First results after a year in orbit

Bertrand Cordier on behalf of the SVOM Collaboration

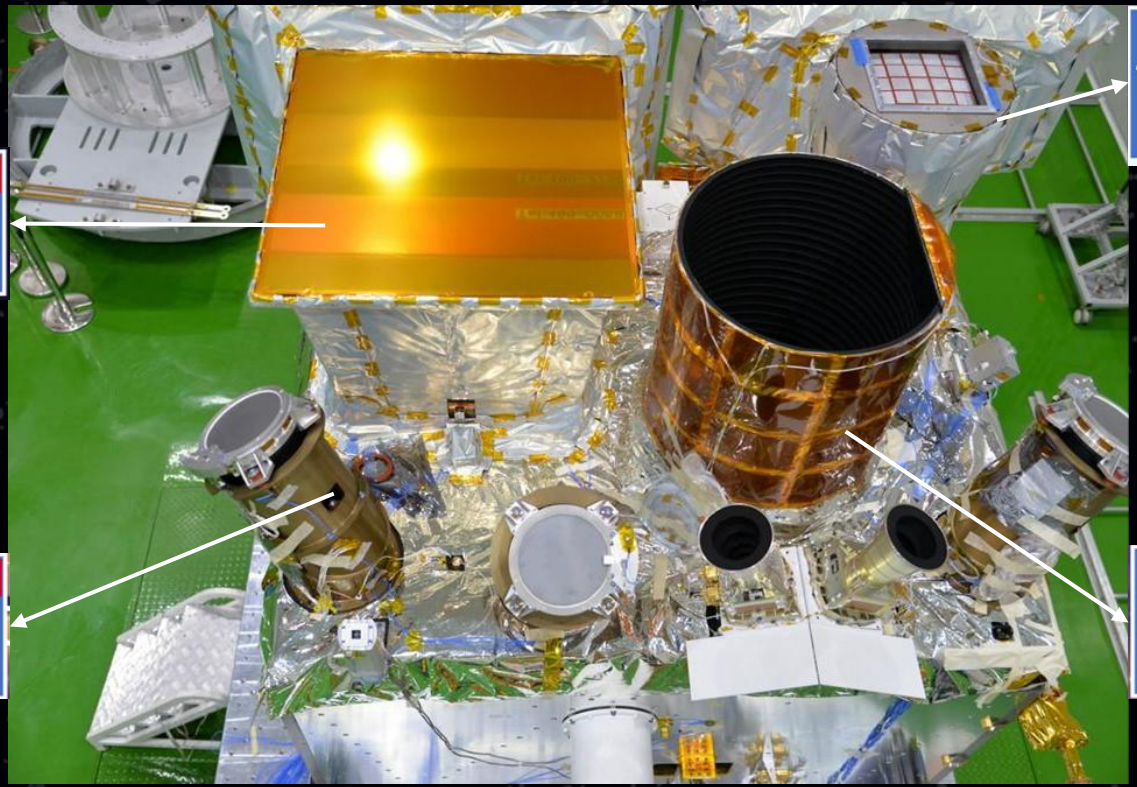
Site SVOM *https://www.svom.eu/*

SF2A 2025 - Toulouse
July 1rst, 2025

The SVOM Consortium

- **China (PI J. Wei)**
  - SECM Shanghai
  - Beijing Normal University
  - Central China University Wuhan
  - Guangxi University Nanning
  - IHEP Beijing
  - KIAA Peking University
  - Nanjing University
  - NAOC Beijing
  - National Astronomical Observatories
  - Purple Mountain Observatory Nanjing
  - Shanghai Astronomical Observatory
  - Tsinghua University Beijing
- **Mexico** UNAM Mexico
- **France (PI B. Cordier)**
  - CNES Toulouse
  - APC Paris
  - CEA Saclay
  - CPPM Marseille
  - LUX Meudon
  - IAP Paris
  - IRAP Toulouse
  - IJCLab Orsay
  - LAM Marseille
  - LUPM Montpellier
  - OAS Strasbourg
- **UK** University of Leicester
- **Germany**
  - MPE Garching
  - IAAT Tübingen

The Space Variable Objects Monitor (SVOM)



ECLAIRs

« The trigger camera »
Wide-field X and Gamma rays telescope

Spectral range : 4 keV – 150 keV
Localization accuracy < 12arcmin

GRM

"The Gamma-Ray burst Monitor"
X-rays and Gamma-rays detectors

15 keV – 5 MeV
Localization accuracy < 5°

MXT

"The Micro-channel X-ray Telescope"
Narrow-field X-ray telescope

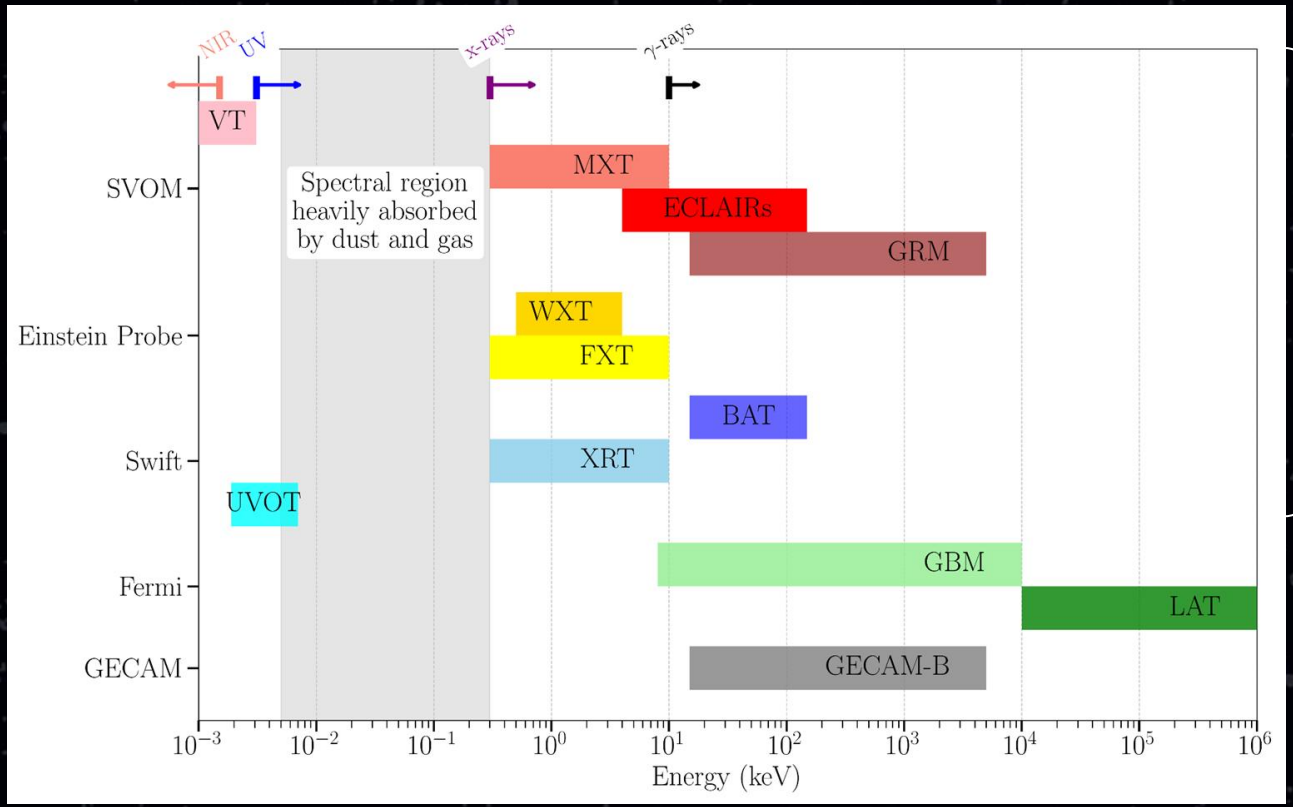
Spectral range : 0.2 keV – 10 keV
Localization accuracy < 1arcmin

