

The Cherenkov Telescope Array

IMAGE ANALYSIS TECHNIQUES AND COMMISSIONING OF THE GCT CAMERA

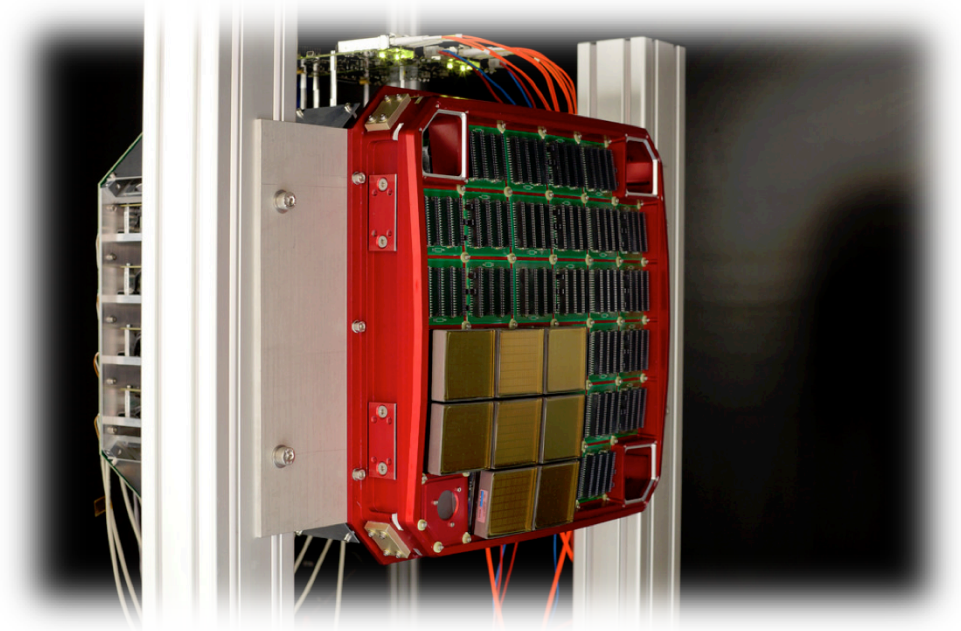
JASON WATSON

UNIVERSITY OF OXFORD

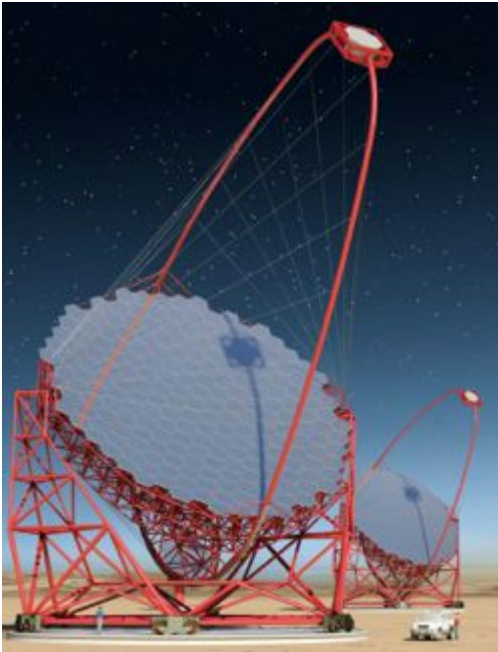
D.PHIL SUPERVISOR: DR. GARRET COTTER

FERMI SUMMER SCHOOL 2015

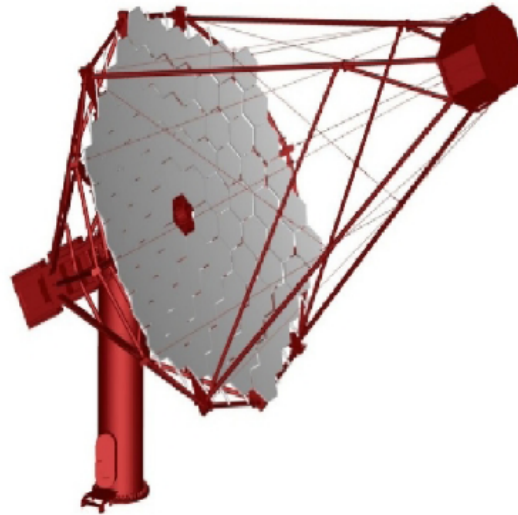
1 JUNE 2015



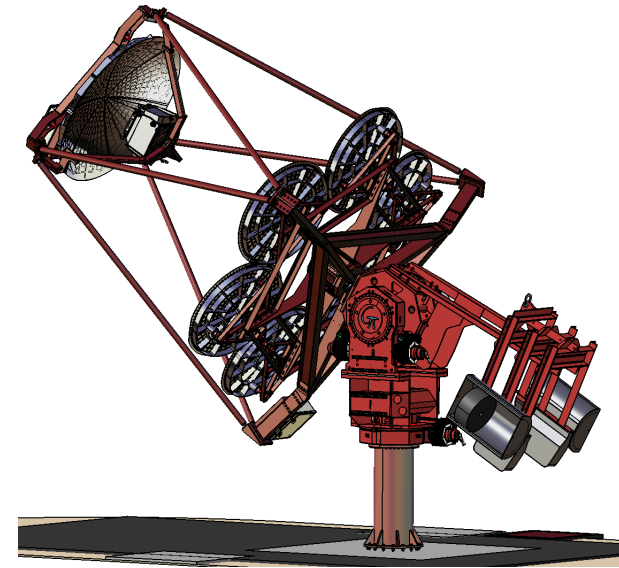
Large Size Telescope (LST)



