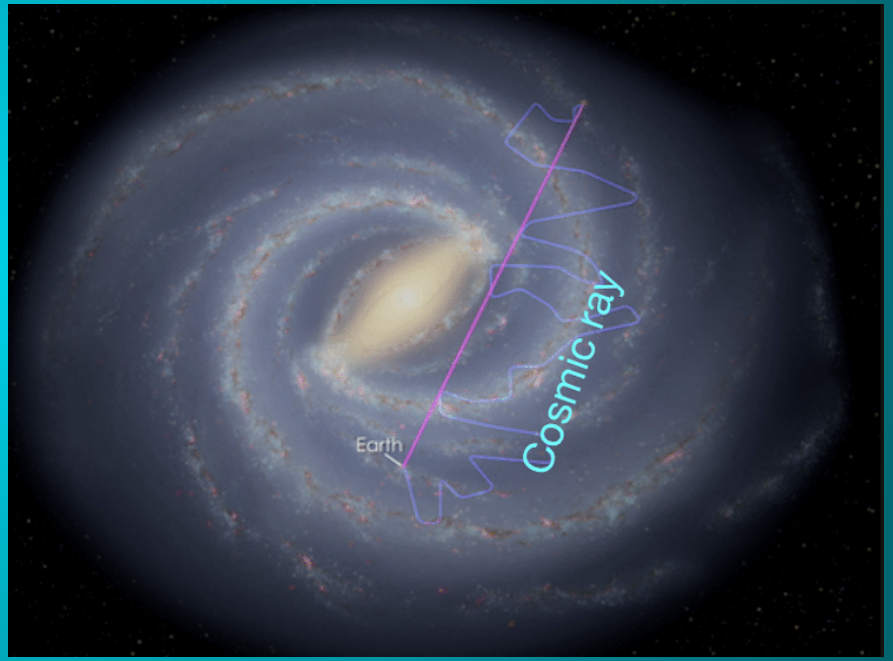
COSMIC RAYS AND PHOTON DETECTION TECHNOLOGY

Sagi, 2024

Cosmic rays:

- Essentially are charged particles

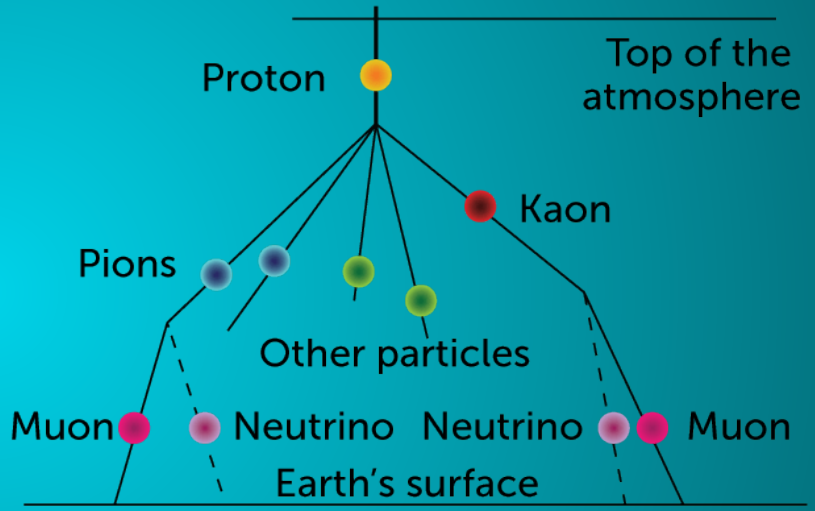
  It is “known” to be comes from the sun solar flare => make more accurate hypothesis on the origin of cosmic rays.



Cosmic rays on earth

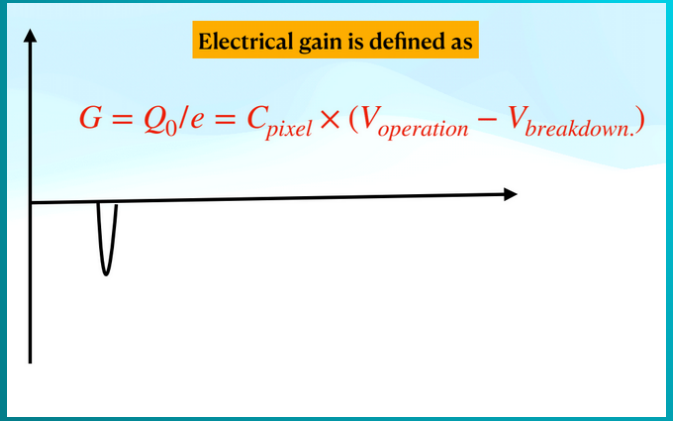
- Earth atmosphere decaying the charged particles make it split into multiple smaller pieces.