VT

"The Visible Telescope"
Narrow-field visible telescope

Ritchey Chretien Φ=400mm
Localization accuracy < 1arcsec

SVOM: a unique spectral range to study the high-energy transients



They (except GRM) localize

(<10 arcmin)

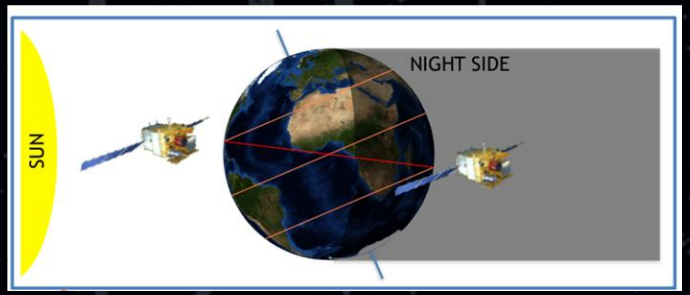
+

onboard auto follow-up of sources

SVOM is placed in a Low Earth Orbit (LEO)

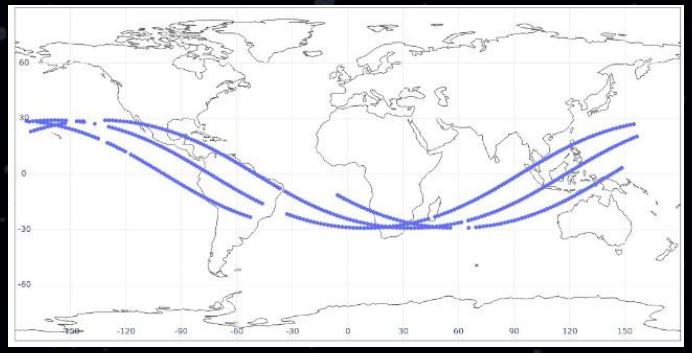
Anti-Solar pointing strategy

~625 km, ~29° inclination angle, 1 orbit ~ 96min



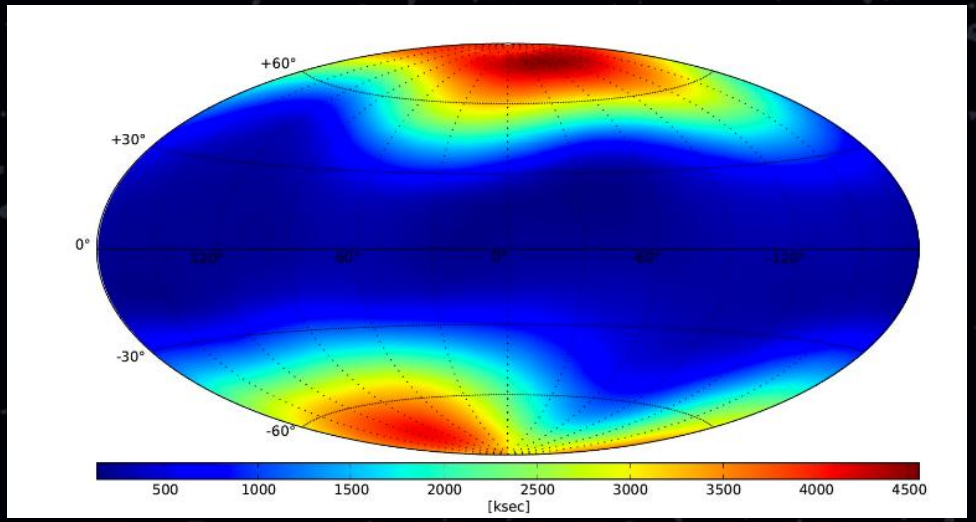
The satellite track on Earth

+/- 30° latitude



ECLAIRs exposure map simulation (over a year)

Initial Hypothesis : 65 GRBs/year, 1 ToO per day
- 4 Ms in the direction of the galactic poles
- 500 ks on the galactic plane

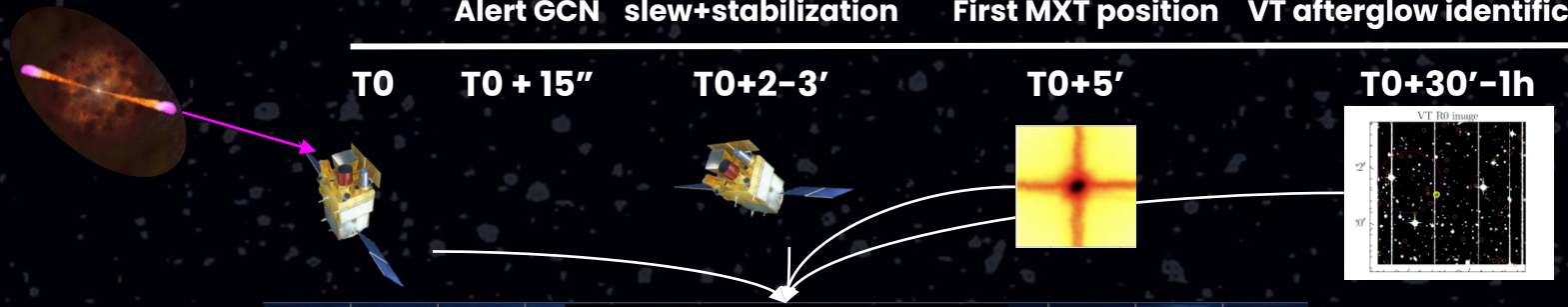


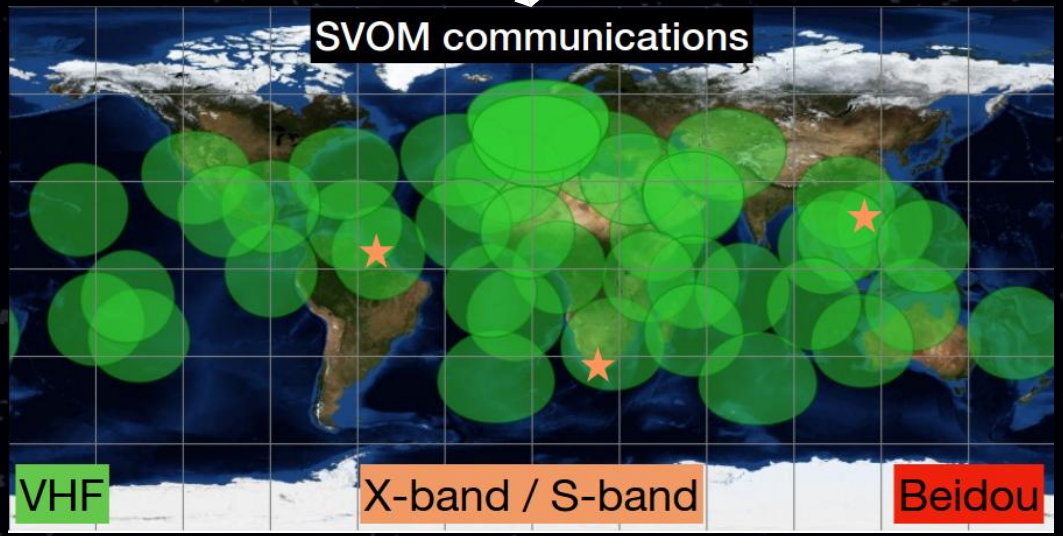
SVOM: a powerful transient detection and alerting machine

