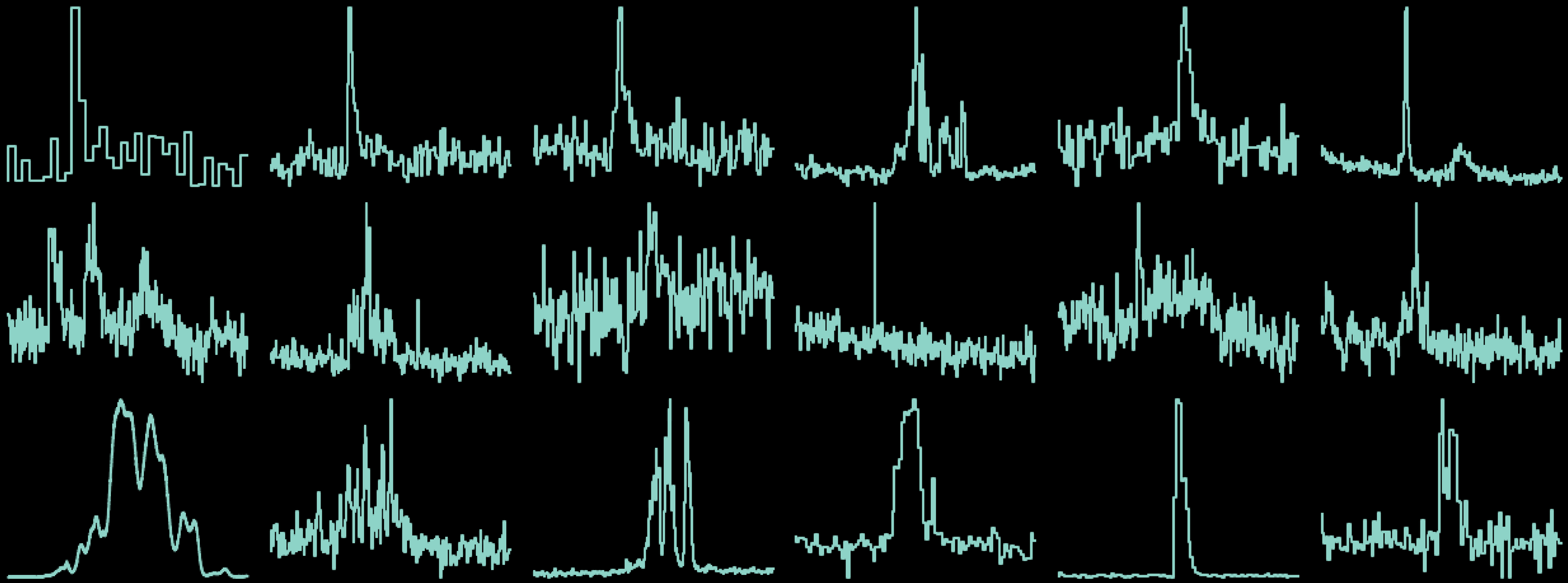


The First GRBAlpha and VZLUSAT-2 catalogue: gamma-ray transients and detector sensitivity

Marianna Dafčíková, Masaryk University, Czech republic

Collaborators: J. Ripa, A. Pal, N. Werner, F. Munz , M. Kolar, L. Szakszonova, M. Duriskova, N. Husarikova, et al.

FUNDED BY GAČR CZECH SCIENCE FOUNDATION

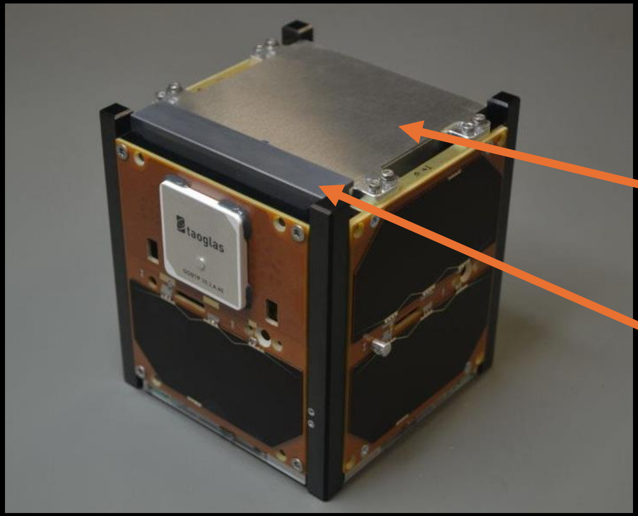
Supported by GAČR project number 24-11487J

GRBAlpha

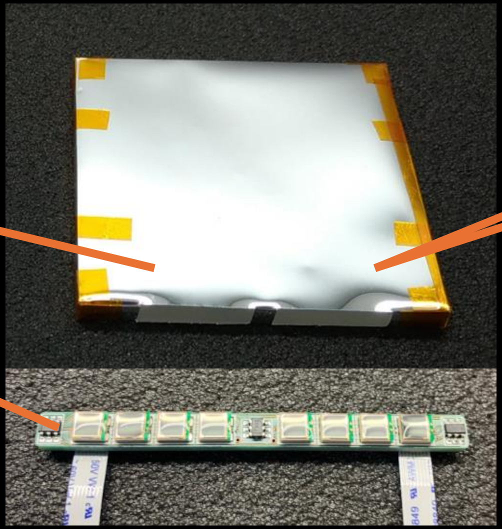
- 1U CubeSat
- Launched in March 2021
- 550 km polar orbit
- CsI(Tl) scintillator read-out by 2x4 SiPMs
- Technological experiment for CAMELOT

