Characterization of NUV SiPM matrices for the full equipment of the pSCT camera proposed for the CTA Observatory

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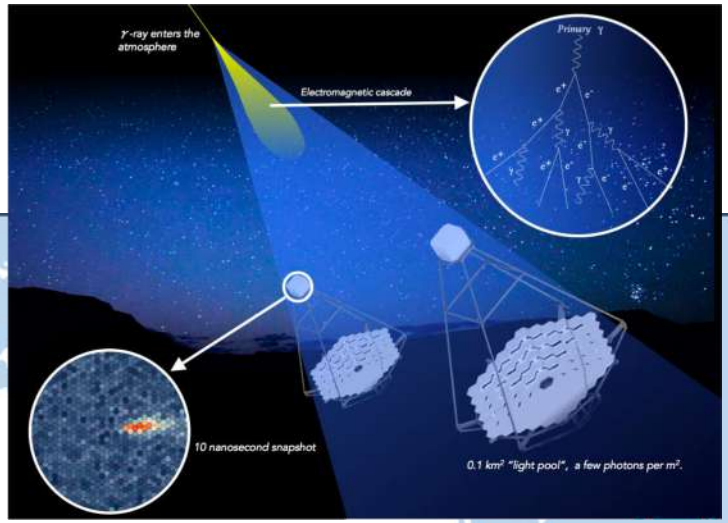
for the CTA-SCT Project

Gamma-ray detection with Cherenkov telescope array

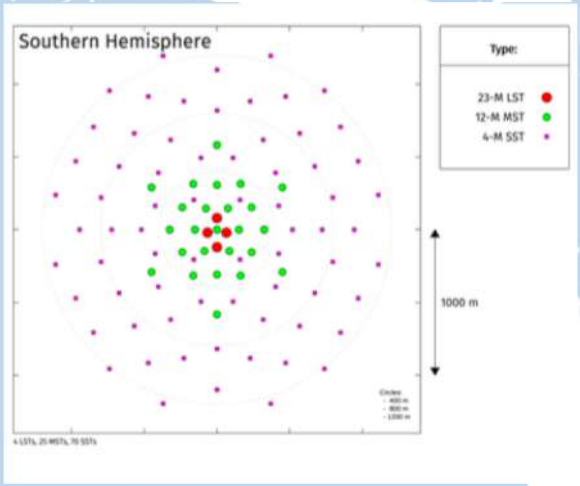
Observatory planned to be operated by 2025



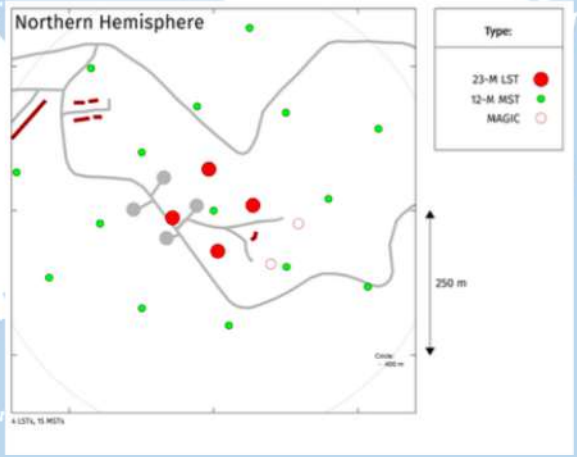
Chile

Cherenkov Telescope Array:

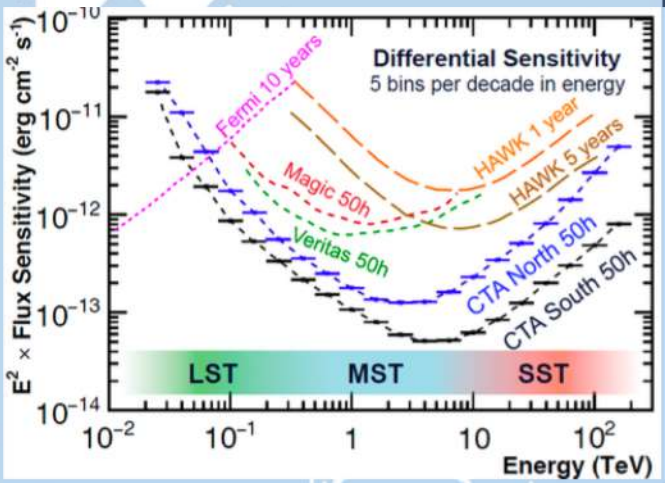
- 100+ telescopes involved
- Increased detection area
- Improved sensitivity
- 2 telescopes sites
- 3 sizes of telescopes



