Recent results of measurements of photodetectors for the ECAL0 calorimeter for the COMPASS-II experiment

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ECALO - reminder

- *Shashlyk*-type electromagnetic calorimeter
- Positioned directly after the recoil proton detector (CAMERA)
- Original readout by micropixel avalanche photodiodes (MAPD by ZECOTEK)

4.20m

3.90m

New photosensor considerer (Hamamatsu MPPC)

Prototype module



Measurement program

- Side-by-side comparison of two sensors:
 - MAPD 3N (currently used in ECAL0)
 - MPPC S12572-010C
- Parameters:
 - Electron gain
 - Dark rate
 - Correlated noise
 - Photon detection efficiency (preliminary results)
 - Linearity (still to do not shown in this talk)
- Depencence of parameters on temperature

Parameters (datasheet)

	MAPD 3N	MPPC S12572-010C
sensitive area	3× 3 mm	3× 3 mm
pixel pitch	8 × 8 µm	10 × 10 µm
number of pixels	135 000	90 000
electron gain	1×10 ⁵	1.35×10 ⁵
dark rate [cps]	9×10 ⁵ - 9×10 ⁶	- 10 ⁶





Measurement setup





Histograms

MAPD 3N



Breakdown Voltage

MAPD 3N



Breakdown Voltage





Gain

MAPD 3N

MPPC S12572-010C



(due to growing CT+AP)

Dark vs Light Gain

MAPD 3N



Dark Rate

MAPD 3N

MPPC \$12572-010C



 $DR = f(\Delta V)^*g(T)$

Dark Rate

MAPD 3N



$$DR = \left[A \cdot \left(\Delta V - C\right)^2 + B \cdot \left(\Delta V - C\right)\right] \cdot \left(\frac{T}{T_{ref}}\right)^{\frac{5}{2}} \cdot e^{\frac{-D}{2kT} - \frac{-D}{2k \cdot T_{ref}}}$$
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Dark Rate DR(T)

MAPD 3N



CT + AP(V)

MAPD 3N

MPPC S12572-010C



 $P(CT+AP) = 1 - (N_{1cnt}/N_{1pois})$

PDE



Vertical axes not to be compared

Summary

- The MPPC looks as a good replacement for MAPD
- The noise is significantly lower (by an order of magnitude)
- PDE measurements need to be cross-calibrated
- Still need to check linearity and recovery time
- Measurements of larger quantity of sensors is considered (estimates on production spread)