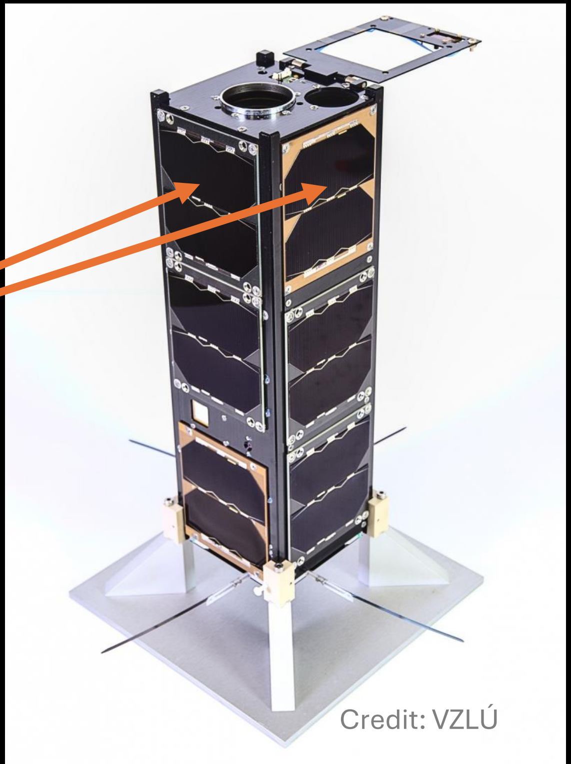
VZLUSAT-2

- 3U CubeSat
- Launched in January 2022
- 530 km polar orbit
- Secondary payload: 2 GRB detectors



Pál et al., 2020, 2023





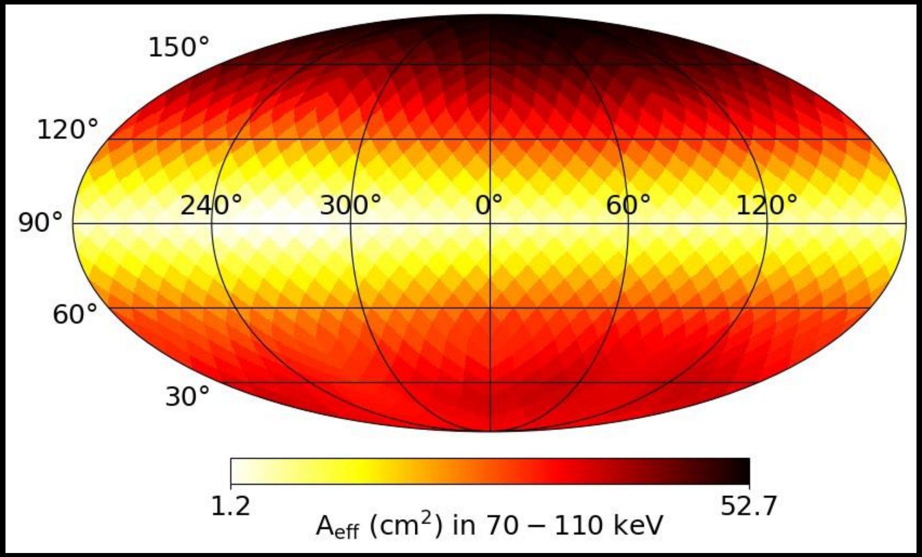
Credit: VZLÚ

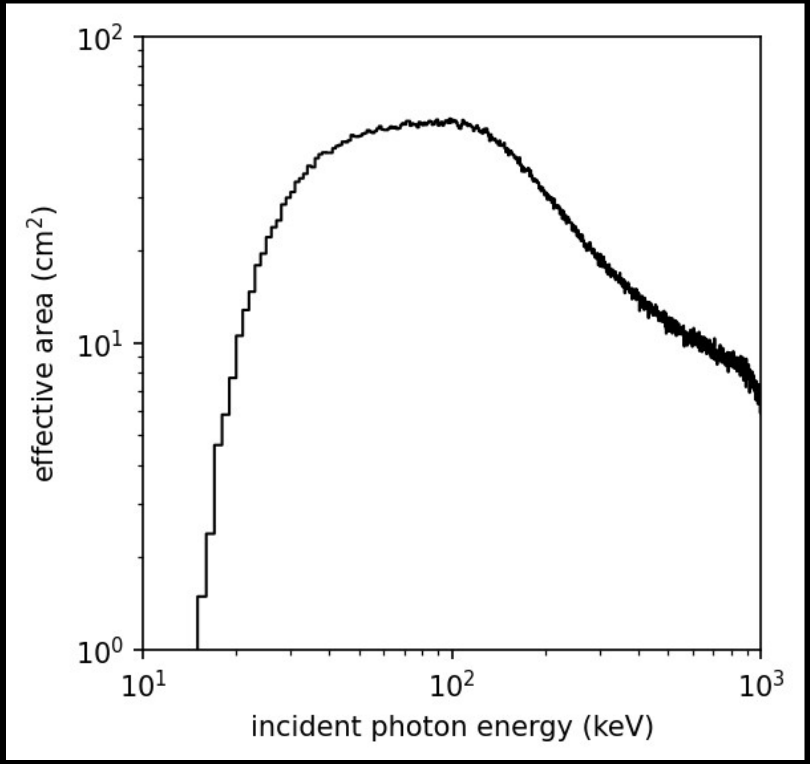
Observations

- GRBAlpha operations done by students, nonstop measurements
- VZLUSAT-2 measurements less frequent
- 0.5 and 1 s exposure time, 4 energy bands (70 – 950 keV)
- No trigger algorithm yet, correlation with other missions
  (Fermi, Swift, INTEGRAL, Konus, AGILE, CALET, GECAM, AstroSat, FRB + GW triggers)
- 2 detections/week –> 250 detections/year for a constellation