La Palma

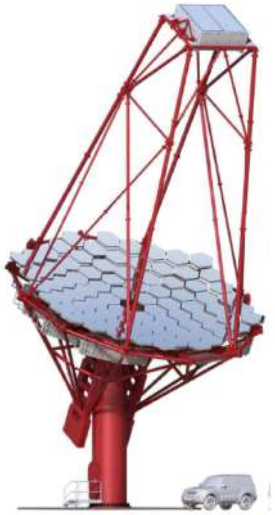


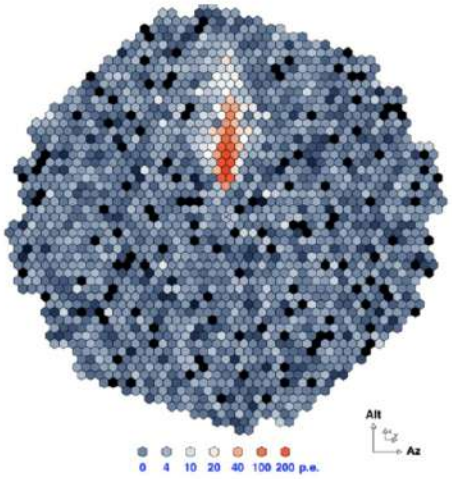
Energy range: 20 GeV-300 TeV

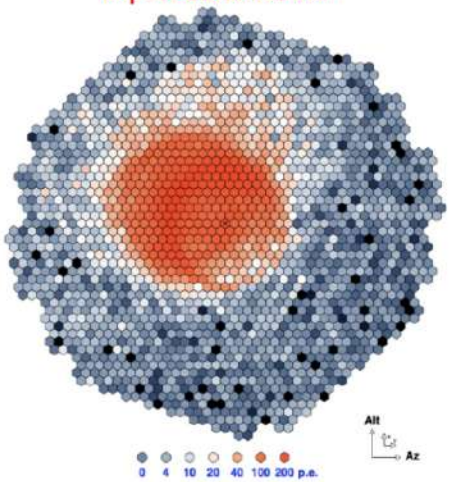


The Schwarschild Couder Telescope (SCT)

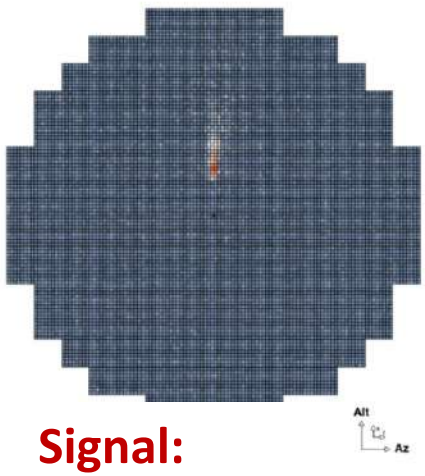
MST
Single mirror
Davies-Cotton
~ 2k PMTs