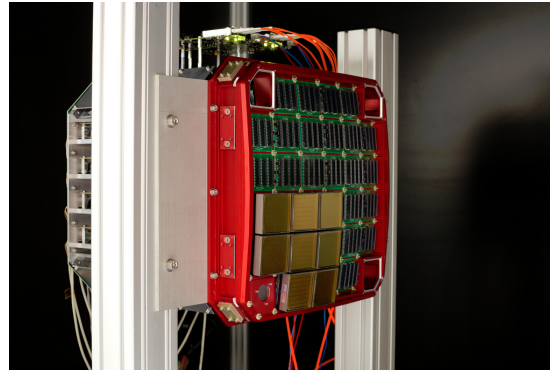
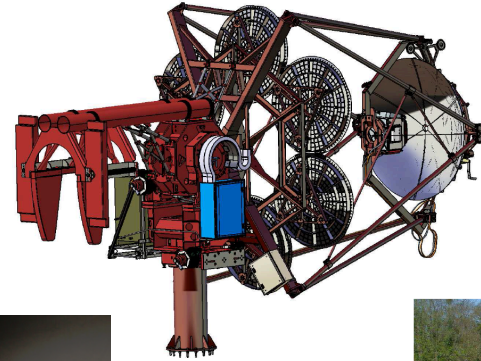
Medium Size Telescope (MST)



Small Size Telescope (SST)



