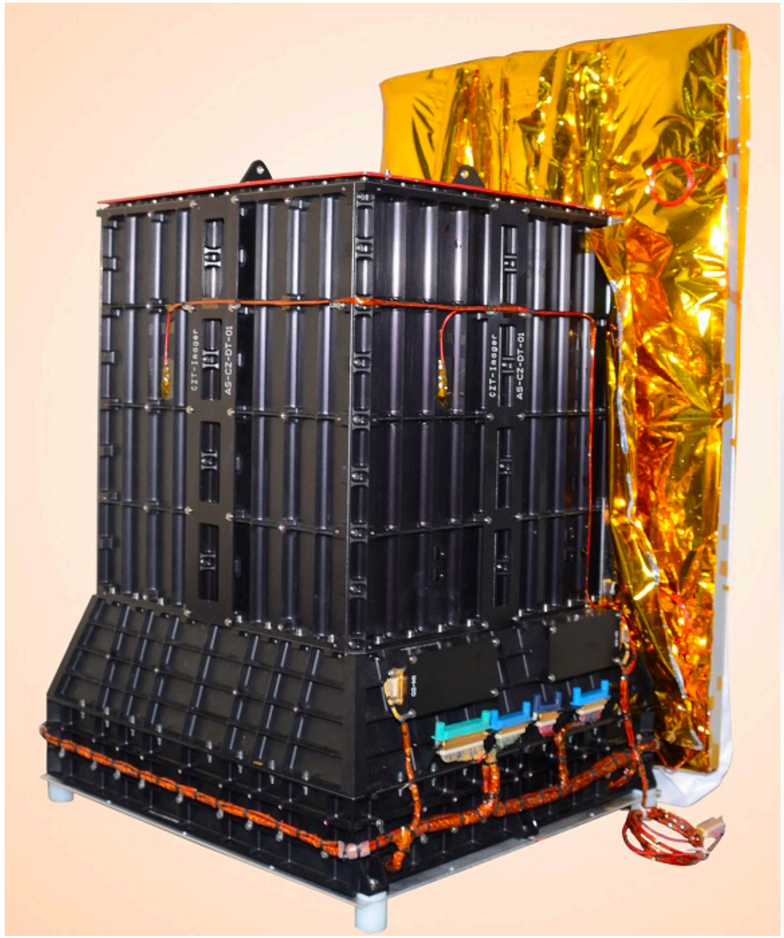
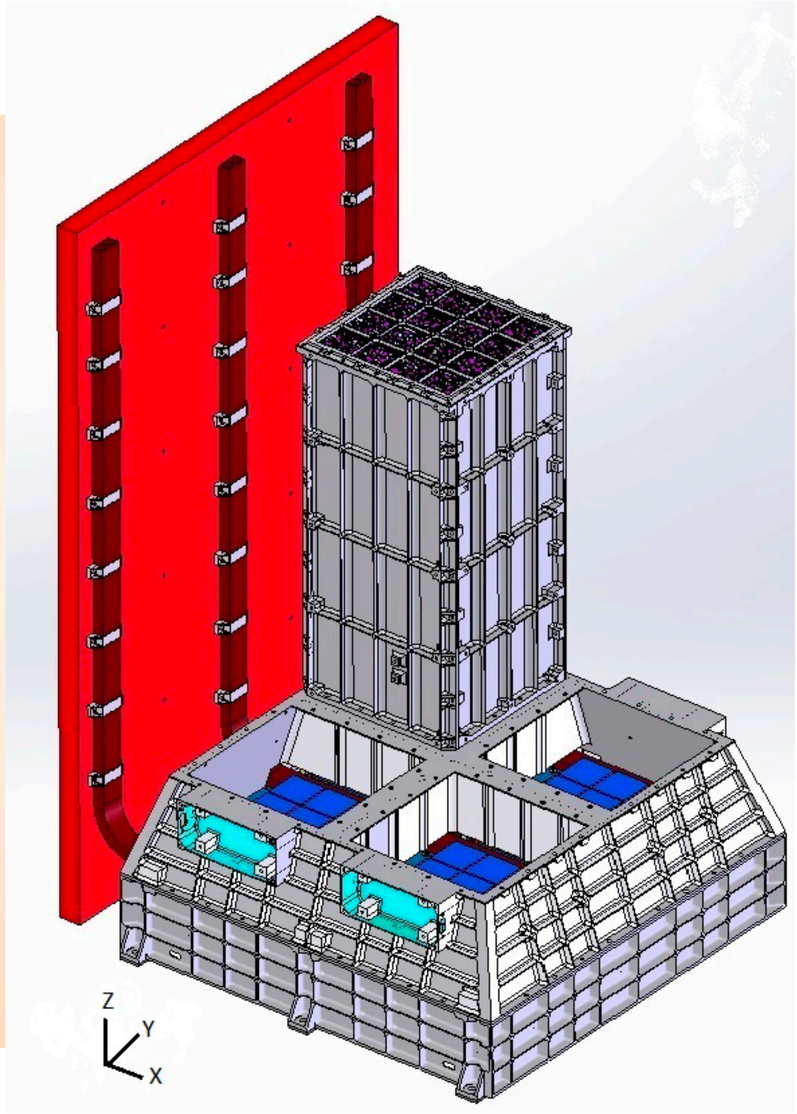
CZTI Calibration

