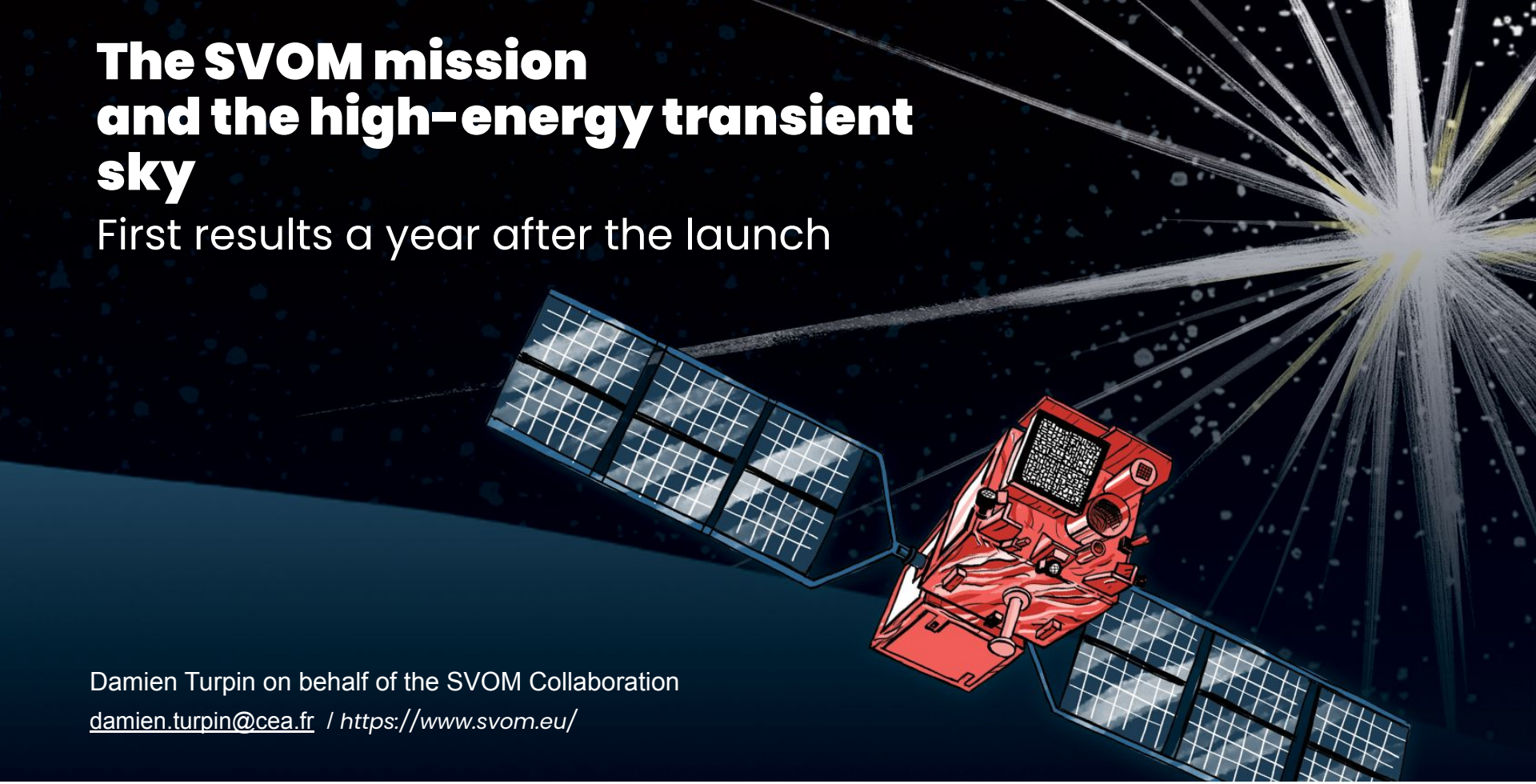
The SVOM mission and the high-energy transient sky

First results a year after the launch



Damien Turpin on behalf of the SVOM Collaboration

damien.turpin@cea.fr / *https://www.svom.eu/*

Rubin LSST-France, IJCLab Orsay June 11, 2025

The SVOM Consortium

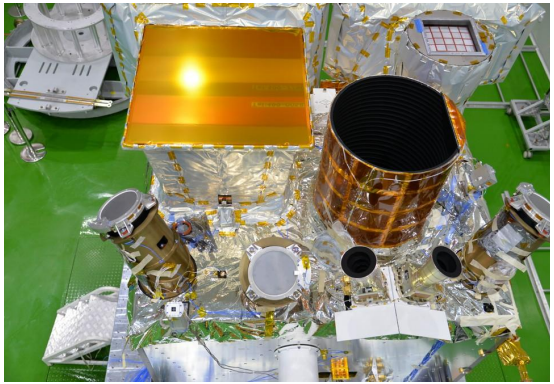
- **China (PI J. Wei)**
  - SECM Shanghai
  - Beijing Normal University
  - Central China University Wuhan
  - Guangxi University Nanning
  - IHEP Beijing
  - KIAA Peking University
  - Nanjing University
  - NAOC Beijing
  - National Astronomical Observatories
  - Purple Mountain Observatory Nanjing
  - 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

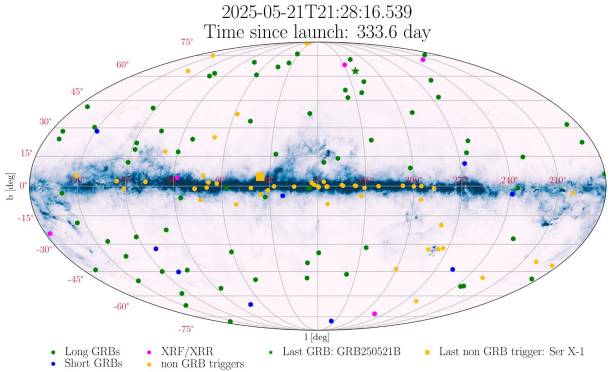
Outlines of the talk

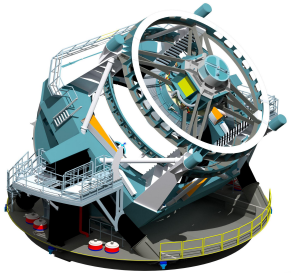
Part I: The SVOM mission in a nutshell

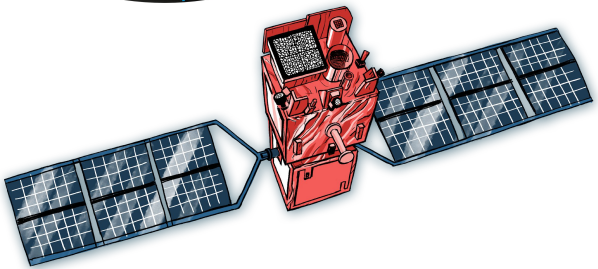
Part II: The SVOM first results

Part III: A future to build with LSST and Fink





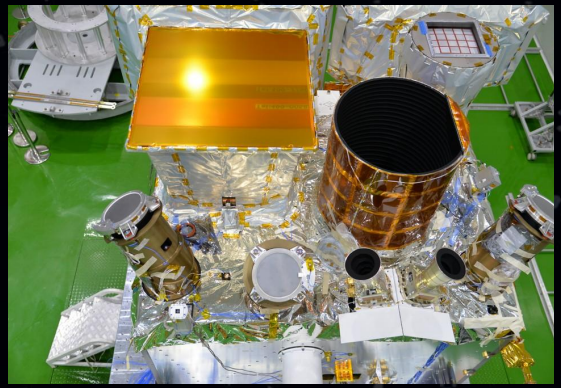




Rubin LSST-France, IJCLab Orsay June 11, 2025

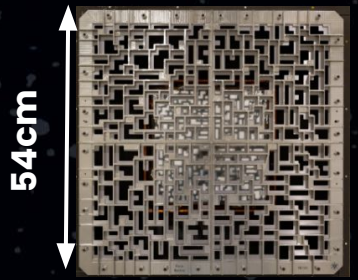
Outlines of the talk

Part I: The SVOM mission in a nutshell

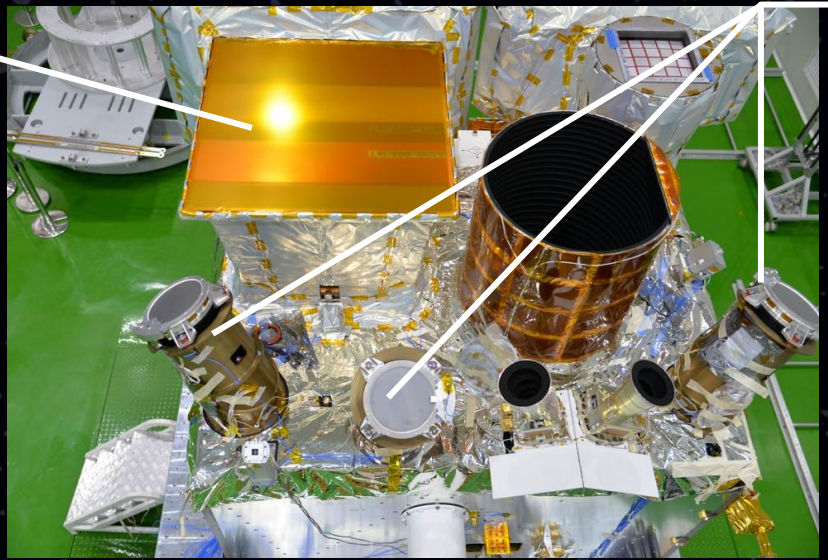


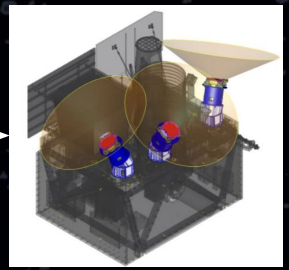
SVOM in its integration room at Shanghai, China in October 2023

I- SVOM: a satellite to study the high-energy transient sky



The SVOM γ-ray monitors





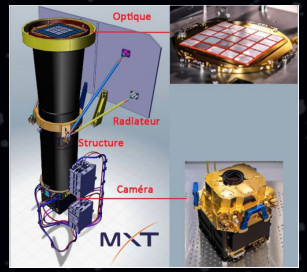
ECLAIRs

- ✓ A coded-mask with CdTe pixels detection plane
- ✓ Energy range: 4-150 keV
- ✓ FoV = 45° x 45° ~ 2 sr (⅛ of all sky)
- ✓ A_{eff} = 200cm² @6keV
- ✓ An onboard real-time trigger and localization system (UGTS):
  - *20 ms to 20 min timescales*
  - *4 energy bands*
  - <12 arcmin localisation (radius)

Gamma-Ray Monitor (GRM)

- ✓ 3 GRDs: NaI(Tl) (16 cm Ø, 1.5 cm thick)
- ✓ Plastic scintillator (6 mm) to monitor particle flux and reject particle events
- ✓ 30° inclination w.r.t. ECLAIRs optical axis
- ✓ Energy range: 15-5000 keV
- ✓ FoV ~ 5.6 sr (~2 sr per GRD)
- ✓ Aeff = 190 cm² at peak (each unit)
- ✓ Real-time trigger (2 GRDs)
- ✓ Rough localization accuracy

I- SVOM: a satellite to study the high-energy transient sky



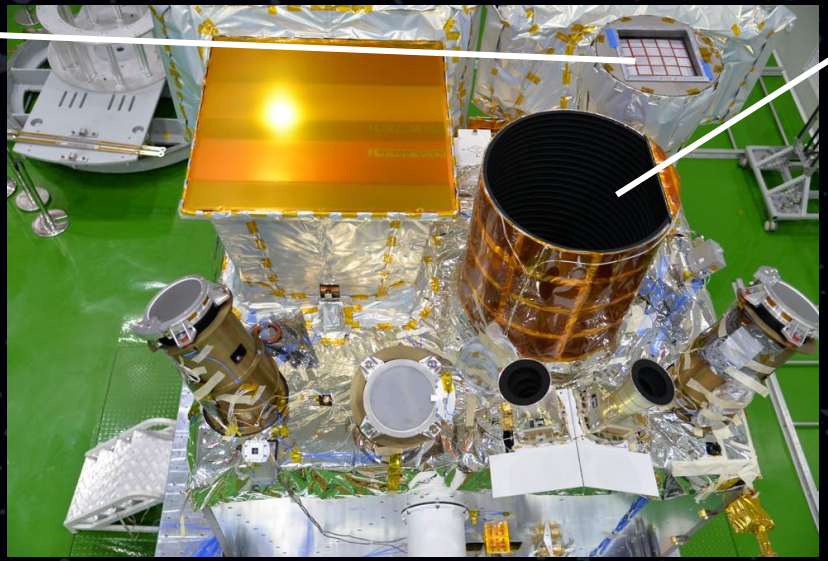
Micro-channel X-ray Telescope (MXT)

