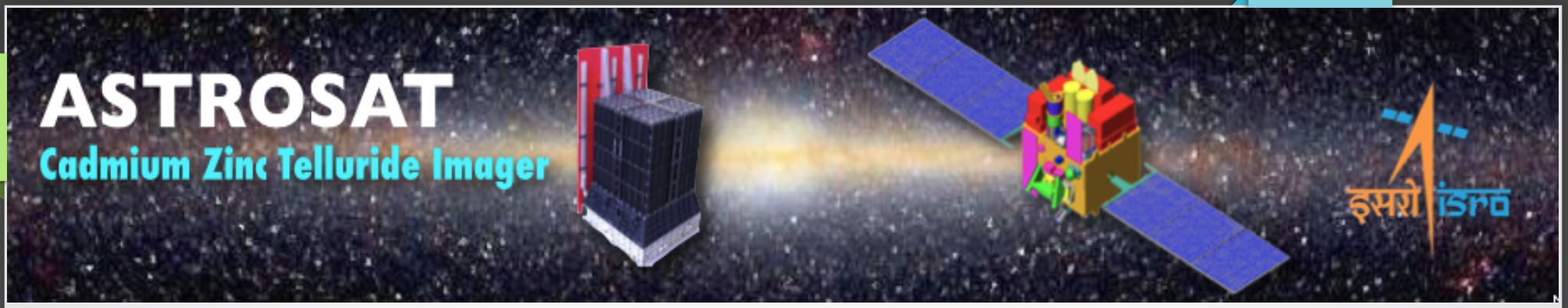


CZTI Observations of GRBs

Vidushi Sharma

5th July, 2017
TIFR-NCRA GRB workshop

Overview

- *AstroSat: CZTI*
- *Detection of GRBs*
- *Lightcurves and spectrum*
- *Distribution on sky*
- *GRB statistics in 1 year*
- *Fluence distribution*
- *T_{90} distribution*

CZTI: Cadmium Zinc Telluride Imager

Hard X-ray detector

CZTI consists of four quadrants,

16 pixelated detectors each.

Imaging Method:

Coded Aperture Mask(CAM): It casts a shadow on the detector when illuminated by a source.

Energy range:**100 keV to < 250 keV**

Effective Area ~ 500 cm^2

Thickness = 5 mm

CZTI Veto Detector(Cesium Iodide),

covers energy range **200keV to 500 keV.**

CZT + Veto detectors together present large field of view(FoV) comprising of the whole sky excluding earth occultation.

GRB detection by CZTI

- All reported GRBs by GCN circulars through BAT or GBM or any other GRB detector are searched in the CZTI lightcurves with different binnings by the visual inspection.
- The GRB detection, localization, T_{90} and lightcurves by Astrosat are provided on the AstroSat CZTI GRB archive page.
- Total GRB triggers : 384 (6th Oct.,2015 - 30th June, 2017)

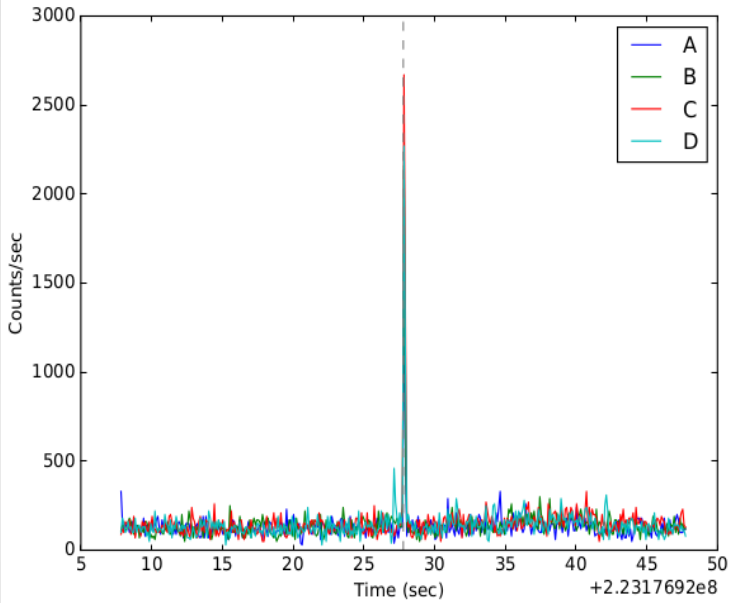
  we expect, GRBs occurence > 900 (In whole sky w.r.t. BAT(~2 sr))