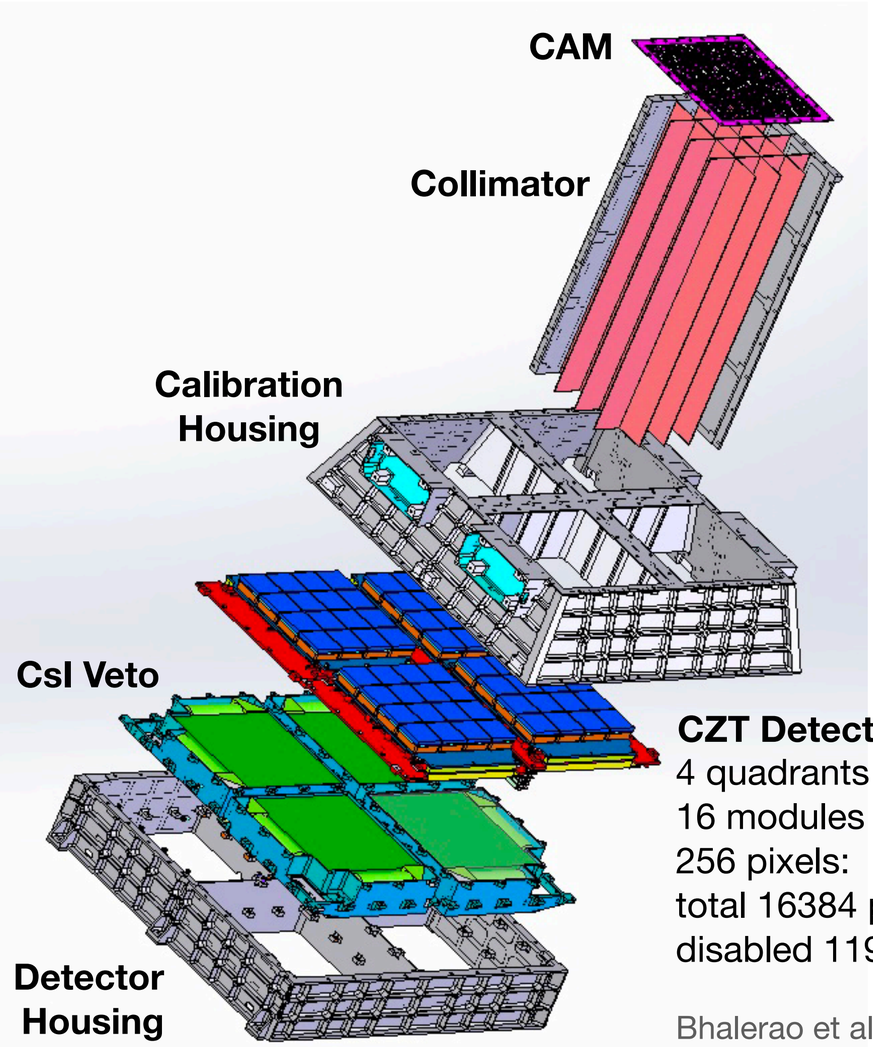
Introduction, Imaging and Timing calibration

Dipankar Bhattacharya 24 August 2022

The CZT Imager on board AstroSat







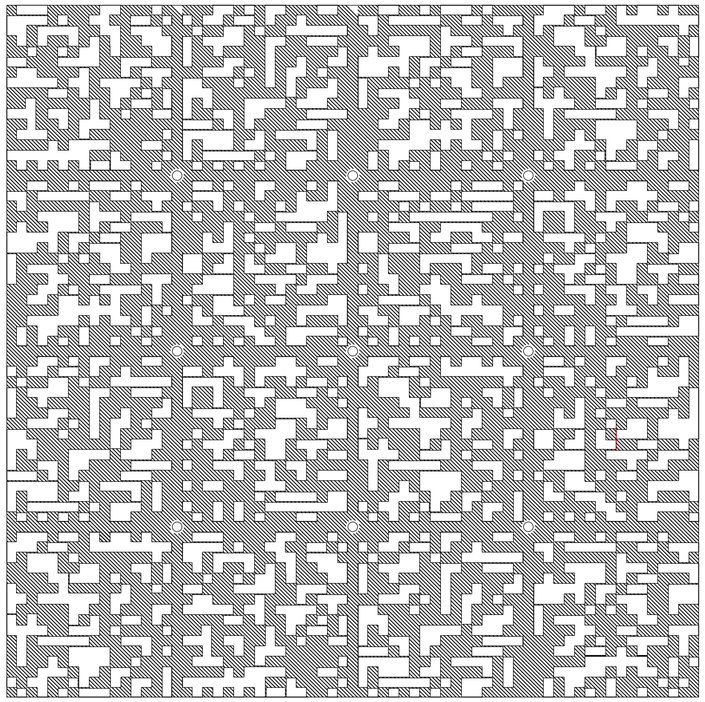
CZT Detectors
4 quadrants x
16 modules x
256 pixels:
total 16384 pixels
disabled 1196