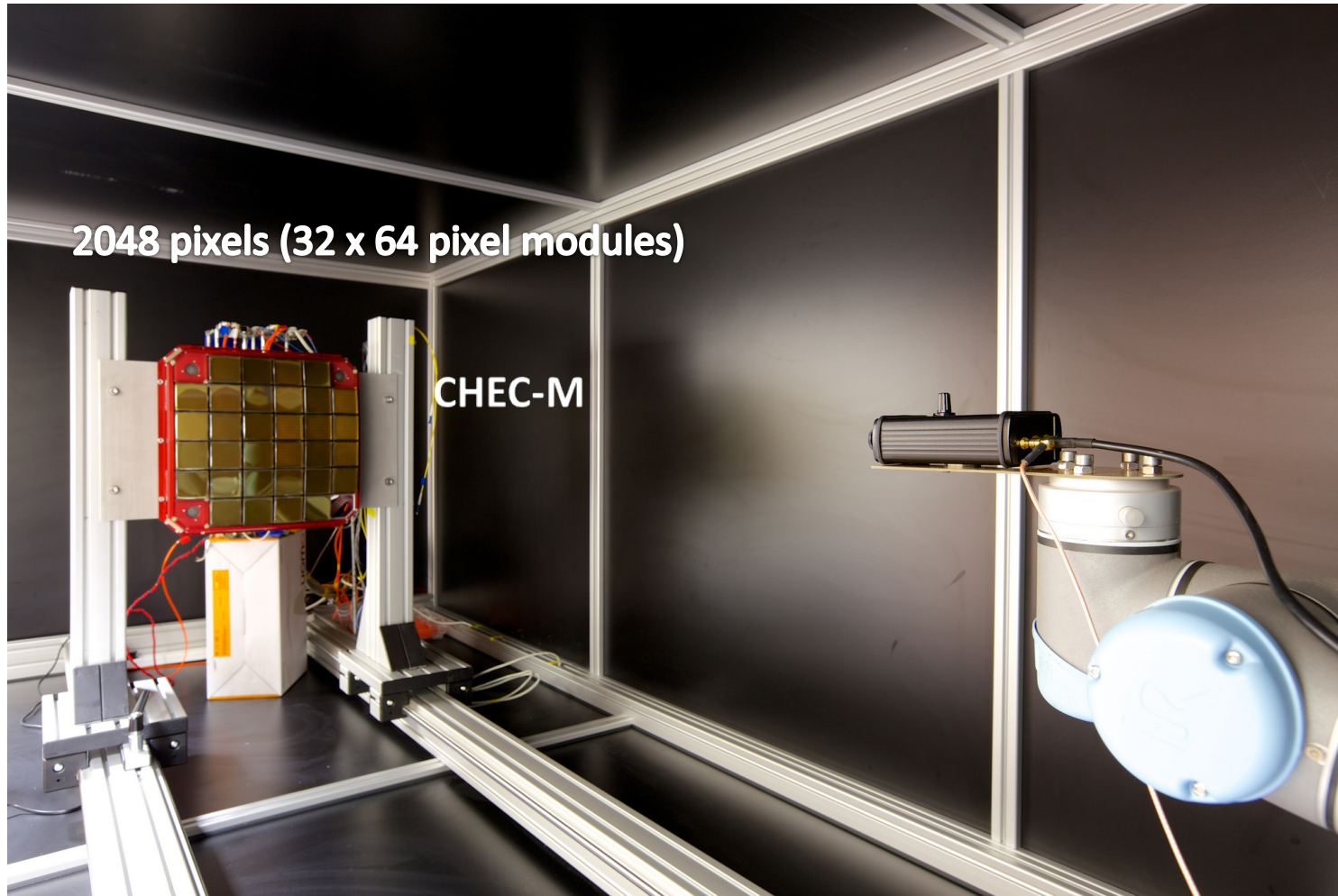
Small Sized Telescopes

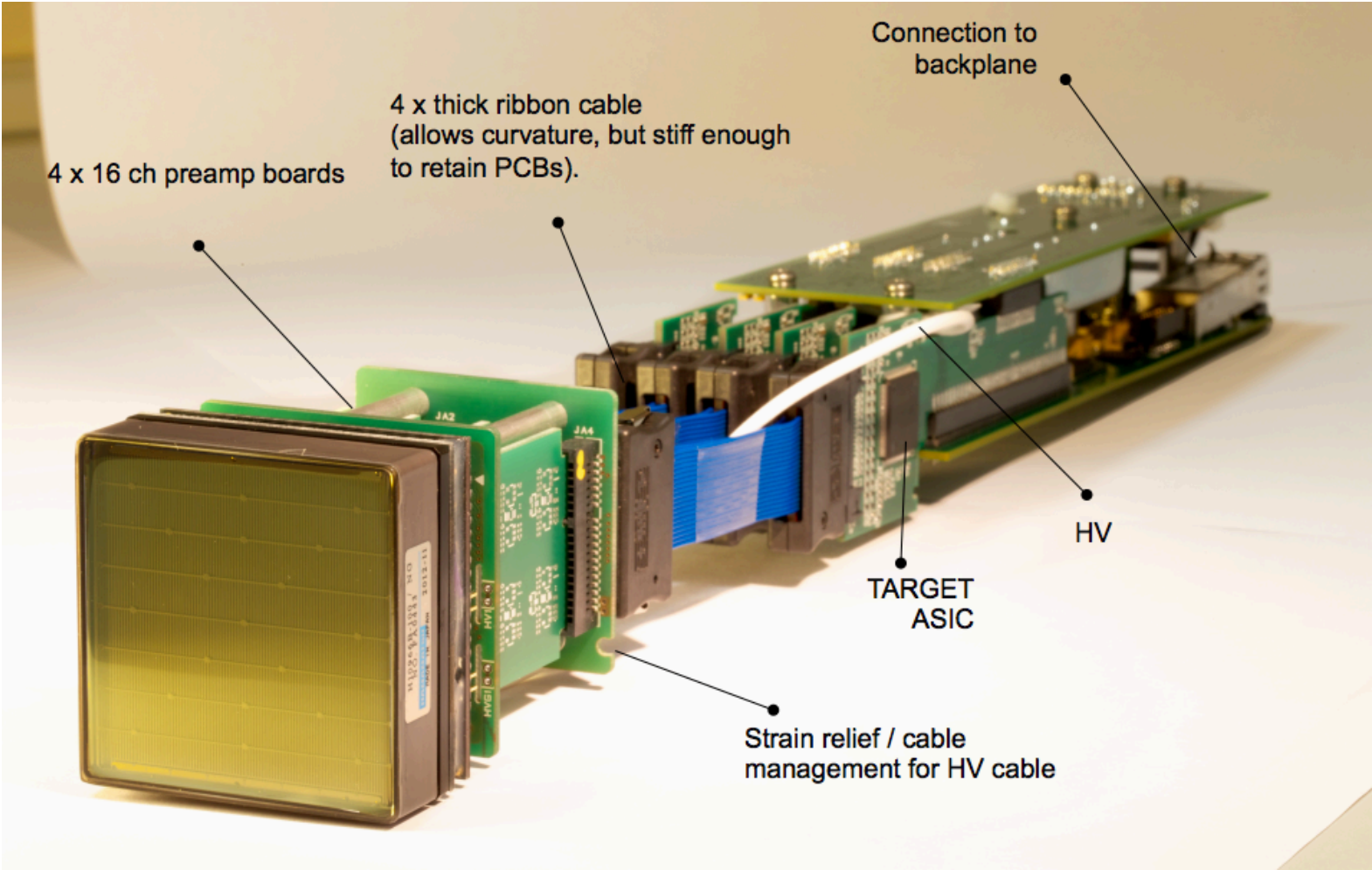


GCT

GATE-CHEC Telescope
Gamma-ray Cherenkov Telescope

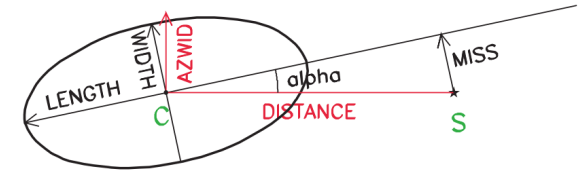
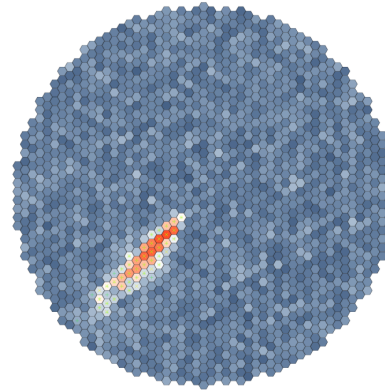
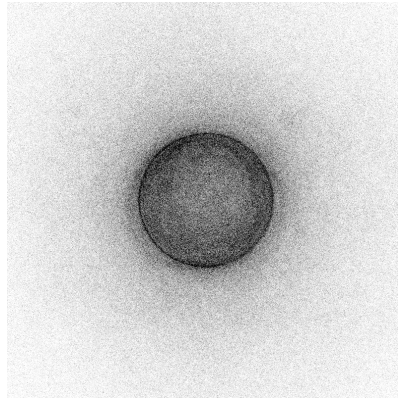
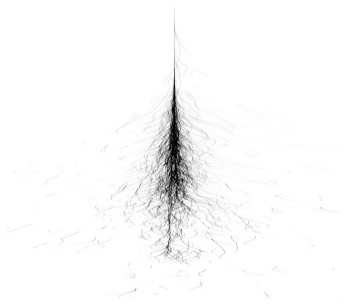
CHEC-M Commissioning





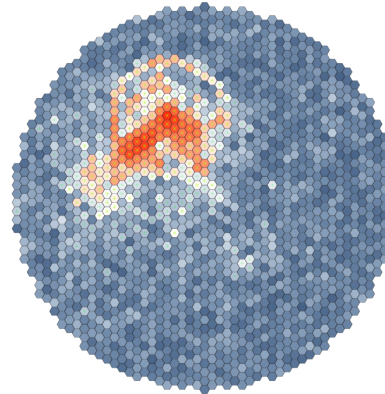
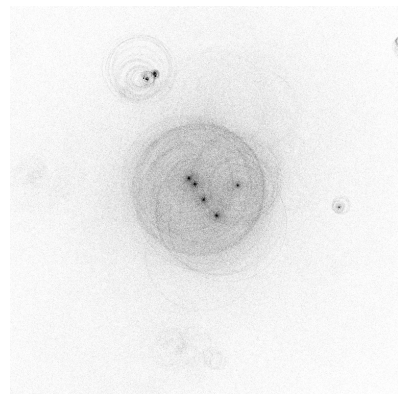
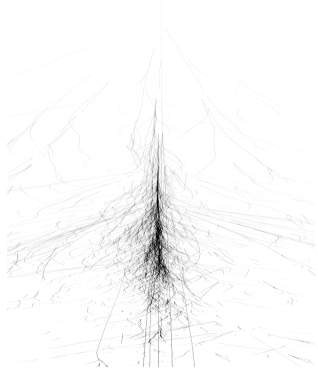
CHEC-M MAPM: Hamamatsu H10966B

