

The Gamma-ray Transients Monitor (GTM) on board FS-8B

Hsiang-Kuang Chang

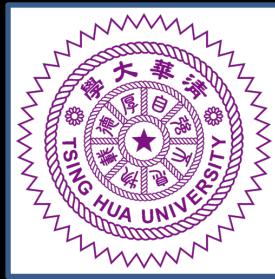
(Institute of Astronomy, National Tsing Hua University, Taiwan)

Chih-Hsun Lin

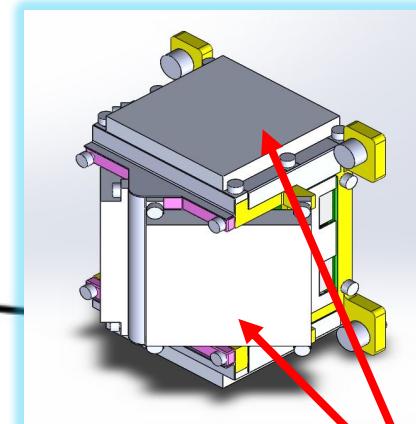
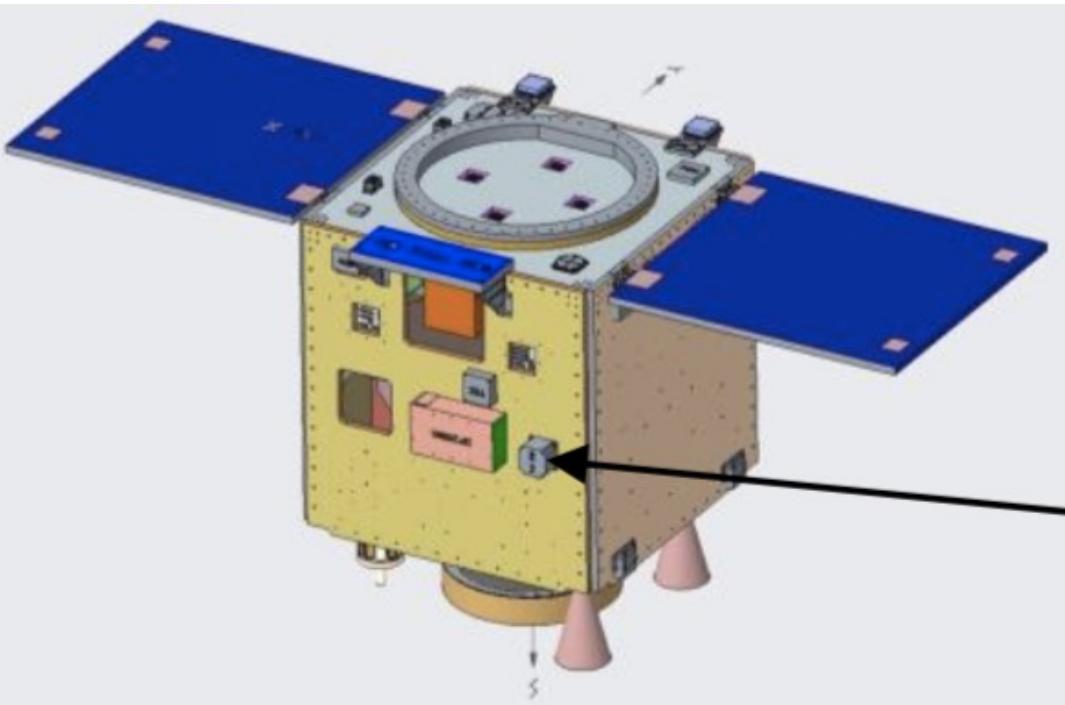
(Institute of Physics, Academia Sinica, Taiwan)

Che-Chih Tsao

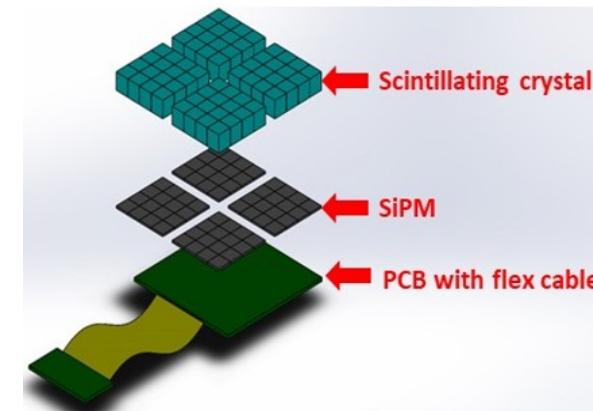
(Department of Power Engineering, National tsing Hua University, Taiwan)

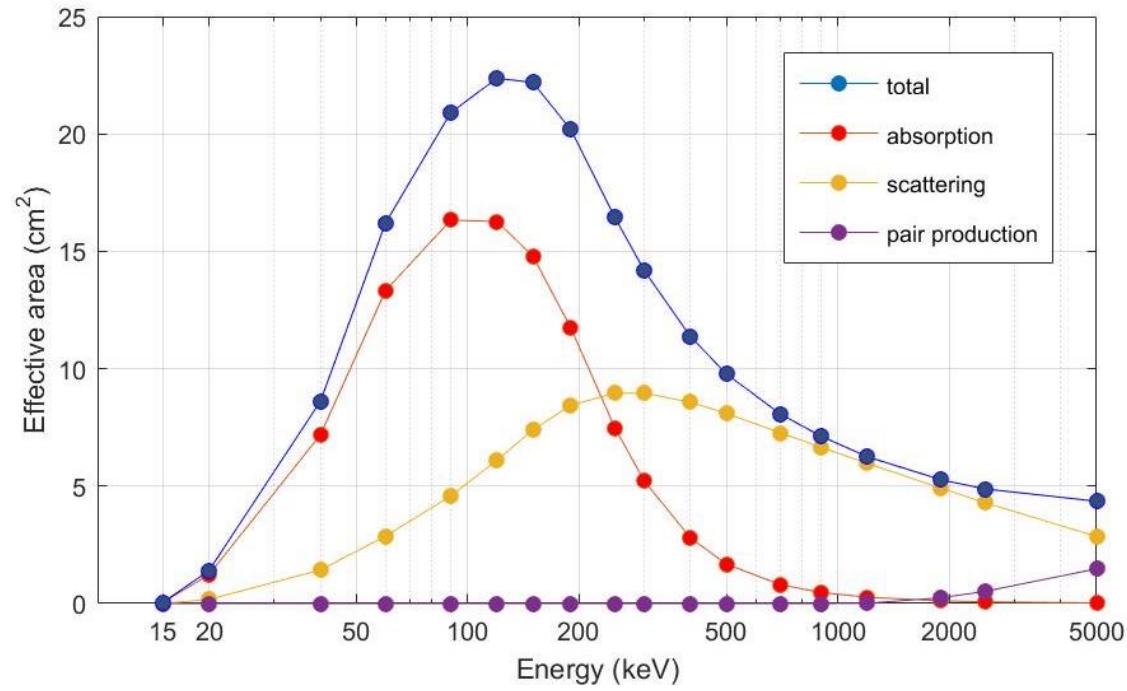
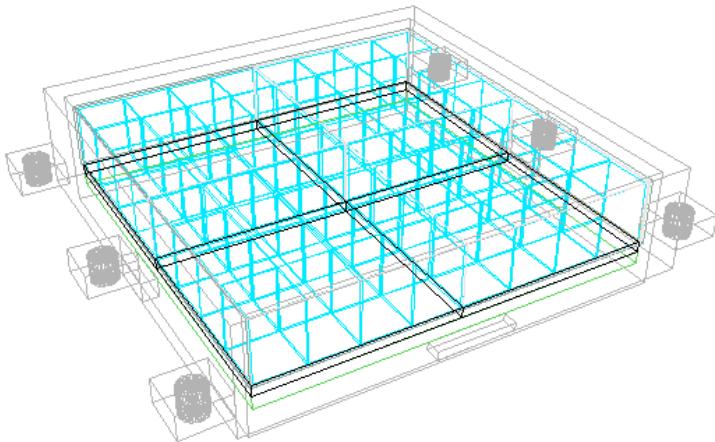