Bhalerao et al 2017

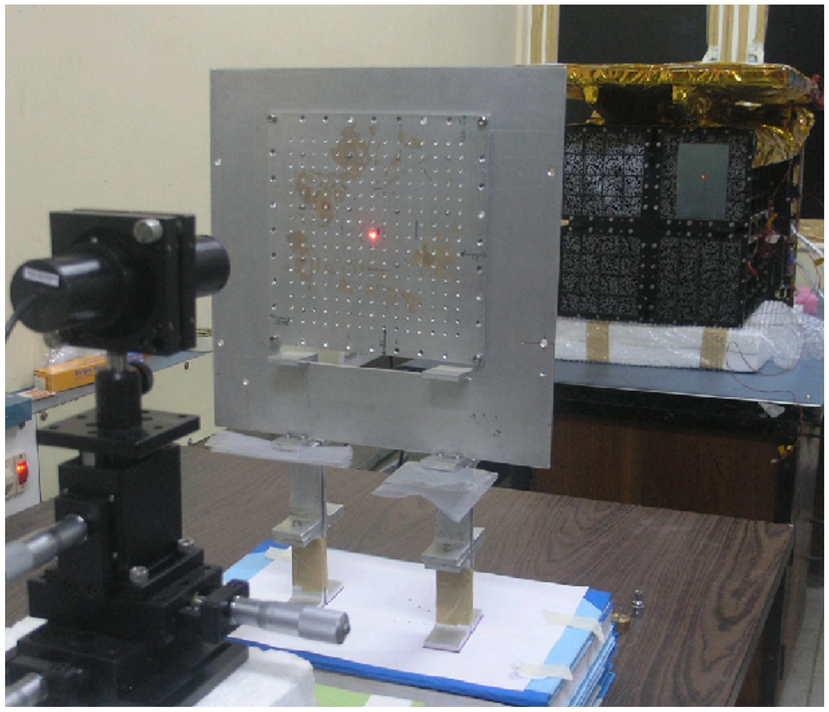
FOV ~5 deg square (25-100 keV)
~open (100 keV - 500 keV)

Angular resolution 16 arcmin (nominal geometric, <100keV)

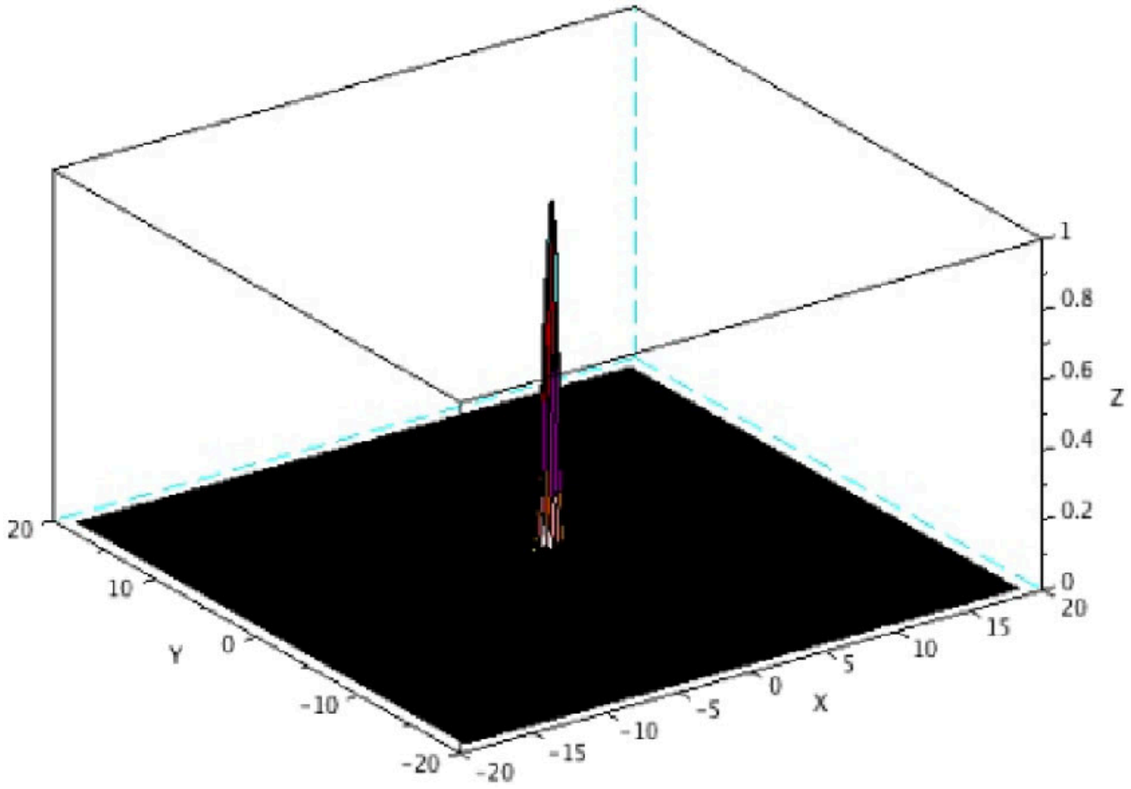
Extensive ground calibration done, primarily for spectral response
Basic imaging characterisation also done on ground