Gamma



C image centroid S potential source

Hadronic



- Hadronic initiated shower 10^4 more frequent
- Undesirable due to their deflection from magnetic fields in journey from source
- Background rejection based on different image shape

➤ Funding in place for 2 prototype cameras

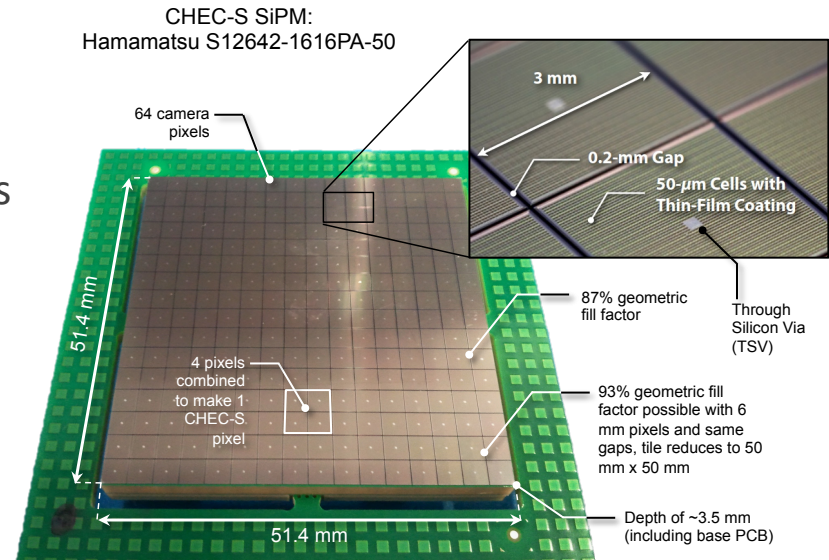
➤ SiPMs have many advantages over MAPMs including:

- Resistance to high light levels allowing observations under moonlight
- Excellent Pulse Height resolution
- Low voltage operation (20 – 100 Volts)

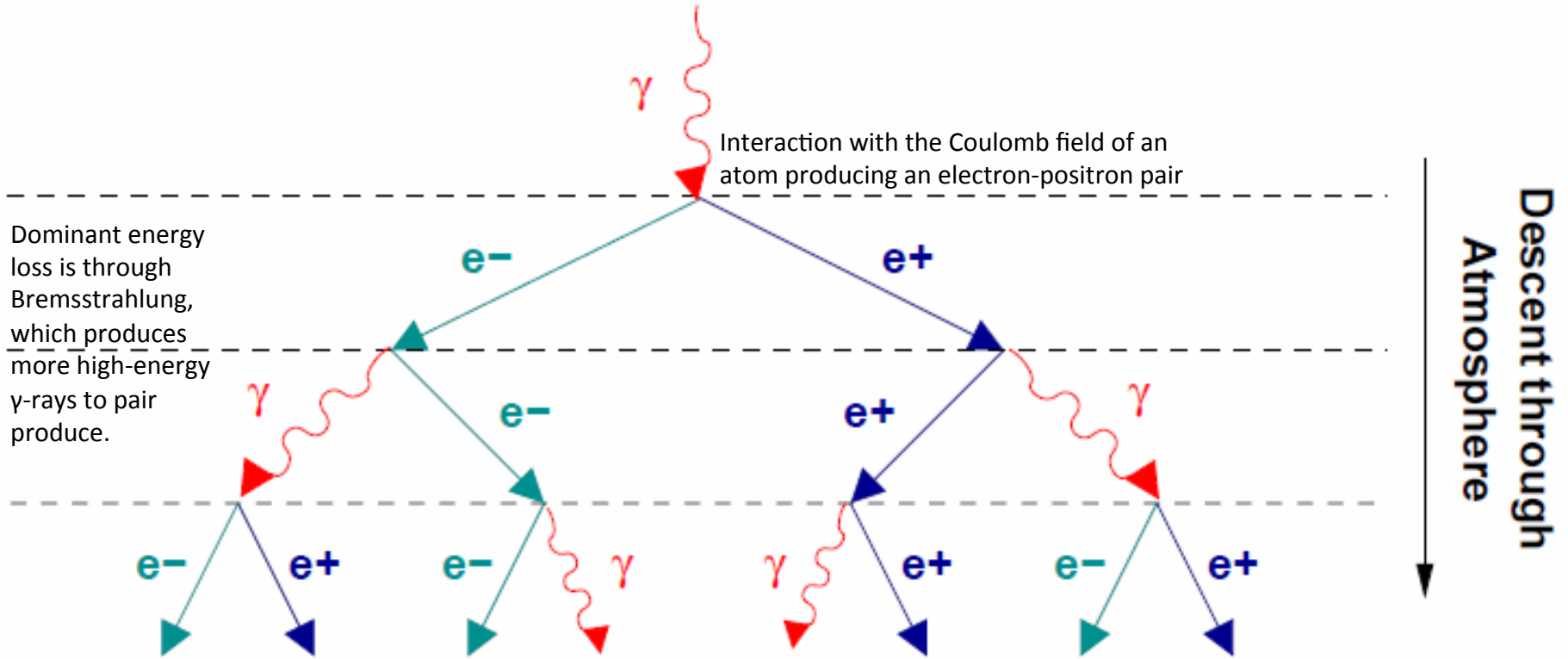
➤ SiPMs require different considerations:

- Much wider pulse shape – pre-amp must shorten SiPM pulses
- Cross-talk - Important to consider for Cherenkov telescopes, can give NSB high amplitudes