✓ Micro-channel plate optics

20 micron size pores in a "lobster eye" config. / Focal length: 1 m / pnCCD camera (256x256 pixels of 75 microns)

✓ FoV = 64x64 arcmin²
✓ Energy range: 0.2-10 keV
✓ Energy resolution ~60 eV @5.9 keV
✓ Aeff = 27 cm² @1 keV (central spot)
✓ Localization accuracy <30 arcsec

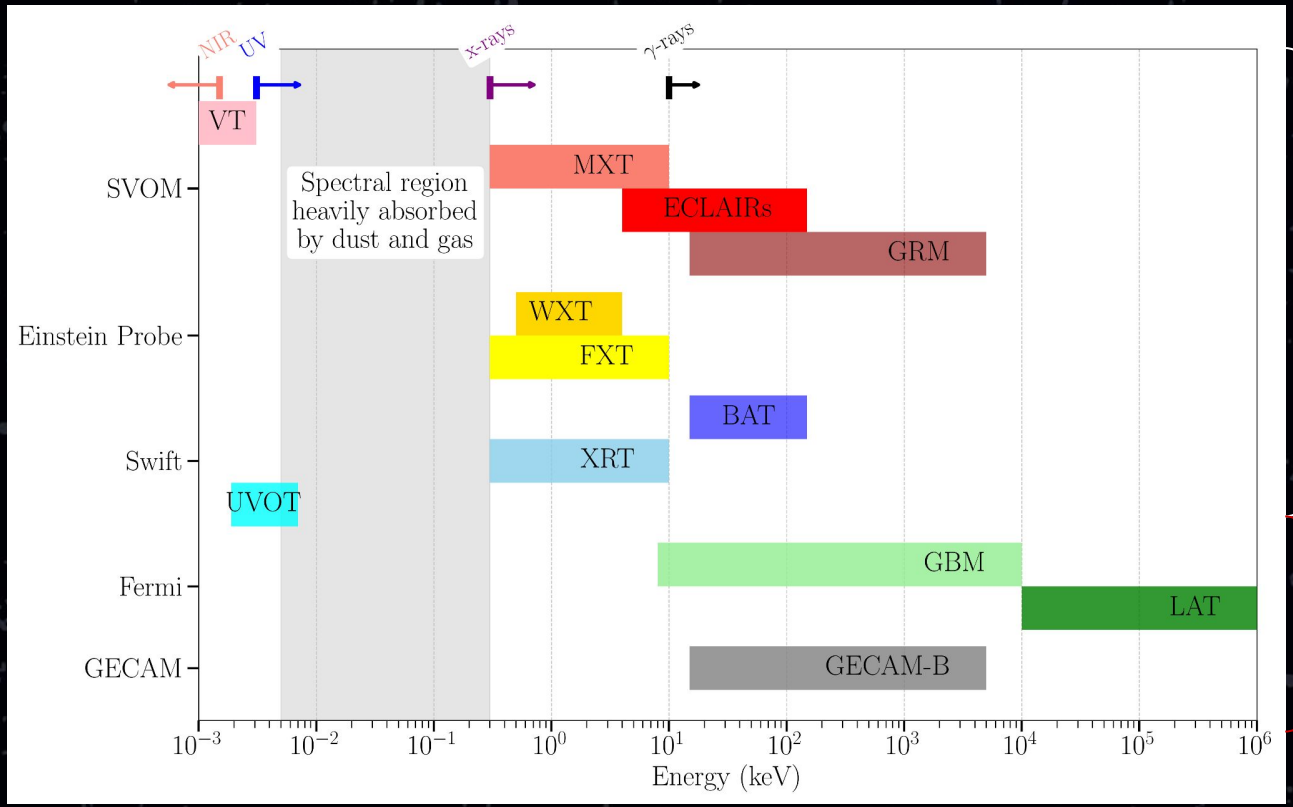
The SVOM follow-up instruments



Visible Telescope (VT)

✓ Ritchey-Chrétien Telescope
✓ 40 cm Ø, f=9
✓ Focal length: 3.6 m
✓ 2 channels: blue (400-650 nm) and red (650-1000 nm)
✓ 2k x 2k CCD detector each
✓ FoV : 26 x 26 arcmin²
  - covering ECLAIRs error box in most cases
✓ Sensitivity M_v = 23 in 300 s
  - will detect ~80% of ECLAIRs GRBs
✓ Localization accuracy < 1 arcsec

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



They (except GRM) localize

(<10 arcmin)

+

onboard auto follow-up of sources

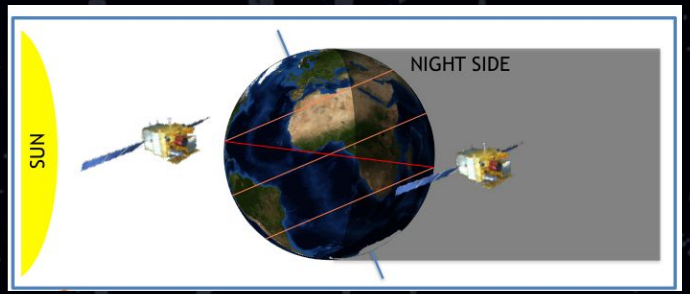
They (don't) poorly localize

no follow-up

I- SVOM is placed in a Low Earth Orbit (LEO)

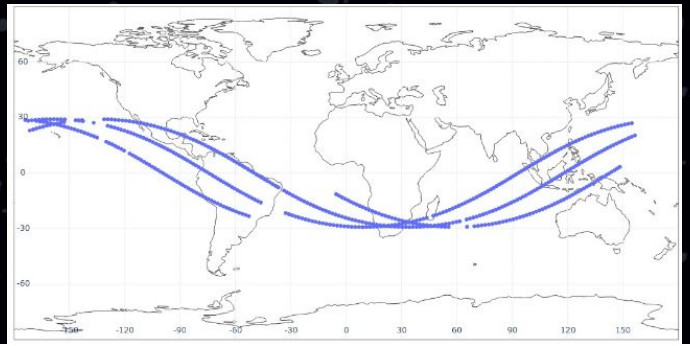
Anti-Solar pointing strategy

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



The satellite track on Earth

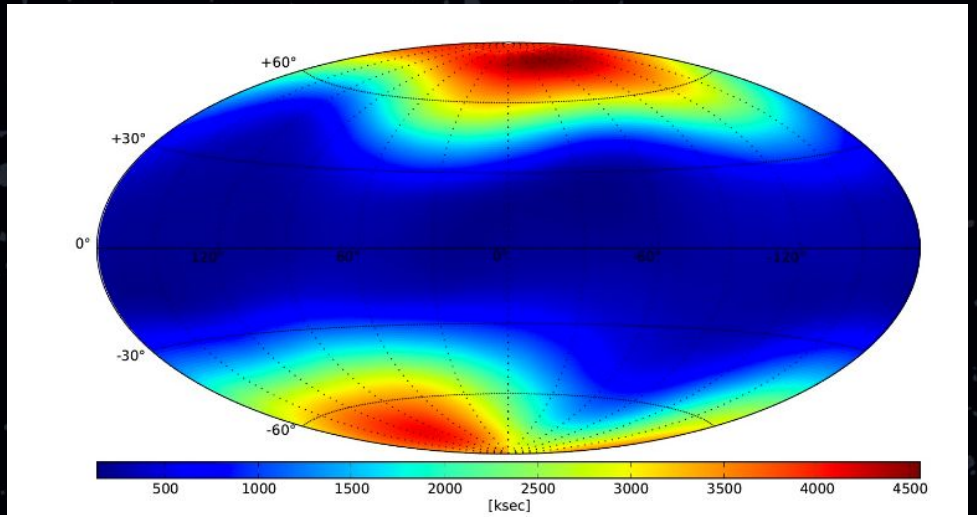
+/- 30° latitude



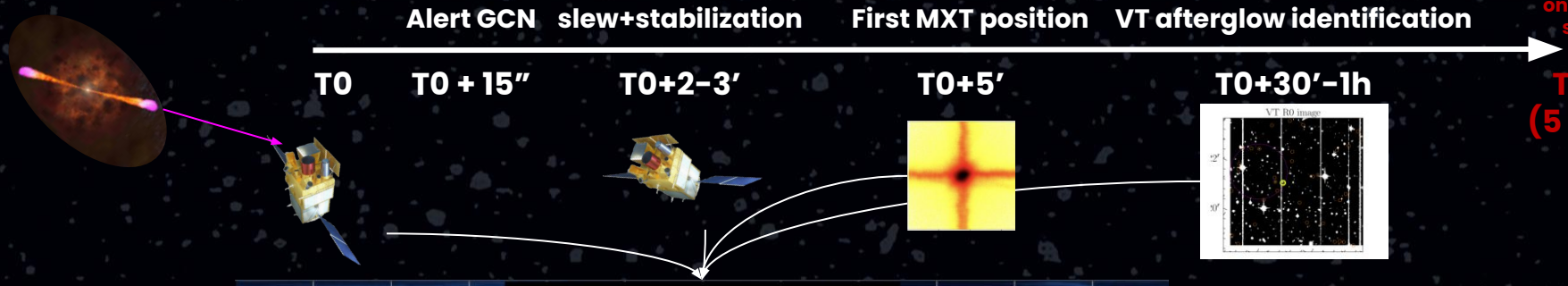
ECLAIRs exposure map simulation (over a year)

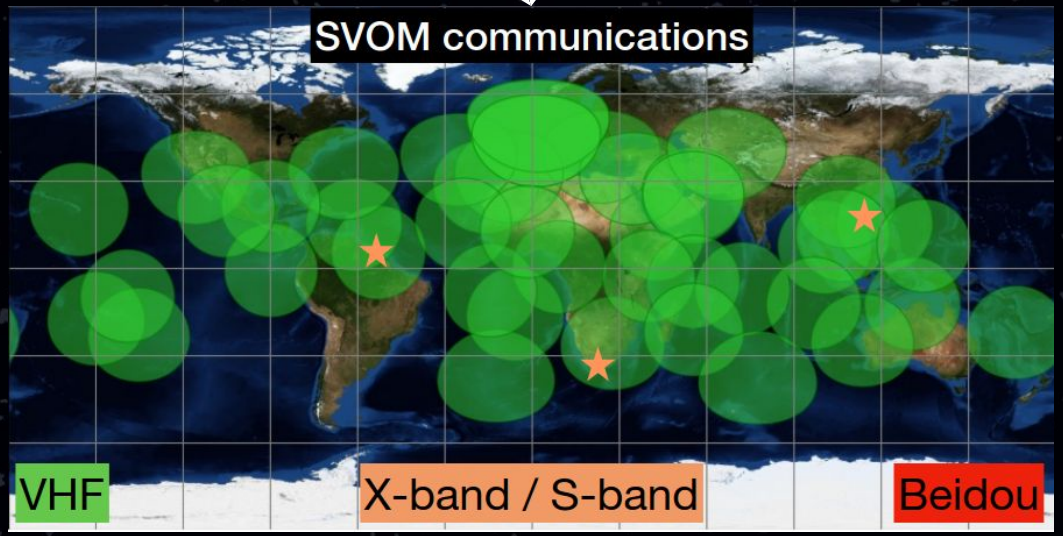
Initial Hypothesis : 65 GRBs/year, 1 ToO per day
- 4 Ms in the direction of the galactic poles
- 500 ks on the galactic plane

SPOILER ALERT Lessons from the first 6 months :
we performed much more ToOs… increasing consequently the galactic plane observations