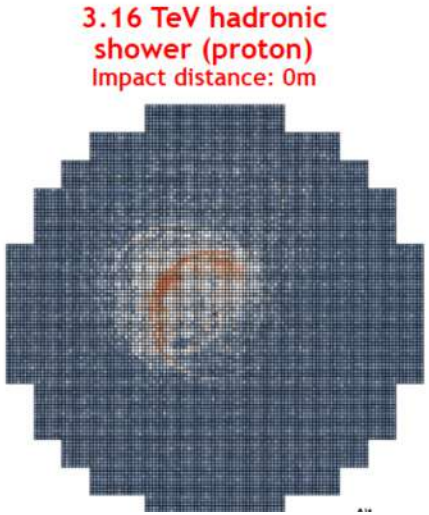






SCT
Double mirror
Schwarzschild-Couder
~ 12k SiPMs



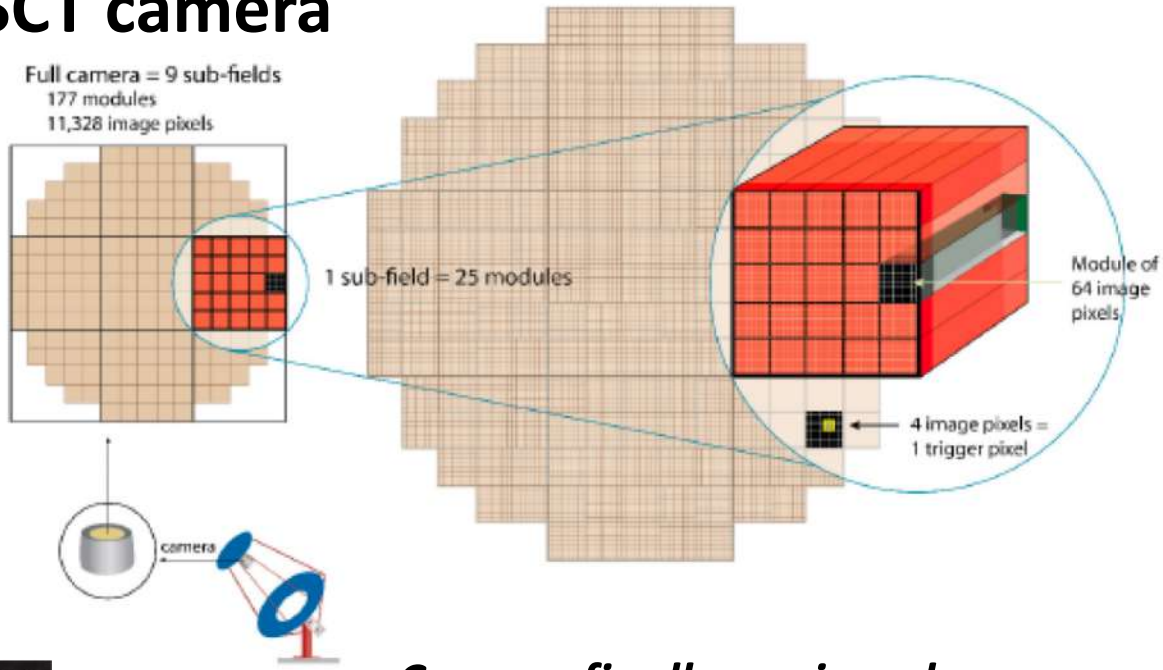


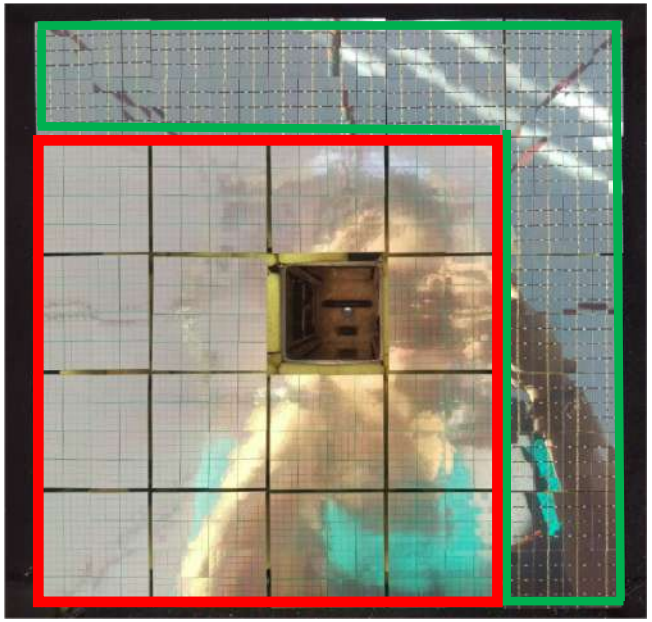
Signal:
γ-ray Shower

Background
proton shower

pSCT camera

177 modules (64 pixels)