Alert GCN | slew+stabilization | First MXT position | VT afterglow identification

End of the auto onboard alert sequence

T0 | T0 + 15″ | T0+2–3′ | T0+5′ | T0+30′–1h | T0+8h (5 orbits)





Downgoing links

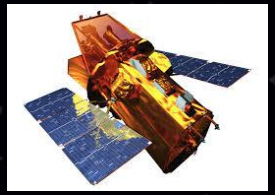
- **VHF** (fast but few data products)
- **X-band** (slow but complete data)

Upgoing links

- **S-band** (slow, few hours)
- **Beidou** (fast, few minutes)

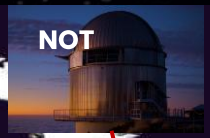
SVOM: Boosting the space and ground-based telescope synergies

Great synergies with Einstein Probe and Swift teams



Automatic ToO request to EP-FXT (since April 2025) **and Swift-XRT** (since Feb. 2025)

A dedicated ground-based follow-up segment
from 25 cm to the 8m class telescopes



TAROT

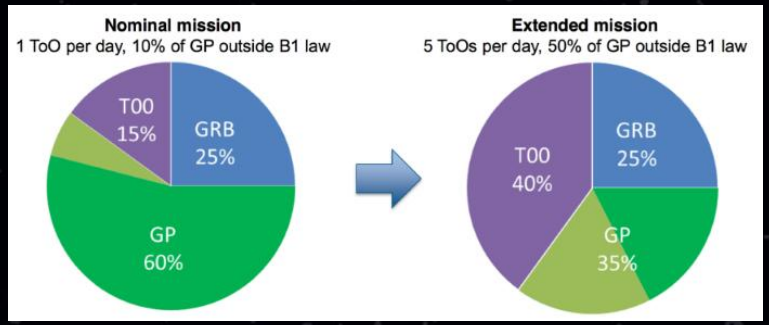
- Official Partners
- Associate Partners
- Purchase of time (LCOGT time coming 2025B)
- Close collaboration

SVOM: the scientific programs

Gamma-ray bursts

The SVOM Core & ToO programs

reserved to SVOM Co-Is



The General & ToO programs

GP obs (known sources): Observation proposals awarded by a TAC (your proposal has to include a SVOM co-I).
ToO obs (not anticipated flaring sources): If you want a ToO, please contact the SVOM PIs

Magnetar Giant flares

CVs, x-ray binaries

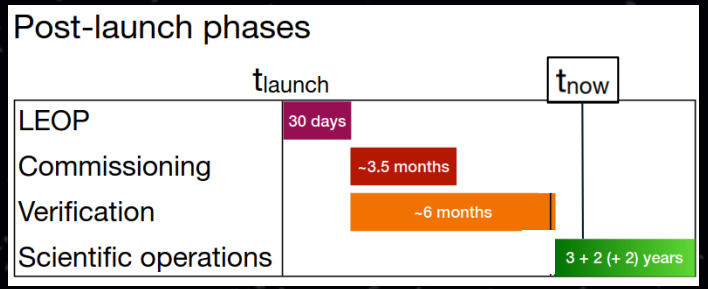
Flaring stars

AGNs/Blazars

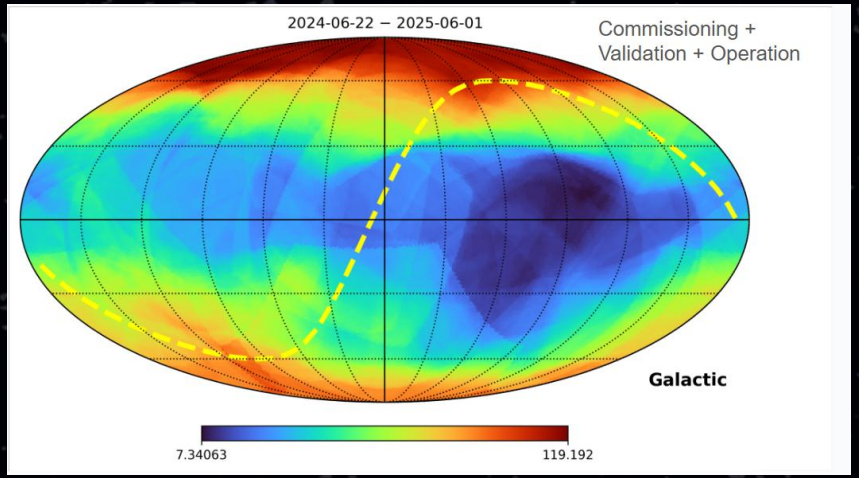
Supernovae

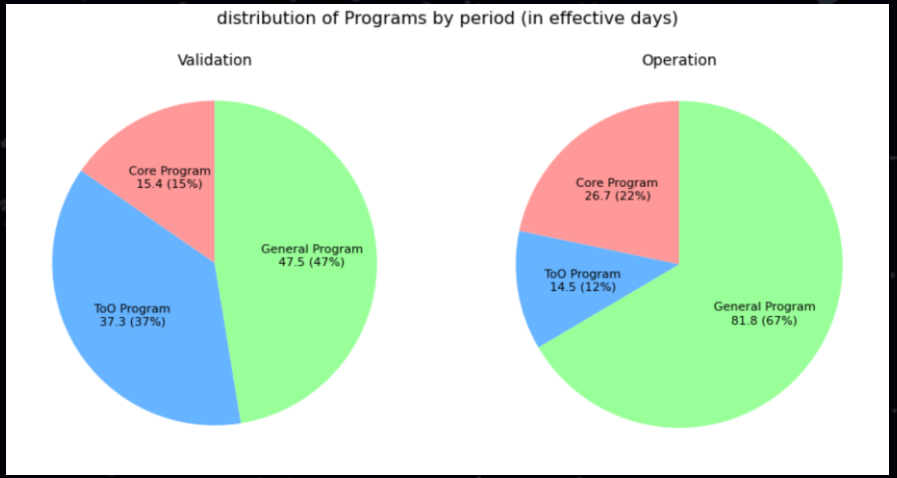
TDE, FRB, etc.