GTM on board Formosat-8B



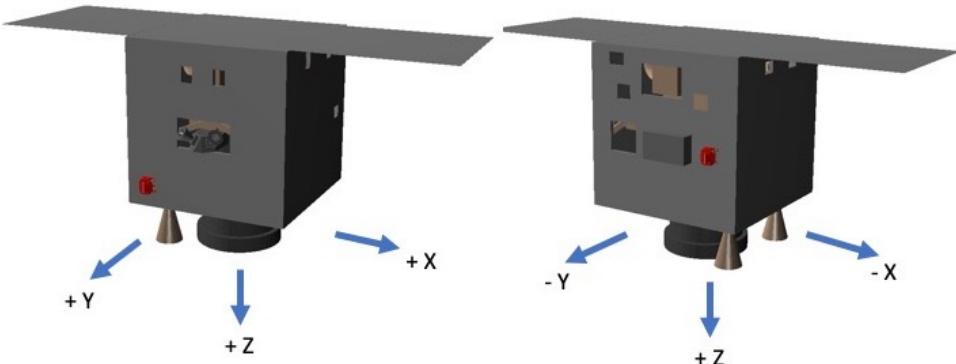
GTM consists of two identical modules located on two opposite sides of FS-8B. Each module has four sensor units facing different directions to cover the whole sky. Each sensor unit is composed of a GAGG (Gadolinium Aluminum Gallium Garnet) scintillator array (51 mm x 51 mm x 8 mm) and SiPM of corresponding pixel size for readout.





The effective area of one GTM GAGG
(Gadolinium Aluminum Gallium Garnet)
sensor unit.

FS-8B/GTM, Source and Background Models



MEGAlib (Zoglauer et al. 2008)

Background:

A polar (97°), low-altitude (560 km) Earth orbit; embedded in MEGAlib.

Source spectral model:

$$N_E \propto E^\alpha e^{(-E(2+\alpha)/E_p)}$$

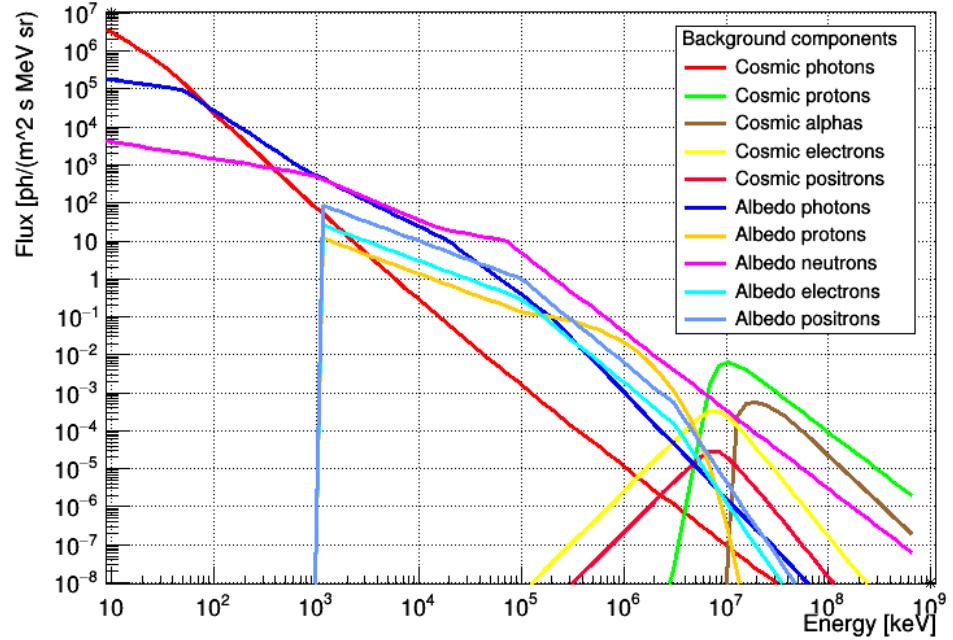
Long GRBs:

$\alpha = -1$, $E_p = 300\text{keV}$, duration 10 sec

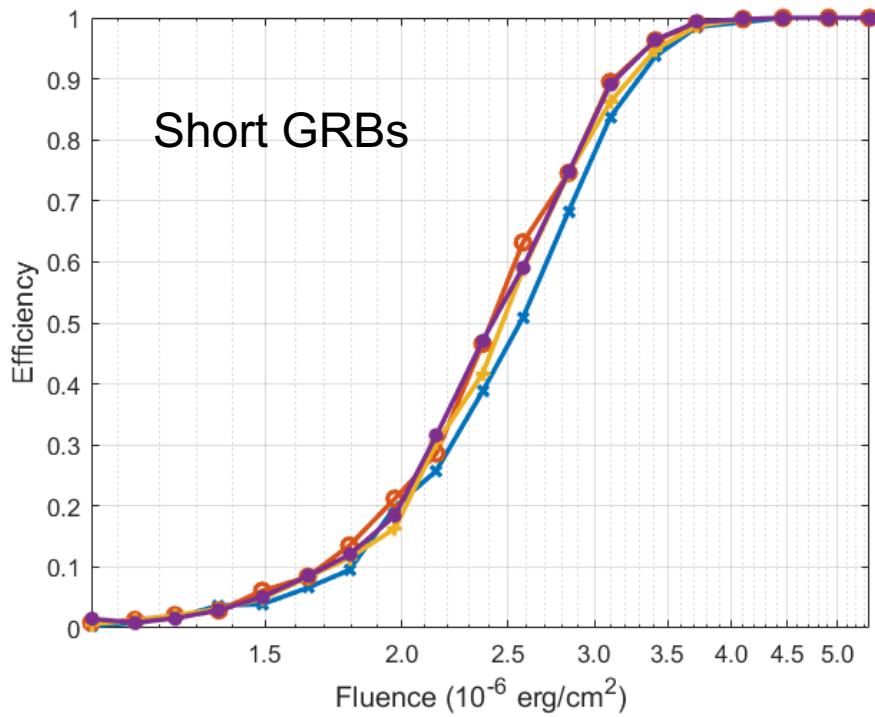
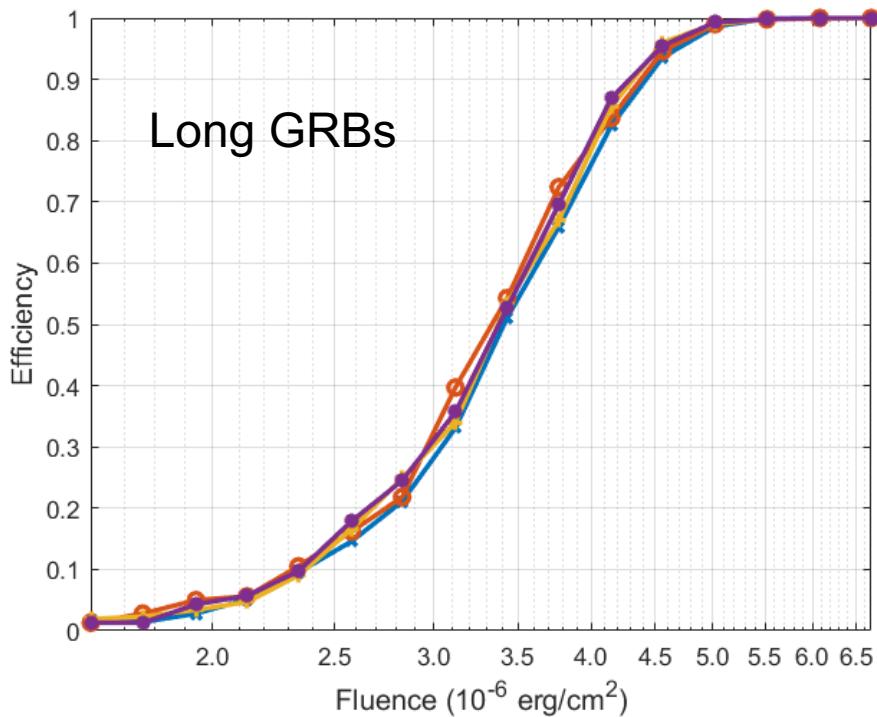
Short GRBs:

$\alpha = -0.5$, $E_p = 500\text{keV}$, duration 0.5 sec

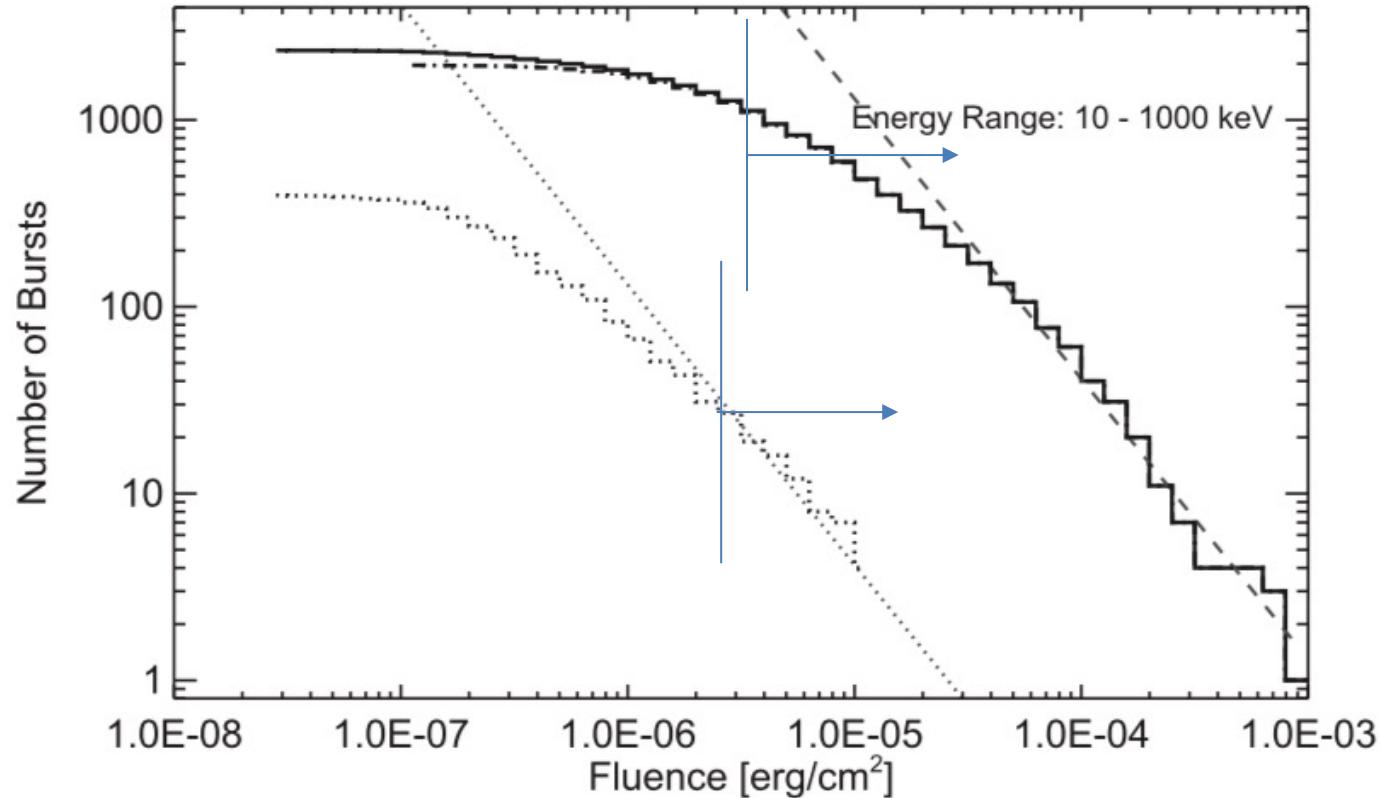
These numbers are the median of t_{50} and corresponding spectral parameters of Konus-WIND-detected GRBs (Svinkin et al., 2016; Tsvetkova et al., 2017).



GTM's GRB detection efficiency



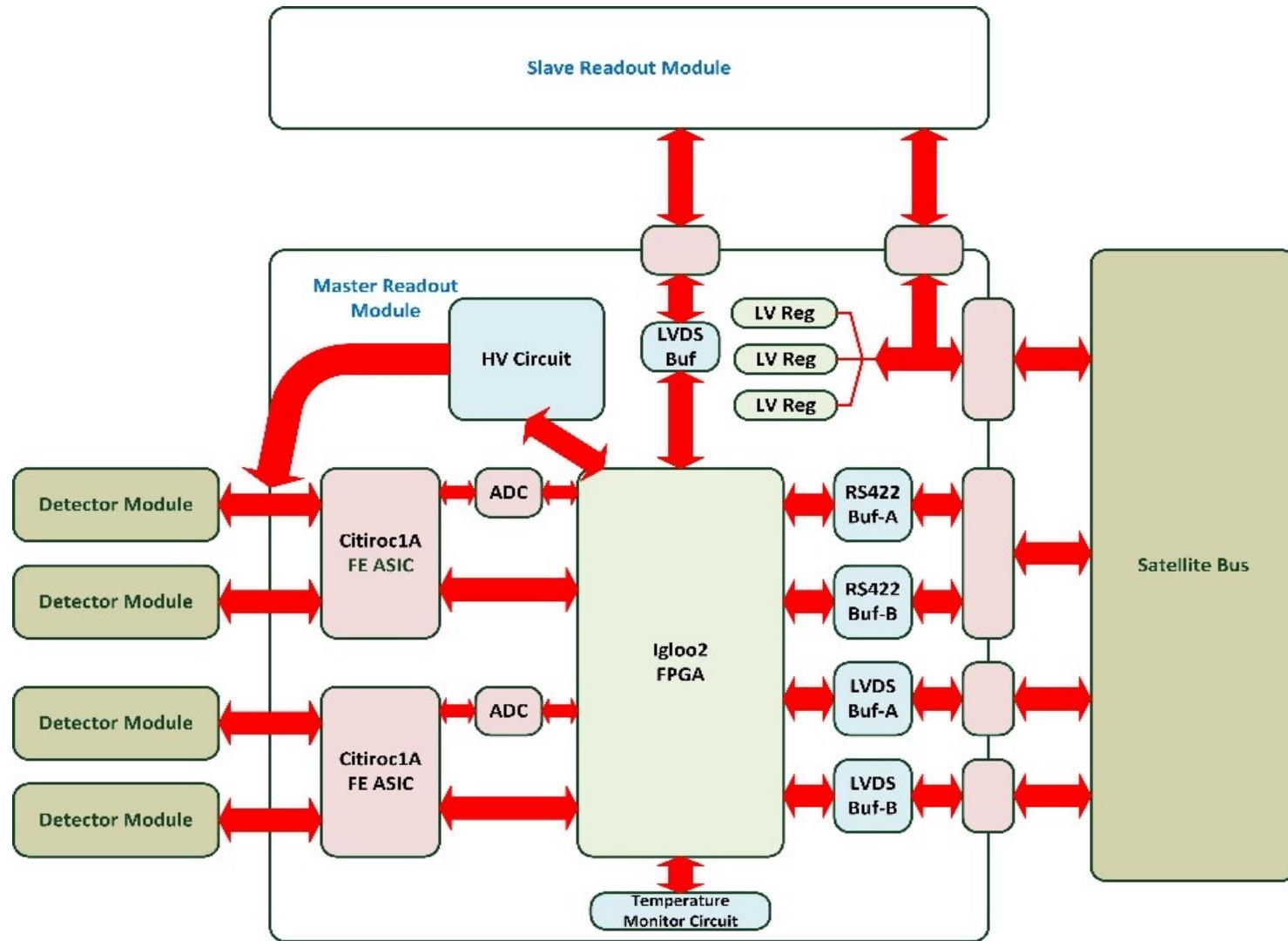
(Chang et al. 2022, AdSR 69, 1249)