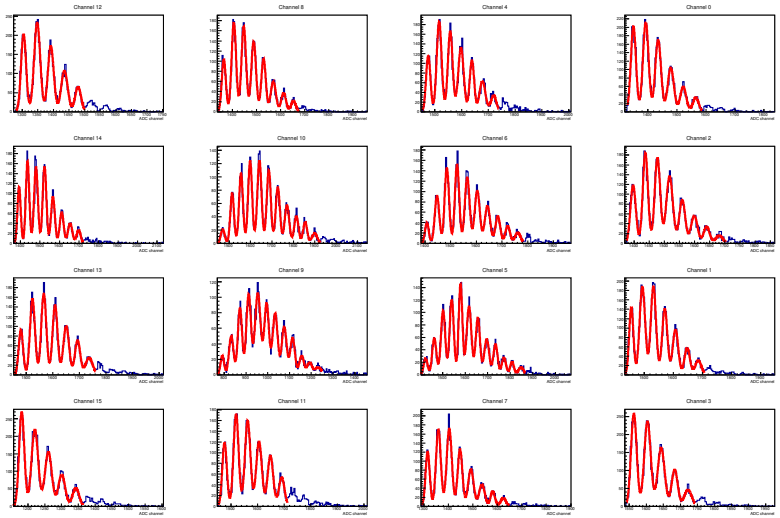


Camera finally equipped

- **15 modules equipped with Hamamatsu MPPC**
- **9 modules equipped with FBK HD-3 SiPMs (top and right corner)**
- Central module removed to allocate a special module for the telescope pointing procedure

FBK matrices quality check

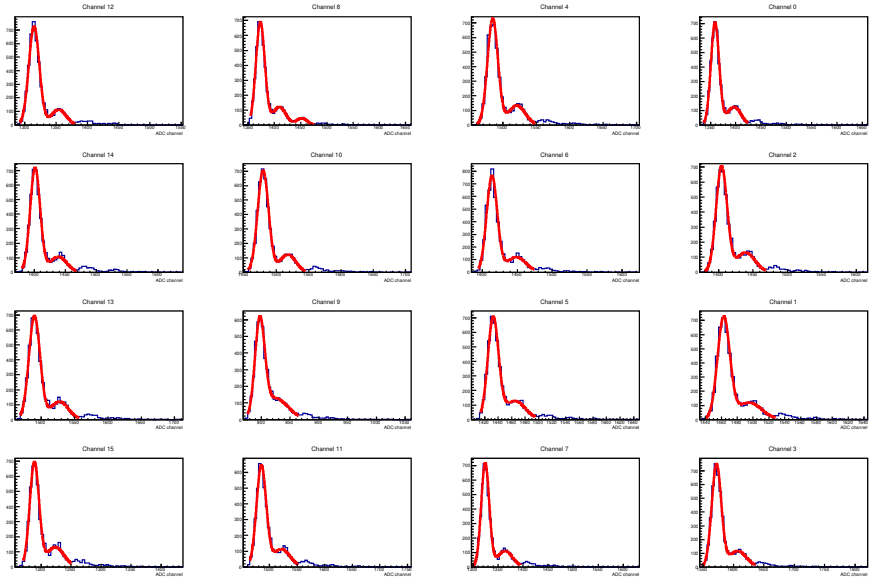
NUV-HD3 single 6 x 6 mm^2 SiPM arranged in 4 x 4 matrices



50 matrices characterized

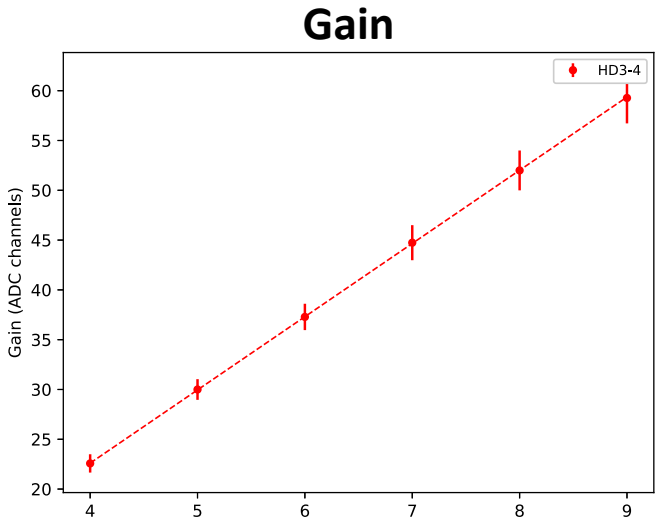
Matrices characterized covering the voltage range 31-36 V