2024 June, 22nd when the SVOM story began



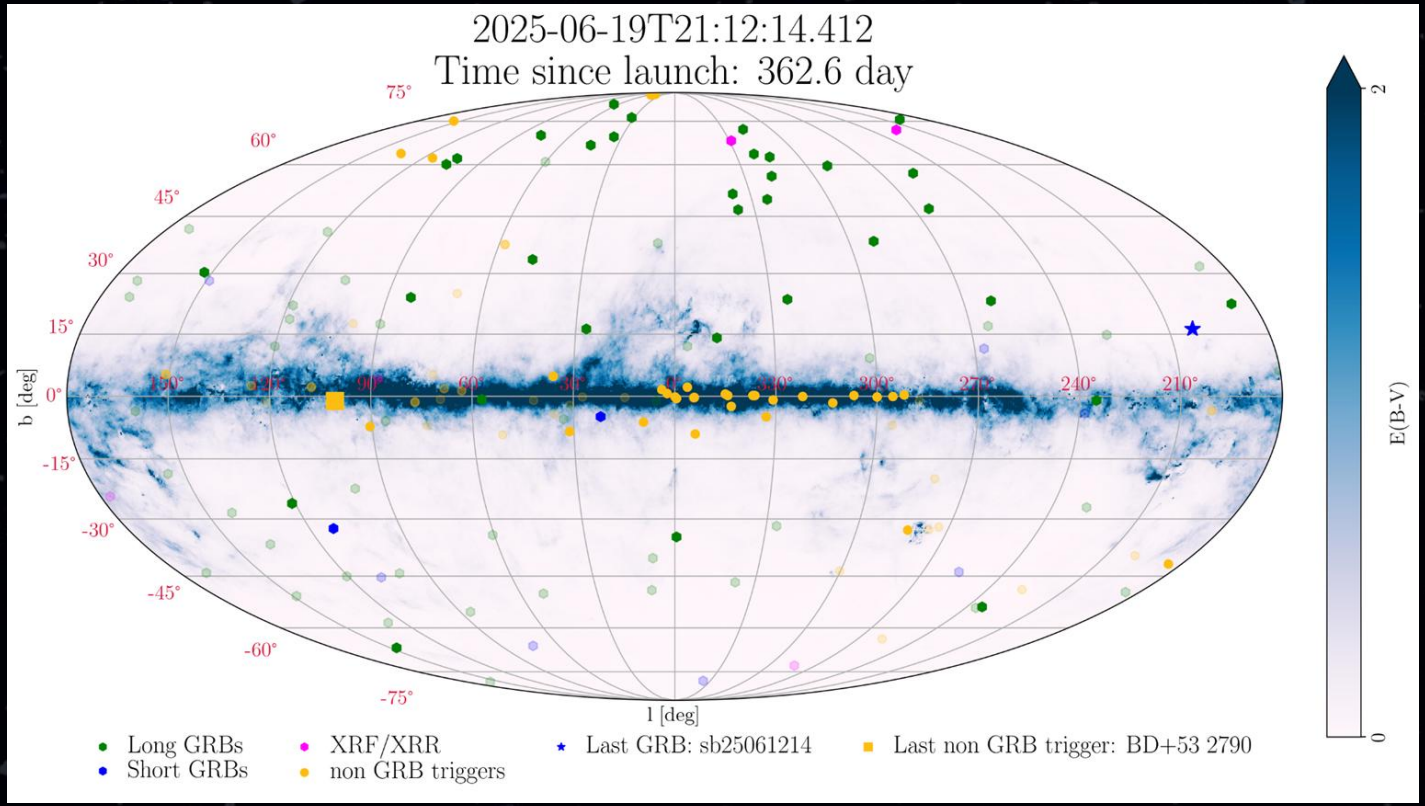
A year of observations





Commissioning : 22/06/2024 - 01/10/2024
Validation : 10/01/2024 - 15/01/2025
Operation : 15/01/2025 - 01/06/2025 -> Nominal scientific operation

1 year after launch: the SVOM x-ray/γ-ray transient sky



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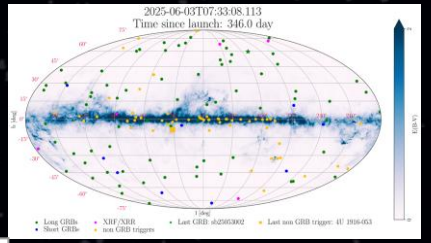
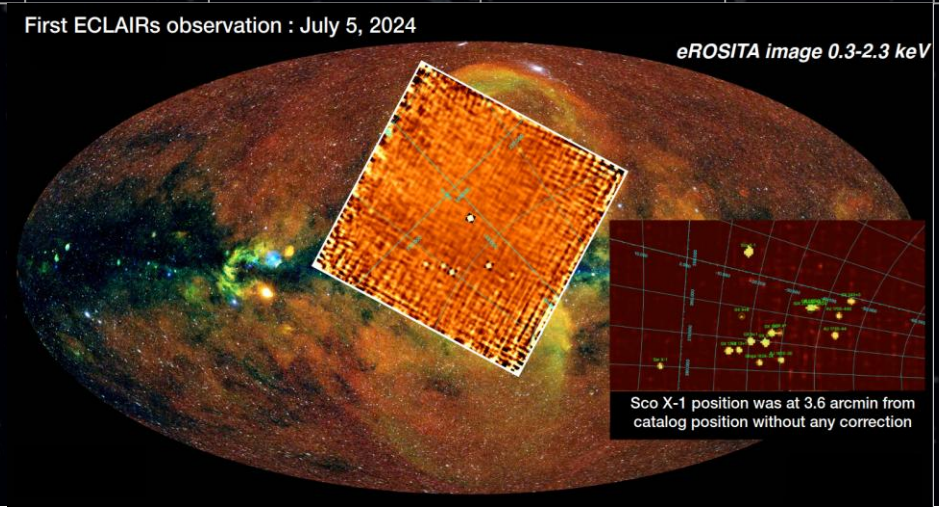
The SVOM x-ray/γ-ray transient sky in more details



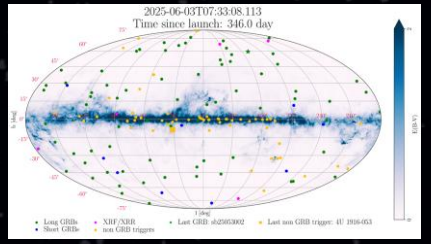
γ/x-ray transients general statistics

SGR	LMXB	HMXB	Variable/Flare star	AGN/Blazar	unknown	Total
3 (4%)	~40 (54%)	~19 (24%)	4 (6%)	3/1 (4%)	6 (8%)	~76

Preliminary numbers



The SVOM x-ray/γ-ray transient sky in more details



Gamma-ray Burst general statistics

	GRM detection (Half time in commissioning)	ECL detection (Half time in commissioning)	Total ECL+GRM detection	Jointly detected by other missions	# z_{GRM}	# z_{ECL}
Observed	110	46	131 105 Long (80%), 18 Short (14%), 8 XRF (6%)	89 (68%)	10 (9%)	16 (35%)
Expected	>100	30 - 60	–	–	–	> 50%

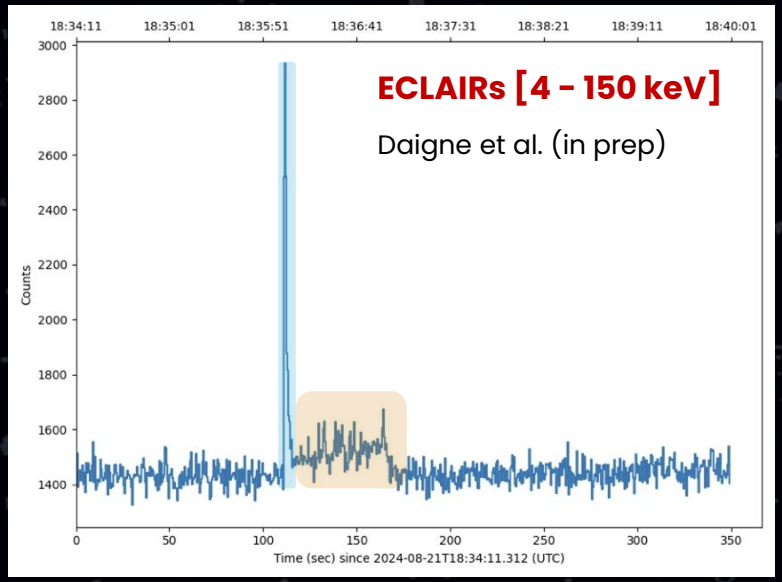
	ECL median loc.	MXT median loc.	x-ray afterglows	Optical afterglows	Radio afterglows	z > 4
	~7′	~40″	48 (36 ECL)	34 (27 ECL)	5	4/26 (15%)