One Quadrant Mask Pattern: Quadrant A
Same pattern placed in different orientations in other quadrants



Ground calibration with radioactive sources

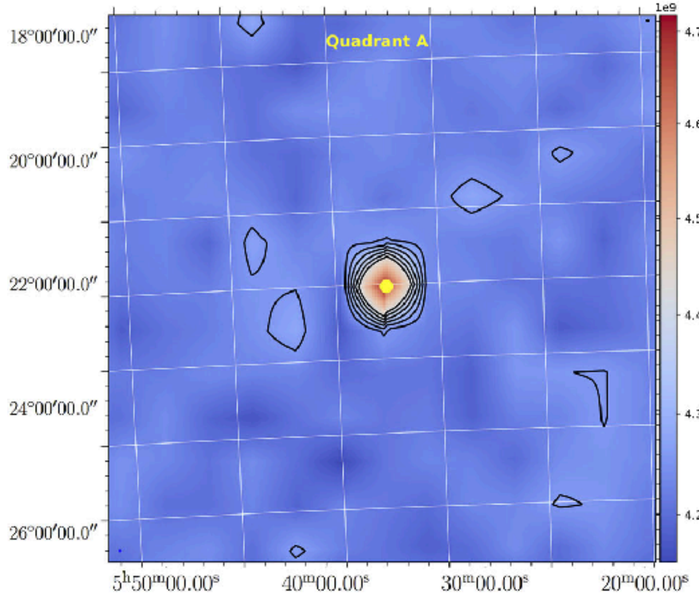


Recovered location accuracy better than 5 arcmin

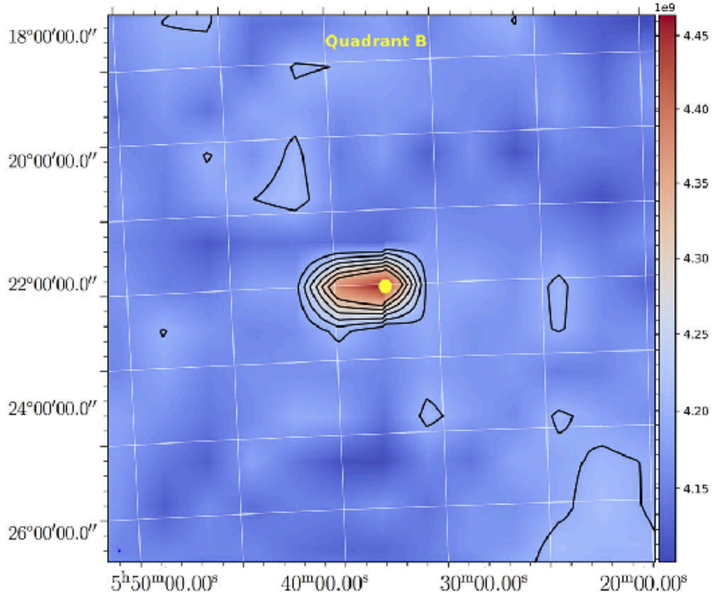
Nominal geometric resolution of the CAM system: 16 arcmin

Vibhute et al 2021

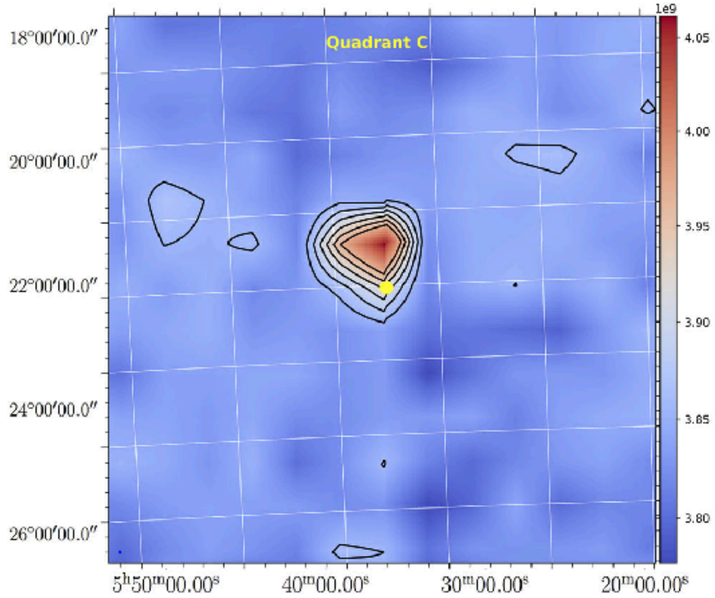
Quadrant-wise Mask shifts determined from in-flight images of the Crab