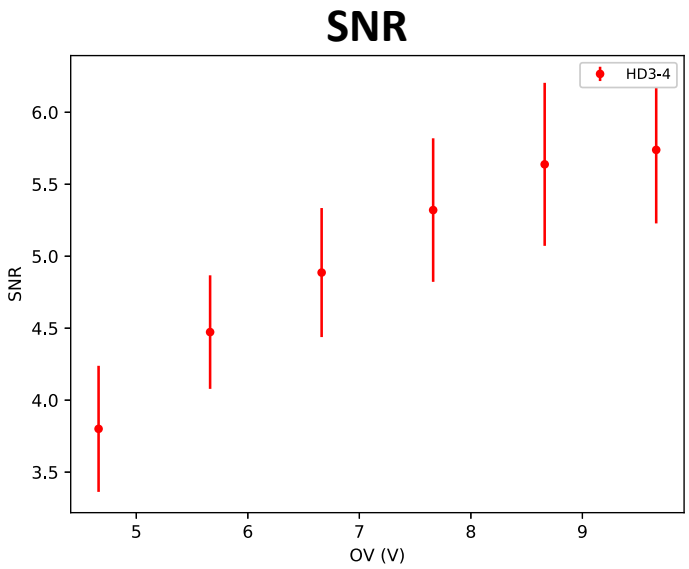
Under dark conditions

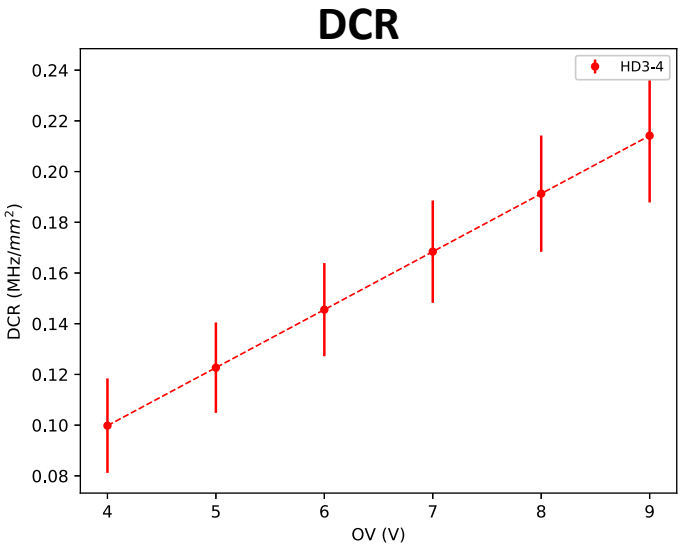


Gain, SNR and DCR

Gain, SNR and DCR mean over all the pixel tested as a function of OV

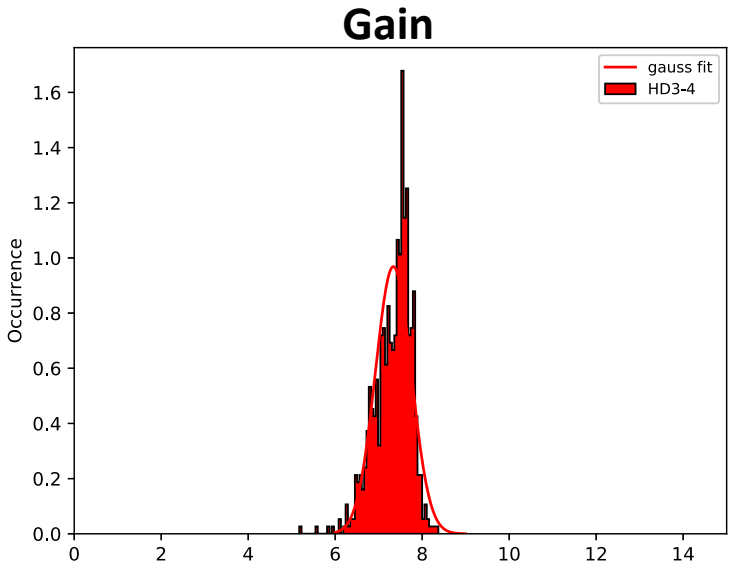


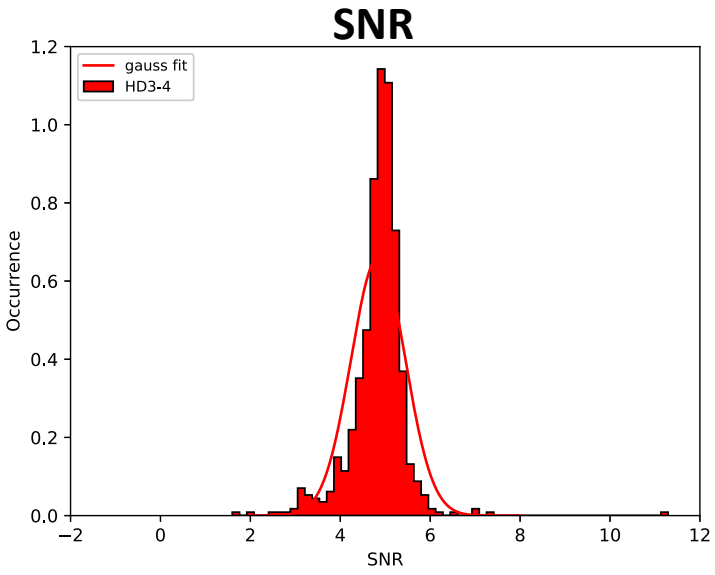


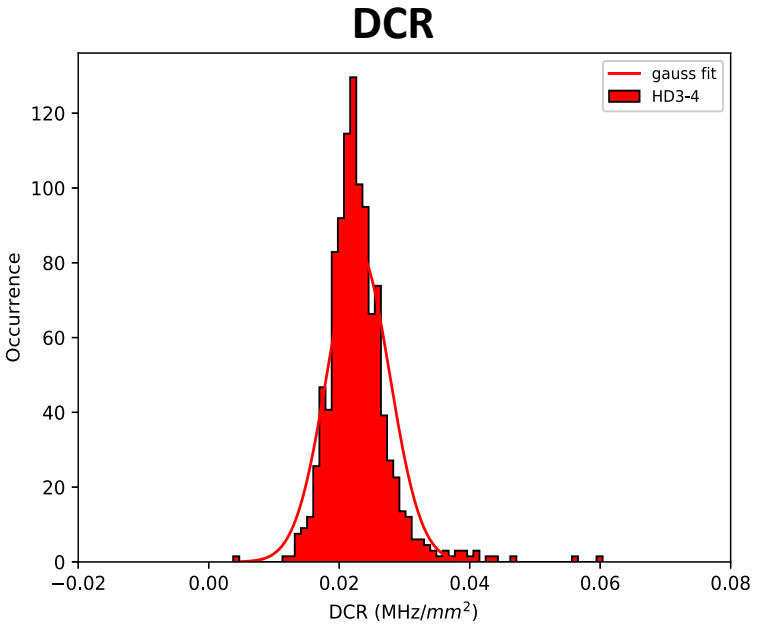


Gain, SNR and DCR

Gain, SNR, DCR distributions per over-voltage unit of the HD3-4 matrices







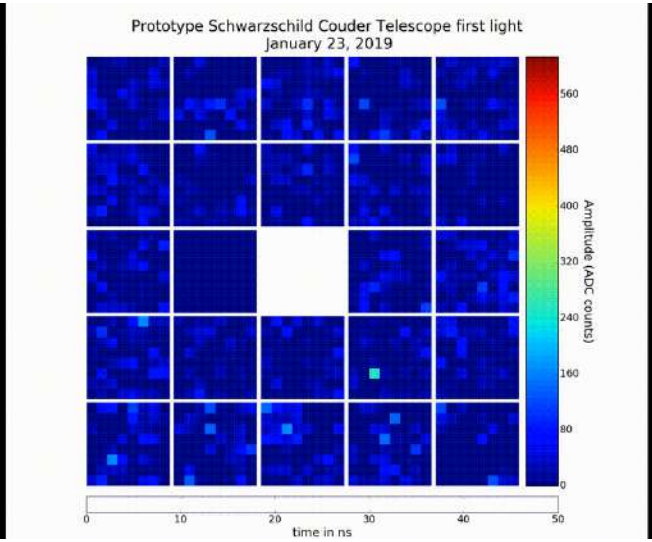
pSCT Inauguration

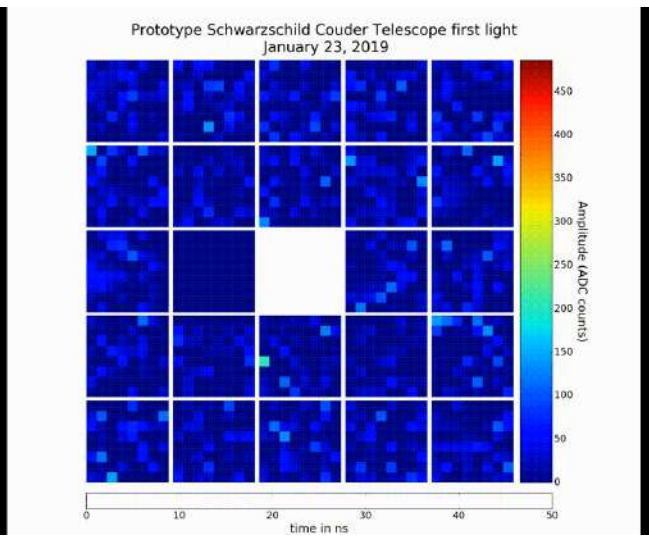