Fermi/GBM	***~231***
Swift/BAT	***149***

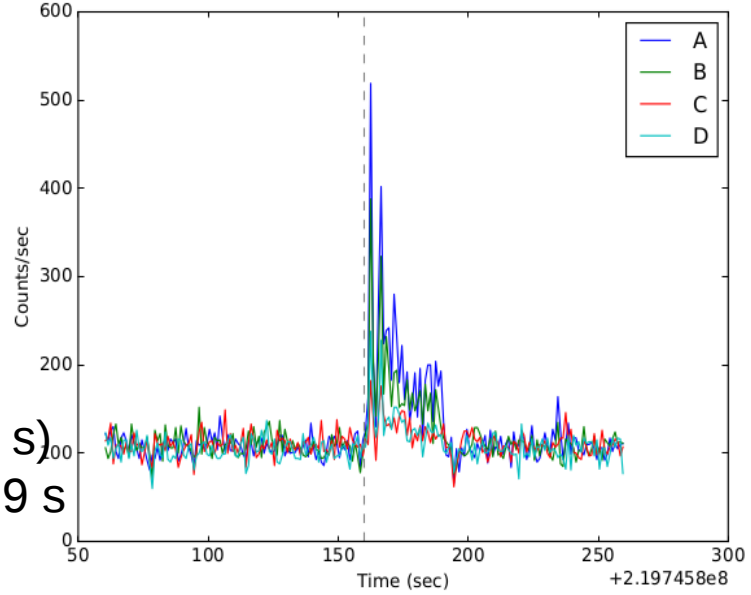
- Total GRBs detection by AstroSat:

CZTI	***121 (sGRBs=11)***

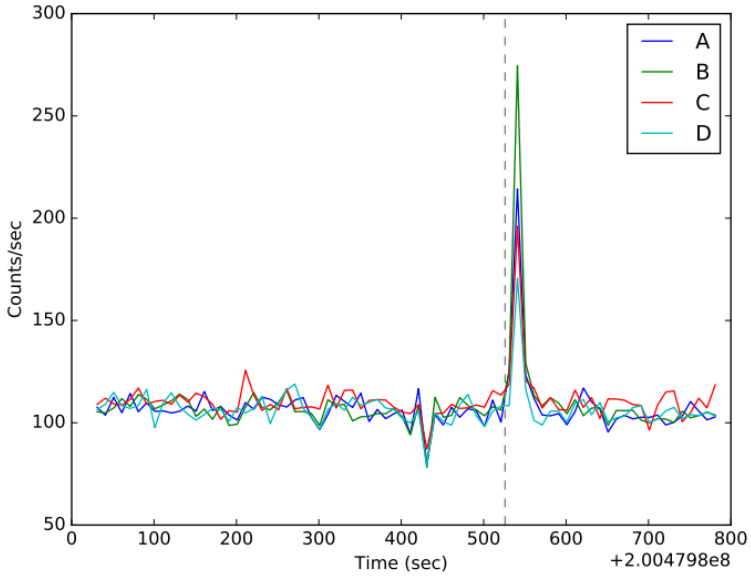
GRB lightcurves



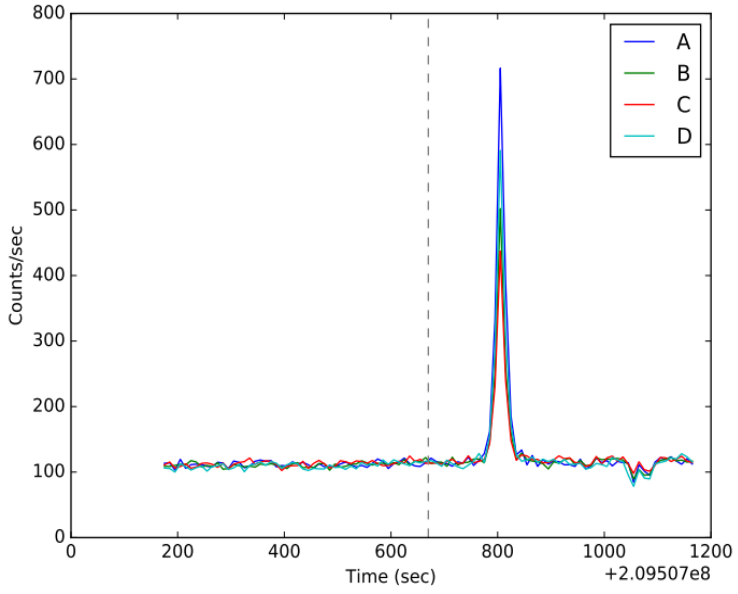
Short GRBs (< 2 s)
GRB 170127C, 0.91 s



Long GRBs (> 2 s)
GRB 161218B, 29 s