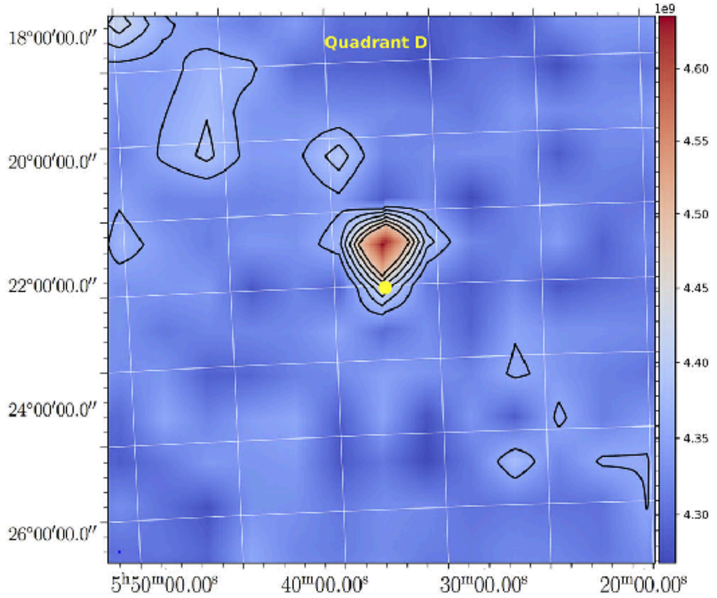
(a) Quadrant A.



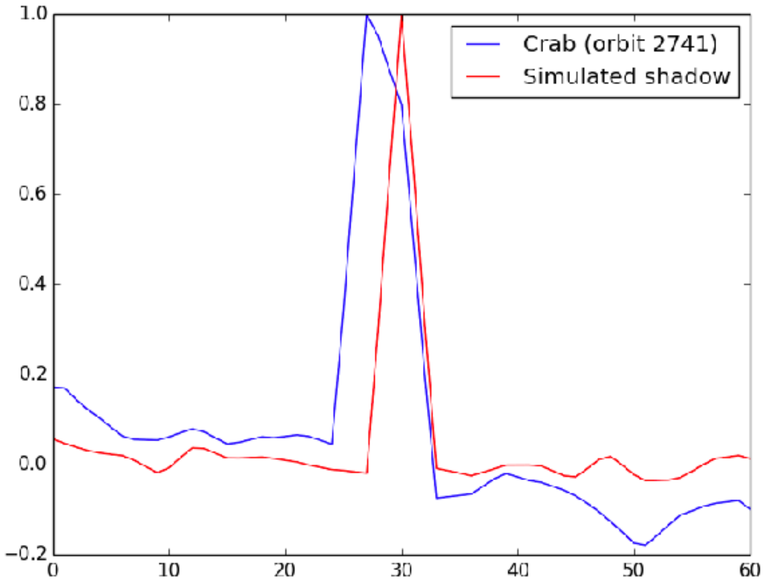
(b) Quadrant B.

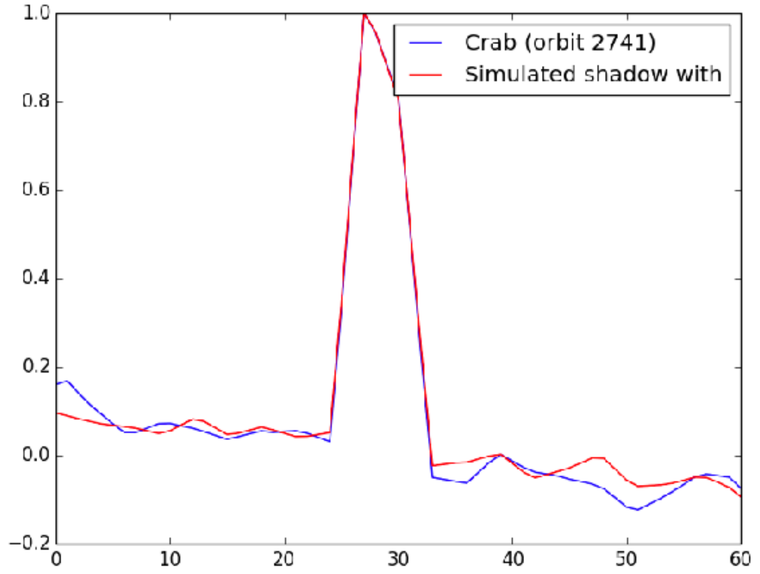


(c) Quadrant C.



(d) Quadrant D.