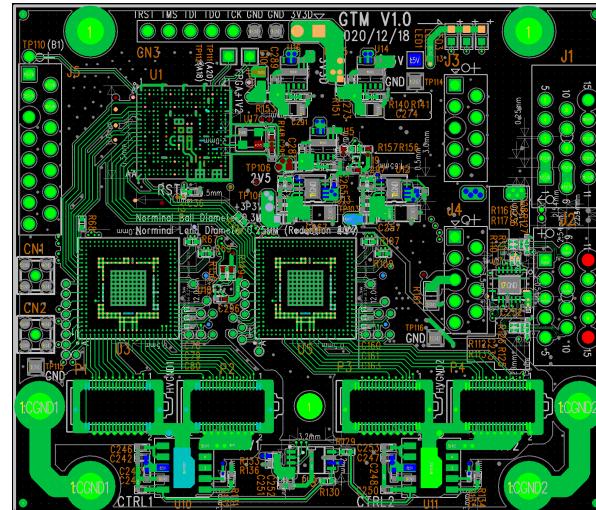
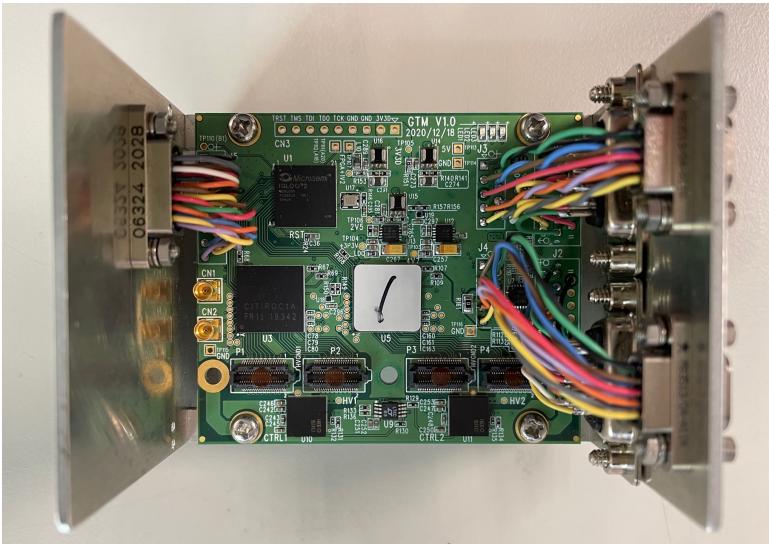
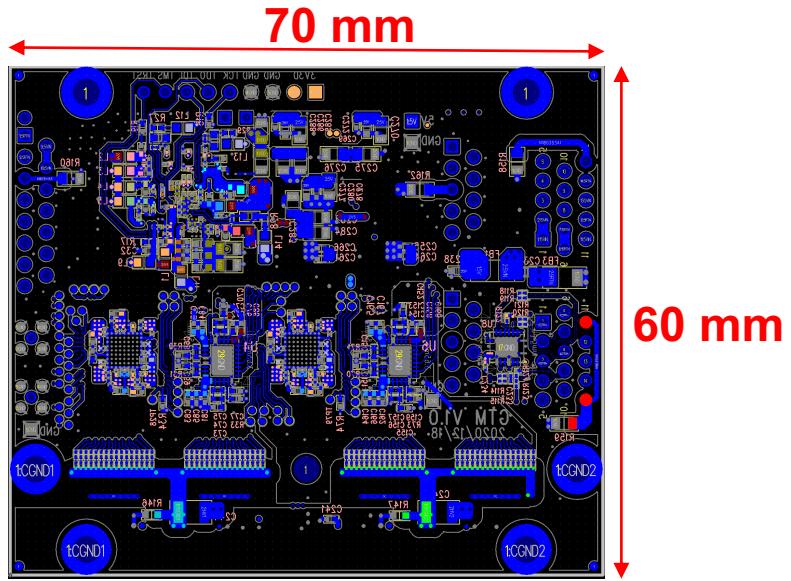
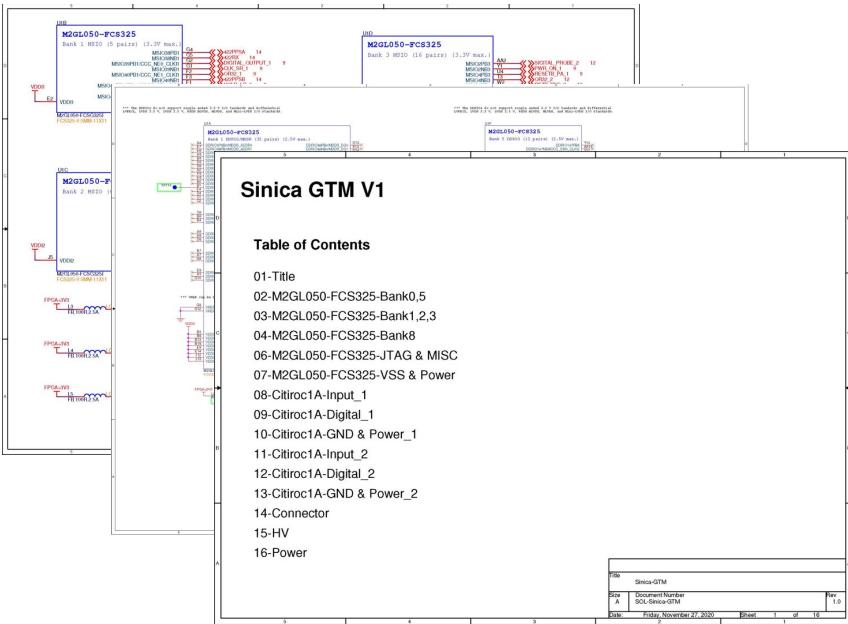
Fermi/GBM 10-year GRB fluence distribution (von Kienlin et al. 2020)

Assuming a 36% duty cycle,
FS8B/GTM will detect about 40 GRBs per year.