➤ Building of CHEC-S prototype to start in November



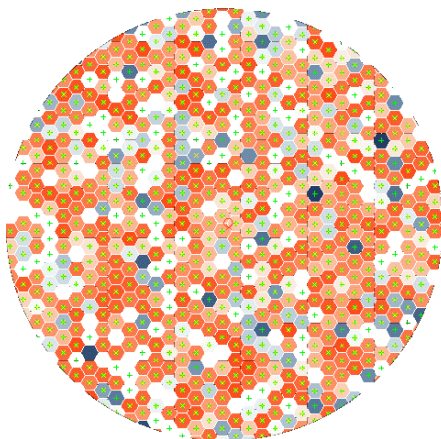
Particle Showers



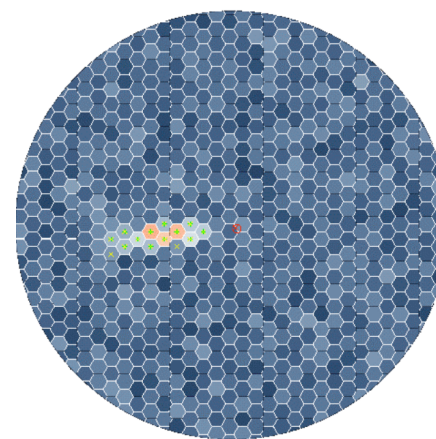
Particles travel superluminally in the atmosphere and hence emit Cherenkov radiation

Night Sky Background (NSB)

100 μ s

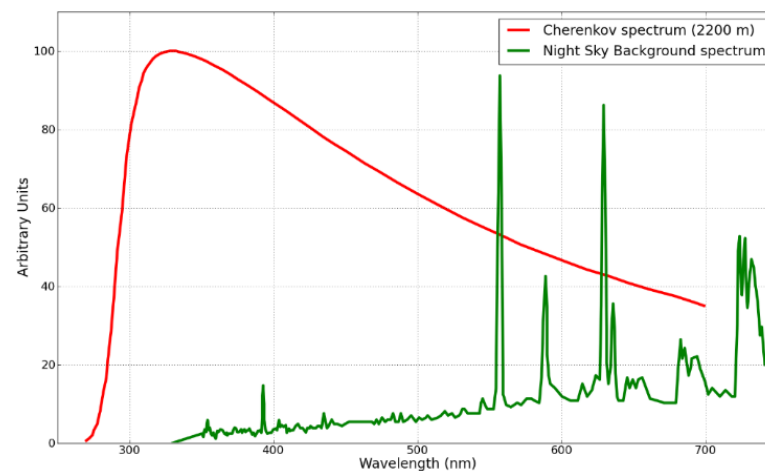


10 ns



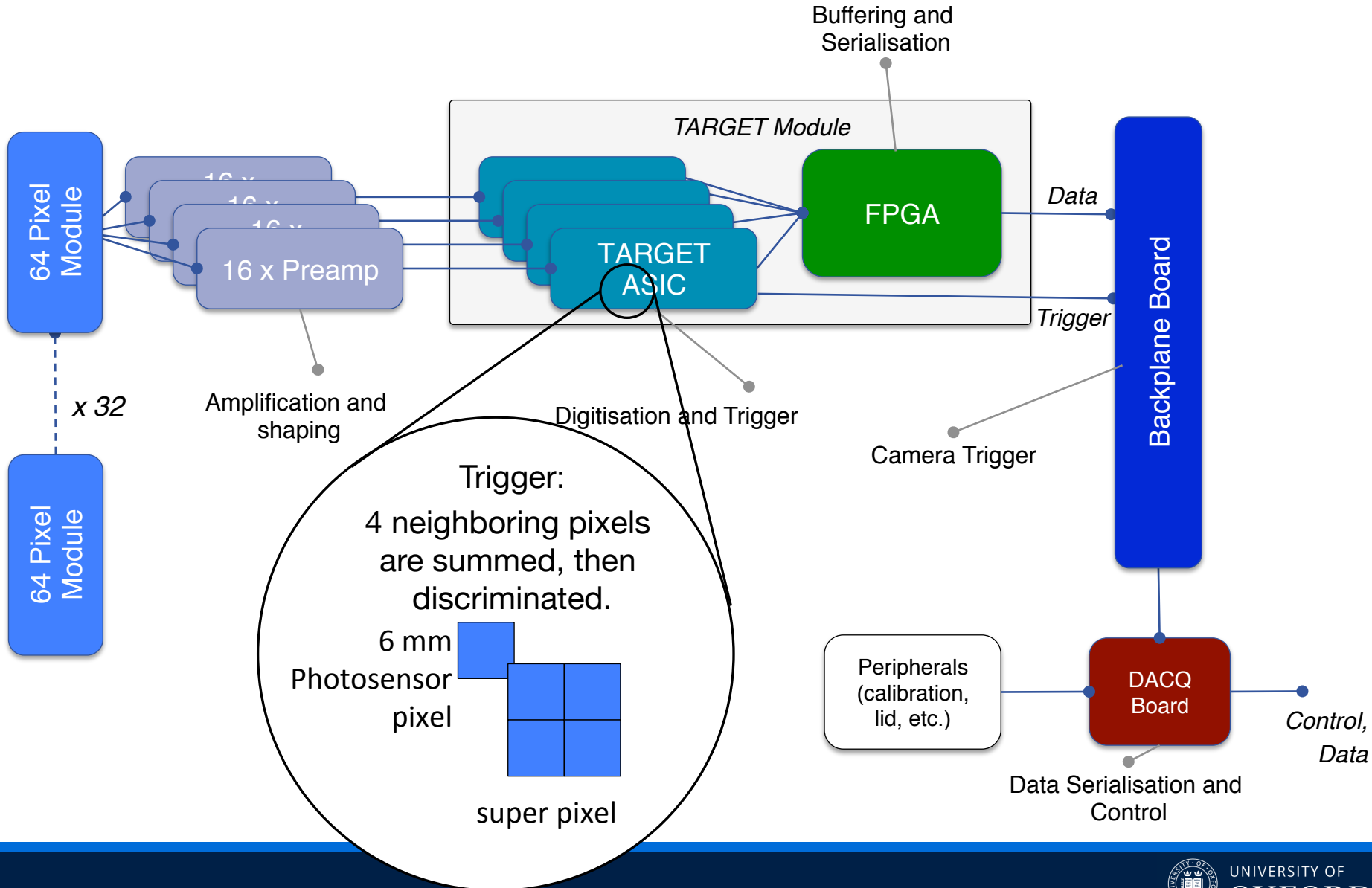
(W. Hofmann, HESS)