I- SVOM: a powerful transient detection and alerting machine





Downgoing links

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

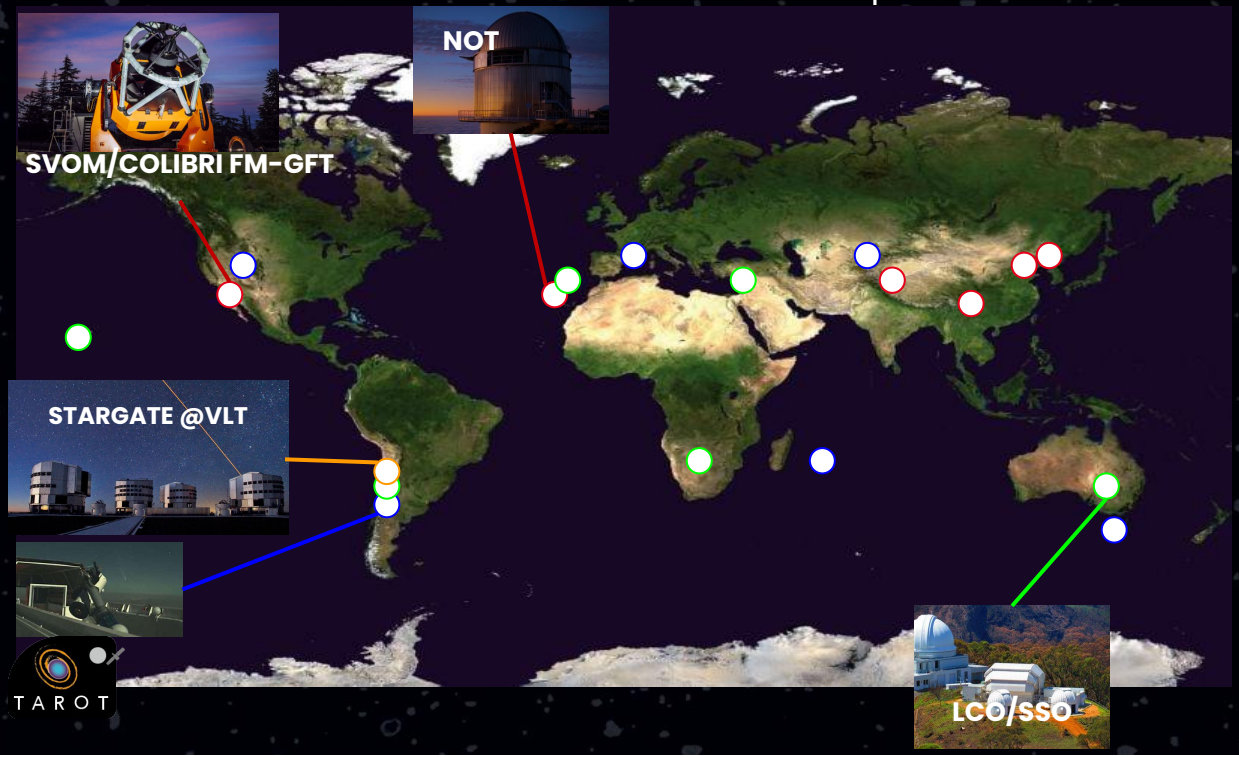
Upgoing links

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

I- SVOM: Boosting the space and ground-based telescope synergies

A dedicated ground-based follow-up segment

from 25 cm to the 8m class telescopes

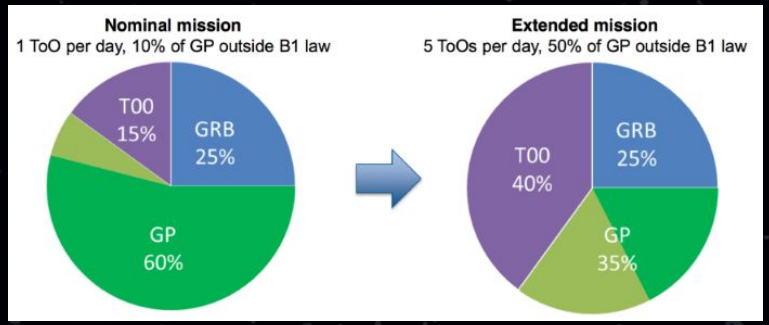


I- SVOM: the scientific programs

Gamma-ray bursts

The SVOM Core & ToO programs

reserved to SVOM Co-Is



The General & ToO programs

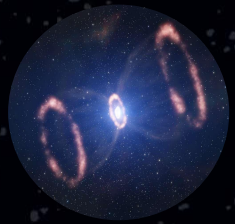
GP obs (known sources): Observation proposals awarded by a TAC (your proposal has to include a SVOM co-I).
ToO obs (not anticipated flaring sources): If you want a ToO, please contact the SVOM PIs

Magnetar Giant flares

CVs, x-ray binaries

Flaring stars

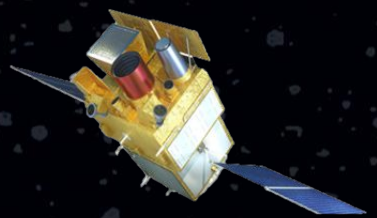
AGNs/Blazars



Supernovae

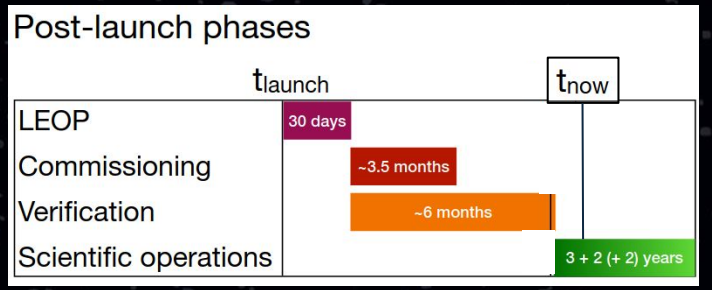
TDE, FRB, etc.

I- Take-home messages: SVOM mission innovations in a nutshell



- **A 4 keV low energy trigger threshold**
  (new space of discoveries for soft x-ray transients, 30-60 GRB/yr with ECLAIRs, >100 GRB/yr with GRM)
- **A full spectral coverage of the burst's emission from 4 keV - 5 MeV**
  (A kind of Swift/BAT + Fermi GBM capabilities in the same platform)
- **A large FoV (1°x1°) for the MXT x-ray telescope**
  (allows to monitor large part of the sky in one shot, optimised for Multi-messenger transients)
- **A sensitive 40 cm telescope operating in blue and red channels**
  (largely inspired by the Swift/UVOT but with more sensitive + red channel)
- **A pointing strategy optimised to coordinate fast follow-up observations during night time**
  (to maximise the number of redshift measured for each detected bursts, goal: >50% of SVOM GRBs with a measured redshift)
- **A network of robotic telescopes (0.2 - 1.3 m) fully dedicated to (promptly) respond to the SVOM alerts**
  (to systematically catch the early optical/IR emission of SVOM's bursts)

I- 2024 June, 22nd when the SVOM story began



Outlines of the talk

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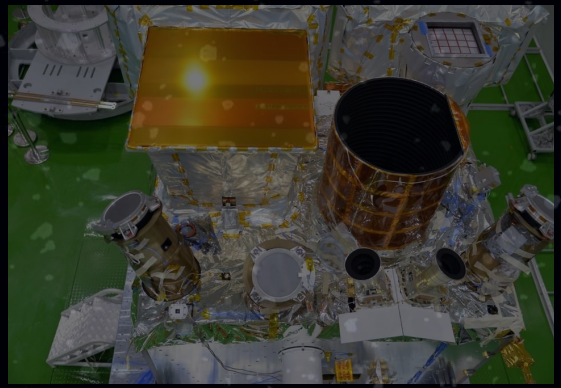
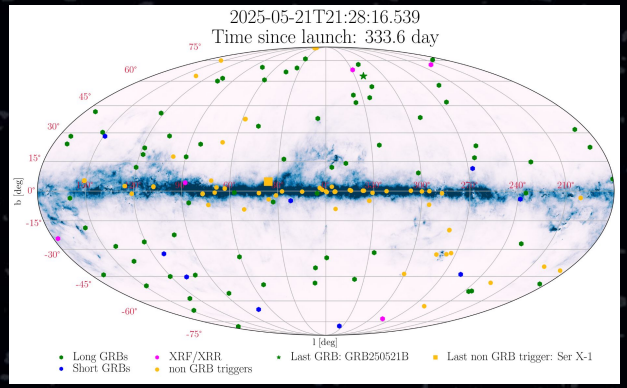
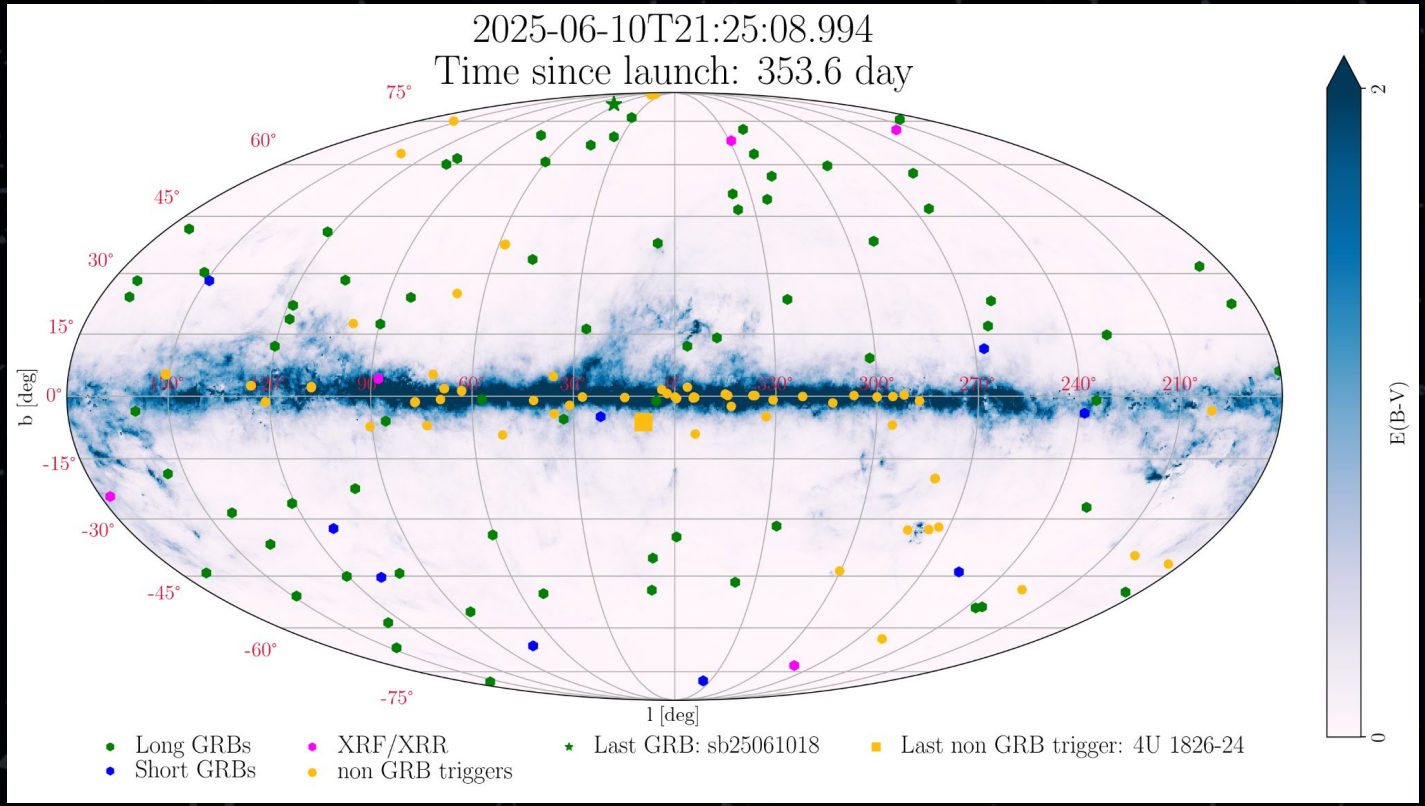
Part II: The SVOM first results