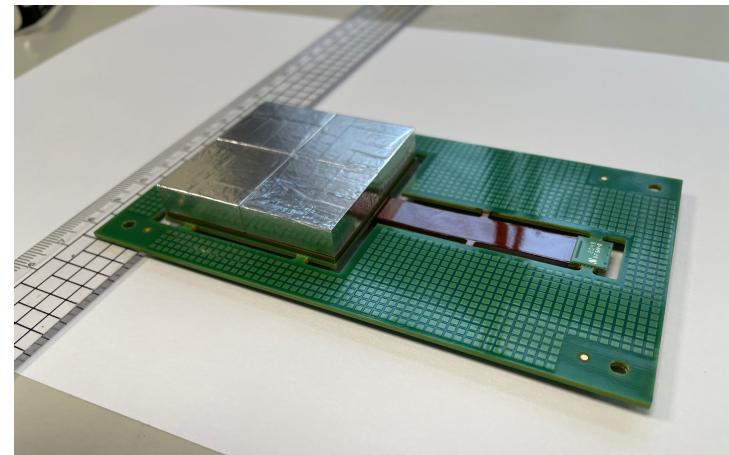
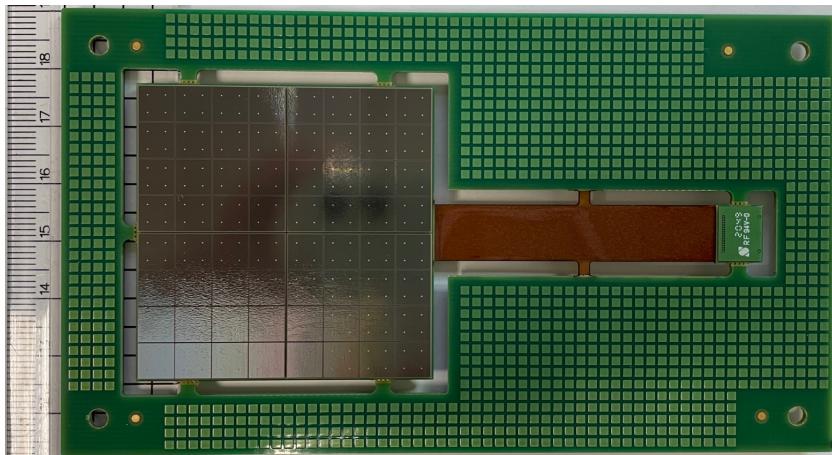
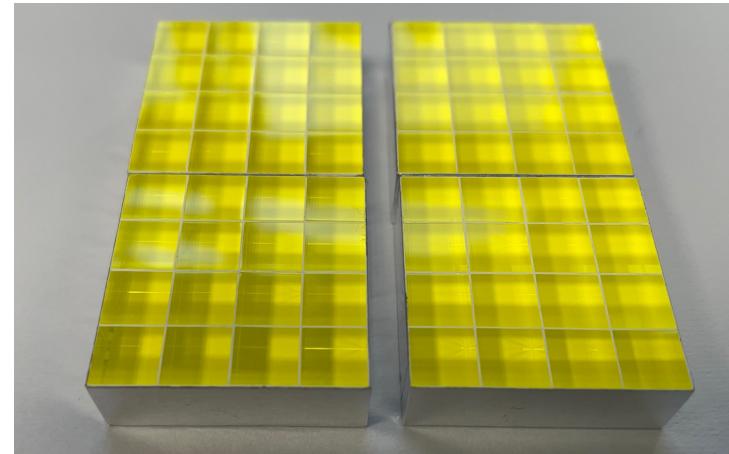
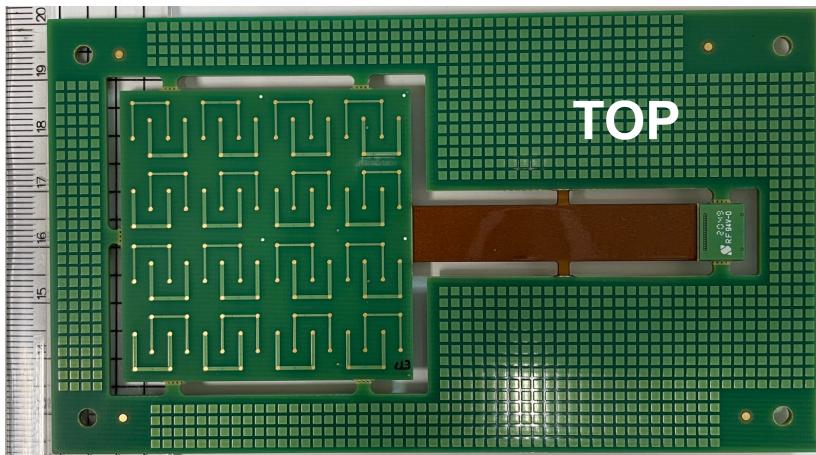
Readout system