face-on

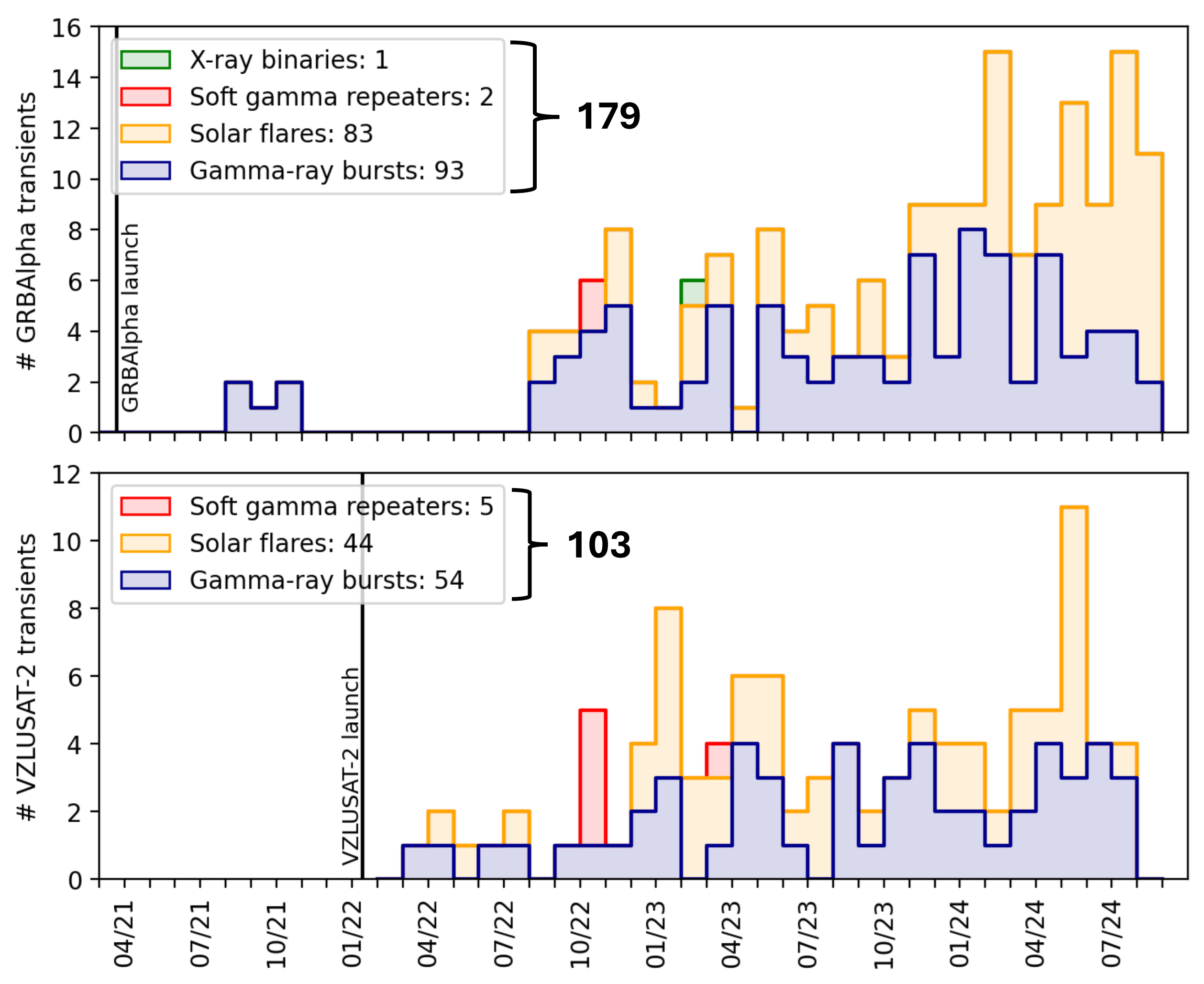
edge-on

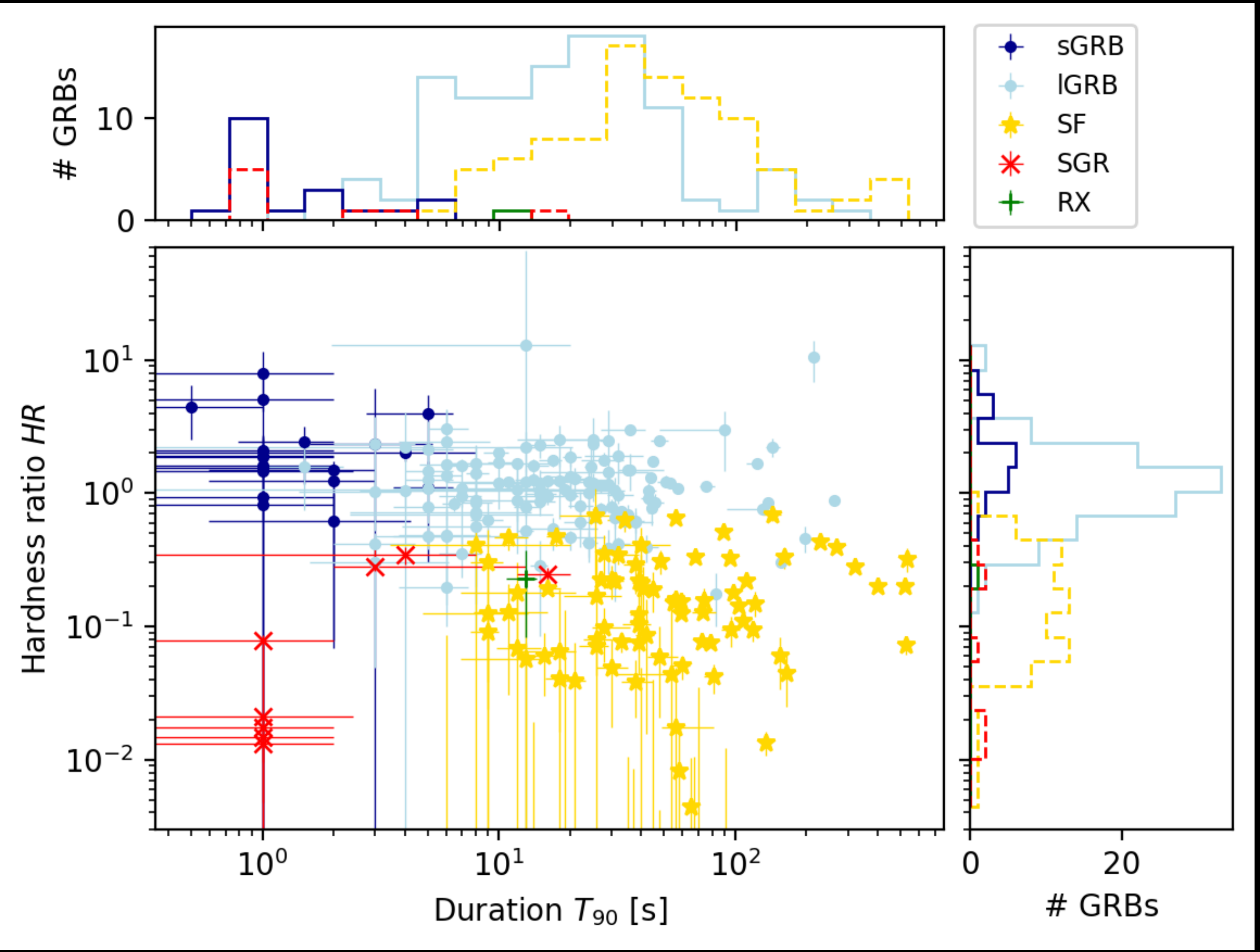




Confirmed detections

https://monoceros.physics.muni.cz/hea/GRBAlpha/
https://monoceros.physics.muni.cz/hea/VZLUSAT-2/