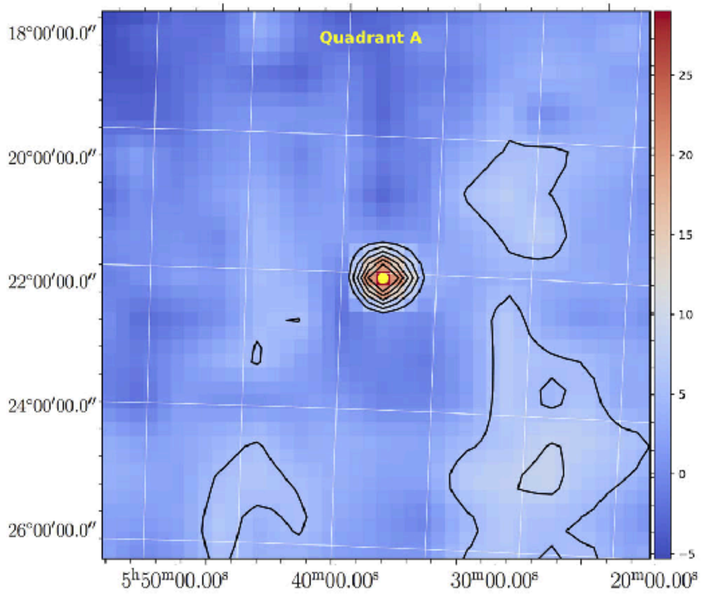




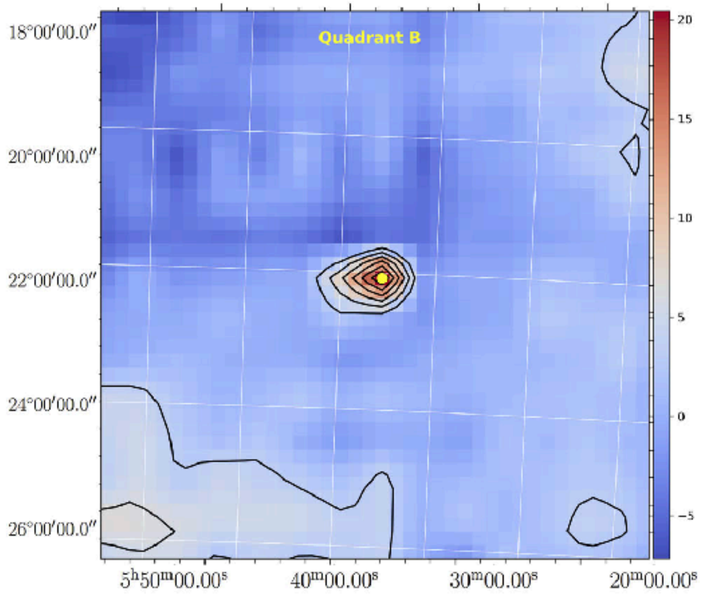
Raw

Vibhute et al 2021

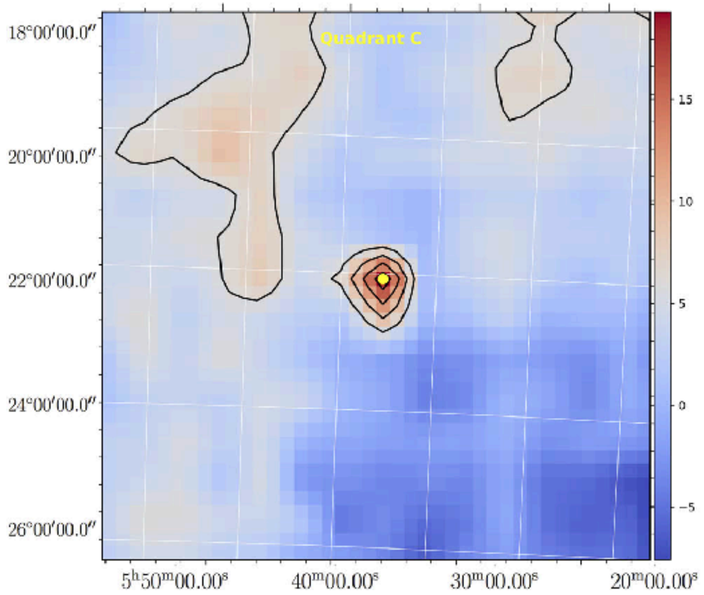
Quadrant-wise Mask shifts determined from in-flight images of the Crab