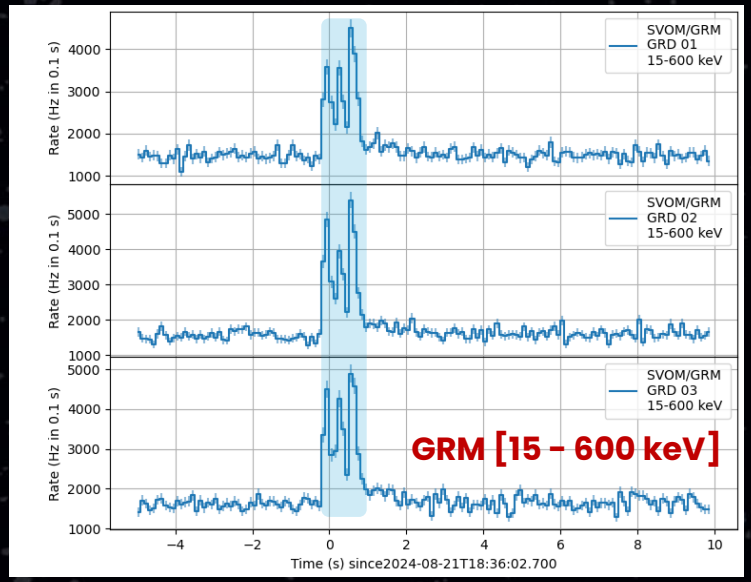
SVOM to explore the short GRB population and the merger origin

Our goal: Better understanding the **short GRB-merger connection** and **the physics of ejection/emission in the post-merger phase**: SVOM can contribute to build a sample of fully characterized short GRBs, including the properties of the host galaxy.

GRB 240821A

the first ECLAIRs + GRM detection is a short merger burst with an Extended soft emission tail seen at z = 0.238





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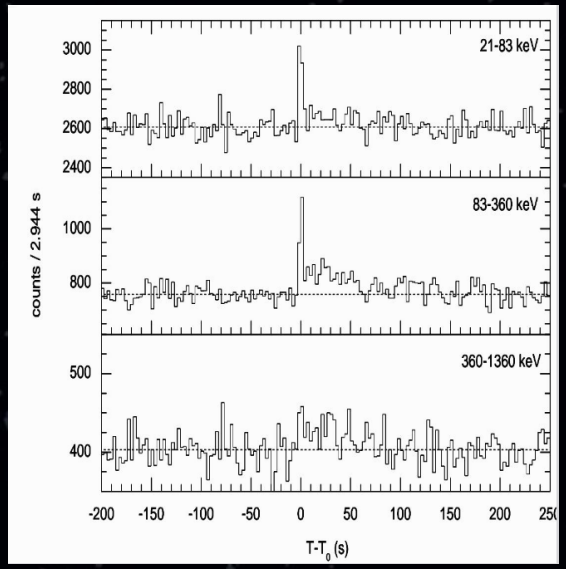
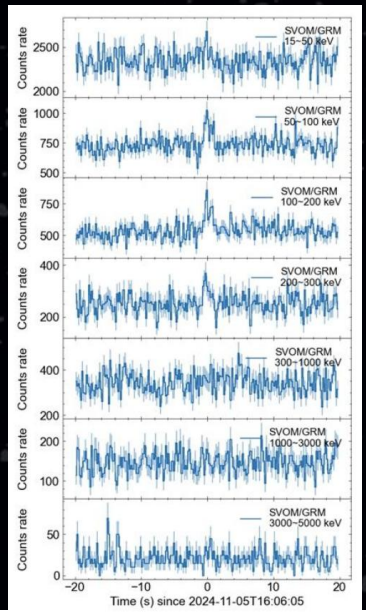
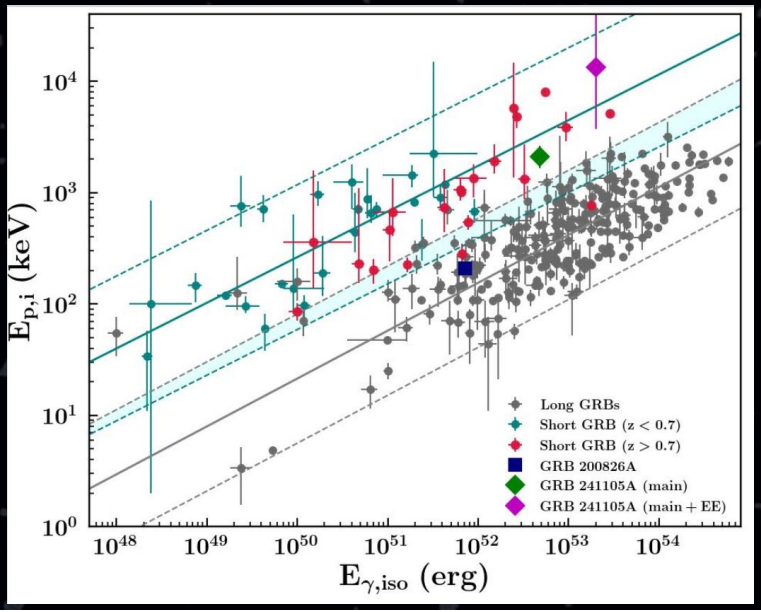
GRB 241105A
An other SGRB+EE merger or a disguised LGRB seen by Fermi/GBM Konus-WIND and SVOM GRM?







SVOM to explore the short GRB population and the merger origin

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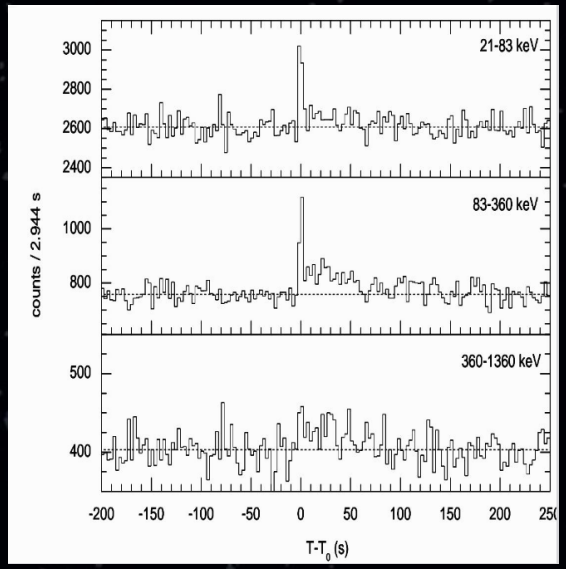
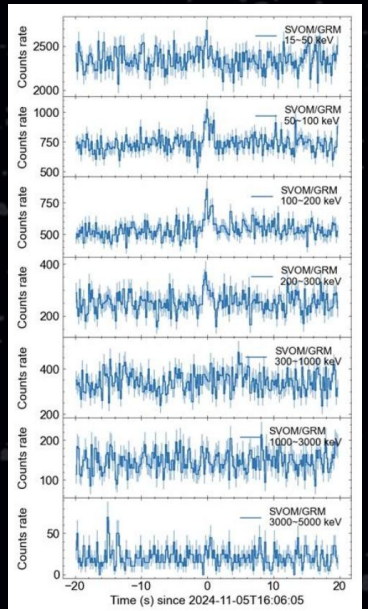




- Tail less soft than in GRB240821A
- Multi-λ follow-up including SVOM/VT
- VLT: z = 2.681 (GCN#38097) = would be the highest redshift for a SGRB
- Host galaxy: **JWST photometry** (GCN#38654)
  = massive host, star-forming, at low-metallicity, similar to other collapsar hosts at this redshift.