Notable detections

- GRB 230709B and GRB 230709C: **42 minutes** apart

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News By Tereza Pultarova published March 29, 2023

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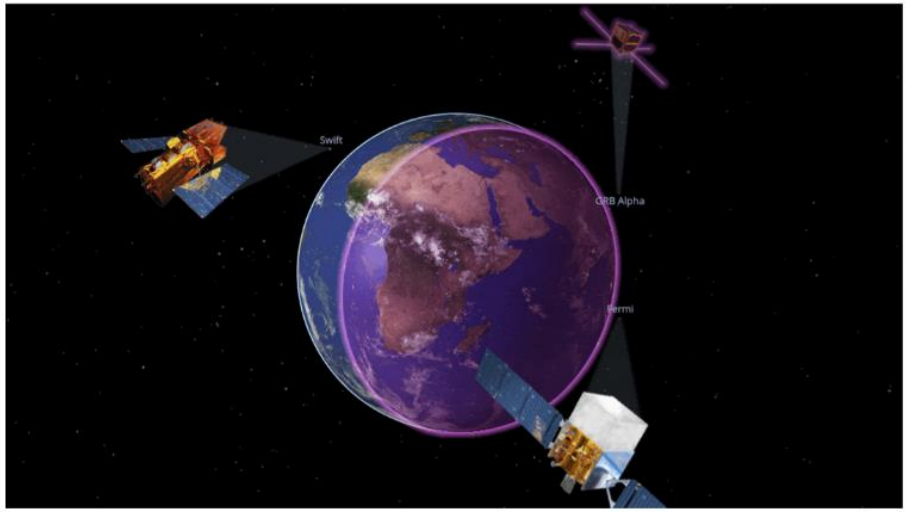
Comments (1)

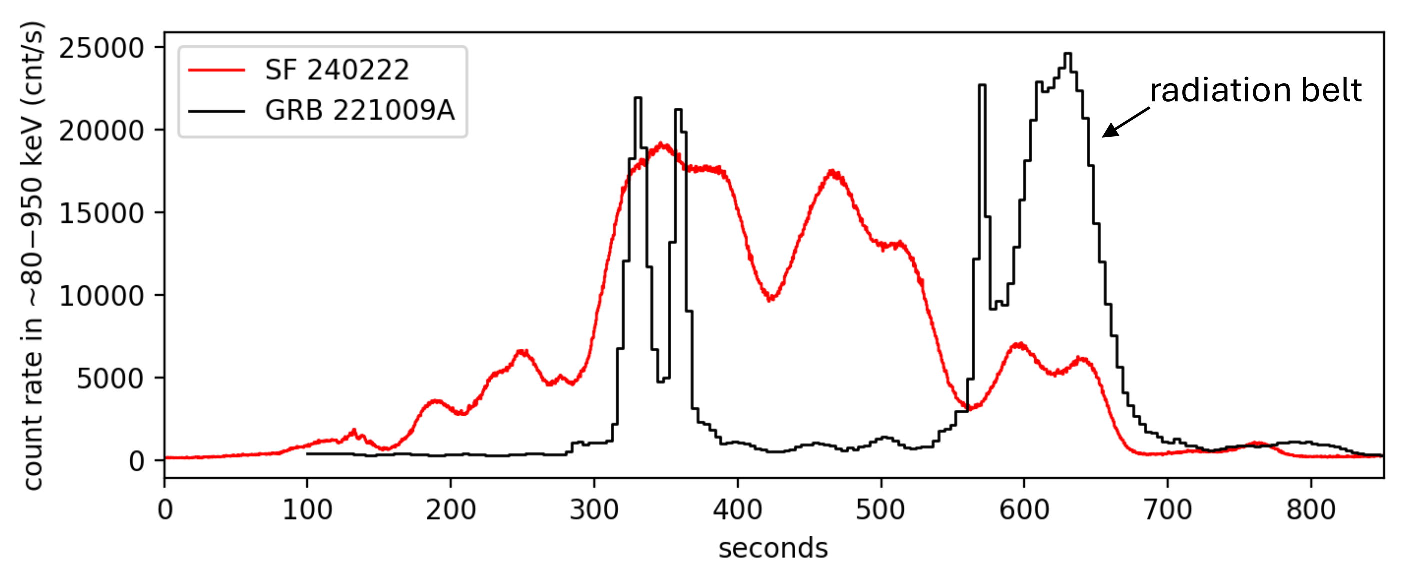


Tiny cubesat called GRBAlpha played a key role in determining the peak intensity of the brightest gamma-ray burst ever seen. (Image credit: Francis Reddy/NASA Goddard, University of Maryland)

Credit: space.com

Notable detections

- GRB 230709B and GRB 230709C: **42 minutes** apart
- GRB 231215A: most distant GRB at z = 2.305 (**10.8 Gyr**)
- GRB 221009A (+ GRB 230307A): peak flux without saturation
- X6 class solar flare on 2024-02-22: nearly as bright as the BOAT



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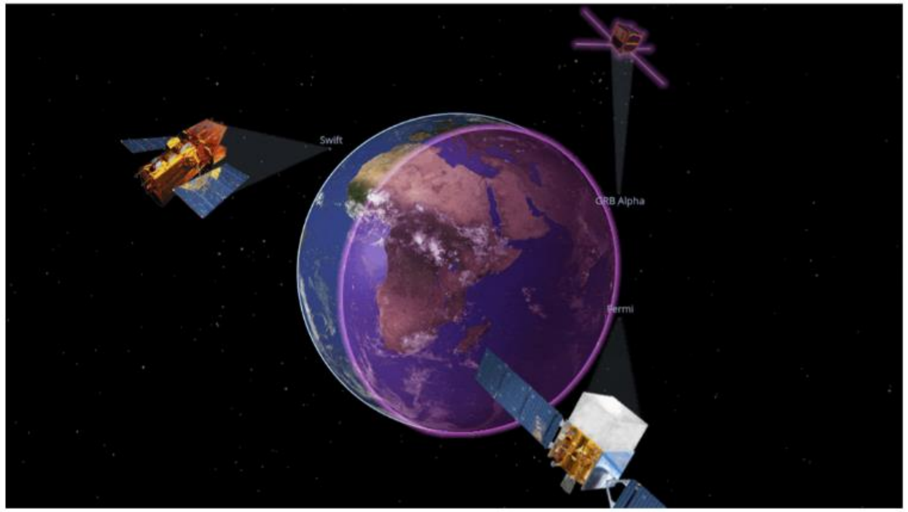