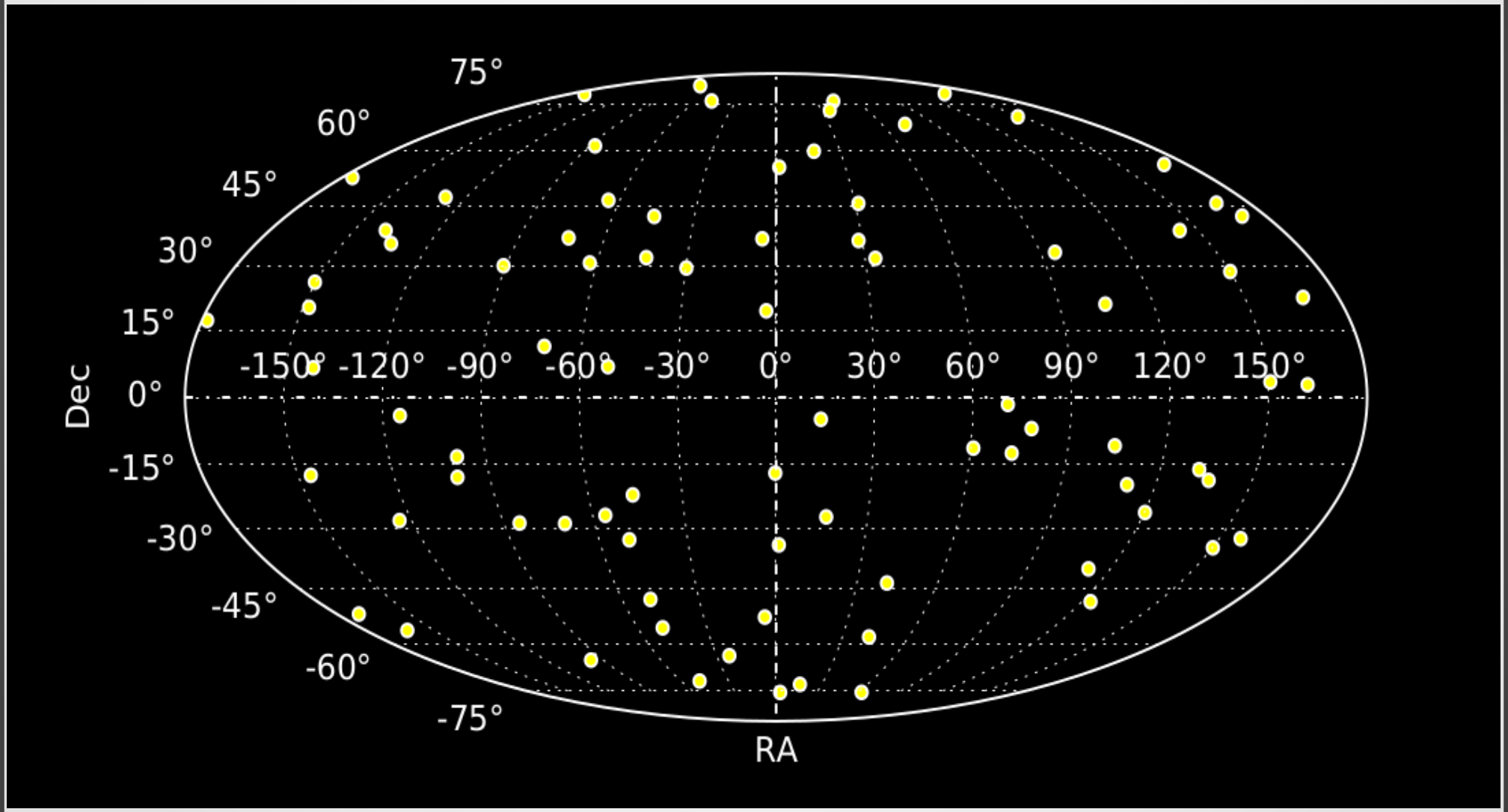
GRB 160509A



GRB 160821A

GRBs distribution on the sky: Isotropic

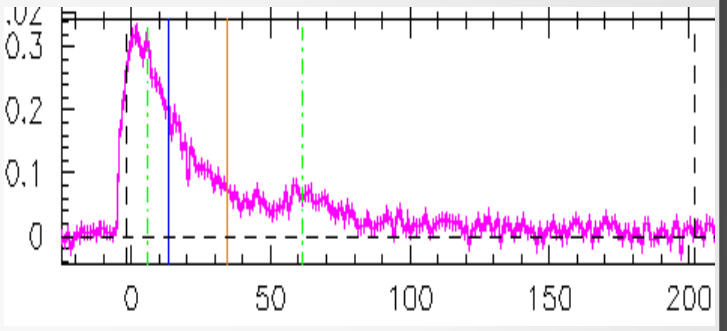
GRBs with knowm RA Dec = 82, till 31st Jan., 17