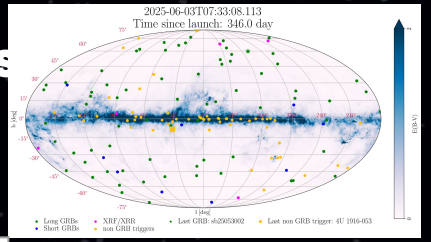


II- The SVOM x-ray/ γ-ray transient sky

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



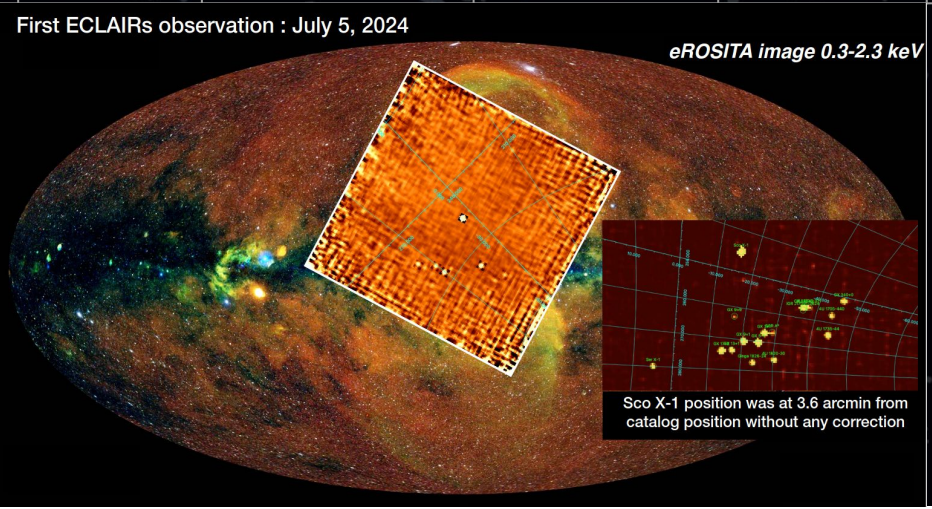
II- The SVOM x-ray/ γ-ray transient sky in more details



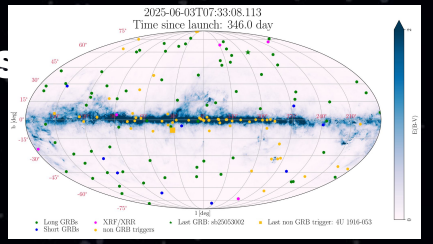
γ/x-ray transients general statistics

SGR	LMXB	HMXB	Variable/Flare star	AGN/Blazar	unknown	Total
3 (4%)	~40 (54%)	~18 (24%)	4 (6%)	2/1 (4%)	6 (8%)	~74

Preliminary numbers



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



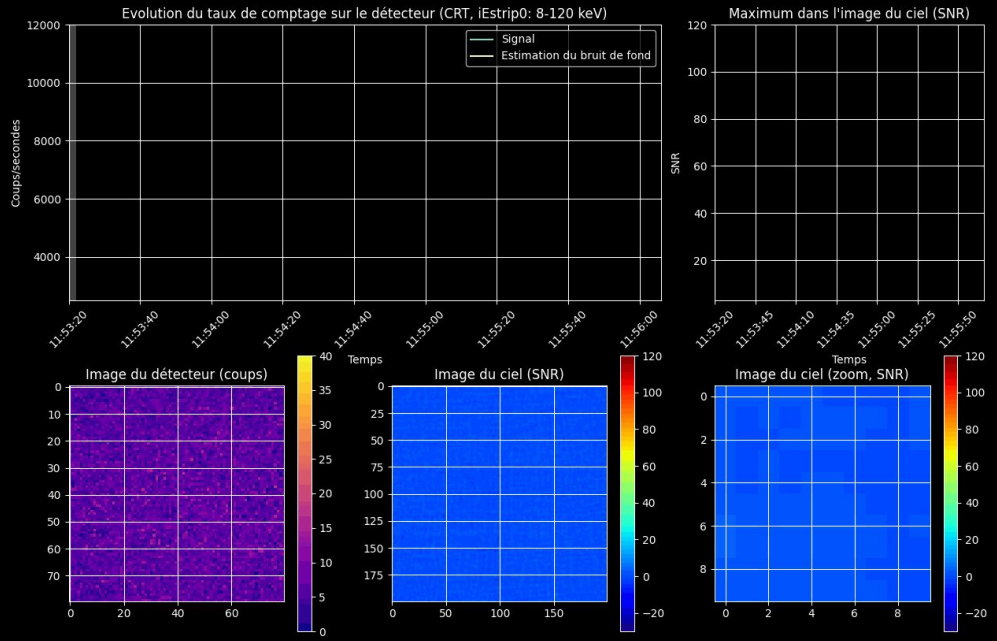
Gamma-ray Burst general statistics

	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	45	129 105 Long (81%), 17 Short (13%), 7 XRF (6%)	88 (68%)	10 (9%)	16 (36%)
Expected	>100	30 - 60	–	–	–	> 50%

	ECL median loc.	**MXT median loc.**	**x-ray afterglows**	**Optical afterglows**	**Radio afterglows**	**z > 4**
	~7′	~40″	47	33	5	4/26 (15%)

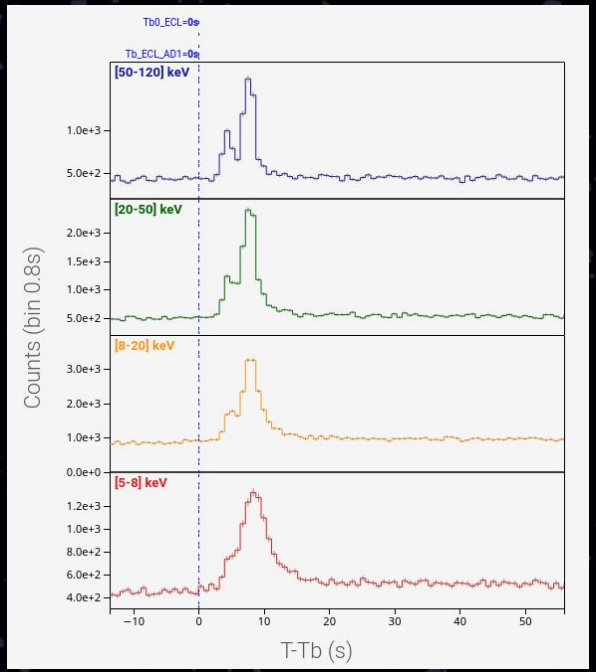
II- GRB 241018A: a GRB textbook case detection by SVOM

Détection de GRB 241018A: 2024-10-18T11:53:20



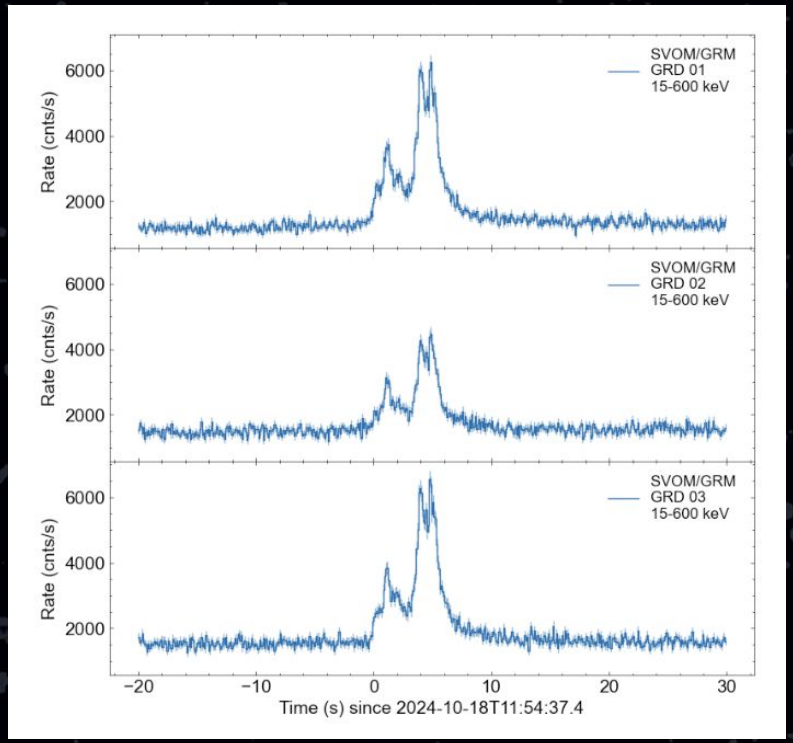
credits: N. Dagoneau (CEA/Irfu)

ECLAIRs detection
@2024-10-18T11:54:37.50



II- GRB 241018A: the 1st GRB textbook case detection by SVOM

Simultaneous GRM detection….



…Followed by MXT and VT afterglow detections

GCN Circular 37812
Subject GRB 241018A: Detection of a bright long GRB by SVOM

GCN Circular 37831
Subject GRB 241018A: SVOM/GRM observation
Date 2024-10-20T16:26:45Z (2 days ago)
From zhengchao astro@foxmail.com

GCN Circular 37814
Subject GRB 241018A: X-ray afterglow candidate observed by MXT
Date 2024-10-18T16:00:16Z (4 days ago)

GCN Circular 37819
Subject GRB 241018A: SVOM/VT follow-up and optical candidate
Date 2024-10-18T19:43:45Z (4 days ago)
From Liping Xin at NAOC, SVOM <xlp@nao.cas.cn>
Via Web form

38161. GRB 241018A: cubesat Avion detection
37841. GRB 241018A: SVOM/C-GFT optical observations
37837. GRB 241018A: 1.3m DFOT Optical upper limit
37836. GRB 241018A: EP-FXT afterglow detection
37832. Konus-Wind detection of GRB 241018A
37831. GRB 241018A: SVOM/GRM observation
37830. GRB 241018A/sb24101802: Mephisto optical upper limit
37828. GRB 241018A: BOOTES-4/MET optical upper limit
37827. GRB 241018A: Mondy optical upper limit
37826. GRB 241018A: SVOM/VT further analysis and counterpart confirmed
37825. GRB 241018A: GROWTH-India telescope optical upper limit
37823. GRB 241018A: Swift-XRT observations
37822. GRB 241018A: REM optical/NIR upper limits
37821. GRB 241018A: NOT optical observations
37819. GRB 241018A: SVOM/VT follow-up and optical candidate
37818. GRB 241018A: LCO/0.4m optical upper limits
37817. GRB 241018A: Swift ToO observations
37814. GRB 241018A: X-ray afterglow candidate observed by MXT
37812. GRB 241018A: Detection of a bright long GRB by SVOM

VT started to observe the field of GRB 241018A triggered by SVOM/Eclairs(Atteia et al., GCN 37812) in an automatic way after the slew of the satellite. The VT conducted observations simultaneously in two channels: VT_B (400nm-650nm) and VT_R (650nm-1000nm).

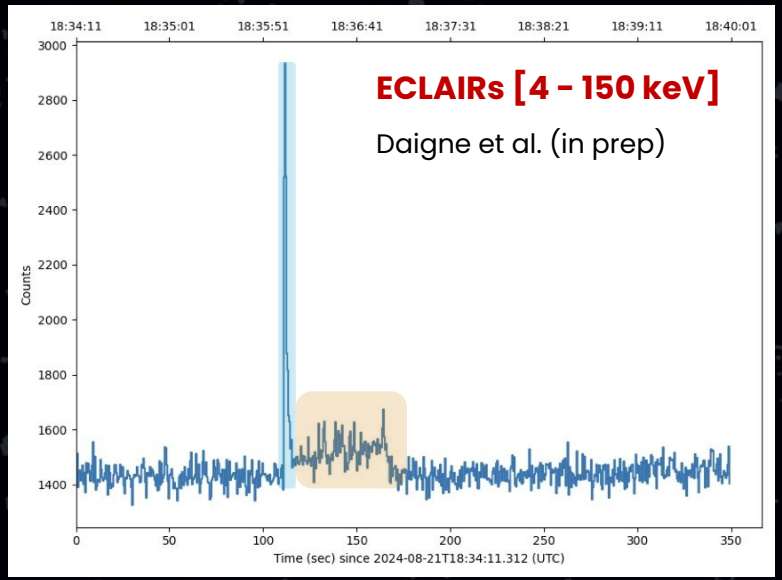
With the VHF data started at 2024-10-18T12:00:28 UT, in which the cataloged source brighter than 21 mag is completed relative to the PS1 catalog. An uncatalogued source was found within the errorbox of Eclairs and has an angular distance of 1.8509 arcmin from the position of MXT (Maggi et al., 37814).