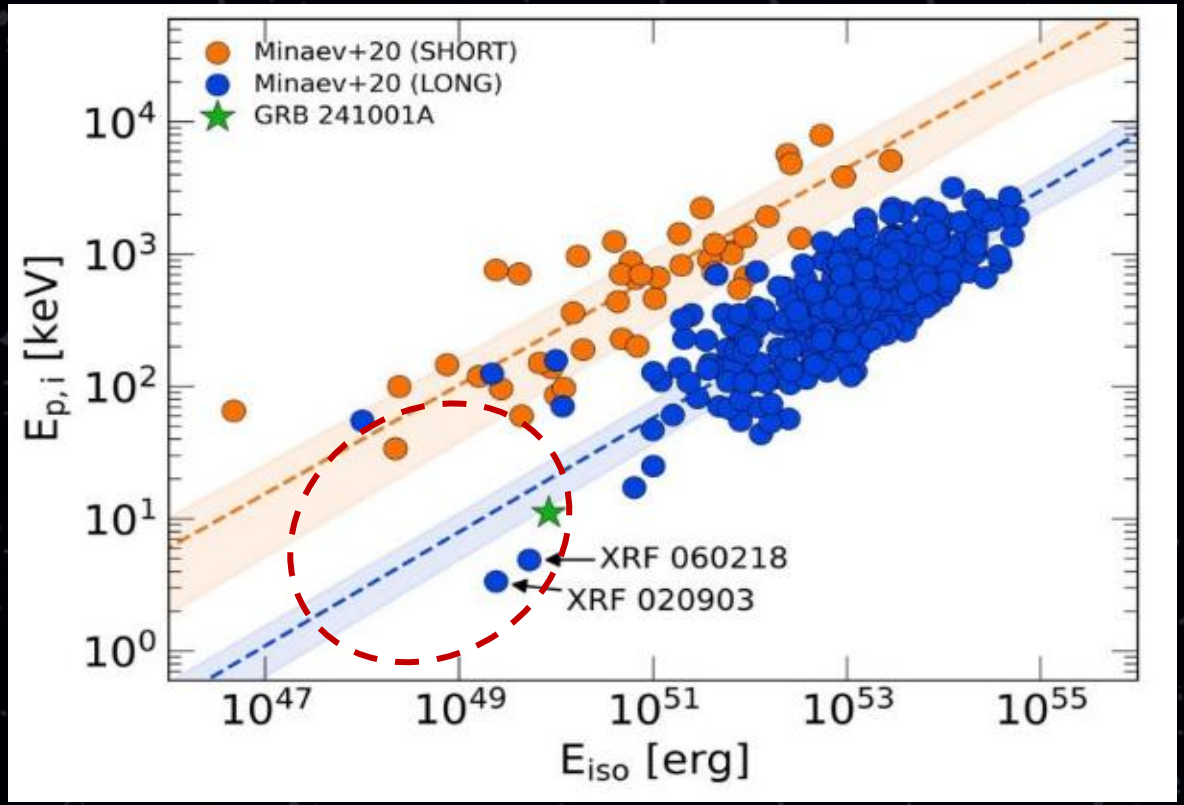
Collapsar origin favored!

D. Dimple et al. (in prep)

SVOM to explore the poorly known XRR/XRF burst population

Our goal: bring a complete physical interpretation of the poorly known population of **very soft x-ray burts**

- connection between classical collapsar GRBs and “failed” or low-luminosity GRB collapsars?
- Shock breakout emission?
- geometry effect -> off-axis jet?
- Low Γ jets?
- High-z redshift effect?

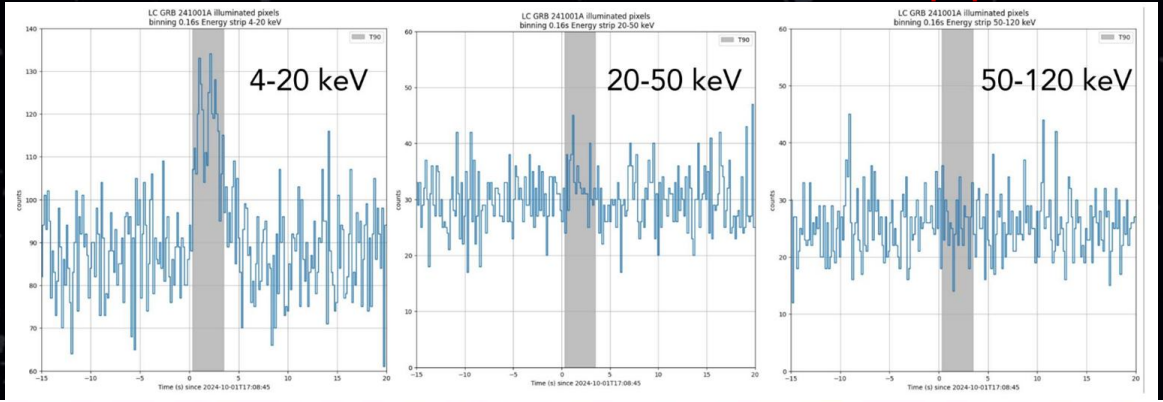


SVOM to explore the poorly known XRR/XRF burst population

GRB 241001A (SVOM)

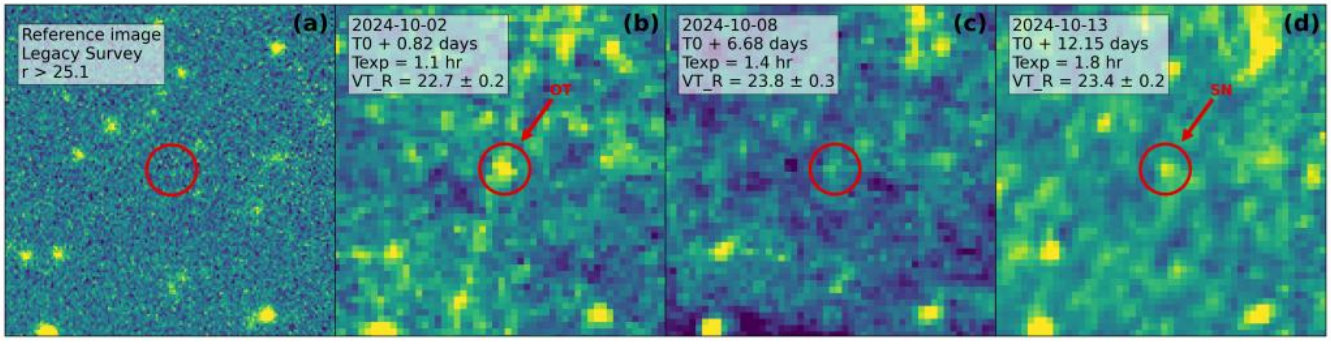
A very soft x-ray burst associated with a type Ic supernova (seen by JWST)

Schneider et al. (in prep)



ECLAIRs light curve in different energy bands

credits: *collaboration SVOM/IRAP, Marius Brunet*



Time series of VT obs.

