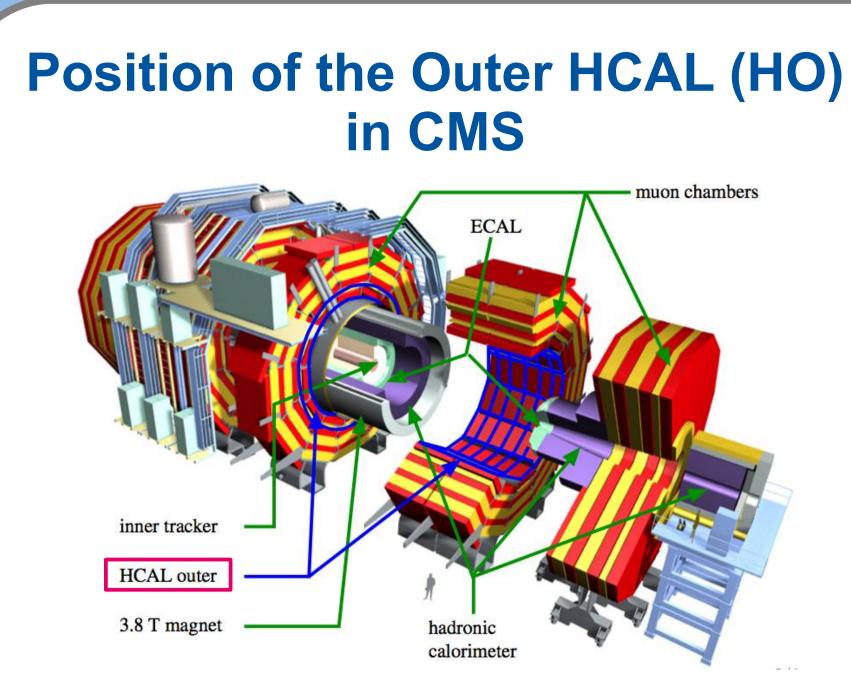


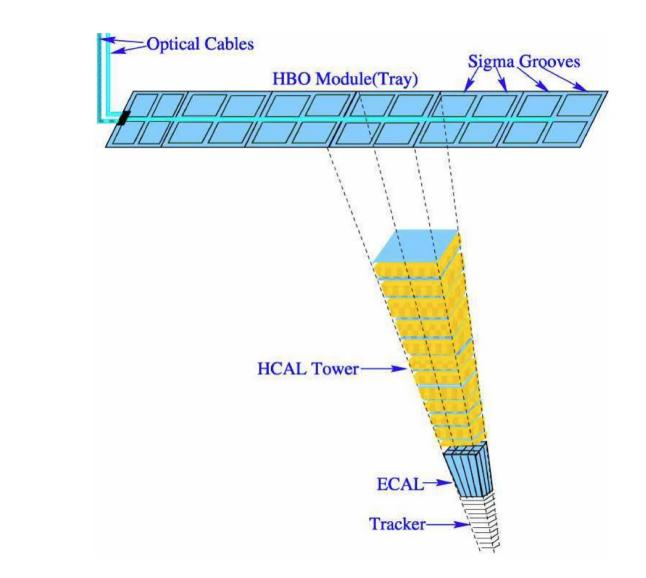
SiPM Operational Experience 45 in Outer HCAL in CMS



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What HO is used for:

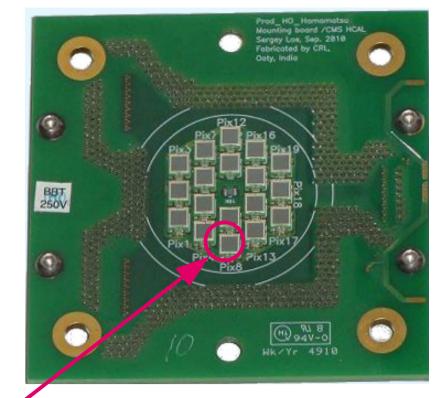
- Tail catcher behind the solenoid
- Improve ET measurement of jets leaking through the magnet
- Eventually useful for muon tagging