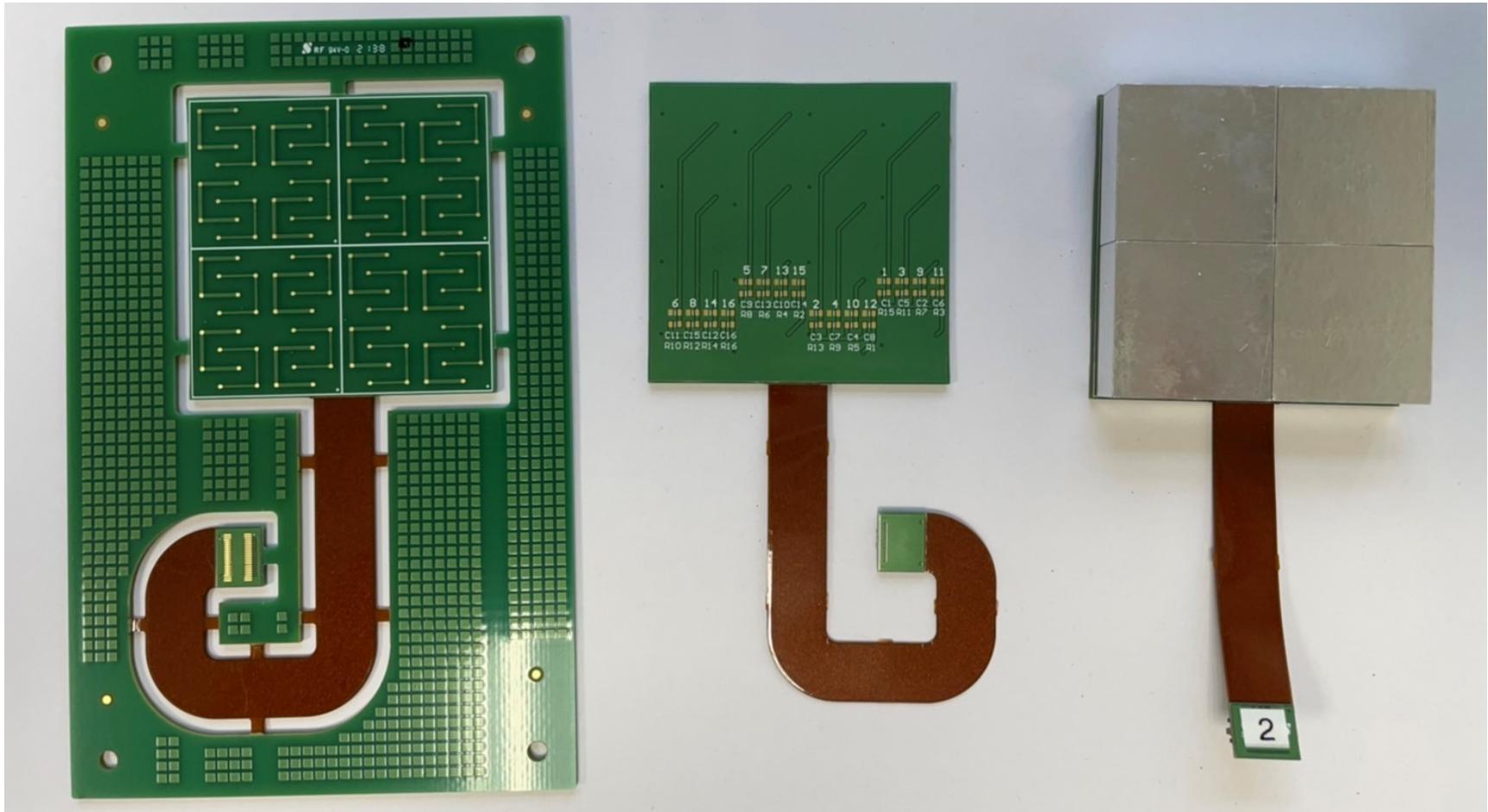
Readout system



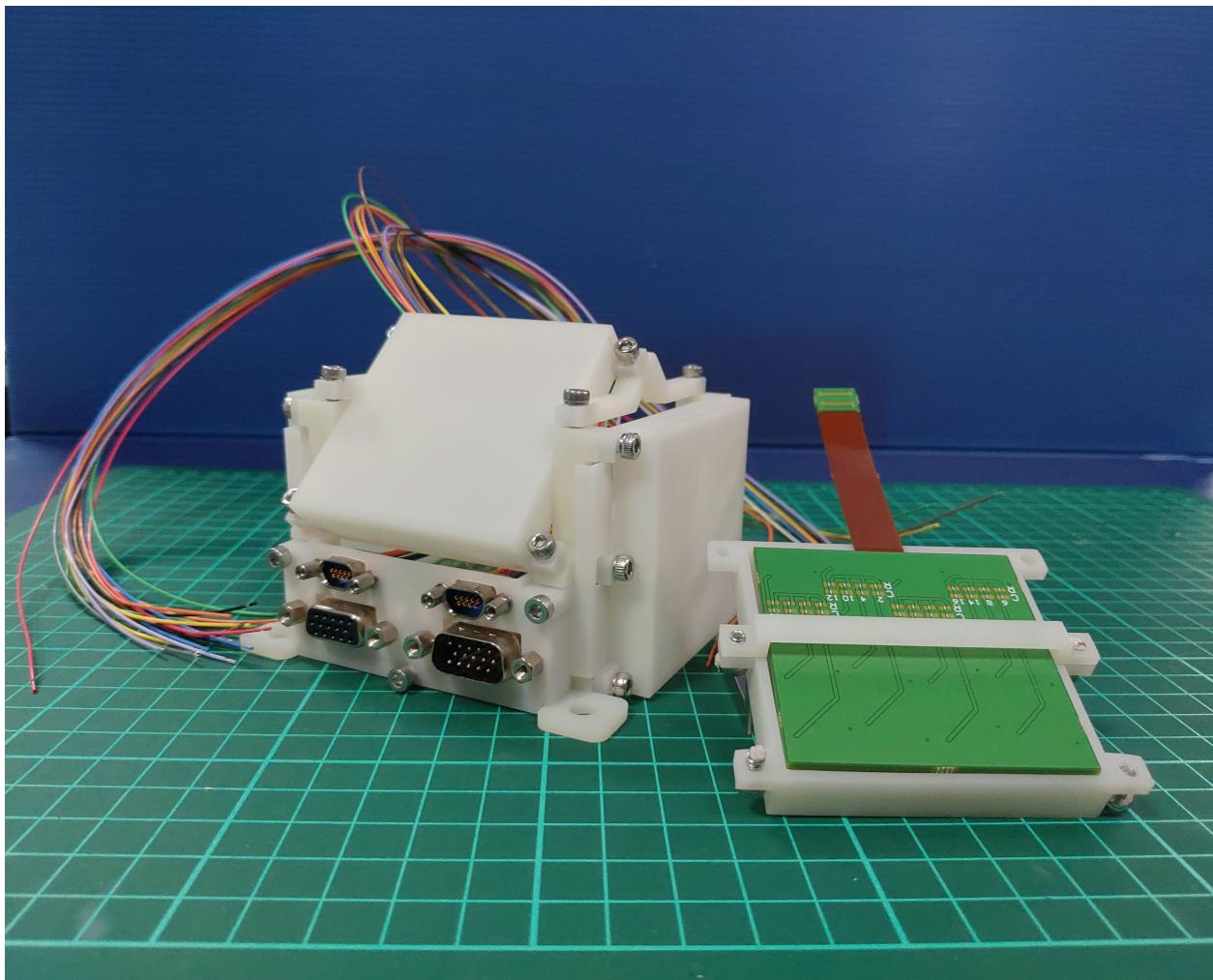
Sensor module



Sensor Module Assembly (QM)

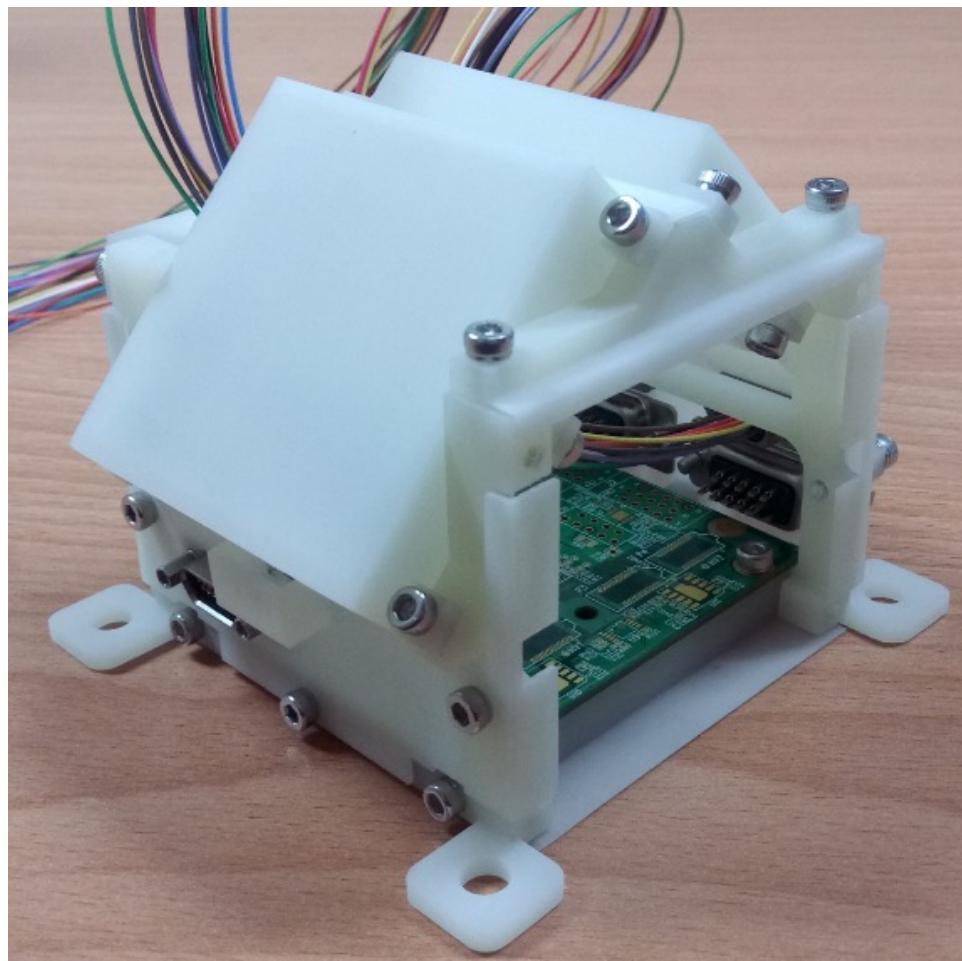
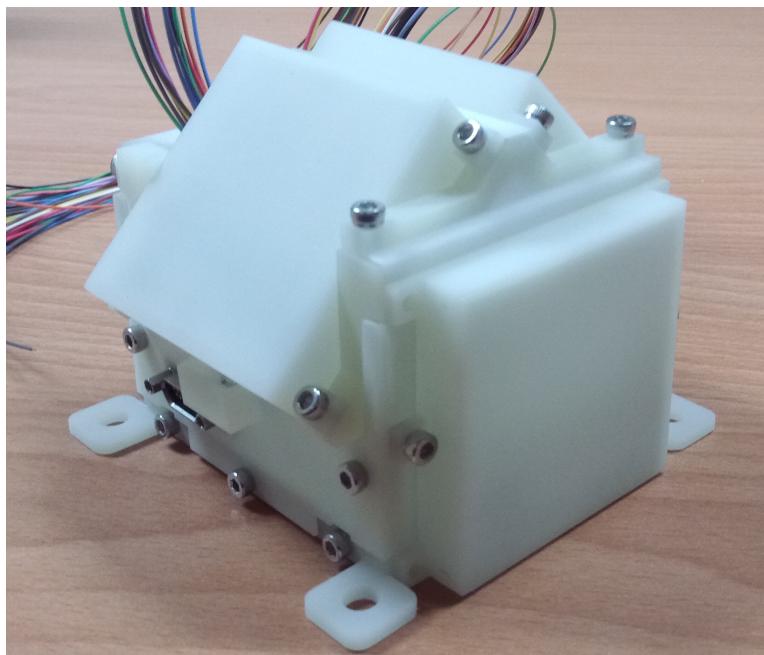