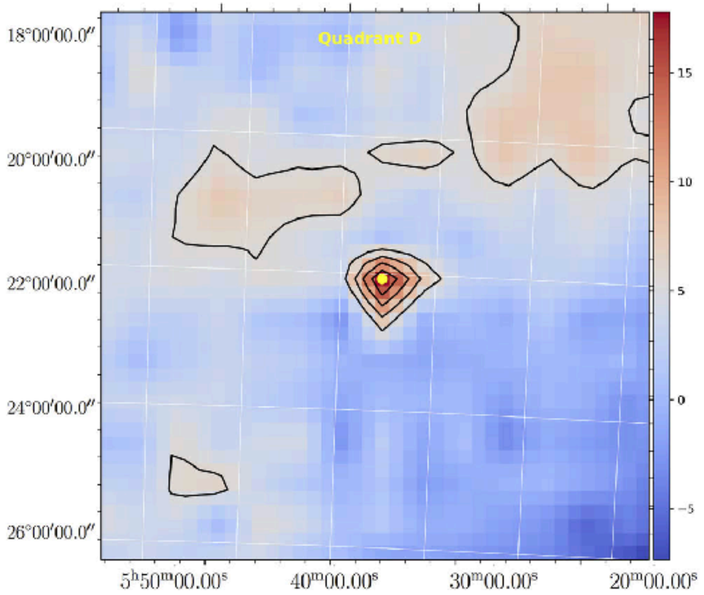
(a) Quadrant A.



(b) Quadrant B.



(c) Quadrant C.



(d) Quadrant D.

Post-correction

Quadrant	X shift (mm)	Y shift (mm)
A	0.00	0.00
B	-1.45	0.00
C	0.00	1.68
D	0.00	1.50