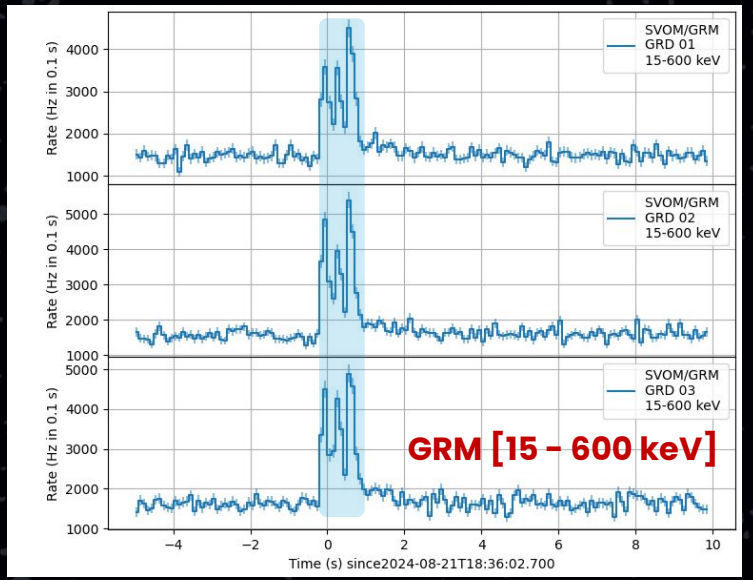
II- SVOM to explore the short GRB population and the merger origin

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

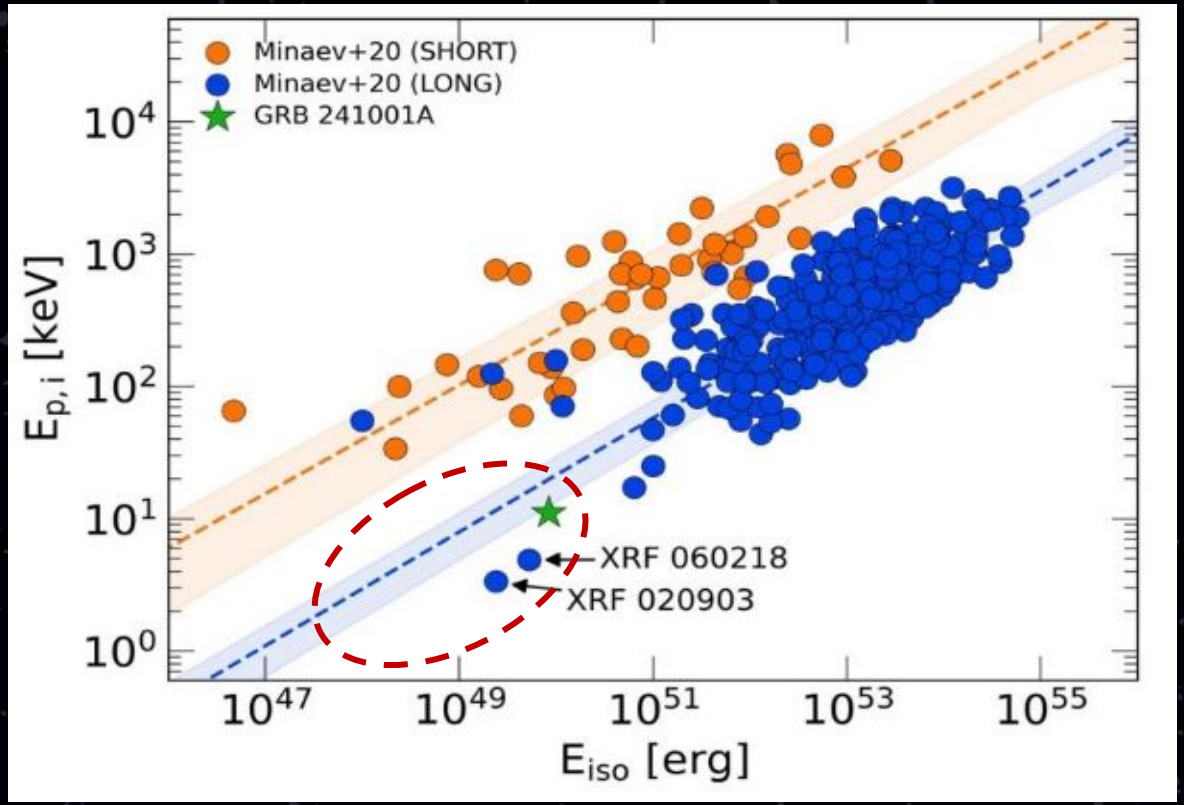




II- SVOM to explore the poorly known XRR/XRF burst population

A poorly known population of very soft x-ray burts

- connection between classical collapsar GRBs and “failed” collapsars?
- Shock breakout emission?
- geometry effect -> off-axis jet?
- Low Γ jets?

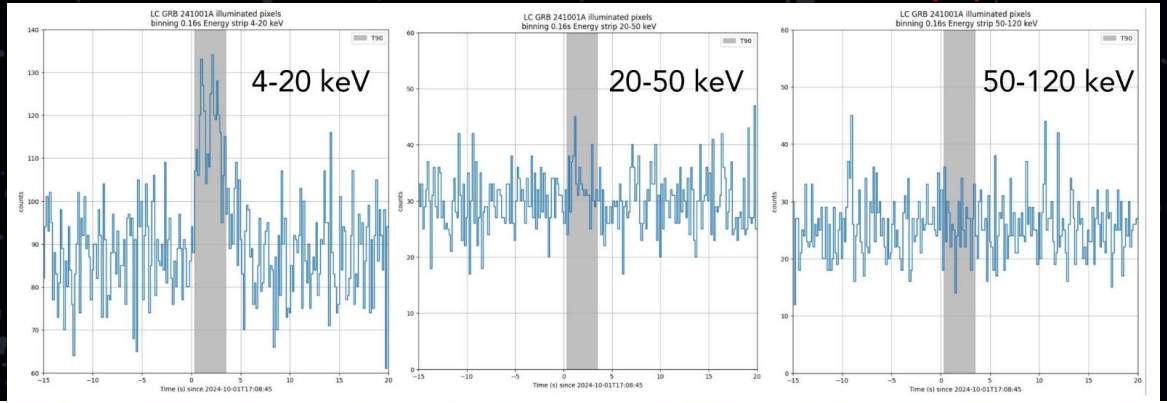


II- SVOM to explore the poorly known XRR/XRF burst population

GRB 241001A (SVOM)

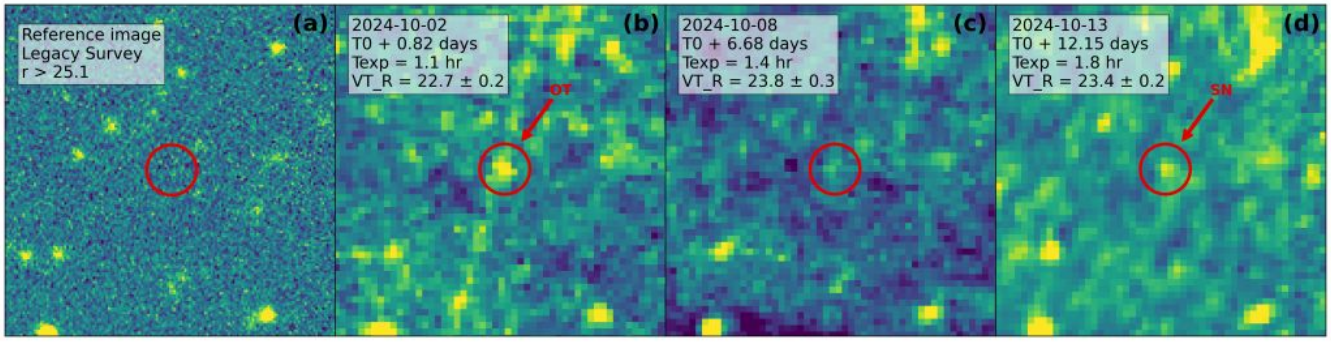
A very soft x-ray burst associated with a type Ic supernova (seen by JWST)

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*

II- SVOM to explore the poorly known XRR/XRF burst population

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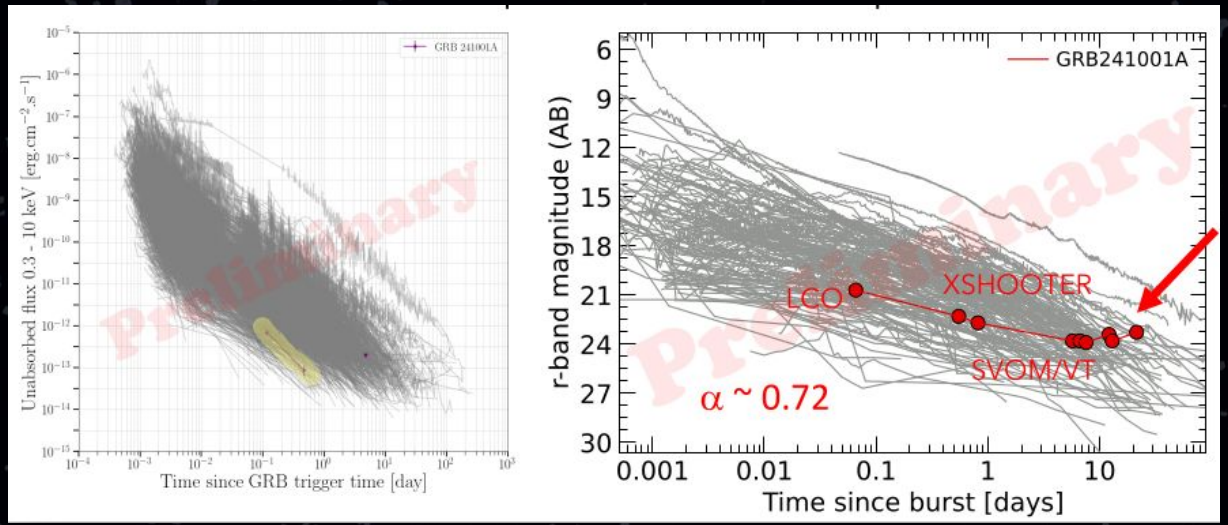
A very soft x-ray burst associated with a type Ic supernova (seen by JWST)

Schneider et al. (in prep)



Redshift z = 0.573
VLT/XSHOOTER (GCN#37677)

Associated type Ic-bl SN
JWST/NIRSPEC (GCN#37867)

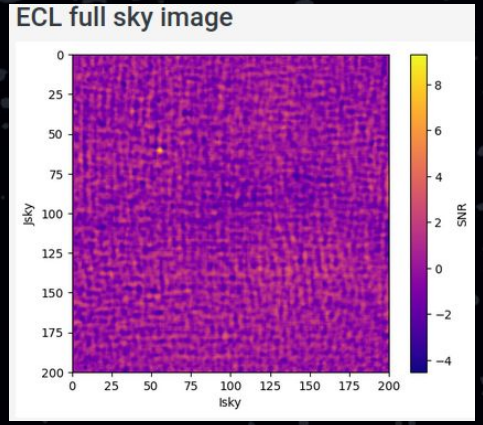
Astrophysical scenario
Shock breakout?
Off-axis jet GRB?
Other?

Other XRF/XRR detected by ECLAIRs under investigation

240819A,
240828B?
241113B (with EP/WXT, Adrien et al. in prep),
250219A?
250317B (Zhao et al. in prep),
250419A?

II- SVOM to explore the high-z GRB population

GRB 250314A at z~7.3!
Detected by ECLAIRs (T90 ~ 20s) and GRM (T90~10s)



Any afterglow then ?

- VT quick follow-up (T_{GRB}+2.2h)-> VT_R>23.3
- NIR afterglow discovered by the NOT (T_{GRB}+12.3h) J=20.85 -> GCN#39727
- VLT/X-shooter redshift

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.

