

Photo-sensors comparison for the dRICH

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for the EICPID RICH meeting

Main requisites

- Single photon detection
- Sizable QE in a wide range of wavelength:
[150,600] nm
- Pixel size: ≤ 3 mm
- Compactness: limited space for arrangement
- Capability to work in magnetic field

Multinode-PMT

H12700 series

Useful for the prototype:

- area about $5 \times 5 \text{ cm}^2$
- 3 mm pixel size

Figure 1: Typical Spectral Response

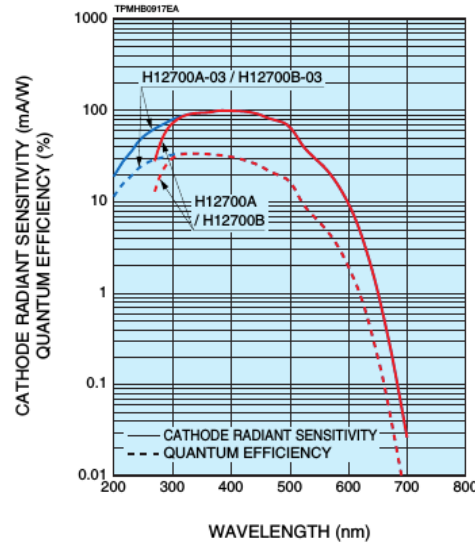


Figure 2: Typical Gain

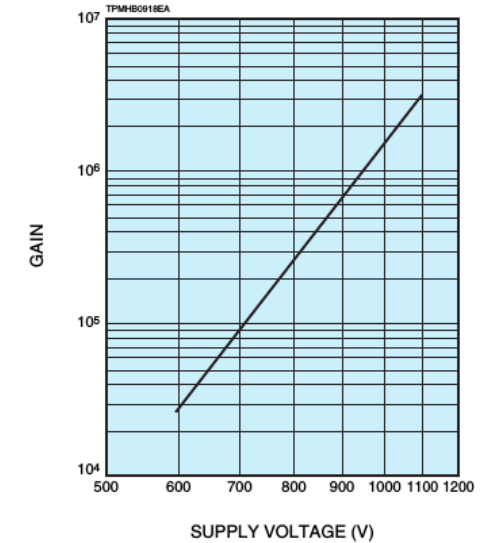
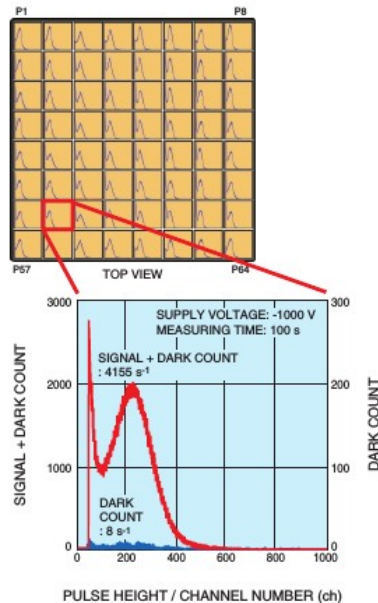


Figure 5: Single Photon Counting (Example)