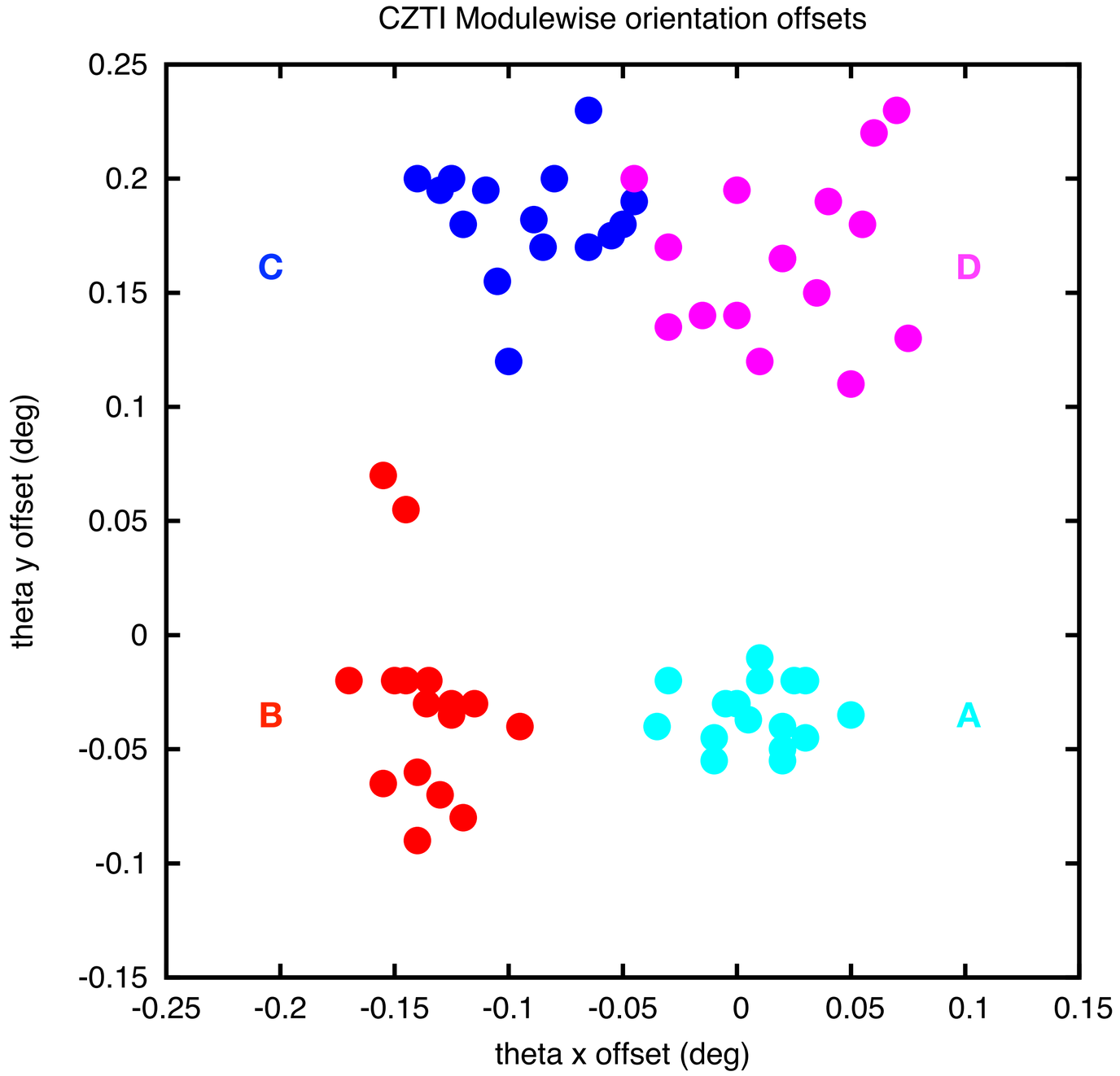
Vibhute et al 2021

Calibration of orientation offsets of individual detector modules

Replaces the Quadrant-wise offset values

Will be included in the next pipeline update

Mithun NPS et al, in preparation



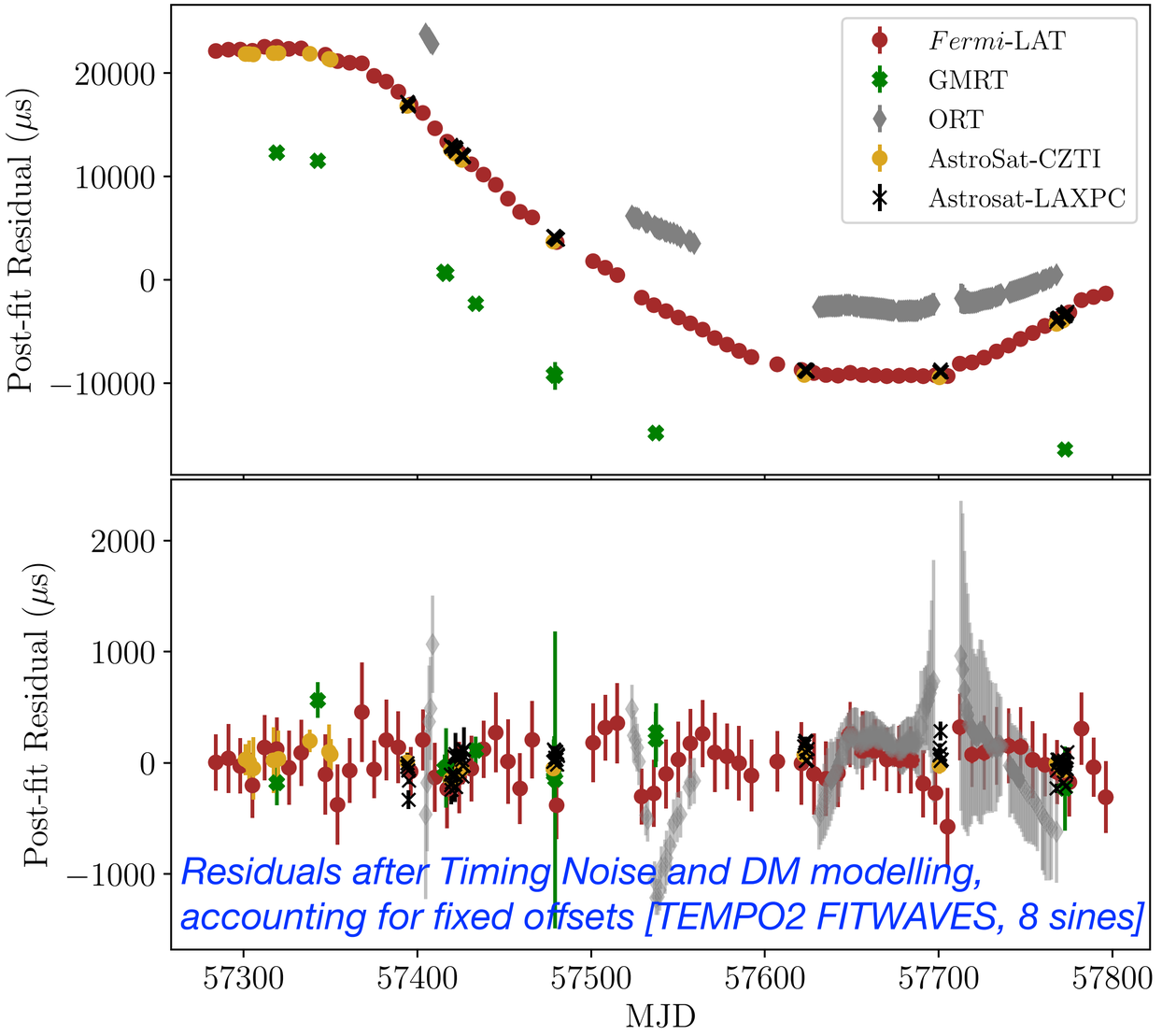
Timing with CZTI

- Event time stamps assigned by on-board CZTI clock. Resolution 20 μs
- Every 16 sec CZTI clock, SPS clock and OBT clock registered simultaneously => Time Correlation Table (TCT)
- CZTI clock timestamps converted to UT using linear interpolation on SPS TCT entries
- Residual jitter has an rms of ~3 μs

Absolute time calibration of CZTI

- Crab Pulsar, barycentred DE200
- Radio timing observations with ORT and GMRT
- Data of over a year: 2015-2017
- Ephemeris generated from grand TEMPO2 fit
- Comparison with Fermi-LAT, LAXPC

Instrument	Clock-offsets in μs (w.r.t. GMRT)
AstroSat-CZTI	-4716 ± 50
AstroSat-LAXPC	-5689 ± 23
Fermi-LAT	-5368 ± 56
ORT	-29639 ± 50



Basu et al 2018, 2021