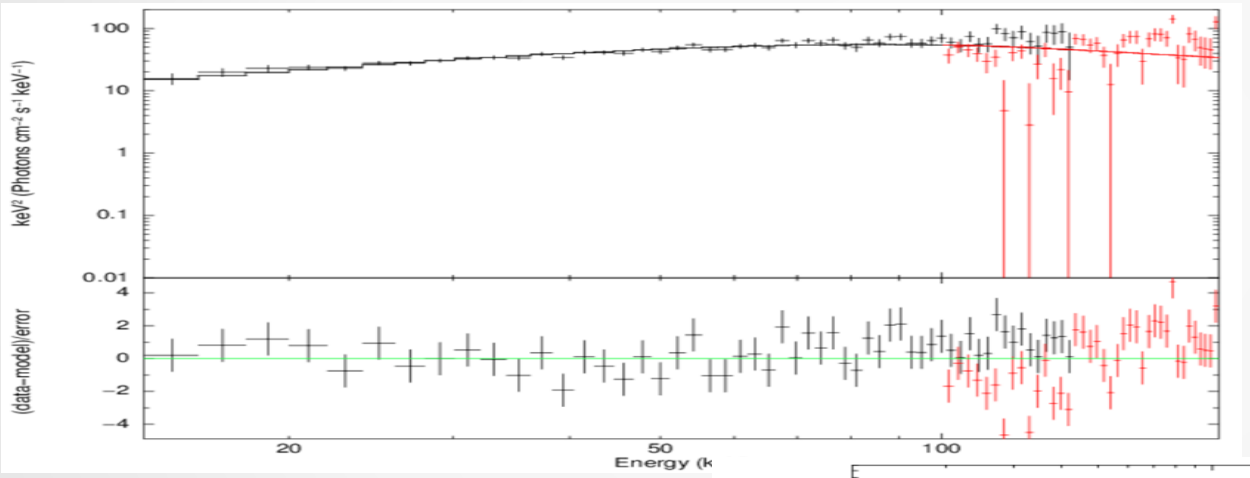
GRB 151006A Spectrum

First reported by Fermi/GBM, followed by Swift/BAT and Astrosat/CZTI.
T90=84 s

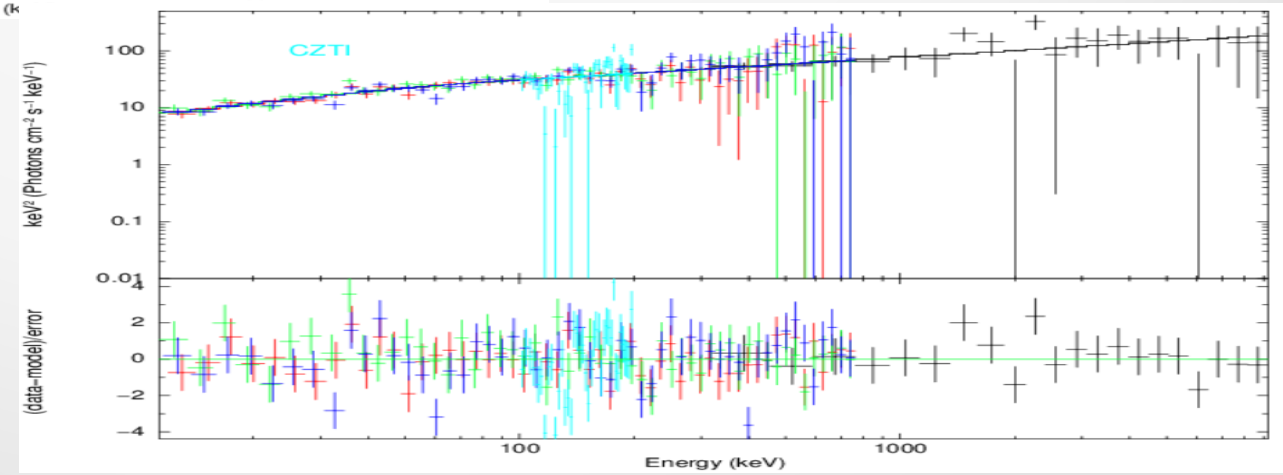
Θ_x, Θ_y =34.35, 58.87



BAT+CZT fitted with Band Function Model



GBM+CZT fitted with Band function model



GRB statistics in 1 year

6Th Oct 2015 - 6th Oct 2016

Total detected GRBs = 249

we expect > 530 GRBs occurence in whole(4π sr) sky w.r.t. BAT(~2 sr)