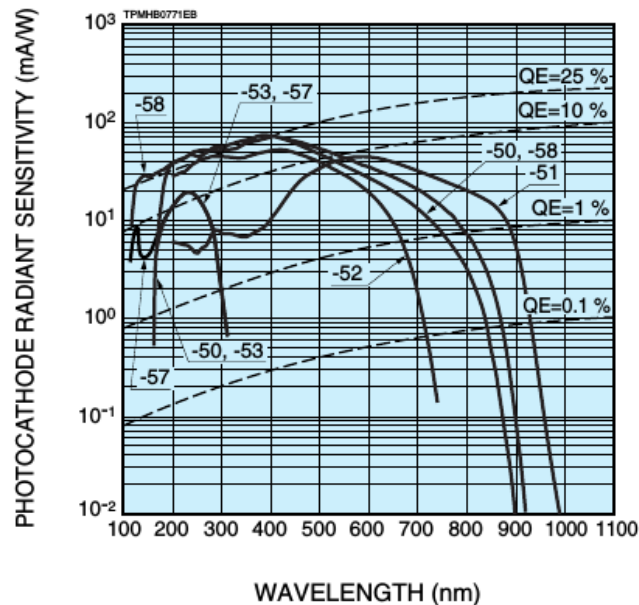
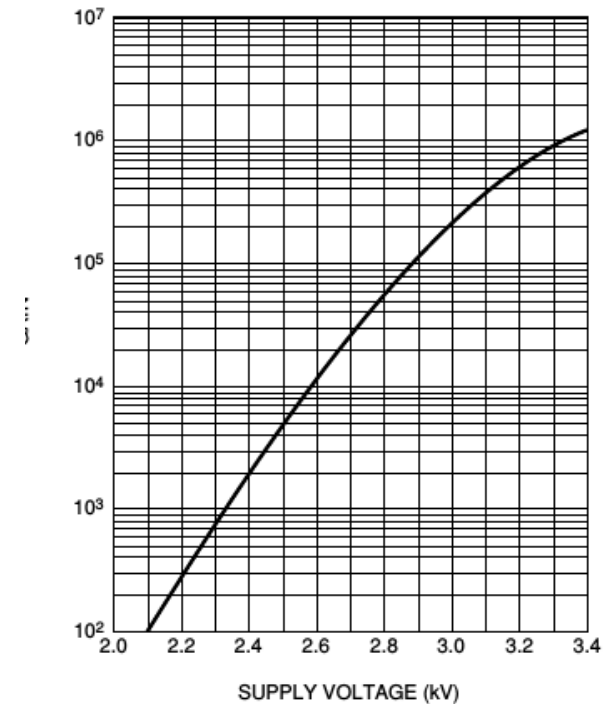
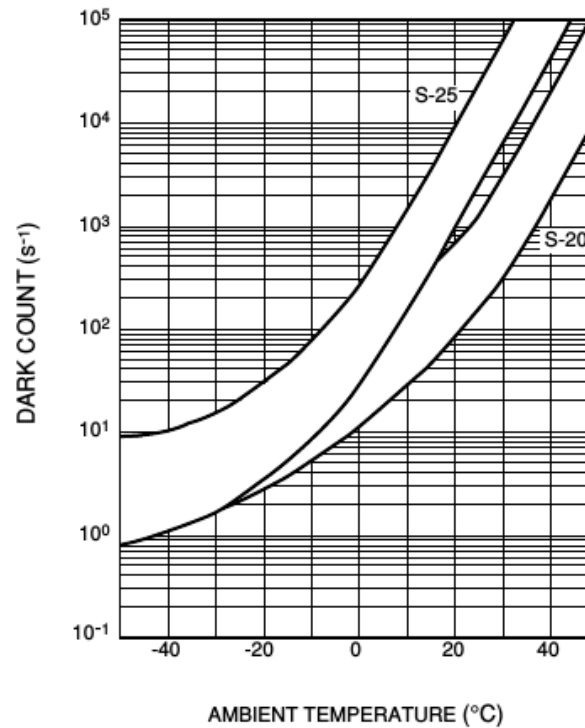
- “low” dark count rate
- Small dead space
- Quite standard device for RICH: “low” cost
- Difficult to work with PMTs in magnetic field!

MCP - PMT

Time resolution:
about 50 ps

Useful for DIRC
detectors

R3809U-50



- “low” dark count rate, comparable with PMTs
- Capability of working in magnetic field
- Very good time characteristics
- Expensive device for large area detectors

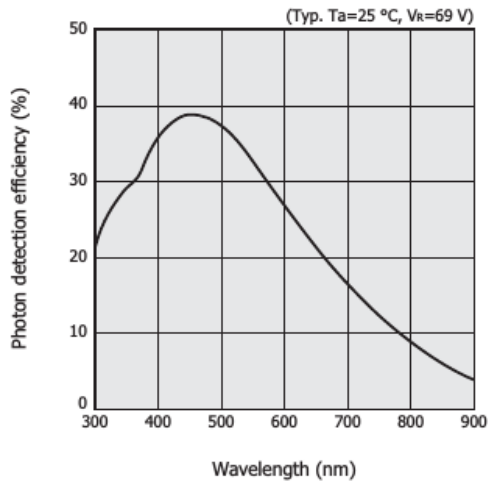
GEM

- The working principle demonstrated for CF₄ gas
- Not useful in the visible light region
- Not easy an extension to visible light in the near future