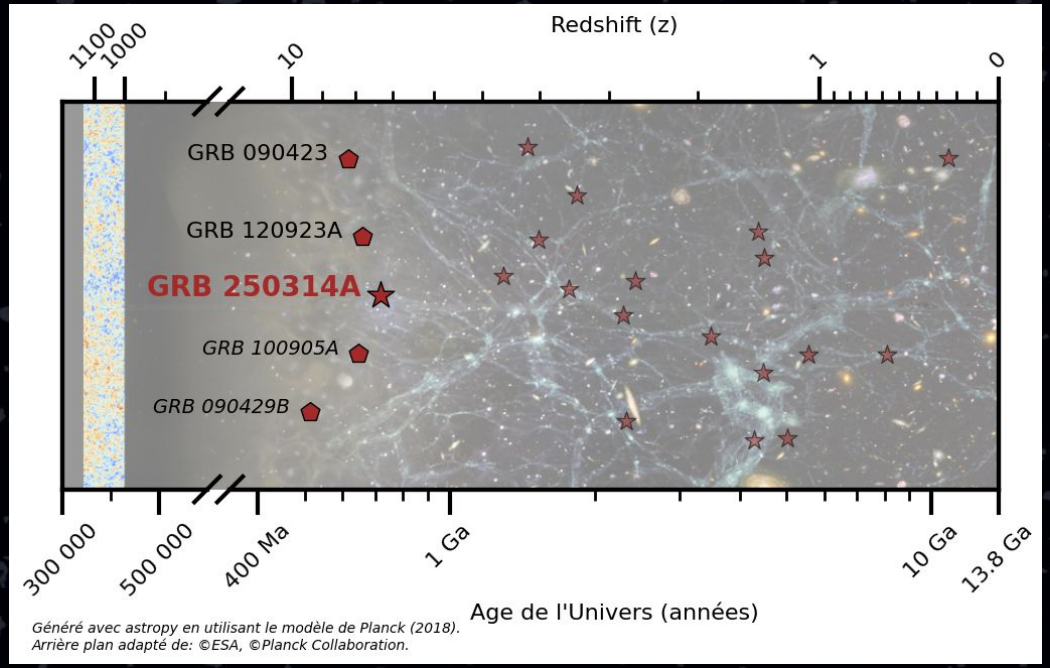
In a preliminary reduction of the spectra, a faint continuum is confidently detected all across the NIR arm (down to 10,300 AA). Tentative signal is also seen in the very red end of the VIS arm, with a drop around 10,090 AA. While the S/N is too low to confidently identify individual metal absorption 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.

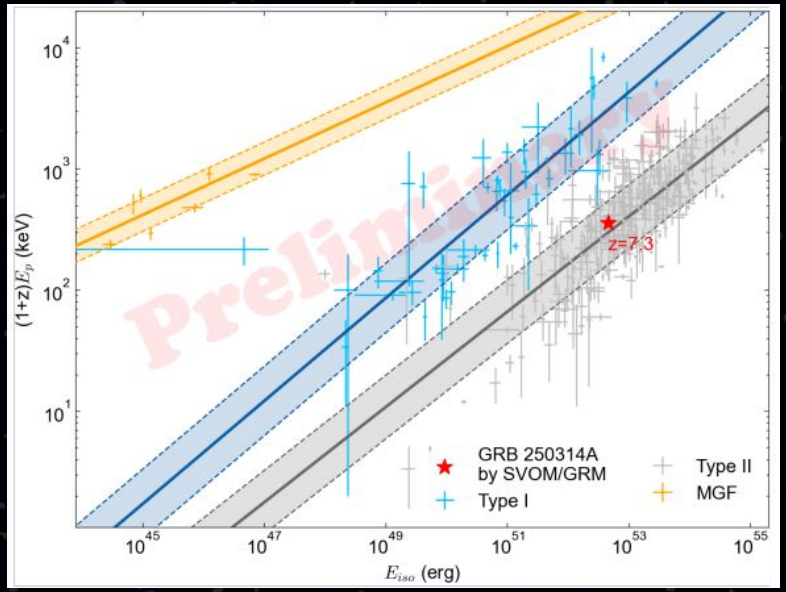
The HAWK-I photometry is consistent with a break, rather than with a generically red shape of the continuum, given the red Y-J vs blue J-H color, consistent with the Y filter being partly dropped out. Assuming a power law model (no dust extinction), a fit to the available photometry provides a redshift 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.

II- 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!





II- Take home messages: SVOM first results in a nutshell

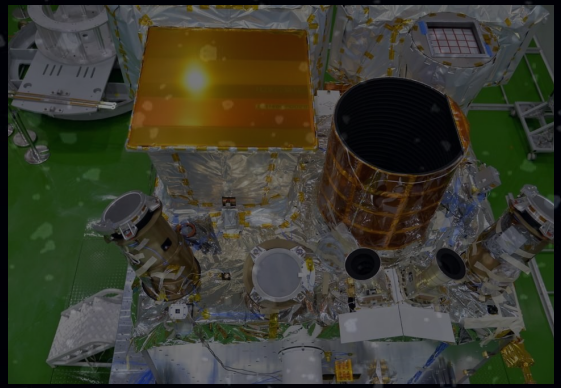
- **A 4 keV low energy band a clear impact to better explore the**
  - soft GRBs: XRR/XRF population? Shock break-out signatures?
  - High-z GRB: GRB 250314A at high redshift @ z = 7.3 (the 1st high-z GRB detected for the past 12 years)
- **A full spectral coverage of the burst's emission from 4 keV – 5 MeV**
  - characterization of the soft γ-ray spectrum by ECLAIRs+GRM
  - SVOM is indeed sensitive to all types of GRBs (103 LGRB, 17 SGRB, 7 XRR/XRF)
- **A large FoV (1°x1°) for the MXT x-ray telescope**
  - afterglow transition in X-rays and optical with MXT and VT
- **A sensitive 40 cm VT telescope operating in blue and red channels**
  - several cases of well characterized events during the prompt/early phases
  - VT is fulfilling all its scientific promises with deep detection/U.L. at early times
  - 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 now automatically slew to the Swift and Einstein Probe alerts to catch the optical counterparts with VT
  - **A productive collaboration with the Stargate, NOT/GTC-GRB groups very responsive in taking spectra of SVOM localized GRBs**

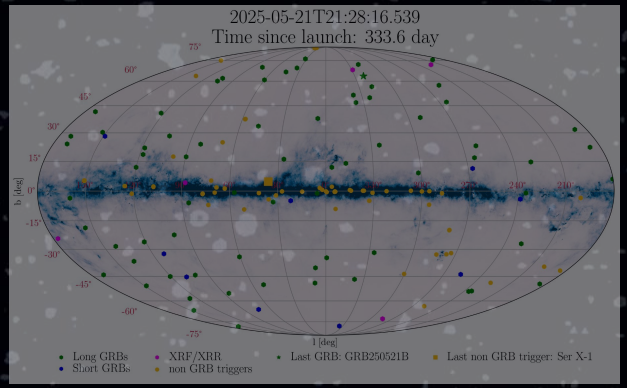
Outlines of the talk

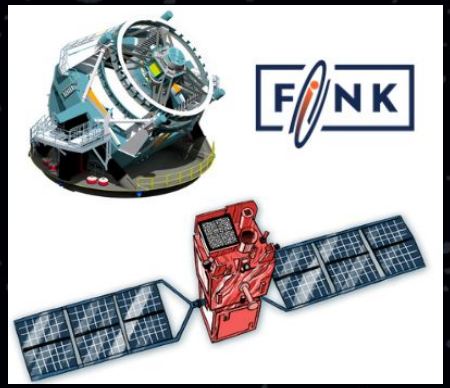
Part I: The SVOM mission in a nutshell

Part II: The SVOM first results

Part III: A future to build with LSST and Fink



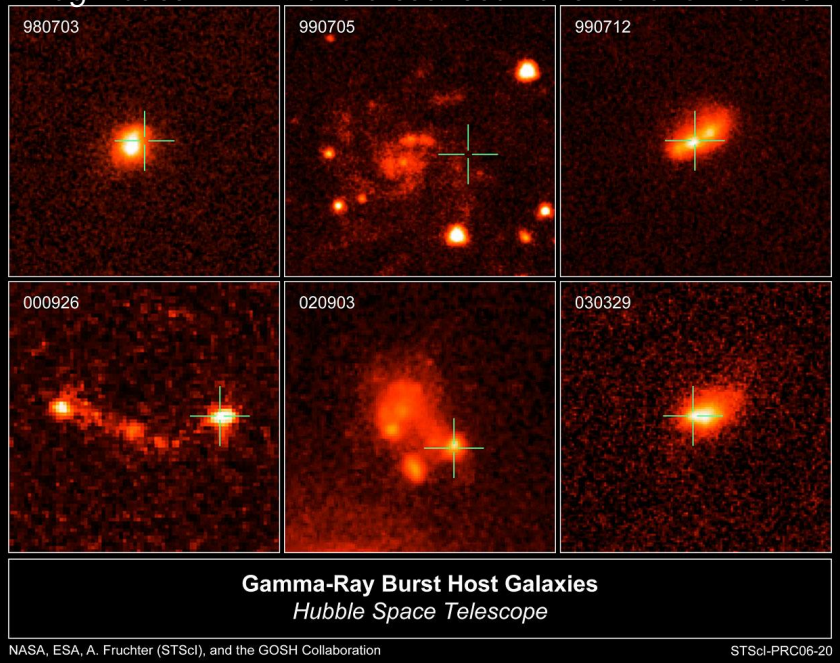




III- LSST and SVOM for the GRB science

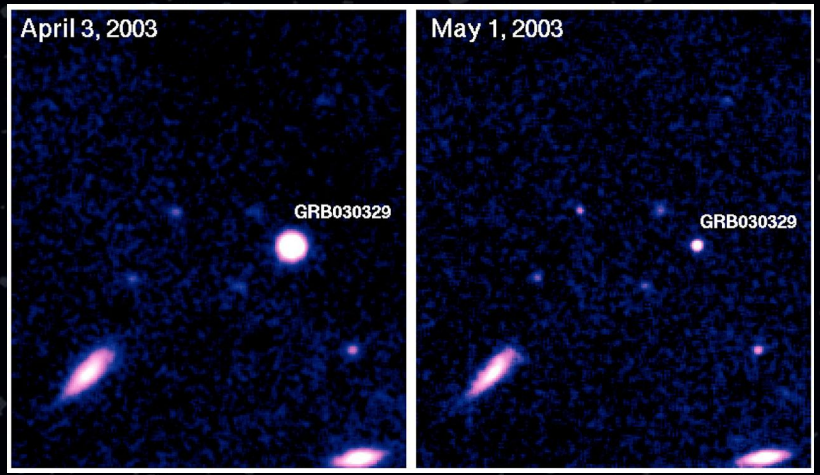
GRB host galaxy studies (morphology, types, SFR, photo-z)

will require several years of LSST survey before reaching deep magnitudes > 25-26 and arsec. localization of SVOM bursts



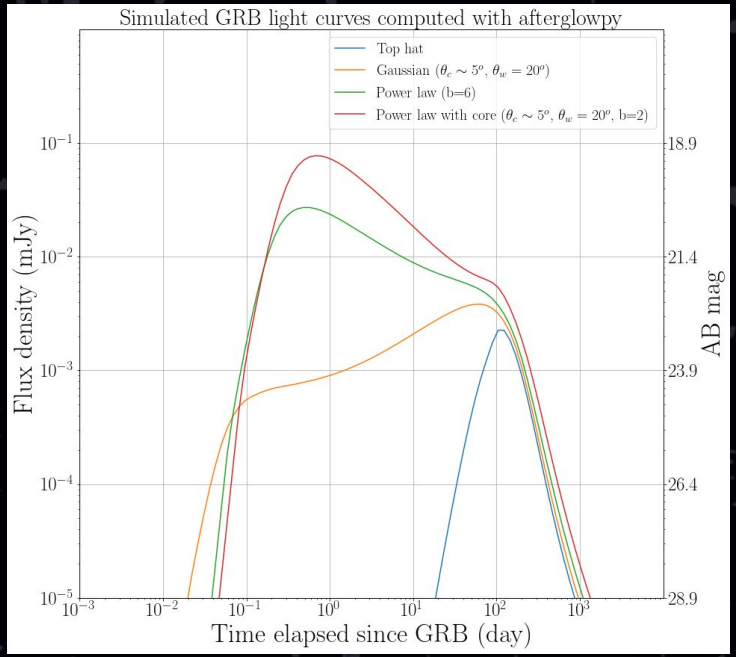
SVOM GRB late follow-up (jet-break signature, late rebrightening, SN/KN association)

will require cross-match in position and time between LSST transients and SVOM GRBs



III- LSST and SVOM for the GRB science: find the hidden off-axis population

Off-axis GRB afterglows with different jet structure at z = 0.1



Orphan GRB

- Identified at optical wavelengths (maybe x-rays with Einstein Probe)
- No gamma-ray signal at all (off-axis at cosmological distances)
- Science outputs
  - Probe the geometry and structure of the GRBs jet (currently highly debated)
  - Host environment and properties
  - LGRB + SNe connection
  - Refine the total GRB rates in the Universe