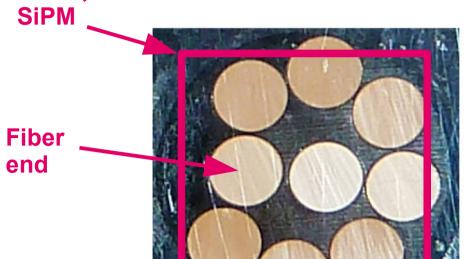
Detector technology:

- Scintillator with wavelength shifting (WLS) fibers in grooves with sigma shape
- Tile geometry matches the projected HCAL tower geometry
- Newly installed SiPMs replace the old HPDs
- → Readout chain remains untouched
- One mounting board comprises 18 SiPMs
- Peltier element on the backside of the PCB for temperature stabilization
- In ring 0 two layers of scintillator
 - \rightarrow More fibers
- \rightarrow Not all fibers fit on the SiPM surface
- Light mixer with specular surface distributes light over whole SiPM

Scintillator with WLS fiber and SiPM readout





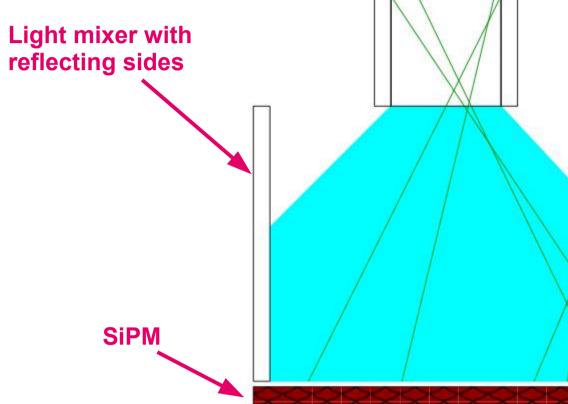


surface

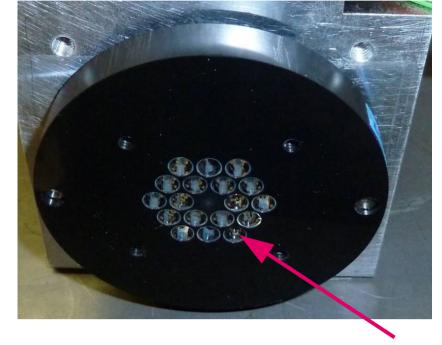
- \rightarrow Prevents loss of light at the SiPM sides
- \rightarrow Increases dynamic range of the SiPM

The installed SiPMs:

- Hamamatsu Multi-Pixel Photon Counter (MPPC)
- (3 x 3)mm² active area
- 50µm cell pitch
- SMD type
- Operating voltage O(70 V)
- Change of gain with temperature at foreseen operating point: -8%/K