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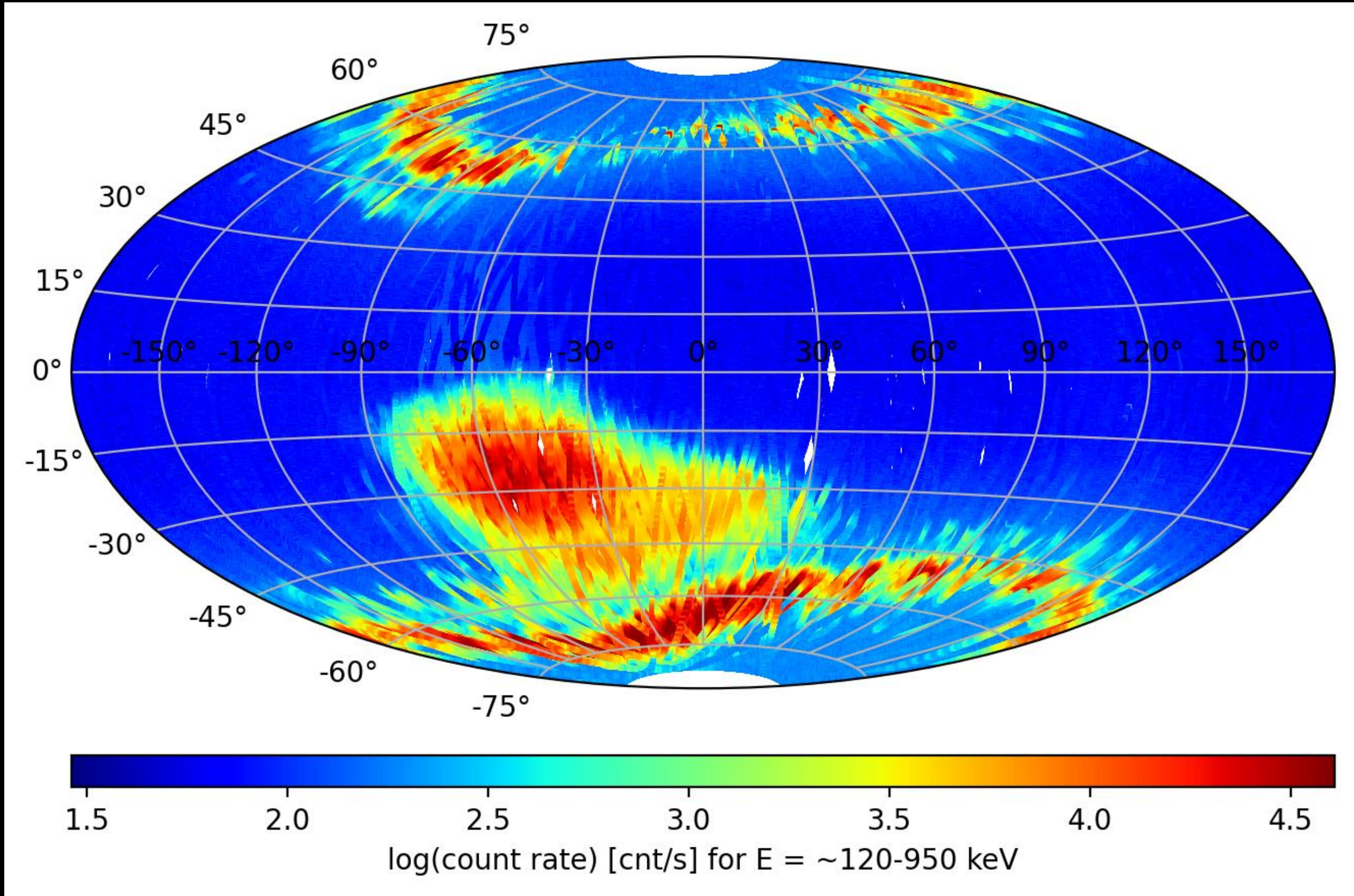
LEO environment