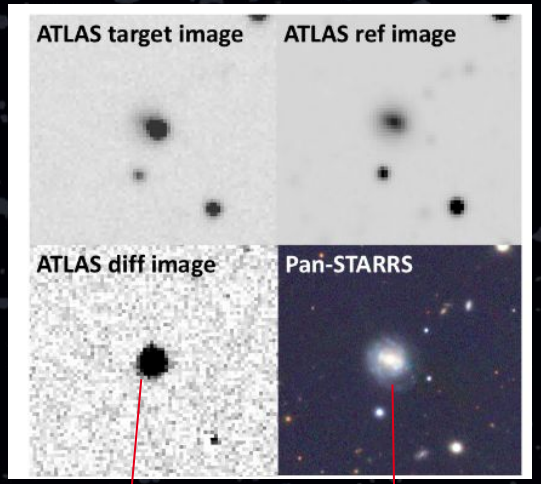
Some studies already started to explore those potential synergies
Masson & Bregeon 2024

A combination of LSST orphan GRB candidates detection + SVOM/VT and SVOM ground-segment observations have a discovery potential in this field

III- LSST and SVOM to study the violent Universe and rare classes of transients

The example of Luminous Fast Blue Optical transients

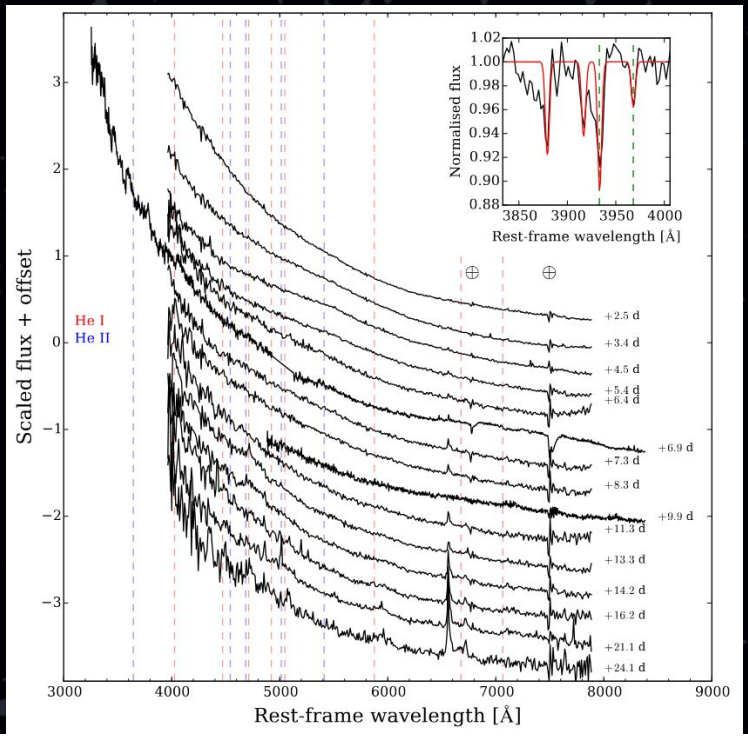
T = 27000 K (t+4.1d) -> 15000K (t+21.1d), featureless at z = 0.0139



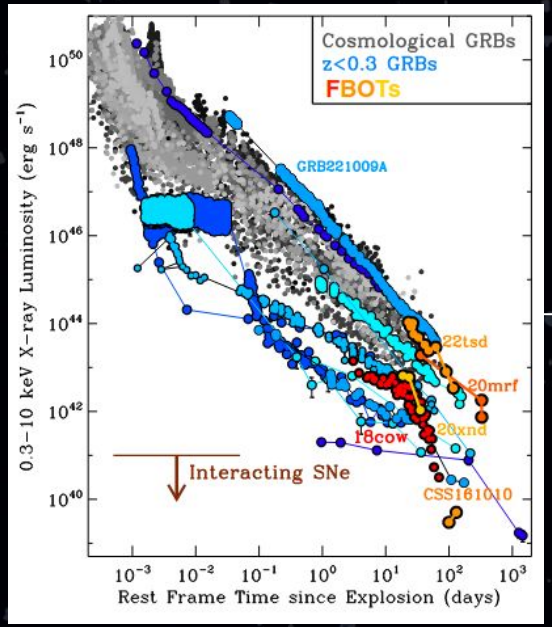
Prentice et al. 2018

"The cow"

CGCG 127-68 host
at z = 0.01406

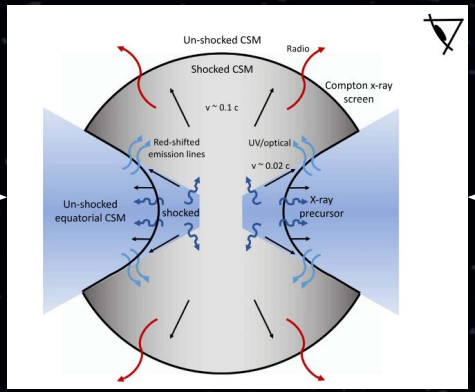


III- LSST and SVOM to study the violent sky and rare classes of transients

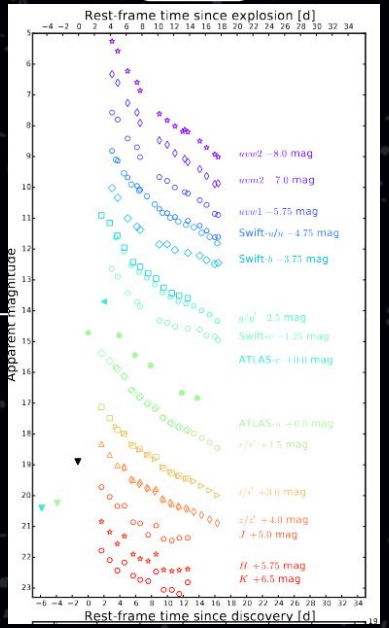


Matthews et al. 2023

Bring more data and detections to test the FBOT astrophysical scenario

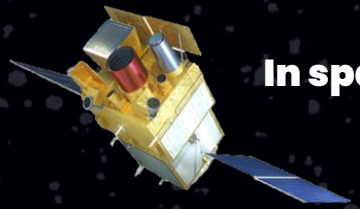


Margutti et al. 2019 (adapted from Fig. 12)



The “cow” Prentice et al. 2018

III- How to setup the link between the two projects?

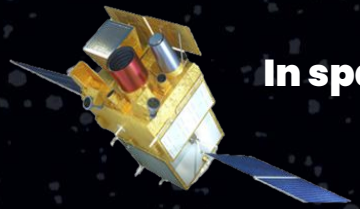


In space

In the Cloud
see the “Fink and more” session tomorrow

On ground

III- What has been already done so far between SVOM and FINK?



In space

Sends alerts

auto request for follow-up
(Not yet in place)

FINK

In the Cloud

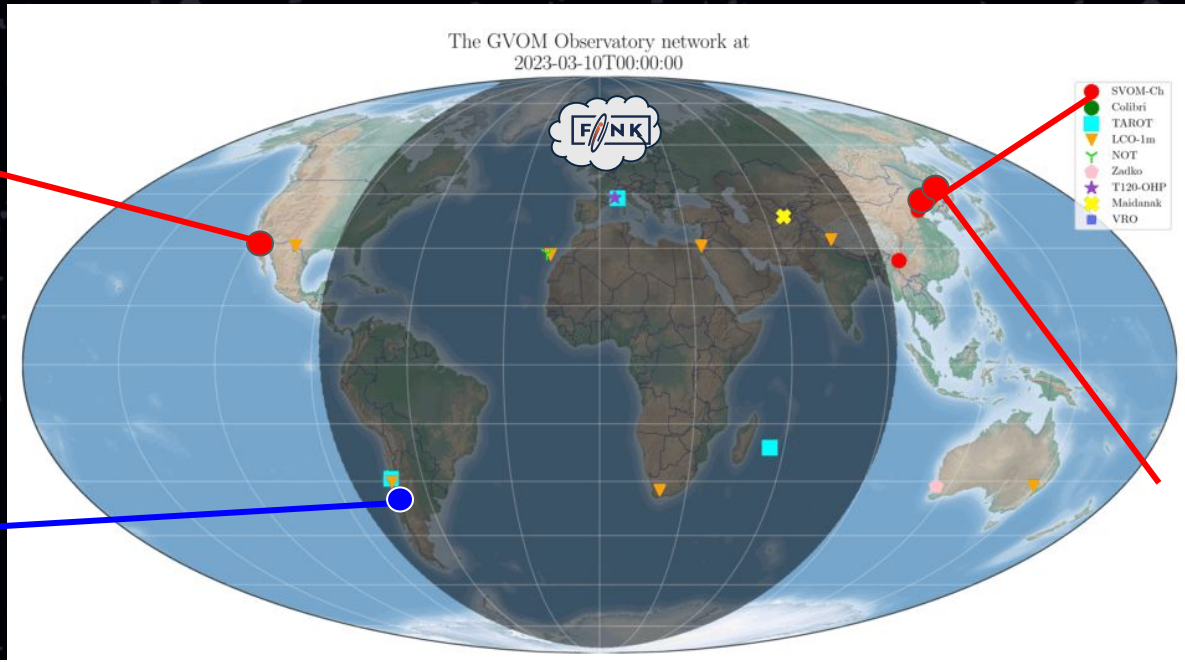
Sends alerts

On ground

III- SVOM/Fink next steps

Connecting the SVOM ground segment to the FINK/LSST alerts to bring us more scientific opportunities in the Time-Domain Astronomy

COLIBRI (OAN-SPM)



Xinglong Obs.

Jilin Obs.

VRO

Rubin LSST-France, IJCLab Orsay June 11, 2025

III- SVOM/LSST: a promising scientific era

- A common GRB science case can be found to boost the scientific return of the SVOM GRB and the LSST transient samples
- SVOM will perform follow-up observations for promising (TBD) optical candidates found during the LSST survey
- SVOM is willing to collaborate with the Fink Collaboration to setup the link between the two transient detection machines
- We are opened to co-developed scientific opportunities. Think about using the SVOM General & ToO Programs for your science purposes (collaboration with a SVOM Co-Is mandatory)

Take-home messages about SVOM first year in general

- The SVOM launch was successful last year June 22nd
- After a 6 months of commissioning and verification phase, we can say that all the SVOM systems (instruments, communication, solar panels, orbit stability, etc.) are working smoothly
- Since April 2025, SVOM has officially started its 3 (+2) years of scientific operation
- Since the launch, SVOM has detected 129 GRBs (110 GRM, 45 ECLAIRs) and >70 x-ray transients (mostly known galactic source). A rich diversity of GRB (prompt and afterglow emission) is already explored and more will come for population studies.
- ~15 publication projects are ongoing + a special issue describing all the mission aspects and the first results will be published in RAA (under preparation).
- A GRB public table is also under preparation to let the scientific community getting access to the SVOM public scientific products.
- SVOM has already established excellent cooperation with many groups: Swift, Einstein Probe, Stargate, NOT-GRB, etc. and more agreement are under preparation
- SVOM is willing to develop common transient science cases with the LSST and FINK communities
  (orphan GRB afterglow searches, Kilonovae searches, regular GRB afterglow science, Host GRB galaxy and redshift determination, Luminous Fast blue Optical transients, new classes of transients?, etc.)

Thanks for your attention!

Any questions?

Operational observing programs

Core Program (CP):

GRB & HE transients detected by SVOM

Automatic slew on ECLAIRs alert

General Program (GP):

Observation proposals awarded by a TAC (your proposal has to include a SVOM co-I).

Targets of Opportunity (ToO):

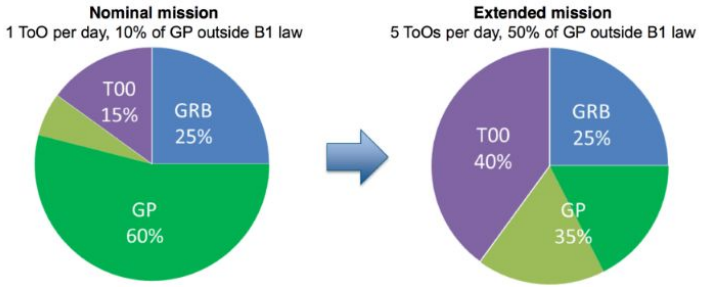
ToO-NOM: Normal ToO

ToO-EX: Fast ToO (mainly through Beidou)

ToO-MM: for large error boxes, with a tiling strategy

Initially 1 ToO/day, will increase during the extended mission.

If you want a ToO, please contact the SVOM PIs.



