Near real time alerts from the POLAR-2 missions

Merlin Kole on behalf of the POLAR-2 Collaboration
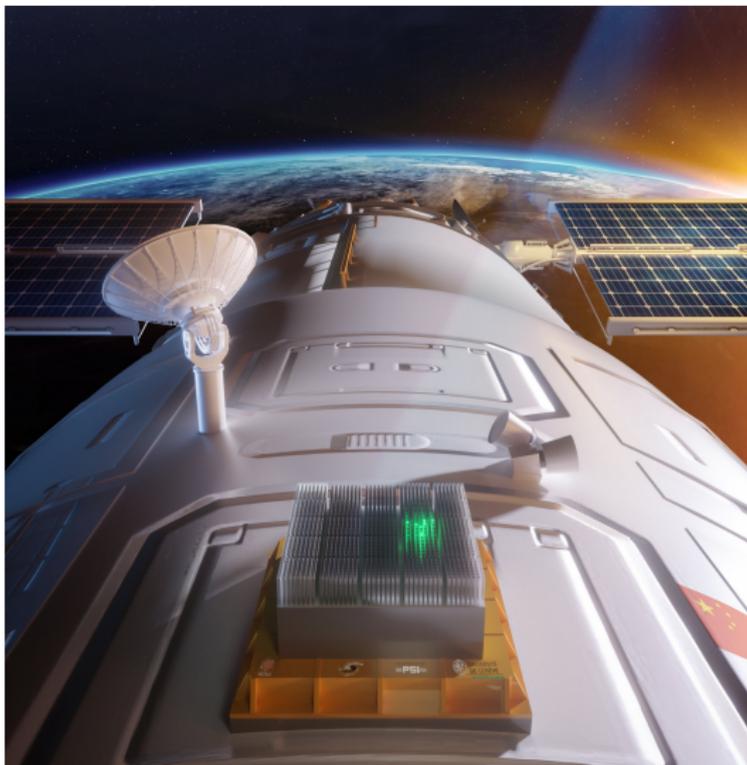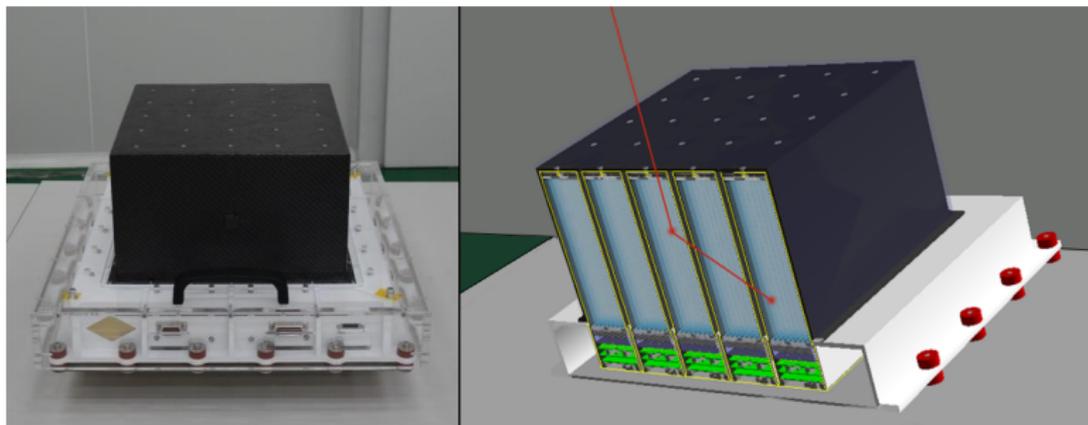
POLAR-2

- POLAR-2: a dedicated gamma-ray polarimeter on the CSS
- Follow-up of the POLAR mission
- Launch approved to go to the CSS in late 2024
- Ideal to provide transient alerts
- System only in early stages

Its predecessor: POLAR

- Gamma-ray polarimetry measured using a plastic scintillator array
- Each photon needs to be measured twice: inefficient
- Compensated with a large effective area of $\approx 300\mathrm{cm}^2$ at 400 keV
- Field of View of half the sky
- Effective area of individual bars depends highly on location of GRB 2 $\rightarrow$ location sensitivity
- Full description of the instrument: N. Produit et al. arXiv:1709.07191

Its predecessor: POLAR

- TG-2 Chinese Space Lab launched on September 15th 2016
- POLAR took data upto April 2017
- Detected 55 GRBs
- Localization capability order of degrees: Y.H. Wang et al. Nucl.Instrum.Meth.A 988 (2021) 164866
- Included in IPN: relative timing error below 100 μs