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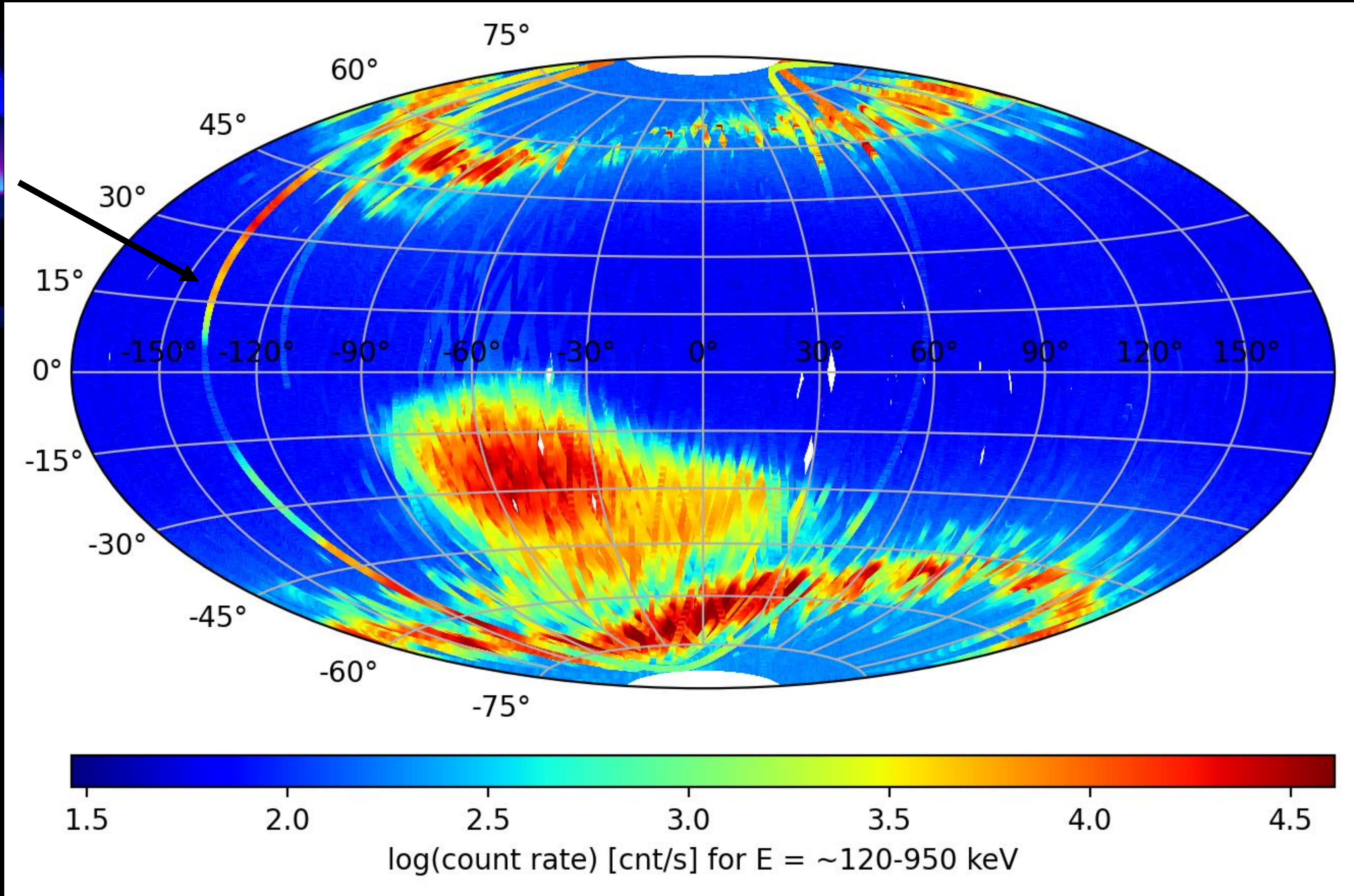
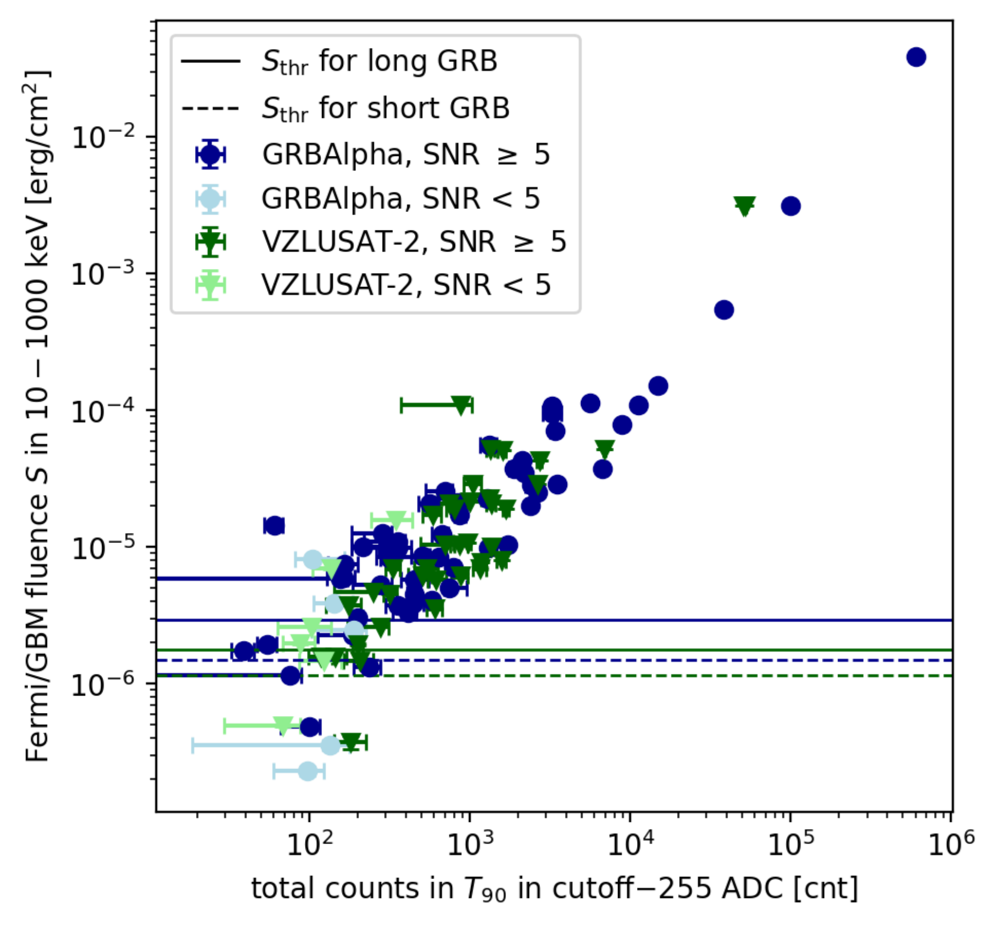
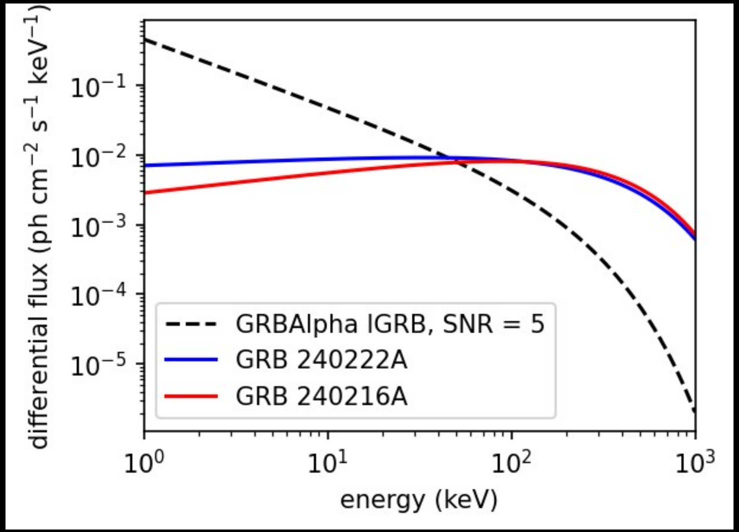