Fermi/GBM	158
Swift/BAT	88
AstroSat/CZTI CZT, Veto	76 48, 73

Overlap in detections

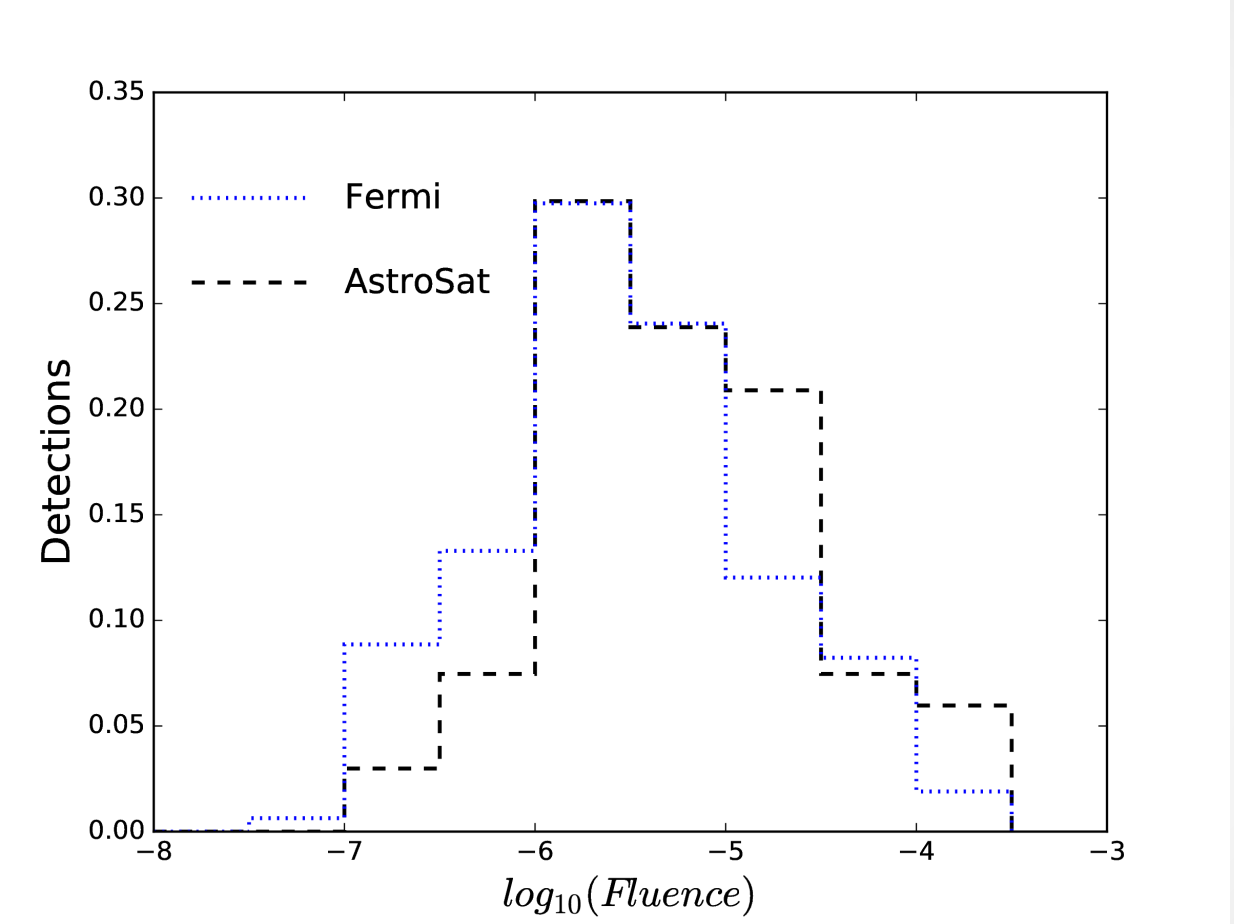
CZTI+BAT	Expected=88*55%~48 Observed=25
CZTI+GBM	Expected=158*55%~87 Observed=54
AstroSat SAA+Data Gap Earth Occultation Total	 ~20.5% ~25% (almost comparable to fermi) ~45%

GRBs not overlapping With FERMI & SWIFT:

GRB 160525C: CALET, GRB 160721A: CALET, GRB 160804B: CALET

GRB 160915A: Lomonosov, GRB 160917B: Lomonosov

Fluence Distribution

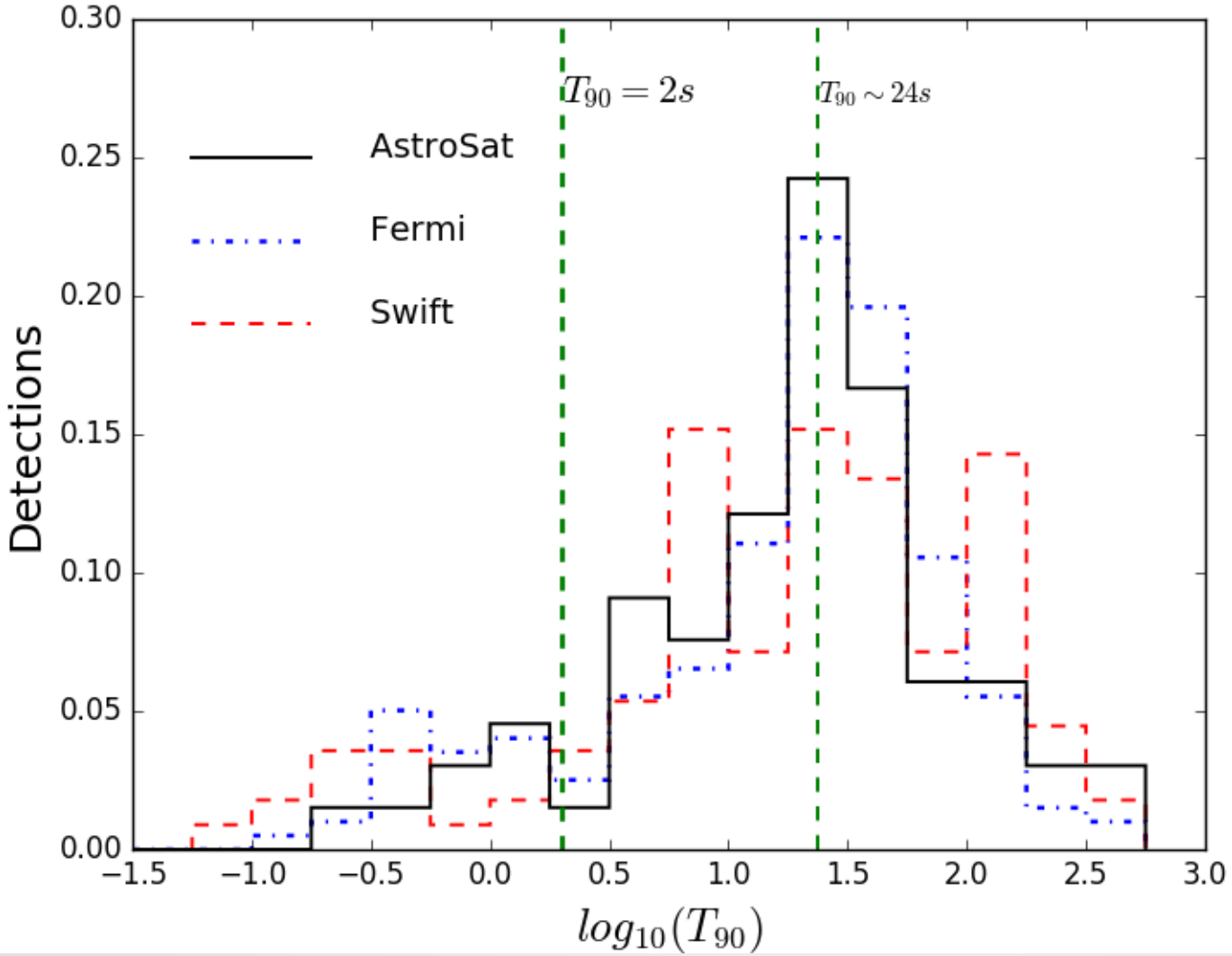


Fluence distributions for Fermi GBM and Astrosat CZTI(in Fermi units). The distributions are normalized to unity.

It detects relatively lesser number of bursts with fluence less than 10^{-6} ergs cm^{-2} .

Durations

T_{90} distribution for Fermi GBM, Swift BAT & AstroSat CZTI



Thus CZTI is sensitive to GRBs of all durations.

The bimodality distribution will be more clearer with further detections.

Under Progress

- More GRBs detections with automated GRB pipeline
- For CZTI spectrum and parameters: Mass modelling

THANK YOU!!!