From T_{GRB}+0.82d (afterglow) - T_{GRB}+12.15d (Supernova rise)

credits:*SVOM/VT, Huali li et Benjamin Schneider*

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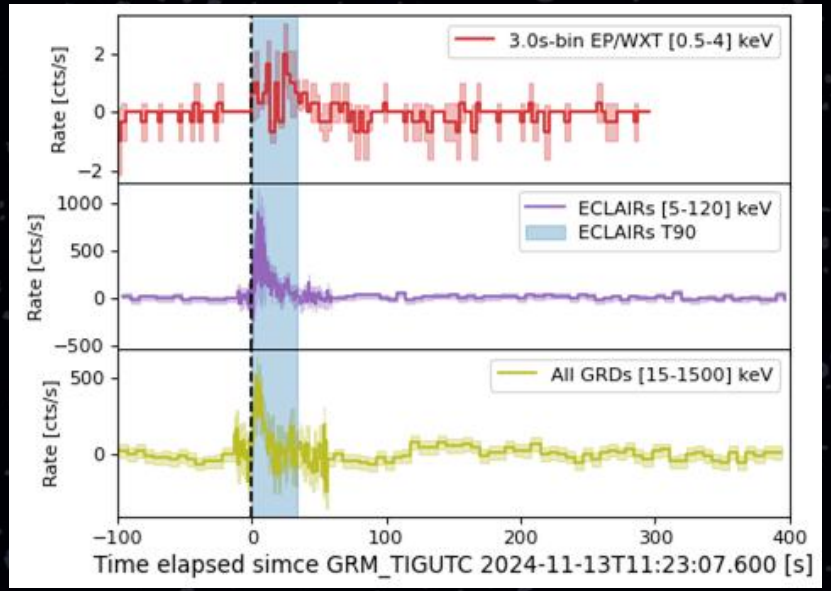
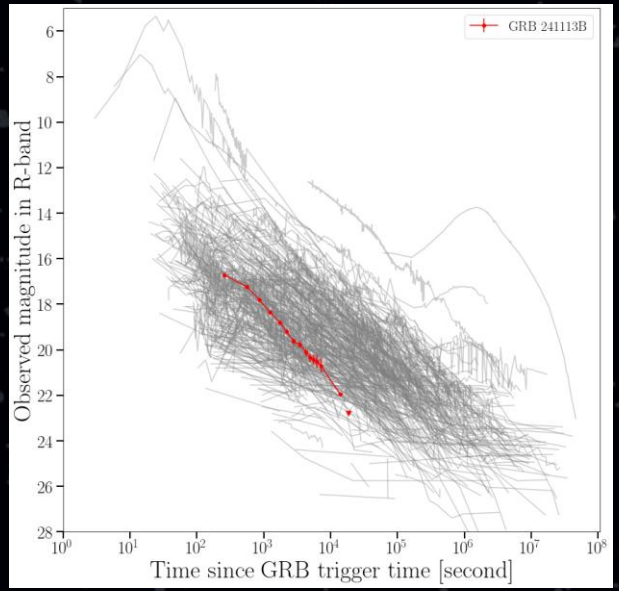
SVOM to explore the poorly known XRR/XRF burst population

GRB 241113B (SVOM)

A very soft x-ray burst jointly detected by EP/WXT

Adrien et al. (in prep)





Again a nice coverage of the optical afterglow

- **SVOM/VT**
- **KAIT** (associate partner)
- **Mephisto** (associate partner)

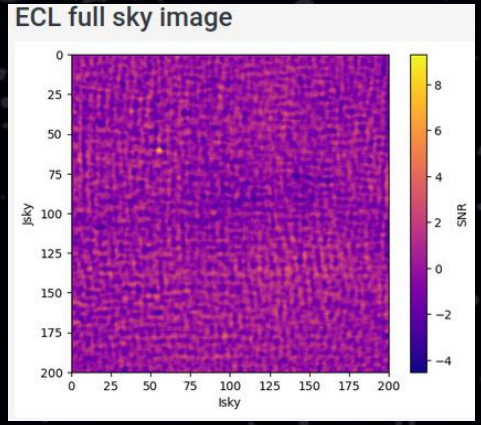
A faint x-ray afterglow also detected by EP-FXT

Other XRF/XRR detected by ECLAIRs under investigation in the SVOM Collaboration

240819A, 240828B?, 250219A? **250317B (Zhao et al. in prep)**, 250419A?, sb25061207/GRB250612D

SVOM to explore the high-z GRB population

GRB 250314A at z~7.3!
Detected by ECLAIRs (T90 ~ 20s) and GRM (T90~10s)
(Cordier & Wei et al., in prep.)



Any afterglow then ?

- MXT/VT quick follow-up (T_{GRB}+177s)
  $F_{0.3\text{-}10keV}>2.5.10^{-11}$cgs /($T_{GRB}$+2.2h) $VT_R>23.3$ -> *GCN#39728*
- NIR afterglow discovered by the NOT
  (T_{GRB}+12.3h) J=20.85 -> *GCN#39727*
- VLT/X-shooter redshift (T_{GRB}+16.5h) -> *GCN#39732*

GCN Circular 39732

Subject GRB 250314A: VLT/X-shooter dropout, redshift z ~ 7.3
Date 2025-03-15T12:45:58Z (3 months ago)
Edited On 2025-03-15T20:14:19Z (3 months ago)
From Daniele B. Malesani at IMAPP / Radboud University <d.malesani@astro.ru.nl>
Edited By Vidushi Sharma at NASA GSFC/UMBC <vidushi.sharma@nasa.gov> on behalf of Daniele B. Malesani at IMAPP / Radboud University <d.malesani@astro.ru.nl>
Via Web form

D. B. Malesani (DAWN/NBI and Radboud), G. Pugliese (API-UvA), J. P. U. Fynbo (DAWN/NBI), B. Schneider (LAM), V. D'Elia (SSDC and INAF-OAR), A. de Ugarte Postigo (LAM), L. Izzo (INAF-OACn and DARK/NBI), P. G. Jonker (Radboud), A. J. Levan (Radboud and Warwick), J. T. Palmerio (CEA/Irfu), N. A. Rakotondrainibe (LAM), A. Saccardi (CEA/Irfu), N. R. Tanvir (U. Leicester), A. L. Thakur (INAF-IAPS), S. D. Vergani (CNRS, Obs. Paris/LUX), D. Xu (NAOC), Z.P. Zhu (NAOC) report on behalf of the Stargate collaboration:

We observed the near-infrared candidate counterpart (Malesani et al., GCN 39727) of the long SVOM/ECLAIRs GRB 250314A (Wang et al., GCN 39719) at the ESO VLT, using the HAWK-I near-infrared imager (on UT4, Kueyen) and the X-shooter spectrograph (on UT3, Melipal).