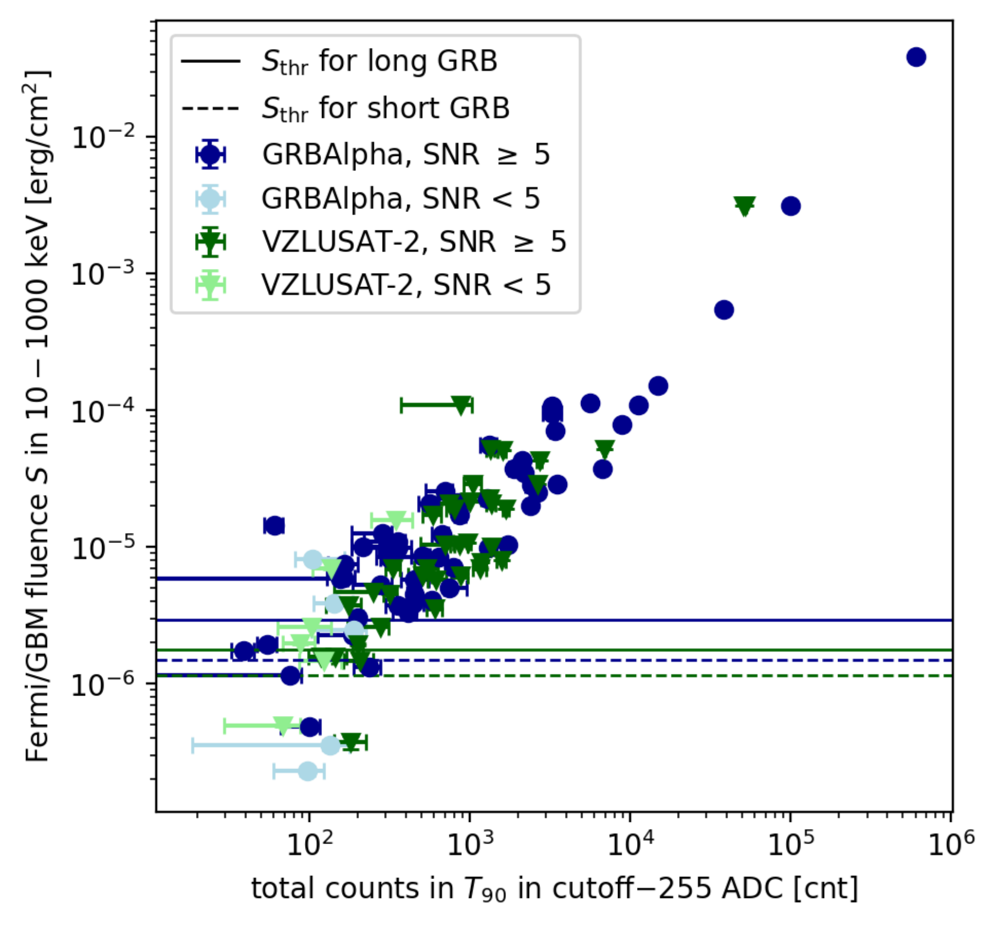
Cross-correlation with Fermi/GBM



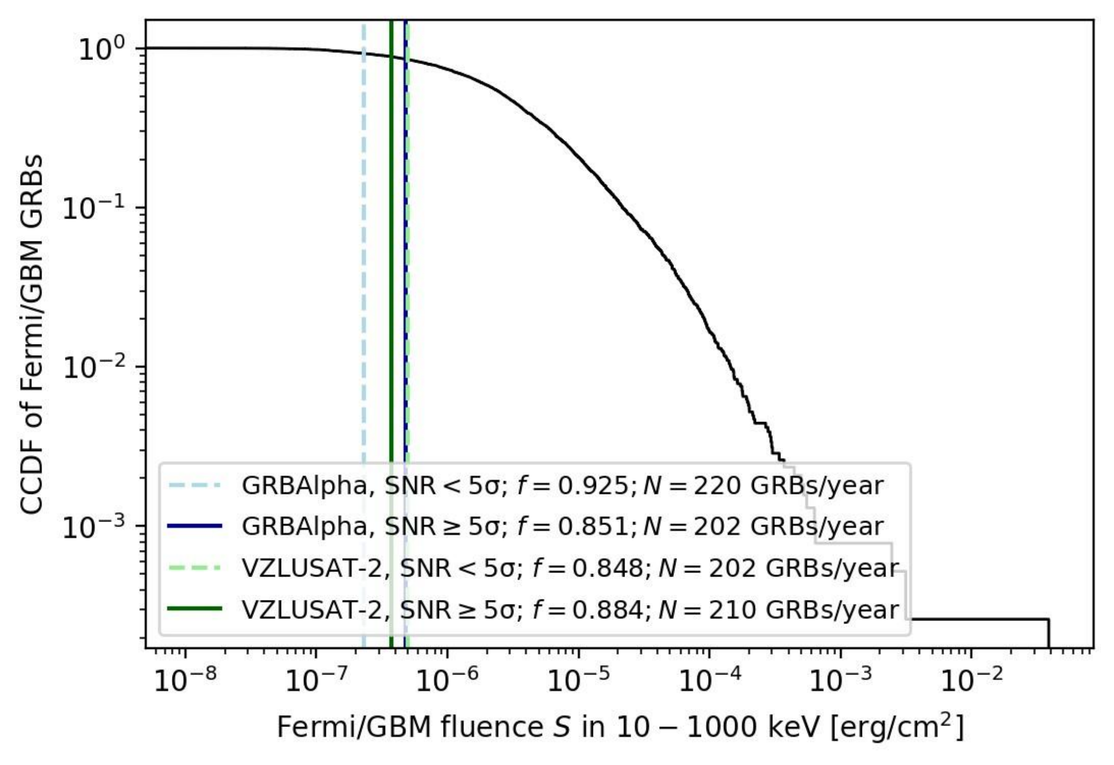
- Unknown GRBAlpha orientation
- No detector response matrix for VZLUSAT-2
- S_{thr} = 5σ detection of a typical GRB
- Significant GRBs with $S < S_{thr}$ were harder