- 0.2 Gamma-rays year⁻¹ m⁻² at 1 TeV
- 12 MHz NSB pixel⁻¹
- Flash duration of individual shower \sim 5 ns
 - Very fast trigger required to reject NSB

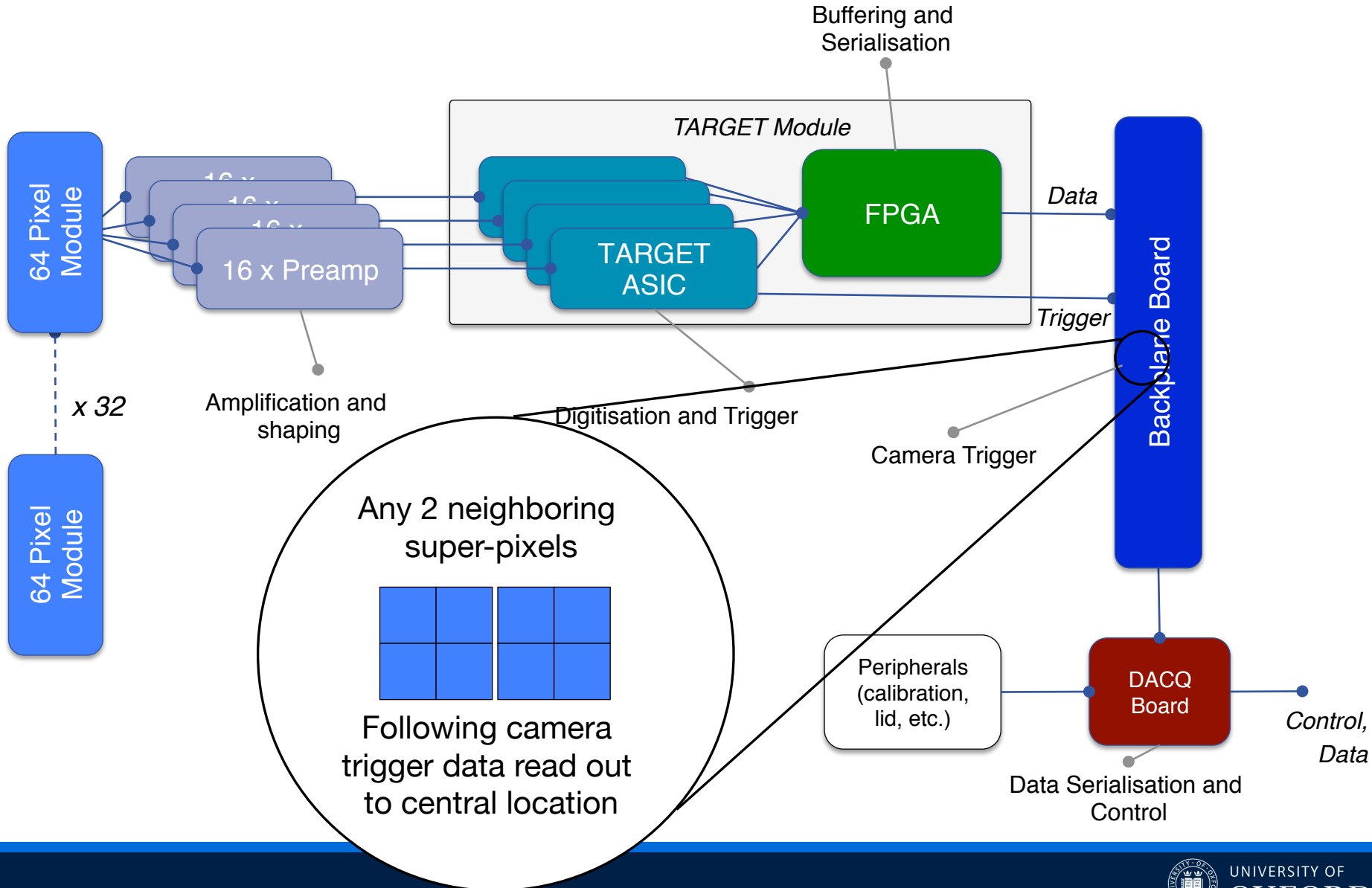


(A. Bouvier et al. 2013)