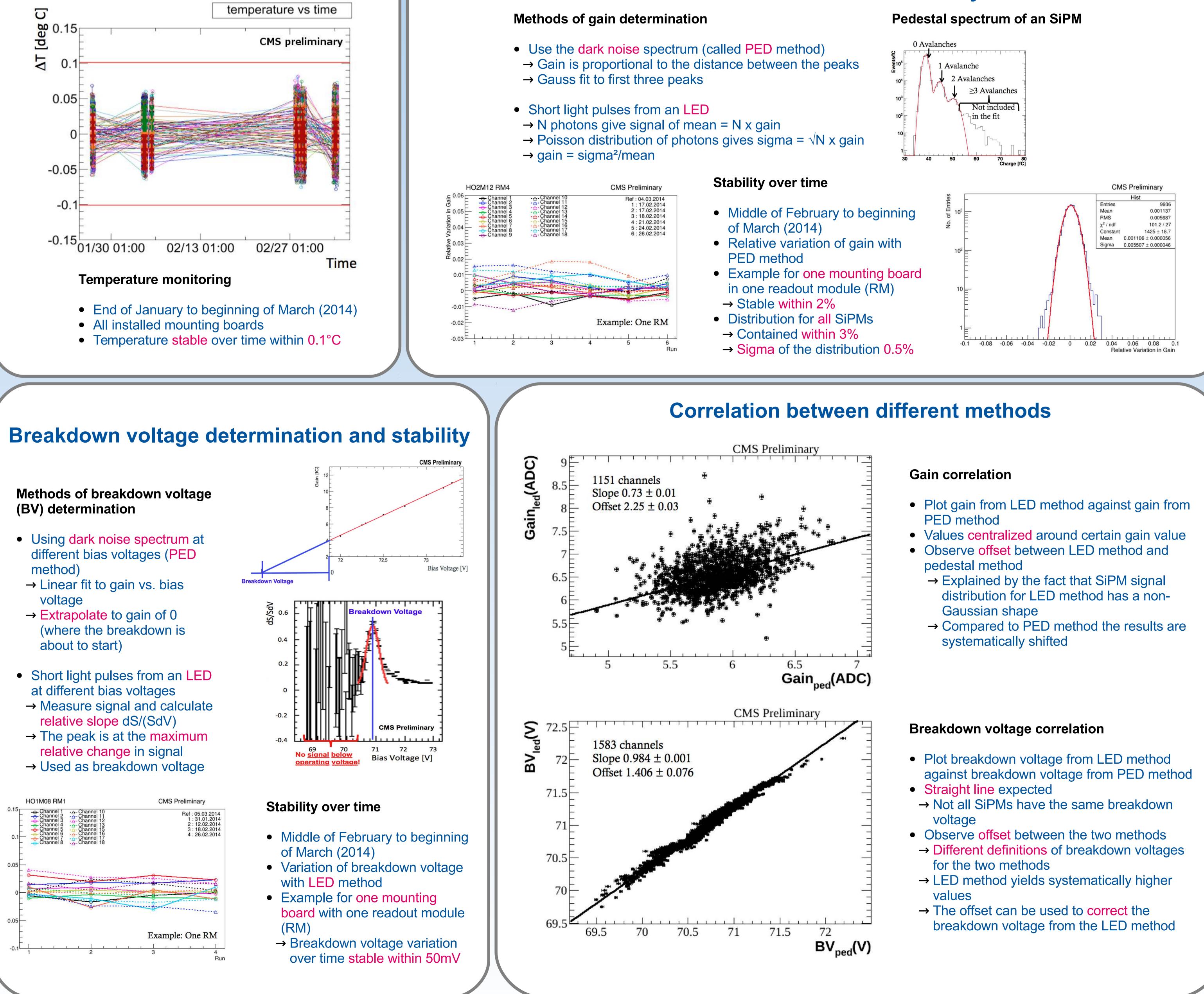






Light mixer

Temperature stability



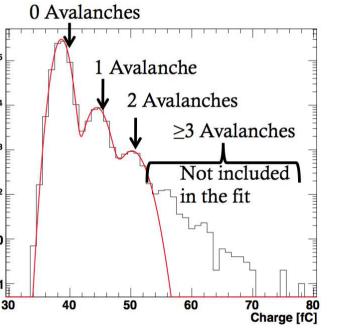
Gain determination and stability

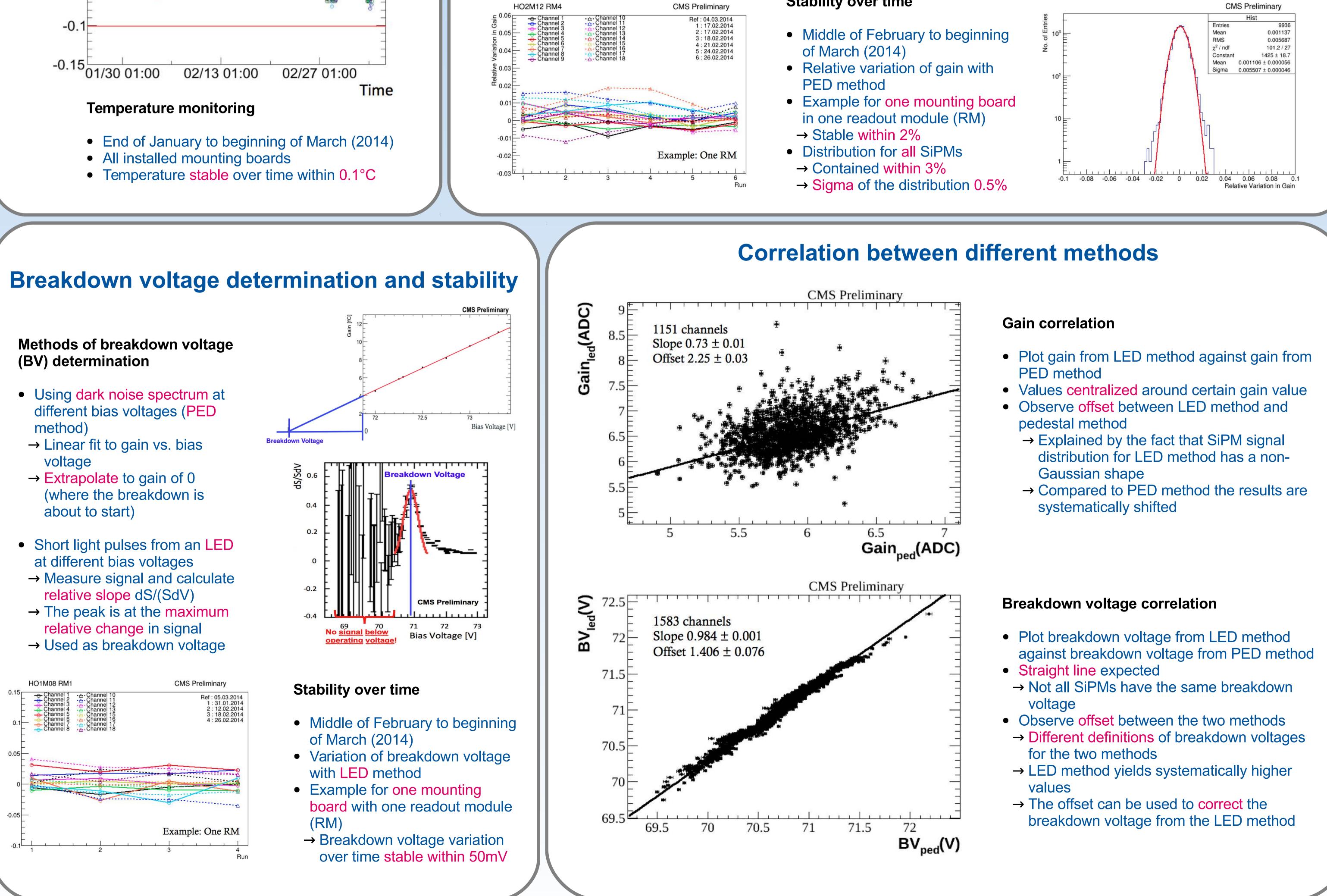
Scintillator

Fiber with

cladding

HO2M12 RM4			CMS Preliminary
iation in Gain	← Channel 1 ← Channel 2 ← Channel 3 ← Channel 3 ← Channel 4 ← Channel 5 ← Channel 6 ← Channel 7	- ☆ - Channel 10 - ☆ - Channel 11 - ☆ - Channel 12 - ☆ - Channel 13 - ☆ - Channel 13 - ☆ - Channel 14 - ☆ - Channel 15 - ☆ - Channel 16	Ref : 04.03.2014 1 : 17.02.2014 2 : 17.02.2014 3 : 18.02.2014 4 : 21.02.2014 5 : 24.02.2014





[1] Lutz B et al. (CMS HCAL Collaboration) 2012, J. Phys.: Conf. Ser. 404 012018