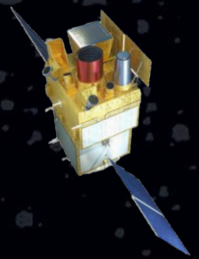
	ToO-NOM	ToO-EX	ToO-MM
Frequency	Nominal mission : 1/day Extended mission : 5/day	1/month => 1/day	1/week
Priority	Low	Low to Highest	Low to Very High
Upload Delays	< 48h (regular S-band)	< 12h (requested S-band) < 1h (Beidou)	< 12h (requested S-band) < 1h (Beidou)
Duration	Base : 1 orbit => 2.7ks Max : 14 orbits => 38ks SAA optimized	Max : 14 orbits => 38ks	Max : 14 orbits => 38ks SAA optimized
Tiling	No	No	Max tiles / orbit = 5 (close)
Data availability	X-band	X-band	VHF for MXT Position, Photon list, VT Attitude chart X-band
Statistics (6 Dec. 2024)	477	52	1

Credits: SVOM Collaboration, C. Lachaud (APC)

I- SVOM: Still the need for humans in the loop 24h/7d

ECLAIRs+GRM

MXT



Instrument Scientists and Trigger Advocates

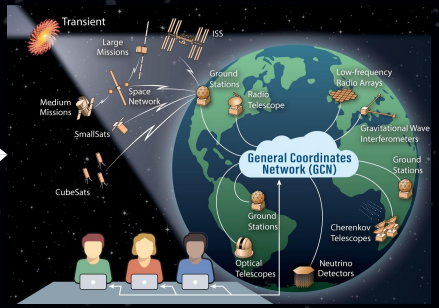
Trigger validation

Trigger yes/no?

Burst Advocates

Main point of contact

Write the High-energy and retraction Circulars



VT

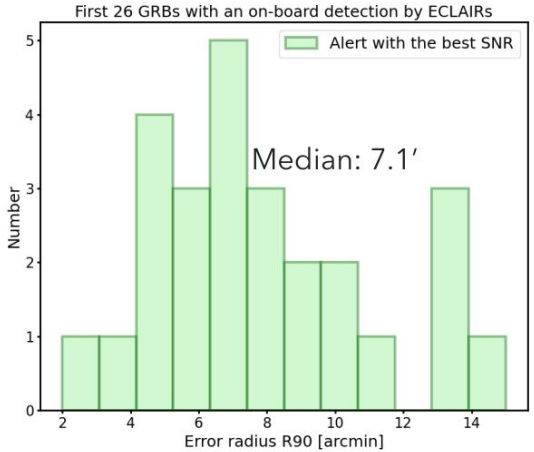
Ground-based partners

Instrument Scientists

Write the follow-up Circulars

SVOM/ECLAIRS: GRB DETECTION RATE – LOCALIZATION – SLEW

- **ECLAIRS:**
  - 26 GRBs detected on-board in 8.7 months ~ 36 GRB/year
  - % of time with active on-board trigger: 45% (July-Nov. 24) → 76% (Dec. 24-March 25)
  - **Expected rate during scientific operations: ~45-50 GRBs detected and localized on-board per year**



Statistical error on ECLAIRs localization
Systematics: 2′

Field-of-view of the follow-up instruments on board SVOM:
- MXT: 58′ x 58′ (Swift/XRT: 24′x24′)
- VT: 26′ x 26′

Automatic slew:
- 54% of GRBs since Launch
- **85% of GRBs since Dec. 24** (lowered threshold)

Credits: SVOM Collaboration, F. Daigne (IAP)

SVOM GRBS: AFTERGLOW DETECTION & REDSHIFT MEASUREMENT

(since Dec. 24: 85% of GRBs detected on-board by ECLAIRs triggered an automatic slew)

	GRM-only on-board-triggers: first 54 GRBs	ECLAIRs on-board triggers: first 26 GRBs	**ECLAIRs on-board triggers: first 14/26 GRBs with auto. slew**
X-ray afterglow	17% (9/54)	81% (21/26)	**100% (14/14)** SVOM/MXT: 5 detections Swift/XRT: 14 ; EP/FXT: 6
Optical/NIR afterglow	13% (7/54)	58% (15/26)	**71% (10/14)** SVOM/VT: 8 det. + 4 early deep UL SVOM/CGFT+FGFT: 3 det. + 3 early UL
Redshift	11% (6/54)	35% (9/26)	**43% (6/14)** **Special thanks to SVOM partners: NOT, Stargate, ...**

= common triggers with Swift/BAT (6) or EP/WXT (3)

SVOM instruments contribute to the follow-up of these GRBs.

Already an excellent efficiency for the follow-up of GRBs detected on board SVOM with ECLAIRs

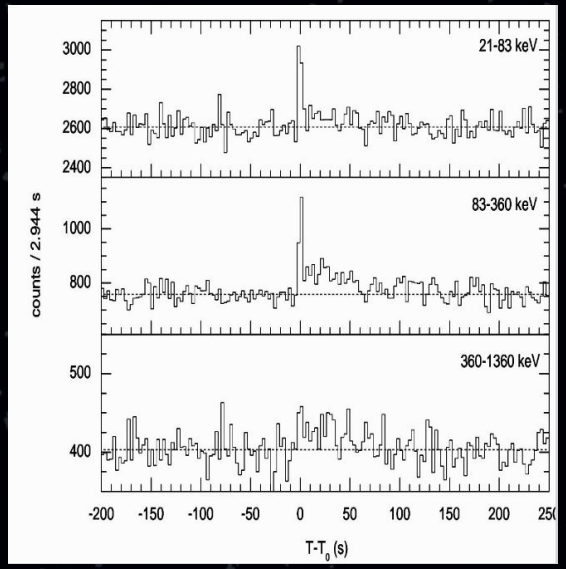
8

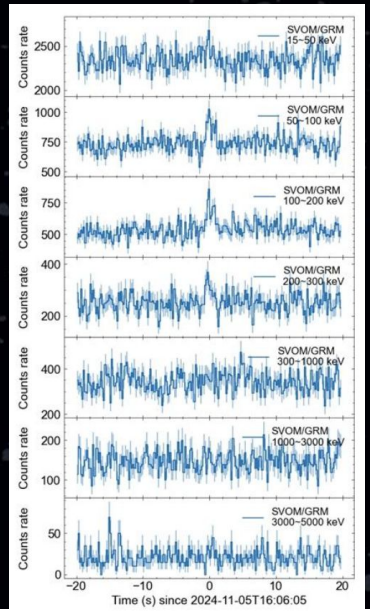
Credits: SVOM Collaboration, F. Daigne (IAP)

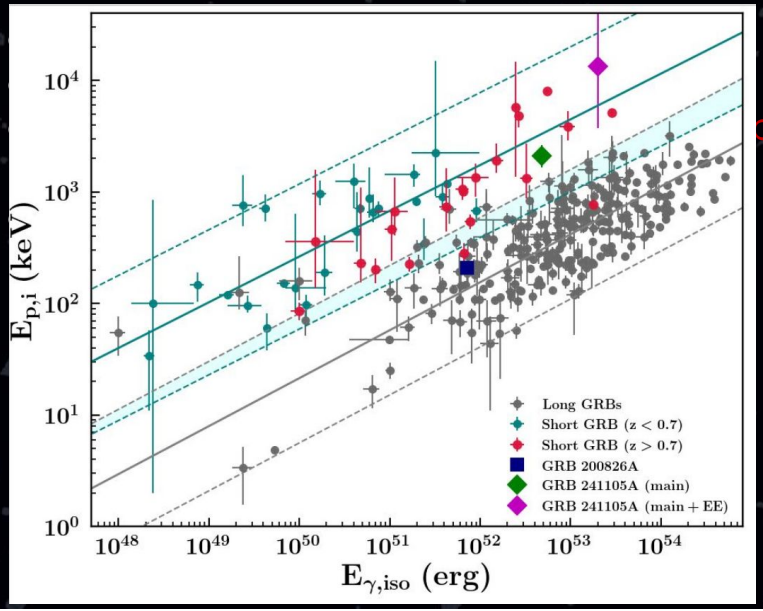
II- SVOM to explore the short GRB population and the merger origin

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.

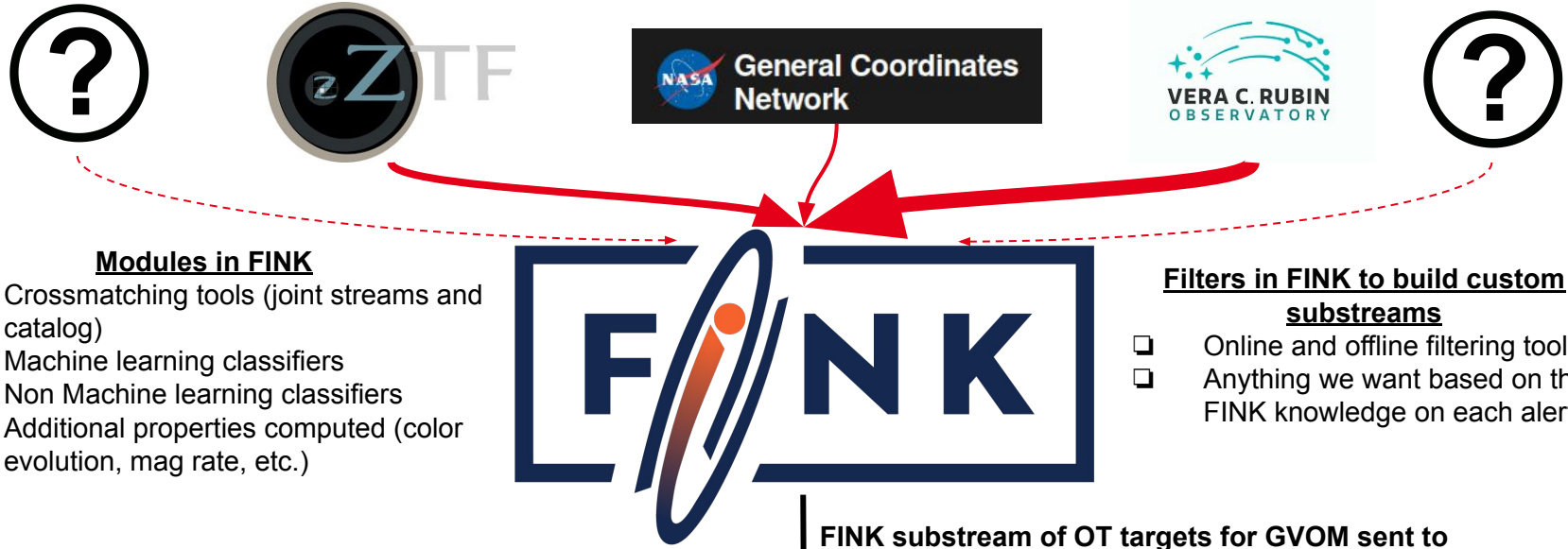
GRB 241105A
An other SGRB+EE merger or a disguised LGRB seen by Fermi/GBM Konus-WIND and SVOM GRM?







The FINK broker: the GVOM toolkits



Modules in FINK

- Crossmatching tools (joint streams and catalog)
- Machine learning classifiers
- Non Machine learning classifiers
- Additional properties computed (color evolution, mag rate, etc.)

Filters in FINK to build custom substreams

- Online and offline filtering tools
- Anything we want based on the FINK knowledge on each alert

FINK substream of OT targets for GVOM sent to the ToO manager

ToO Manager & BA tools

- Visualisation tools of the network and targets of the “day”.
- Distribute (auto or manually) the follow-up alerts to the tel. network (protocol to be defined)
- Generate ToO request for revisits
- Light curve and spectra visualisation

TOM TOOLKIT Las Cumbres Observatory LCO

Infrastructure

- Database
- image server
- web interface with user roles and access rights

The GVOM filters ready for science use and implemented in the FINK/TOM

Telescope network filters

A target must satisfy the following criteria:

- Being observable by COLIBRI, NOT and the Chinese facilities (heart of the network) under the following conditions at each site:
  - Elevation > 30°
  - moon distance > 20°
  - airmass < 2
  - visible at least 2 hours
- gal. latitude |b| > 15°

Astro filters

Not science dependent

- Real/Bogus score > 0.9
- Allowed Fink class. of transients: *Unknown, SN candidate, Ambiguous**
- Being bright enough r/g < 17 mag

FBOTs & on-axis untriggered GRBs

- Have no historical detection more than 5 days prior to the alert time
- The rising/fading rate > 0.3 mag/day

Orphan KNe

- Have no historical detection more than 5 days prior to the alert time
- The rising/fading rate > 0.3 mag/day
- Kilonova score > 0.7

Orphan GRB afterglows

- TBD