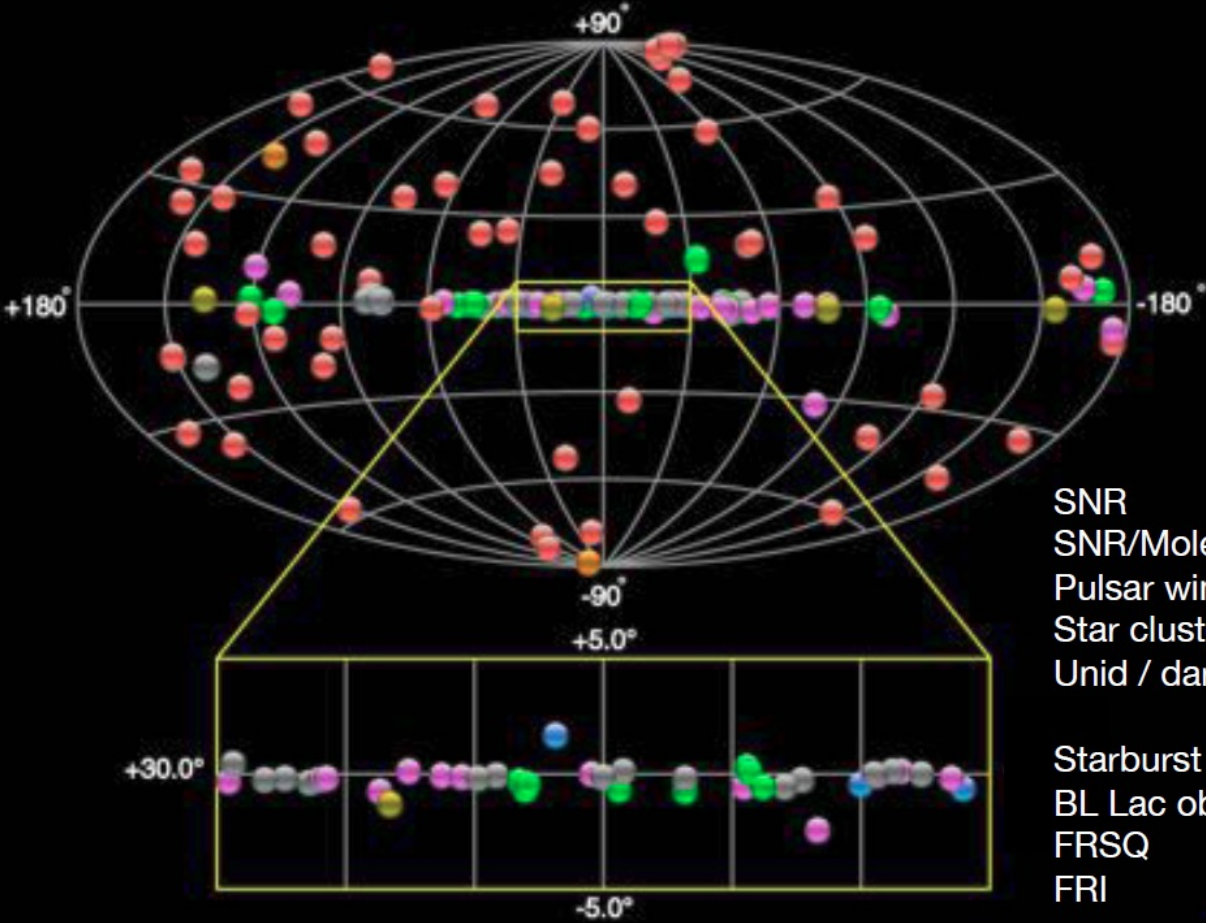
Trigger



Trigger



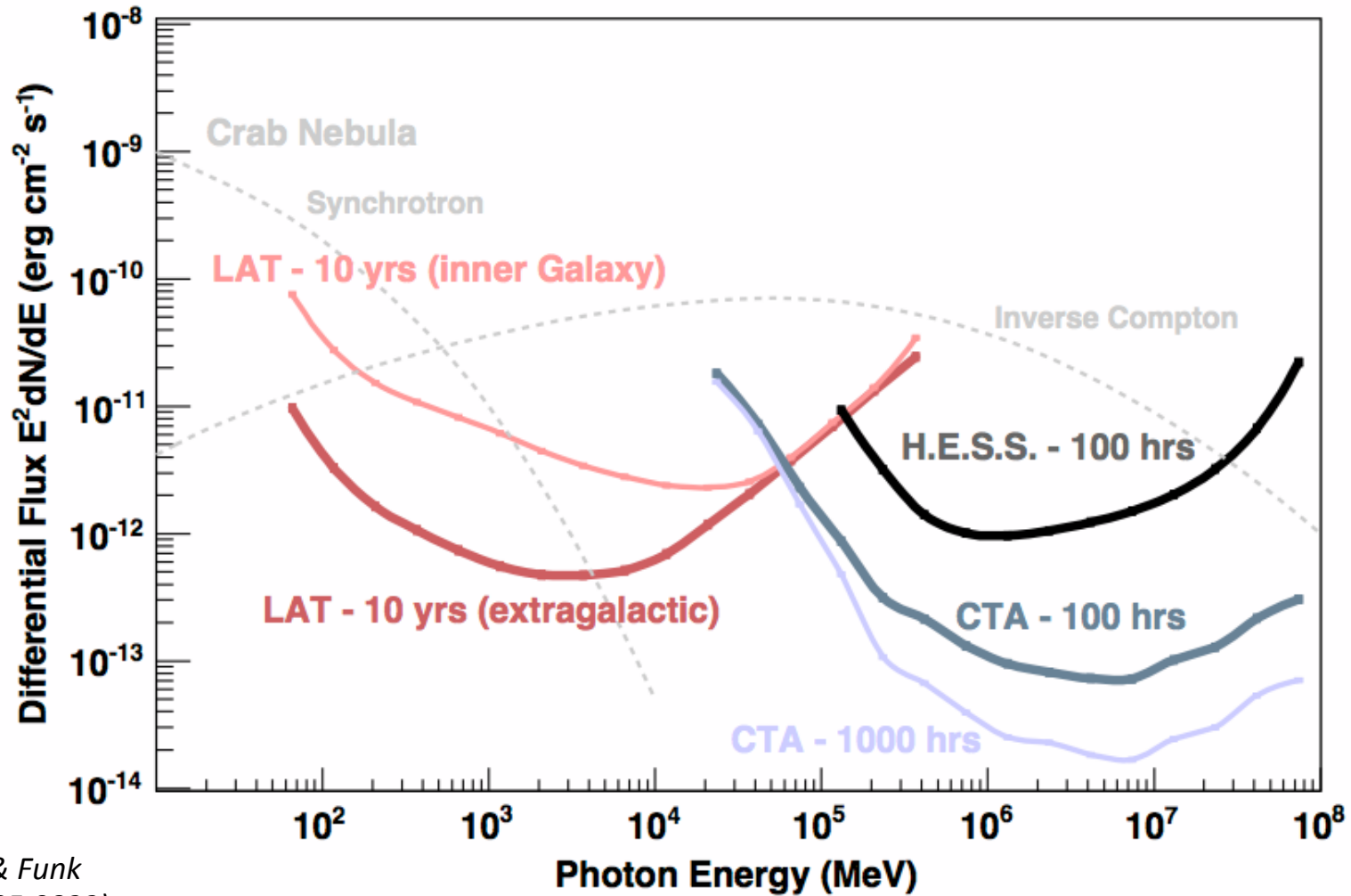
THE VERY HIGH ENERGY GAMMA RAY SKY



- SNR
- SNR/Molec. clouds
- Pulsar wind nebulae
- Star clusters
- Unid / dark sources