POLAR-2

- POLAR was successful but failed 6 months into the mission
- 2018: POLAR-2 initiated in 2018
- 2019: Approved for launch to the CSS in 2024
- Geometrical area increased by factor 4
- Improvements in technology provide an additional factor of 2.5 in effective area
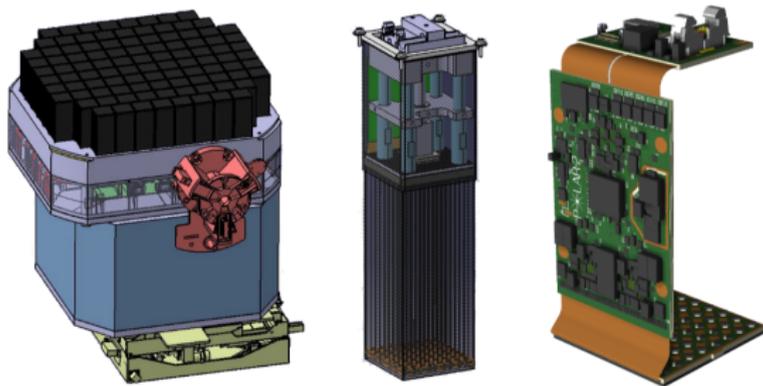
POLAR-2

- Only events where two channels trigger in coincidence used for polarization
- All other events are kept for localization and spectrometry
- Total effective area significantly increased w.r.t. POLAR
- Up to $2000 \mathrm{cm}^2$ at 100 keV
- Reduced for large off-axis angles, but still high
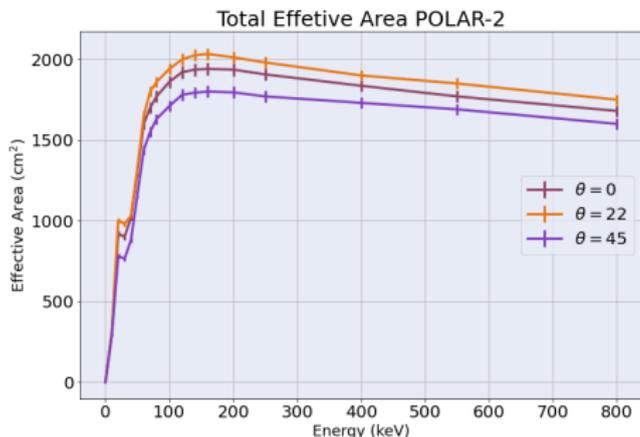
CSS environment

- POLAR-2 placed to always point to zenith
- Data storage on CSS
- Large GPU based computing facility available
- Continuous contact to ground through relay satellites + potenial Beidou connection

Messages to ground

- Short messaging system through satellite
- 560 bit
- Directly sent to terminal on ground
- Option 2: Embed it in telemetry packets sent to ground every 2 seconds
- Have to go through ground stations which could cost time

Localization studies ongoing

- Localization 'a la GBM' → using dependence of effective area 6400 sub-detectors on position GRB
- With computing facilities we can do better
- Option is BALROG (combined localization and spectral fit)
- To be studied how this can work on GPU
- Initial alert with rough localization within a few seconds
- Followed by more detailed localization, light curve and rough spectrum
- Potential updates from ground

Credit: B. Biltzinger et al. 2022
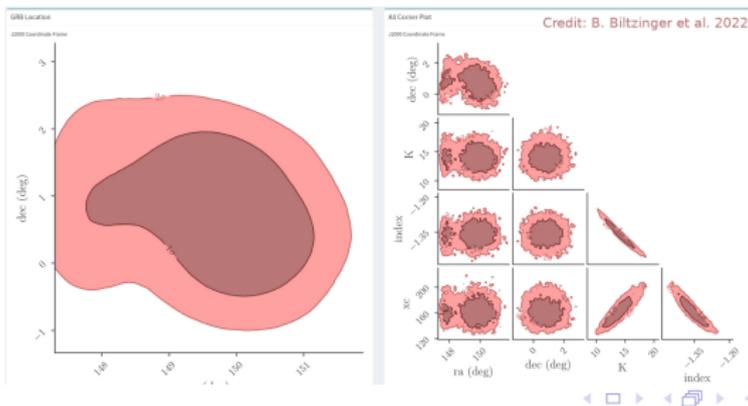
Schedule and outlook
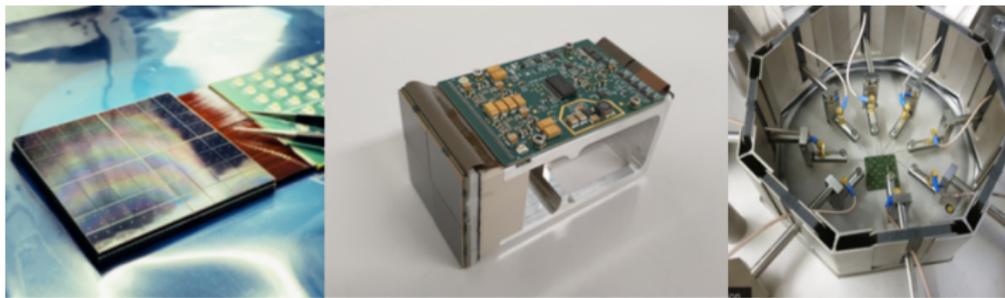
- 2022 start of flight model production
- 2022 setting up network for alerts to ground and testing
- 2023 localization code
- 2024 Launch
- Data taking for at least 2 years