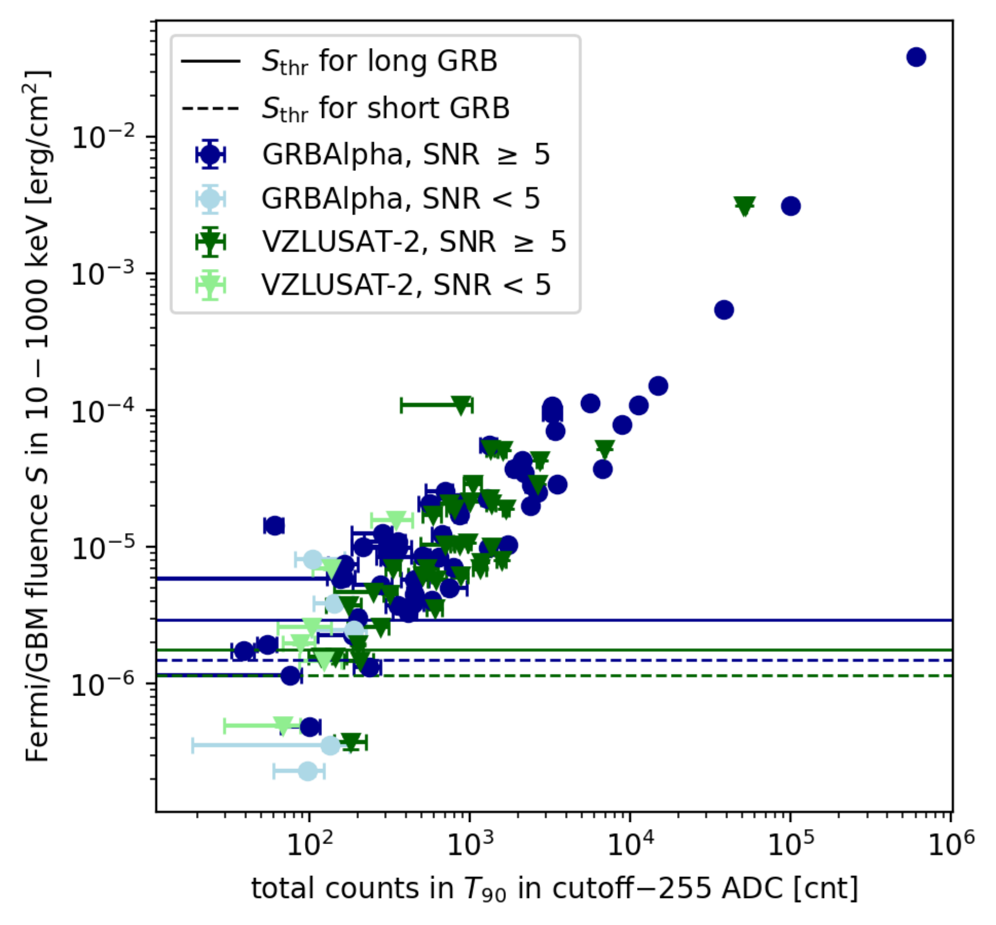
Empirical sensitivity

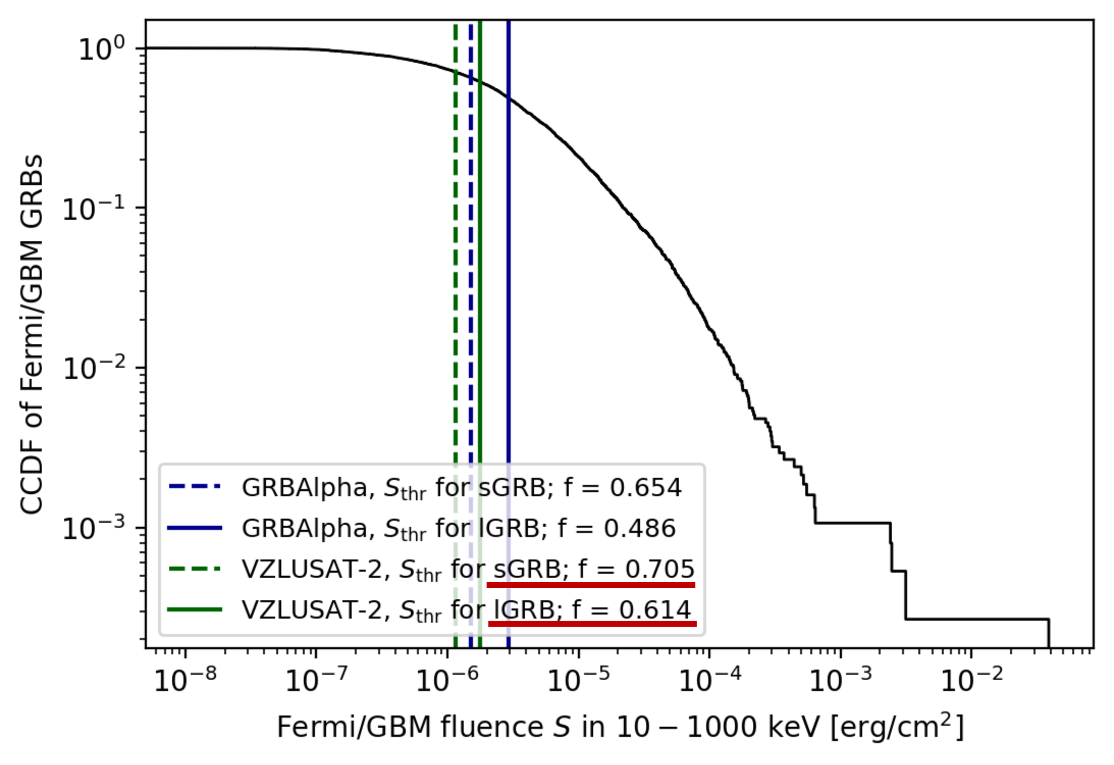


$S \sim 4 \cdot 10^{-7}\ \mathrm{erg \cdot cm^{-2}} \rightarrow 88\%$ GBM GRBs



Theoretical sensitivity





Summary & future plans

- GRBAlpha: 179 detections in 3+ years
- VZLUSAT-2: 103 detections in 2+ years
- Nonstop measurements: 2 detections/week
- Feasible detection of 60 – 85% of all Fermi/GBM GRBs
- Sensitivity higher for short GRBs –> advantage in search for GW counterparts
- LEO background monitoring, SiPM degradation

More data!

→ GRBBeta (2U CubeSat) launched July 9, 2024

More detections and discoveries!

→ Trigger algorithm