- Starburst galaxies
- BL Lac objects
- FRSQ
- FRI

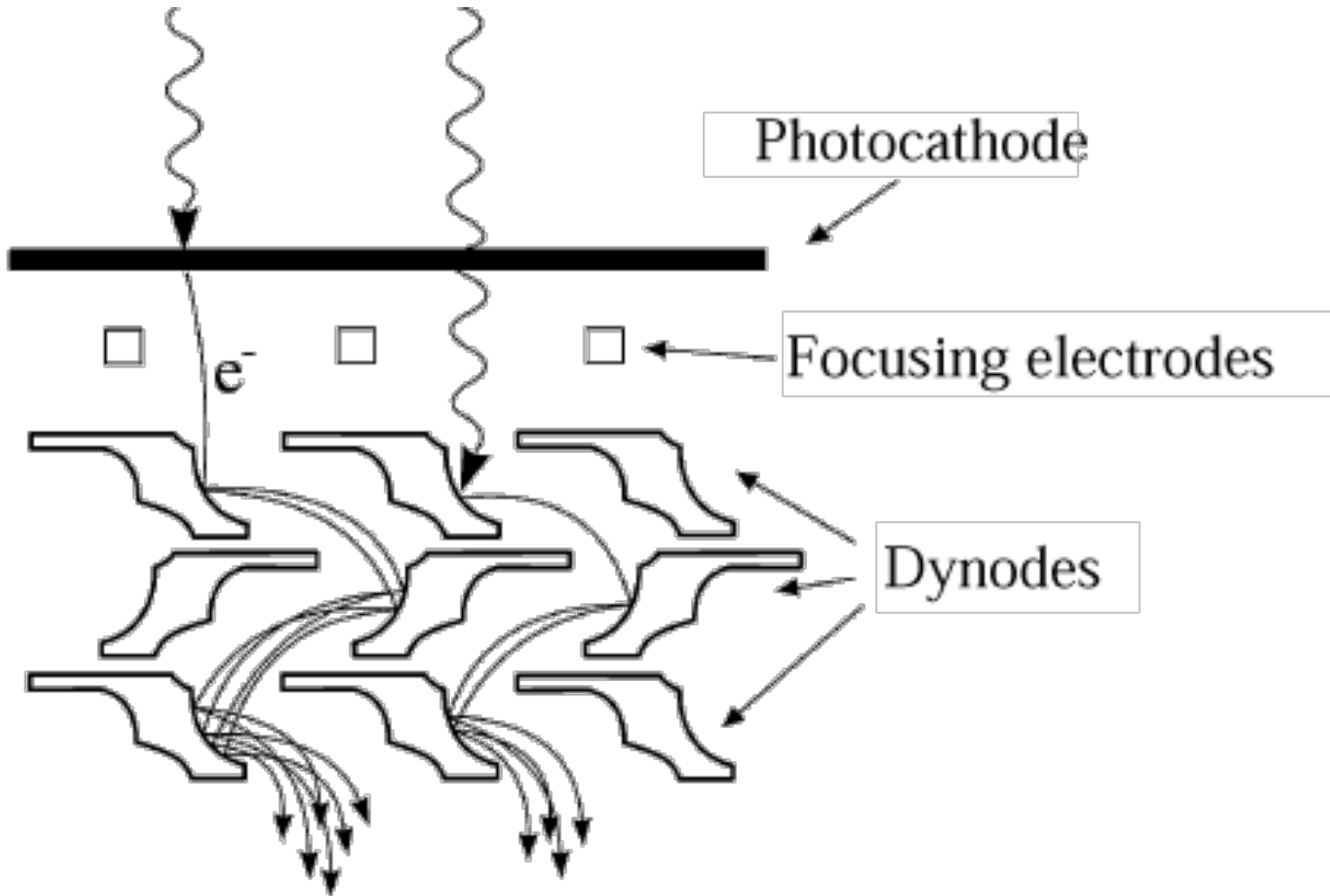
Sensitivity

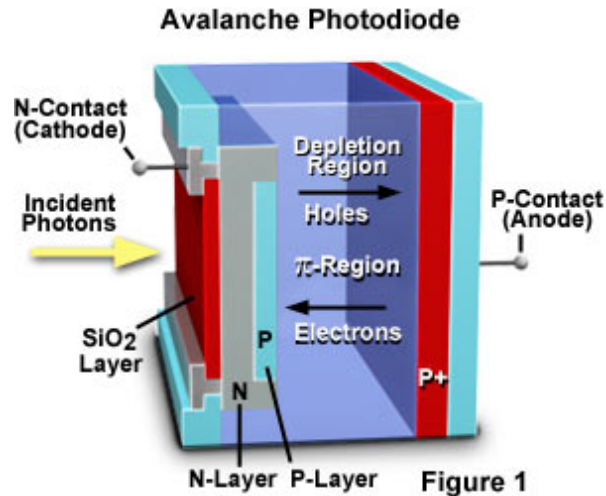


(Hinton & Funk
arXiv:1205.0832)



Multi-Anode Photomultipliers (MAPMs)





- Each pixel is a reverse biased PN-junction
 - (a boundary or interface between two types of semiconductor material, p-type and n-type)
- Photon or thermal excitation in the depleted region will produce a pair of charge carriers (electron-hole)
- Through impact ionization this can trigger an electron-hole avalanche saturating the active area.