Mechanical structure



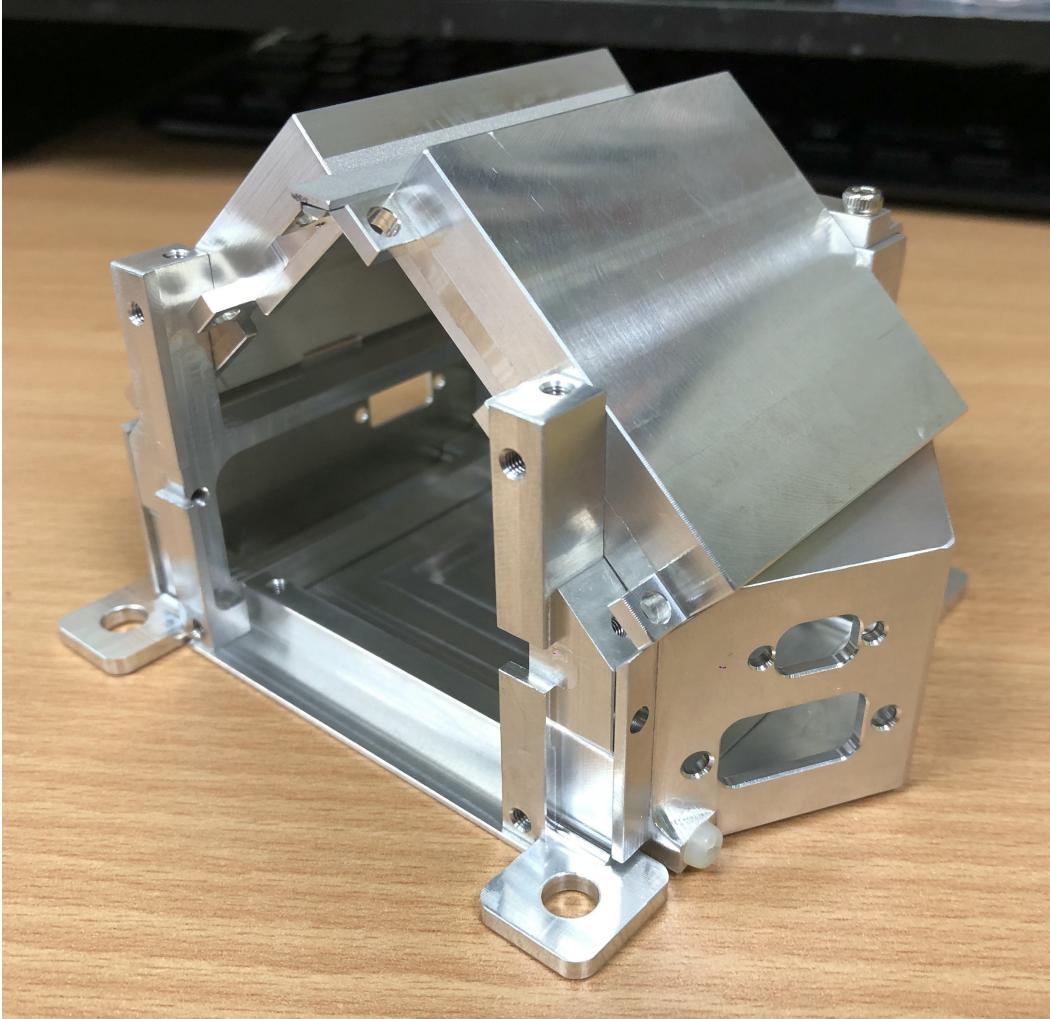
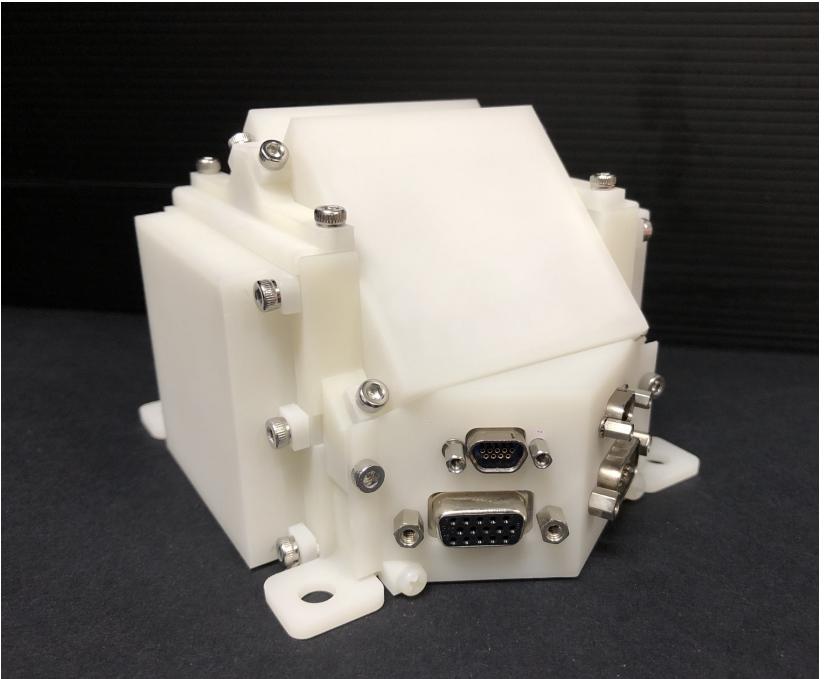
GTM mechanical structure, a 3D-printed model

Mechanical structure



Mechanical structure 3D print

Revised mechanical Structure (EM)



GTM schedule

The diagram illustrates the GTM schedule timeline from 2020 to 2023. A vertical blue line marks the timeline, with specific milestones indicated by blue arrows pointing downwards:

- MDR/SDR** (Mid-Design Review/Spacecraft Design Review) at the start of 2020.
- PDR** (Preliminary Design Review) shortly after MDR/SDR.
- ISD** (Initial System Definition) in Q1 2021.
- CDR** (Critical Design Review) in Q2 2021.
- DRR** (Detailed Requirements Review) in Q3 2021.
- TRR** (Test Requirements Review) in Q4 2021.
- PAR** (Preliminary Acceptance Review) in Q1 2022.
- SMRR** (Spacecraft Mechanical Requirements Review) in Q2 2023.

Two yellow ovals at the top represent **QM test** (Quality Management test) and **FM test** (Flight Model test), each with a downward arrow indicating their timing relative to the milestones.

