Photo-sensors comparison for the dRICH

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for the EIC-PID 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

Multianode-PMT

H12700 series

Useful for the prototype:

- area about 5 x 5 cm^2

- 3 mm pixel size

Figure 1: Typical Spectral Response

TPMHB0917EA
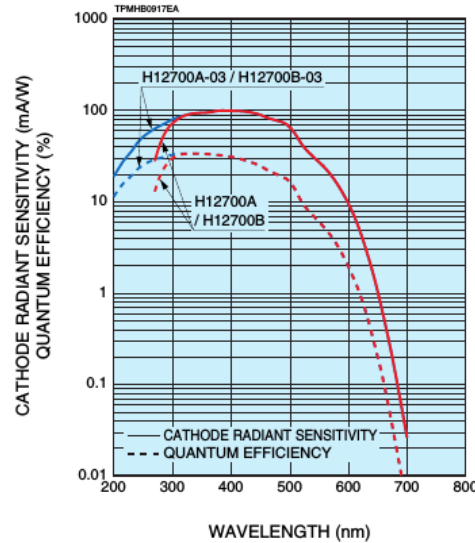
H12700A-03 / H12700B-03

H12700A / H12700B

CATHODE RADIANT SENSITIVITY (mA/W)
QUANTUM EFFICIENCY (%)

— CATHODE RADIANT SENSITIVITY
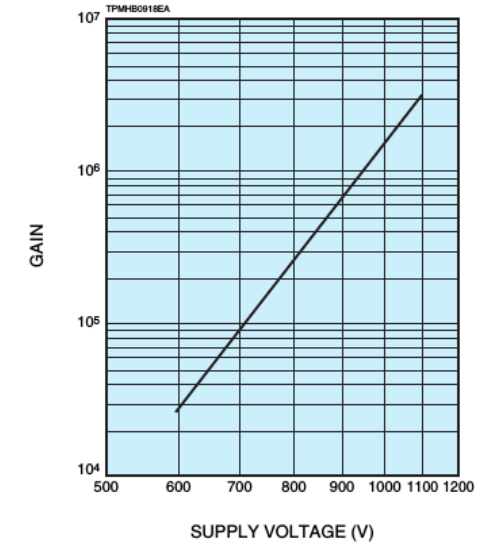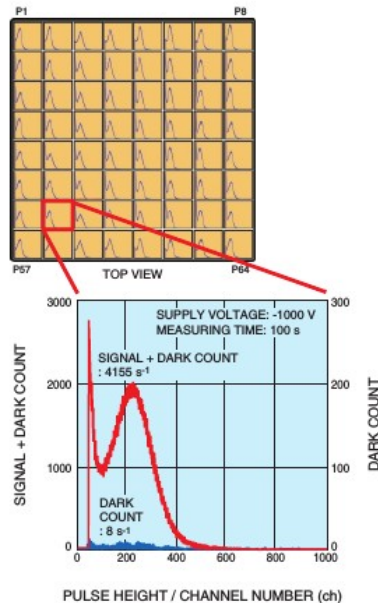- - - QUANTUM EFFICIENCY

WAVELENGTH (nm)

Figure 2: Typical Gain

TPMHB0918EA

GAIN

SUPPLY VOLTAGE (V)

Figure 5: Single Photon Counting (Example)