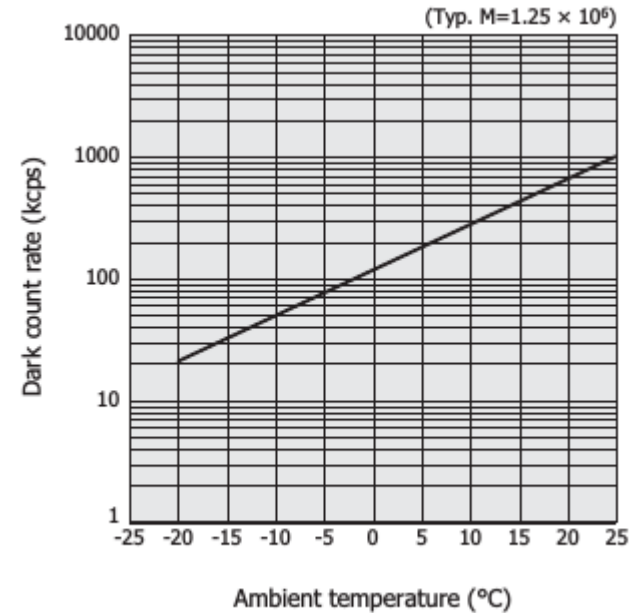
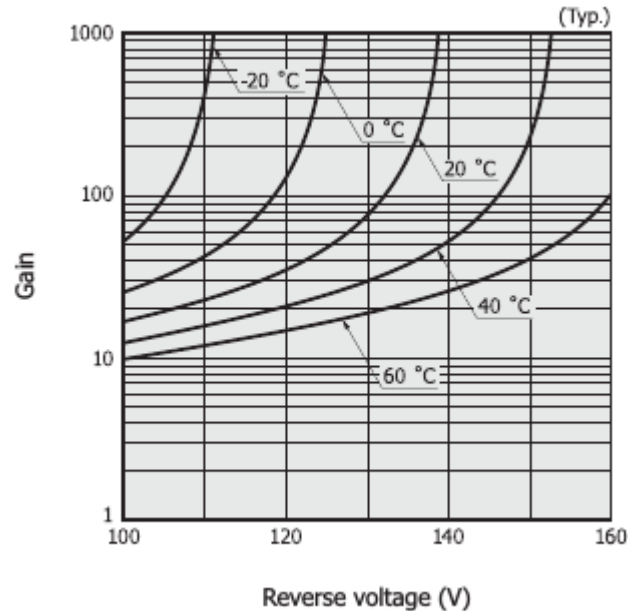
LAPPD

- A future alternative to MCP-PMT
- Fast timing
- A possible candidate in principle, but still in an R&D stage
- Basic informations still missing (i.e. costs)

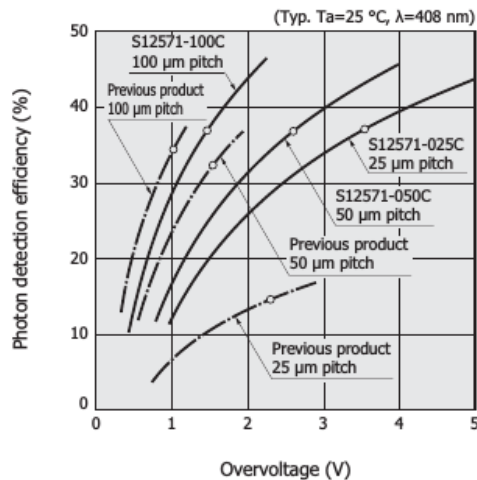
Silicon photomultiplier



Photon detection efficiency does not include crosstalk and afterpulses.



[Figure 2-8] Photon detection efficiency vs. overvoltage



- Insensitive to magnetic field
- Very compact device
- Low cost: comparable with PMTs
- High dark count rate at 25°: time information (order 800 ps) needed to reduce background or cooling system or both

Table of comparison

* correlated aspects
** rate dependent

Parameters	PMT	MCP-PMT	SiPM	LAPPD
Gain	ok	ok	ok	ok
Timing Resolution	good	ok	ok*	good
Dark noise	(KHz)	(KHz)	(MHz)*	(KHz)
Radiation Hardness	ok	ok	(ok)**	ok
Single photon	ok	ok	ok	ok
Magnetic field tolerance	bad	ok	good	ok
Detection efficiency	ok	ok	ok	ok?
Cost	ok	expensive	good	?