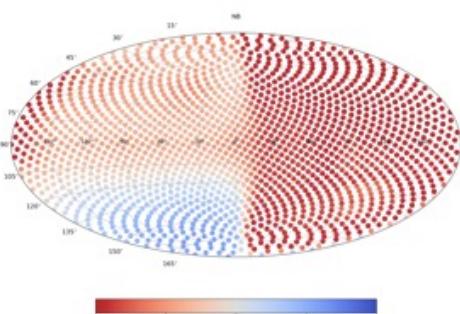
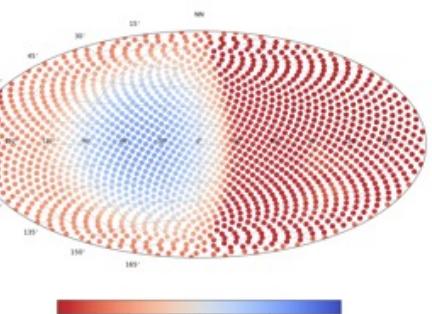
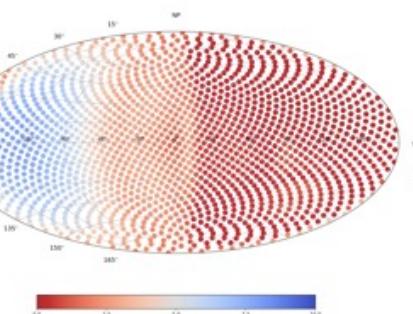
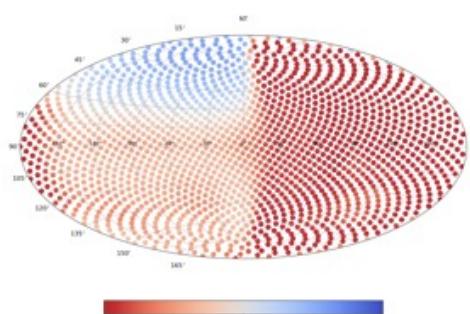
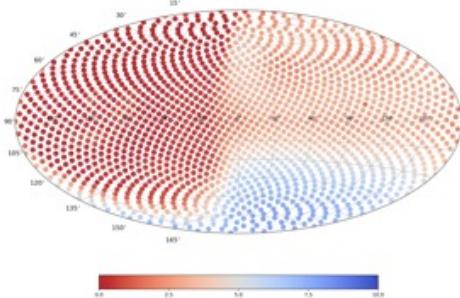
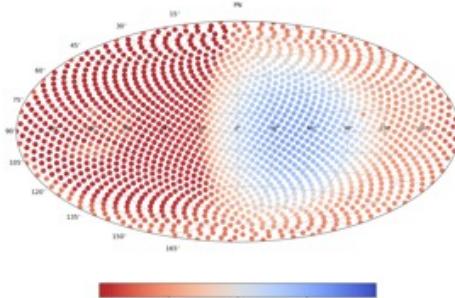
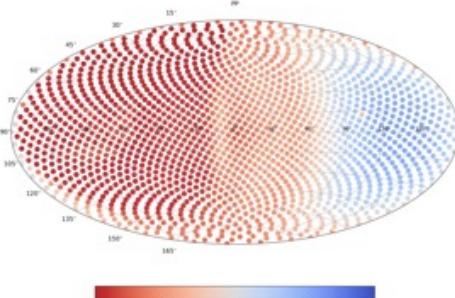
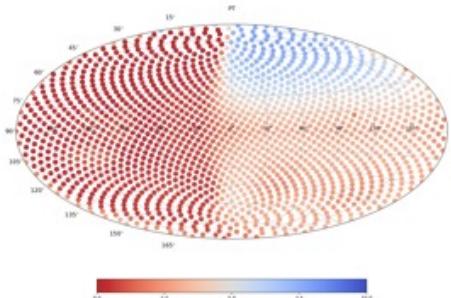
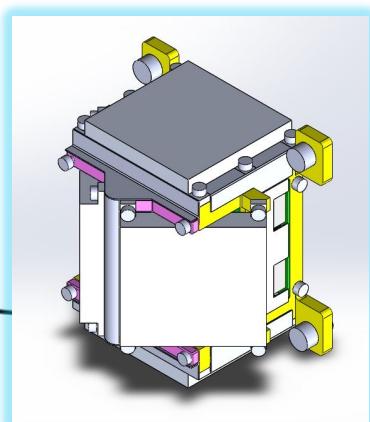
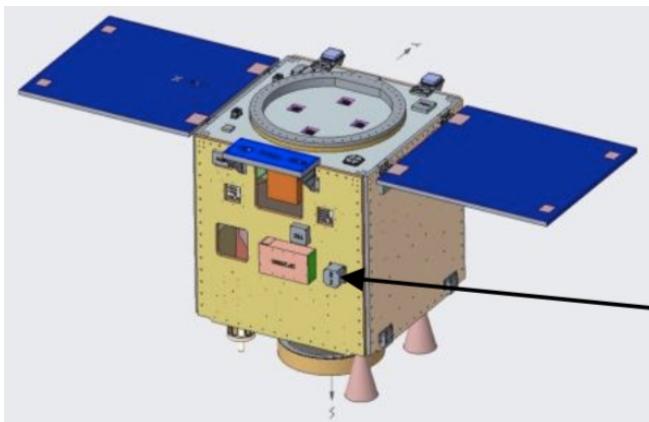
Task Name	2020				2021				2022				2023			
	Q1	Q2	Q3	Q4												
Readout Electronics – EM																
Readout Electronics - QM																
Readout Electronics FM																
ISD Delivery																
Mechanical Design - EM																
Mechanical Design - QM																
Mechanical Design - FM																
Science Data Center (SDC)																

FM delivery in May 2023, launch in 2025

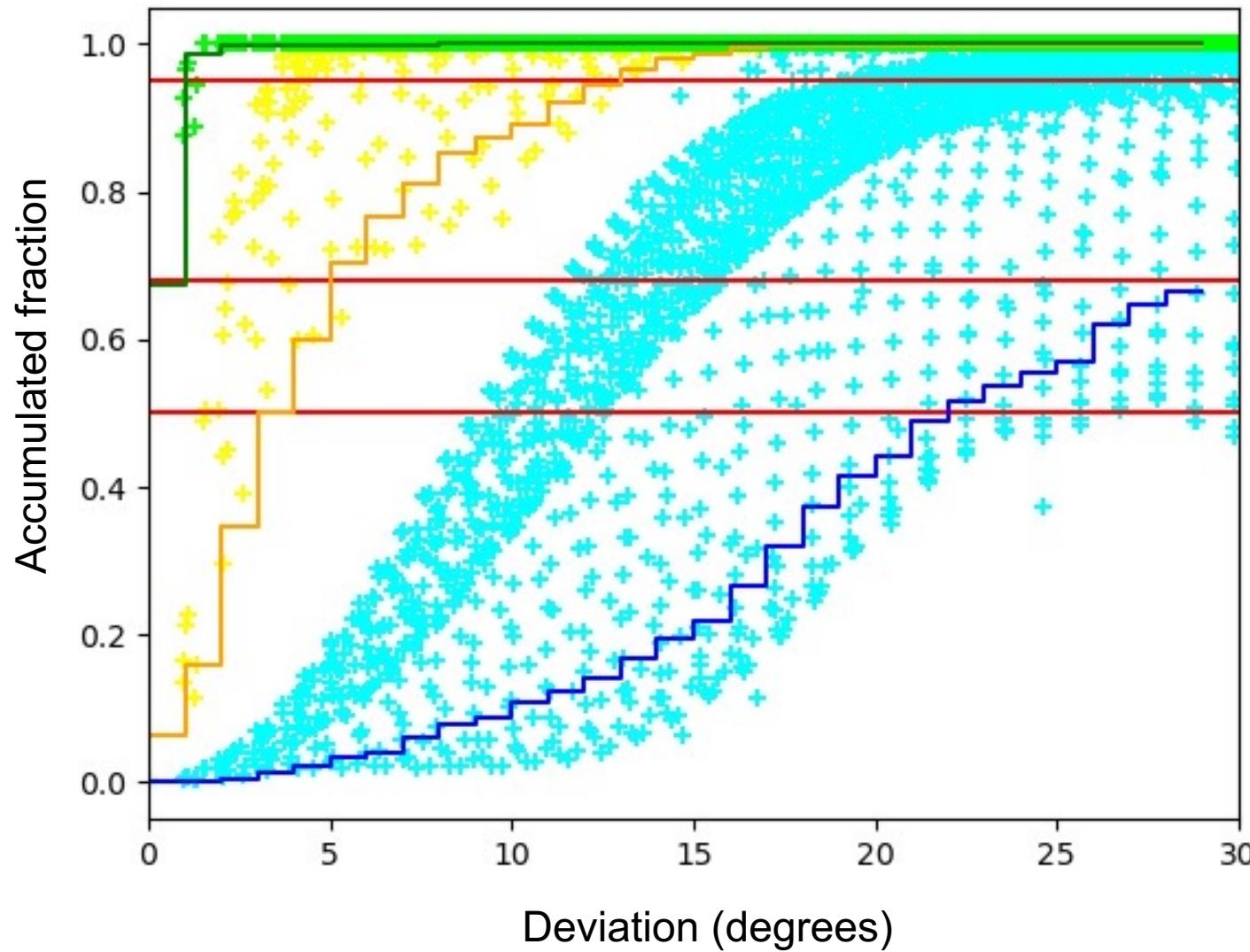
now

Detector response (50-300 keV) of the 8 sensors in different directions in the sky

($\alpha = -1$, $E_p = 300\text{keV}$)



GTM ‘quick’ localization accuracy



(GRB: $N_E \propto E^\alpha e^{(-E(2 + \alpha)/E_p)}$, $\alpha = -1$, $E_p = 300$ keV, duration 10 sec)
($\theta, \phi = (57^\circ, 46^\circ)$)
(Fluence = 4×10^{-4} , 4×10^{-5} , 4×10^{-6} erg/cm² in 10-1000 keV)