P1   P8

P57   TOP VIEW   P64

SUPPLY VOLTAGE: -1000 V
MEASURING TIME: 100 s

SIGNAL + DARK COUNT : 4155 s⁻¹

DARK COUNT : 8 s⁻¹

SIGNAL + DARK COUNT
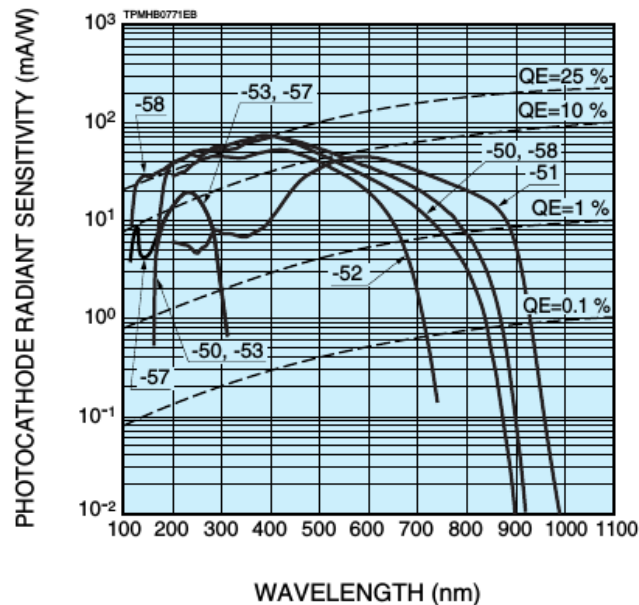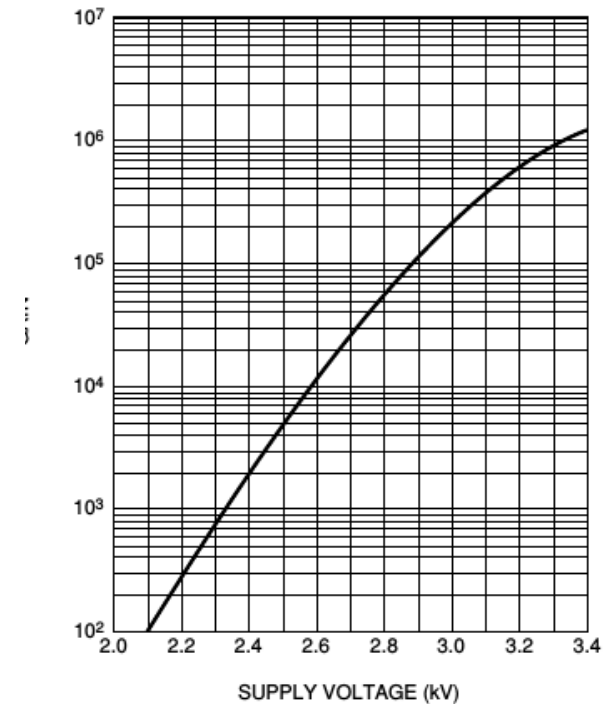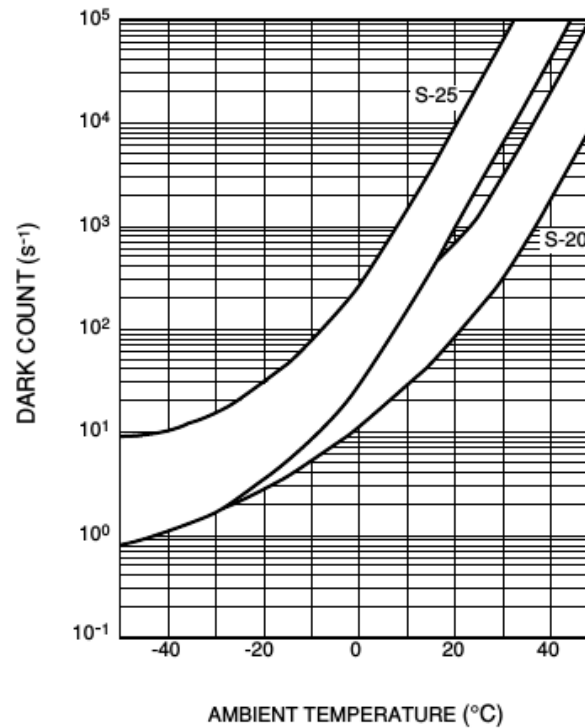
DARK COUNT

PULSE HEIGHT / CHANNEL NUMBER (ch)

- "low" dark count rate

- Small dead space

- Quite standard device for RICH: "low" cost

- Difficult to work with PMTs in magnetic field!
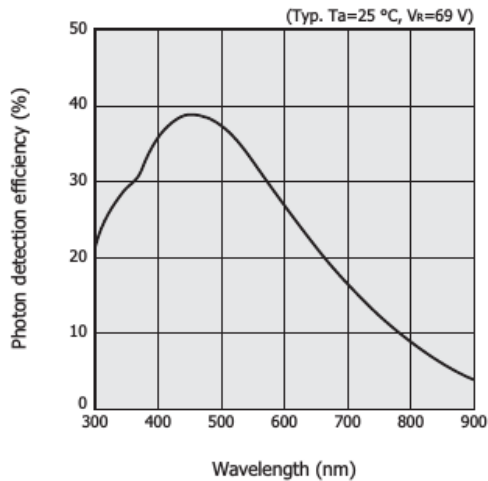
3