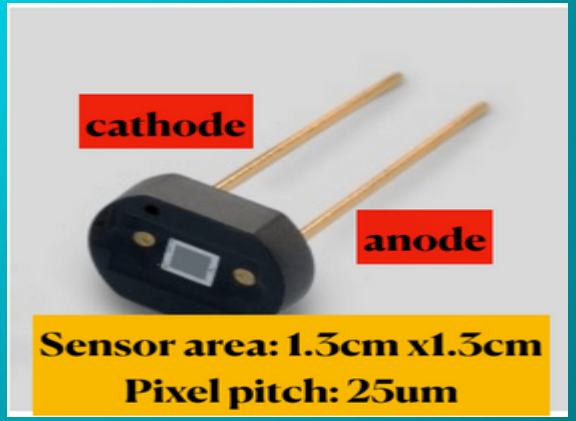
- Muon particles are able to selectively detected on the “eye” among the other photon detection



MPPC photon sensor in photon counting business

- The photoelectric diode in each pixel release charge signal when contact with photon ray
- 1 photon trigger 1 pixel and depend on the amount of pixels activated we have cumulative strength of signal



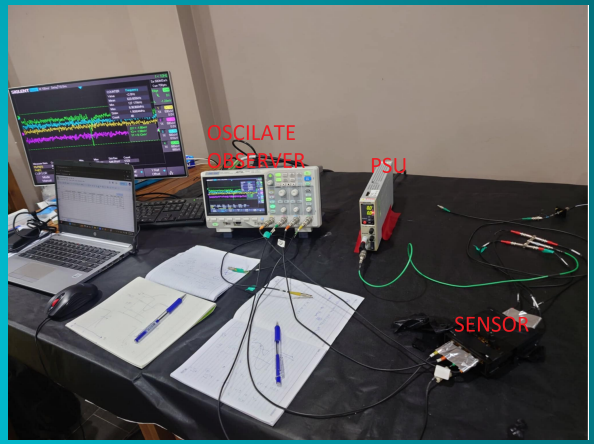


Measurement steps and result (1/3)

1. Setups sensors and oscillators

The 4 sensors are connected to the 4 channels which powered by the 55 V PSU

The larger voltage which equal higher sensitivity (56~58V)



2. Calibration of 1 photon level

Measure level of lowest photon read

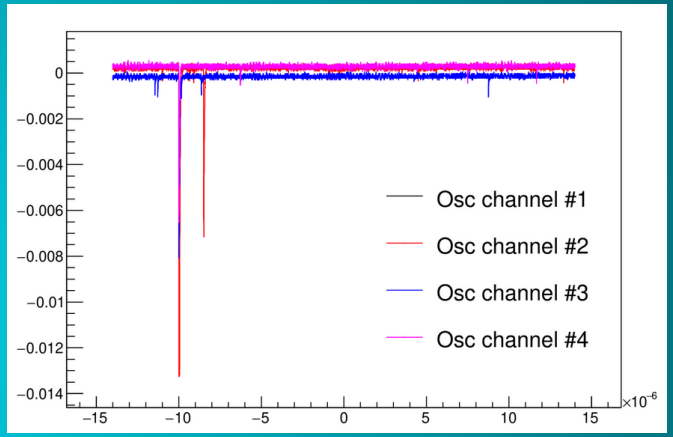
which is 1 photon

	1 photon (mV)	Trig1(mV)	Trig2(mV)
CH1	1.51	0.755	2.265
CH2	1.11	0.555	1.665
CH3	1.05	0.525	1.575
CH4	1.8	0.9	2.7

Measurement steps and result (2/3)

3. Coincident counting

Due to sensor also read random thermal photon hence it emit very frequent signal, coincident will help greatly reduce the count



4. Scintillator application

Scintillators are plastic rod with optic fiber that collect more rays into the photon sensor.

Measurement steps and result (3/3)

Result: Without Scintillator

With Scintillator

1photon 2 channel				
	Hits	Time(s)	f(Hz)	Error number
CH1 and 2	28	120	0.2333333333	0.1889822365
CH1 and 3	26	120	0.2166666667	0.1961161351
CH2 and 3	100	120	0.8333333333	0.1

2photon 2 channel				
	Hits	Time(s)	f(Hz)	Error number
CH1 and 2	76	120	0.6333333333	0.1147078669
CH2 and 3	57	120	0.475	0.1324532357
CH1 and 3	43	120	0.3583333333	0.1524985703

1photon 3 channel				
	Hits	Times(s)	f(Hz)	Error number
CH1, 2 and 3	2	120	0.01666666667	0.7071067812
	5	300	0.01666666667	0.4472135955

2photon 3 channel				
	Hits	Time(s)	f(Hz)	Error number
CH1, 2 and 3	37	120	0.3083333333	0.1643989873
	102	300	0.34	0.0990147543

Overnight records:

From 5 pm to 8:30 am, we record of about 19000 events, 74% of the expectation