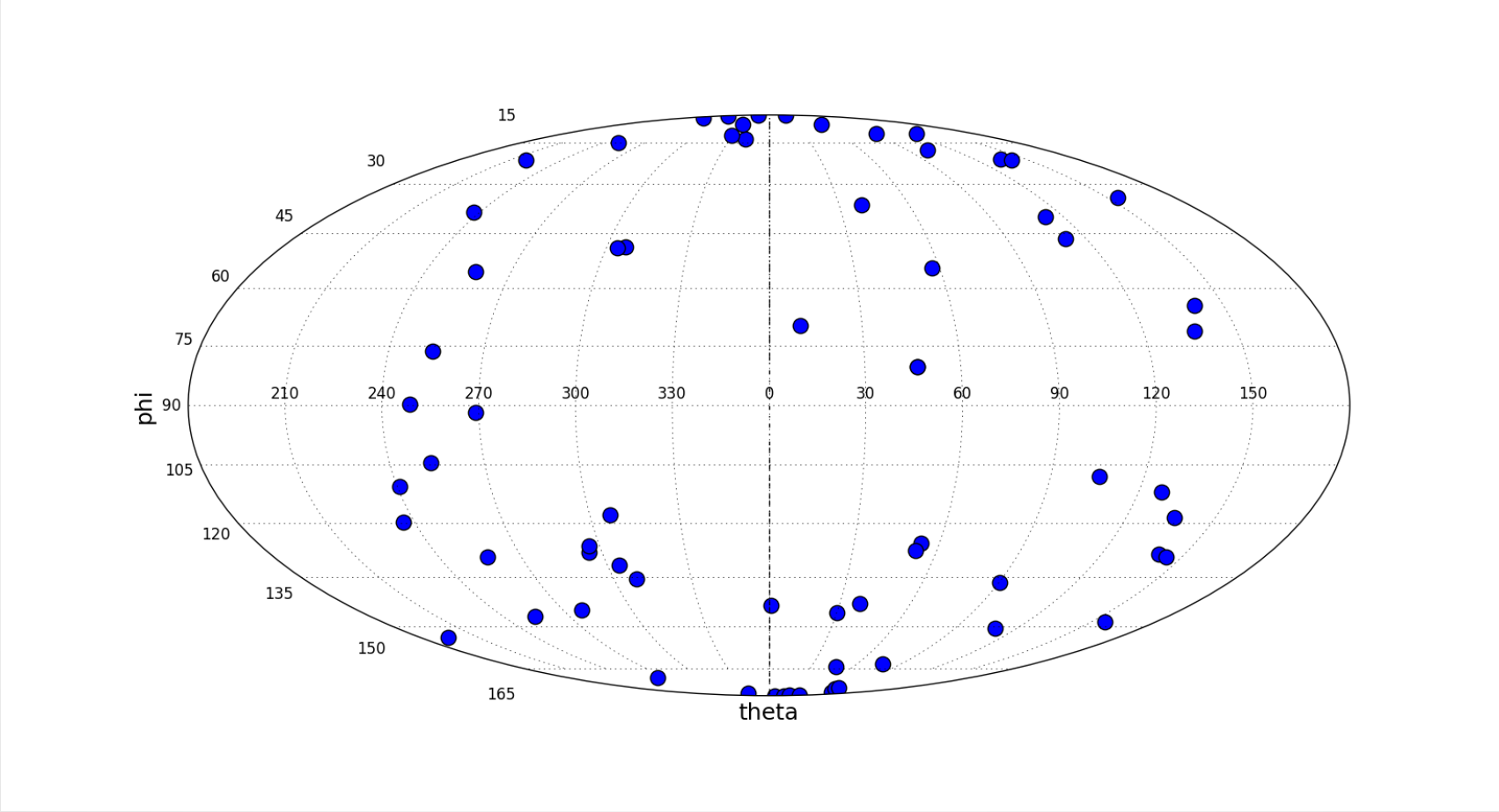
1)

CZTI	***121***
CZT	***83***
Veto	***112***

GRBs distribution on the sky: theta, phi

Using conventional division of T_{90}=2s b/w short & long duration bursts, we find 7(9%) out of 76 GRBs lie in short GRB. Fermi(~15.8%) and swift(~15.9%)

theta, phi distribution: In 1 year



RA Dec distribution till 30th June, 2017
GRBs with known RA, Dec=103