MCP - PMT

Time resolution: about 50 ps

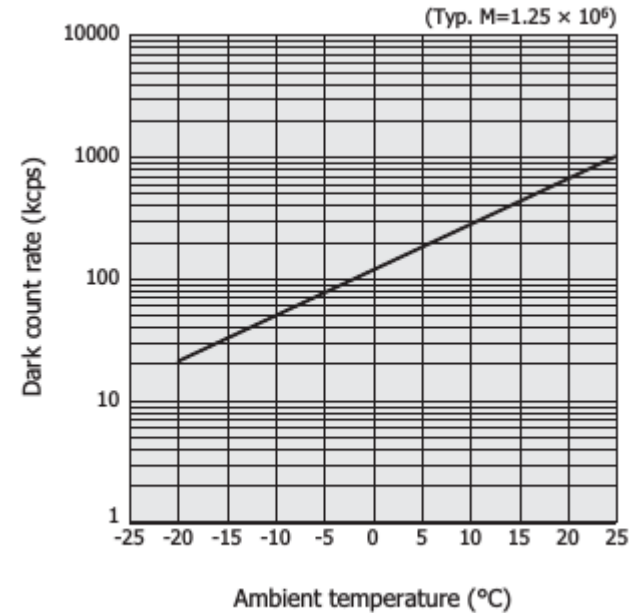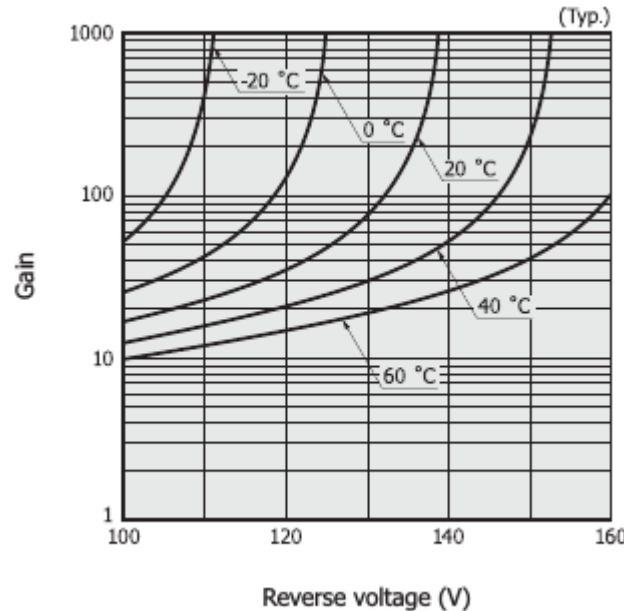Useful for DIRC detectors

R3809U-50

- "low" dark count rate, comparable with PMTs

- Capability of working in magnetic field

- Very good time characteristics

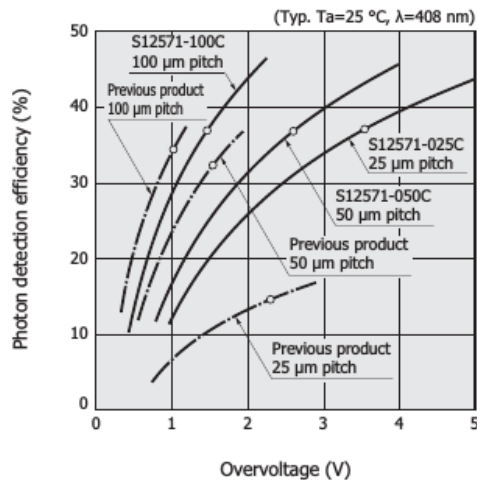- Expensive device for large area detectors

Silicon photomultiplier

(Typ. Ta=25 °C, V_R=69 V)

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

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GEM

- The working principle demonstrated for CF_4 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)

Table of comparison

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
Magetic field tolerance	Not good	ok	good	ok
Detection efficiency	ok	ok	ok	ok?
Cost	ok	expensive	good	?