The object is well detected in the Y, J and H filters. HAWK-I observations started on 2025 Mar 15 at 05:23:28 UT (about 16.5 hr after the GRB). We measure preliminary AB magnitudes:

Y = 23.2 +/- 0.15
J = 22.4 +/- 0.1
H = 22.5 +/- 0.1

For the spectra, the observation mid time was 2025 Mar 15.26 UT (about 17.4 hr after the GRB). The data cover the wavelength range 3000-21,000 AA and consist of 4 exposures of 1200 s each.

In a preliminary reduction of the spectra, a faint continuum is confidently detected all across the NIR arm (down to 10,300 AA). Tentative signal is also seen in the very red end of the VIS arm, with a drop around 10,090 AA. While the S/N is too low to confidently identify individual metal absorption features, the break in the VIS is consistent with the onset of the Lyman forest (with possible contribution from damped Lyman-alpha absorption in the GRB host galaxy). The implied redshift is z ~ 7.3.

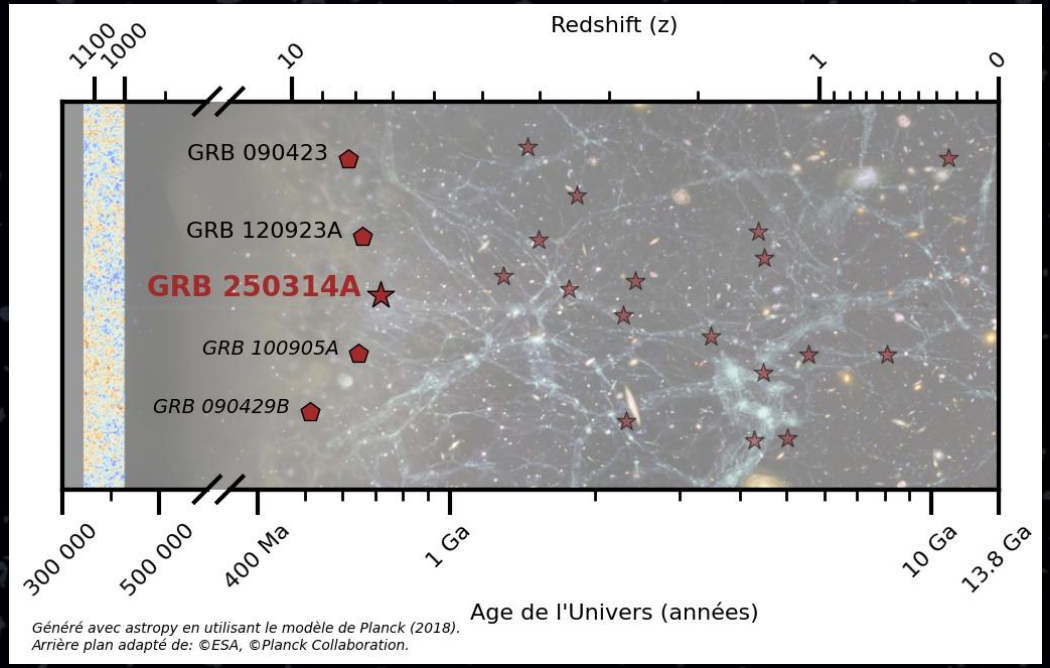
The HAWK-I photometry is consistent with a break, rather than with a generically red shape of the continuum, given the red Y-J vs blue J-H color, consistent with the Y filter being partly dropped out. Assuming a power law model (no dust extinction), a fit to the available photometry provides a redshift z = 7.21 +0.18 -0.38 (1 sigma c.l.), fully consistent with the spectroscopic value.

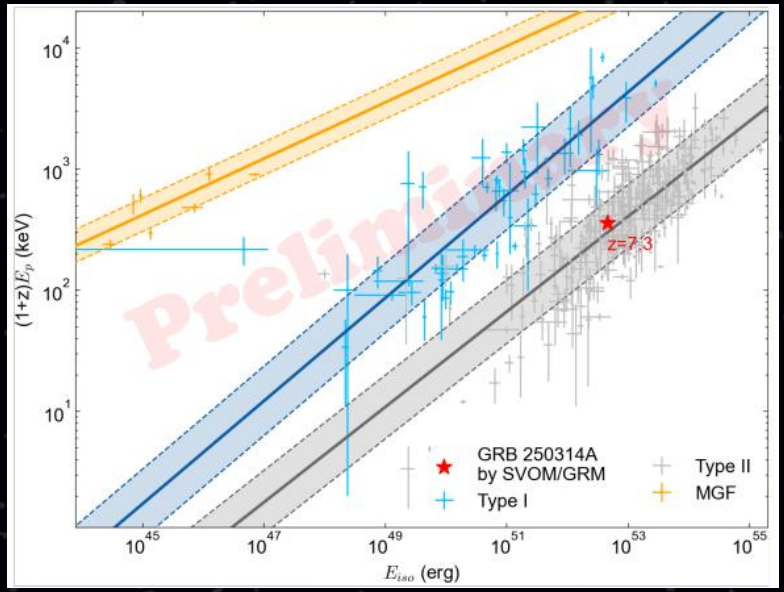
We acknowledge expert support from the ESO staff in Paranal, in particular Cedric Ledoux, Enrico Congiu, Francisco Nogueras-Lara, Pascale Hibon, Rodrigo Romero, and Susana Cerda.

SVOM to explore the high-z GRB population

GRB 250314A at z~7.3!

5th most distant burst, we had to wait 12 years to get this new very high-z burst!





Take home messages: SVOM first results in a nutshell

- **A 4 keV low energy band a clear impact to better explore the**
  - soft GRBs: XRR/XRF population? Shock break-out signatures? (multiple publications under preparation)
  - High-z GRB: GRB 250314A at high redshift @ z = 7.3 (the 1st high-z GRB detected for the past 12 years)
- **A full spectral coverage of the burst's emission from 4 keV - 5 MeV**
  - characterization of the soft γ-ray spectrum by ECLAIRs+GRM
  - SVOM is indeed sensitive to all types of GRBs (105 LGRB, 18 SGRB, 8 XRR/XRF)
- **A large FoV (1°x1°) MXT x-ray telescope & a sensitive 40 cm VT telescope**
  - afterglow transition in X-rays and optical with MXT and VT for some bursts
  - several cases of well characterized events during the prompt/early + late afterglow phases
  - Already one high-z GRB identified
- **A pointing strategy optimised to coordinate fast follow-up observations during night time + network of robotic telescopes (0.2 - 1.3 m)**
  - already high Opt. AG detection/redshift measurement rate (still increasing, to come in a few month: JH filters on SVOM COLIBRI FM-GFT + better operating system now since the commissioning phase)

- **Already fruitful Collaboration with other missions and groups**
  - We have established an efficient ToO link between **SVOM, Einstein Probe & Swift** to systematically catch the x-ray and optical counterparts of respective triggers
  - A productive collaboration with the **Stargate, NOT/GTC/GEMINI-GRB** groups very responsive in taking spectra of SVOM localized GRBs

15 single GRB papers under review

A SVOM special issue under preparation

Thanks for your attention!

Follow the news on www.svom.eu

Save the date : organisation of a SVOM day for the French scientific community
Wednesday 10 December 2025, IAP, Paris