

# CubeSats in support of astrophysics, GRBAAlpha and beyond

A. Pál, N. Werner, M. Ohno, L. Mészáros, J. Řípa, M. Frajt, N. Hirade, J. Hudec, J. Kapuš, M. Koleda, R. Laszlo, P. Lipovsky, H. Mataka, M. Šmelko, N. Uchida, B. Csák, T. Enoto, Y. Fukazawa, G. Galgóczi, K. Hirose, S. Hisadomi, Y. Ichinohe, T. Mizuno, K. Nakazawa, H. Odaka, H. Takahashi, K. Torigoe

## 1.) CubeSat used in astrophysics

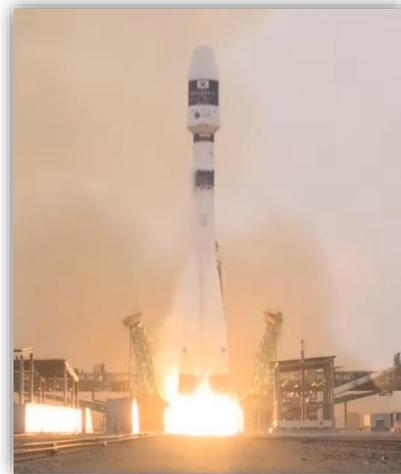
Space science, including the field of astrophysics, is continuously finding innovative use cases for small satellites and CubeSat platforms. These missions support efforts in the democratisation and improved accessibility of space technologies. GRBAAlpha, as one of such missions, is a 1U CubeSat carrying an experimental payload for the detection of gamma-ray bursts (GRB).



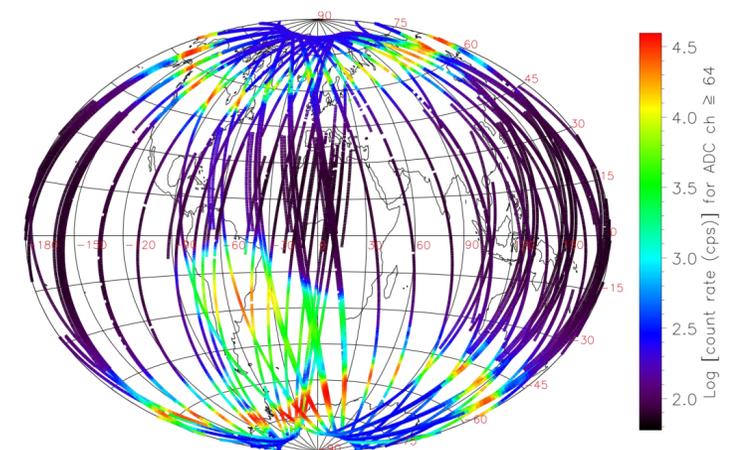
GRBAAlpha CubeSat with 75x75x5mm CsI(Tl) scintillator read out by SiPM detectors on top.

## 2.) Observed phenomena

GRBs are some of the most energetic events in the universe, sometimes accompanying gravitational wave events. Based on a new detector concept utilising a CsI(Tl) scintillator crystal and SiPM detectors (MPPC by Hamamatsu) accompanied by a GPS receiver for precise timestamping, GRBAAlpha is one of the first CubeSats monitoring the high-energy sky. Launched on 2021 March 22, GRBAAlpha is a precursor mission for an initiative called Cubesats Applied for MEasuring and LOcalising Transients (CAMELOT).



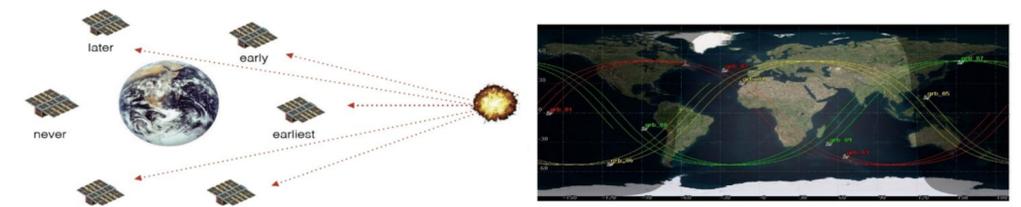
GRBAAlpha was launched on Soyuz 2.1 rocket on 2021 March 22nd



While monitoring GRBs, the detector also provides measurements of the particle background in a 550km low-Earth orbit

## 3.) Next steps

CAMELOT is planned as a constellation of at least nine 3U CubeSats in a low Earth orbit, providing all sky coverage for GRB detection and localisation. The proposed fleet of CubeSats, equipped with large and thin detectors and GNSS receivers, will provide means for precise time-based localisation of gamma-ray transients using triangulation. Thus, this constellation will help in the detection and characterisation of some of the most exciting astrophysical phenomena.



<b>Satellite platform</b>	3U CubeSat
<b>Target orbit</b>	9 satellites constellation in LEO in three orbital planes
<b>Payload</b>	Four 150x75x5 mm <sup>3</sup> CsI scintillators read out by Multi-Pixel Photon Counters (MPPCs)
<b>Goal</b>	Degree-scale timing-based localisation with a similar sensitivity to the Fermi-GBM detector

### MISSION CONCEPT

- Equipped with GPS receiver for precise time synchronisation
- Inter-satellite (Iridium NEXT) communication equipment for rapid data download
- All sky coverage with a large effective area