Fred Lawrence
Whipple Obs.
Amado, AZ(USA)
January 17-18 2019

Camera turned on and first light after few days

(mirrored image compared to the photos shown before)

https://www.cta-observatory.org/sct-first-light/

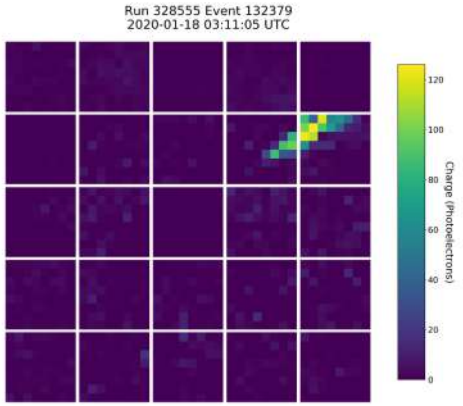




Crab Observations

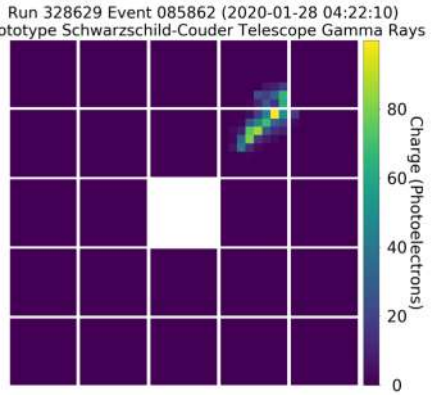
- 48 Crab runs taken between 18 January and 26 February 2020
- Total Livetime
  - 22.81 hours ON Crab
  - 19.15 hours OFF Crab

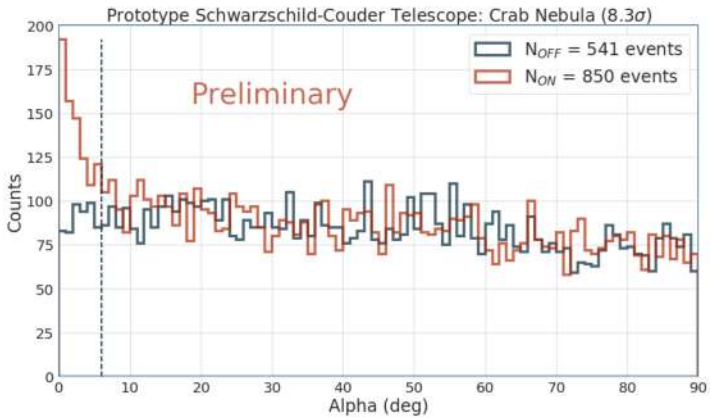
- First pSCTgamma ray event seen on 18 January 2020



Use the T4/pSCT matched dataset to derive selection cuts.

- On Jan 28th, 3 hours of Crab observations were taken in coincidence with VERITAS





Conclusions & Future perspectives

- Crab detected
- Additional 25 FBK modules (1600 pixels) with optimized electronic, that will consist in new (TARGET-C + T5TEA + SMART): pre-amp, digitization and trigger on different ASICs (second half 2021)
- Completion of an entire FBK modules focal plane (177 modules, end 2021)