



First Gamma-Ray Burst Observations with SVOM

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Received 2026 January 21; revised 2026 June 15; accepted 2026 June 21; published 2026 October 5

Abstract

Following its launch on 2024 June 22, the Space-based multi-band Variable Objects Monitor (SVOM) successfully completed its flight acceptance, commissioning, and scientific validation phases in early 2025, during which several tens of gamma-ray bursts (GRBs) were detected onboard. Three quarters of these events have also been detected by other satellites, and a quarter are SVOM-only GRBs. In this article, we describe these early GRB observations, with a first description of the SVOM GRB sample that is emerging, and of the level of characterization already achieved, and with a focus on a few events of particular interest. These early results are very encouraging regarding SVOM's ability to detect and fully characterize (including prompt emission, afterglow and distance) a wide range of GRBs (classical long GRBs, short GRBs, X-Ray flashes, etc.) and to enable the use of these extreme high-energy transients as probes of the distant Universe.

Key words: (stars:) gamma-ray burst: general – (stars:) gamma-ray burst: individual (GRB 250129A, GRB 241105A, GRB240825A, GRB240821A, XRF241001A, XRF250317B, GRB241217A, GRB250314A) – gamma-rays: general

1. Introduction

The core program of Space-based multi-band Variable Objects Monitor (SVOM) is devoted to gamma-ray burst (GRB) studies (Wei et al. 2016). The characteristics of the mission (space and ground-based instruments, slewing

capability, observation strategy following an alert, etc.) were mainly shaped by this scientific objective (Cordier et al. 2026a). The prime objective is to build a sample of fully characterized GRBs, including events belonging to the various classes of GRBs: classical long GRBs (LGRBs), short GRBs (SGRBs) and other GRBs associated with neutron star mergers, soft GRBs classified as X-ray flashes (XRFs), X-Ray rich GRBs (XRRs), etc. The goal is in particular to

²⁴ <https://fsc.svbm.org/home/collaboration/collaborators>

characterize for the same events the temporal and spectral properties of the prompt emission and multi-wavelength afterglow, and to measure the redshift (distance). When possible, the aim is also to characterize the host galaxy and to search for other electromagnetic (supernovae, kilonovae) or multi-messenger (gravitational waves, neutrinos) counterparts. Such a sample will help us advance our understanding of GRB progenitors, of the nature of their central engines, of the properties of their relativistic ejecta, and of the dissipation mechanisms and radiative processes responsible for the different emission phases. This requires in particular a fast and efficient follow-up including spectroscopy at large telescopes, and when possible late observations of the host galaxies. These are also the key observations required to use GRBs as probes of the distant Universe, the second main scientific goal of the SVOM core program.

This article presents early results of this program, for the period from launch to 2025 March 31, corresponding mainly to the commissioning and scientific validation phase. The first observations by SVOM of other astrophysical sources not related to GRBs are reported in Coleiro et al. (2026). During this period, the various components of SVOM were gradually put in place, and by 2024 October, the complete sequence for observing a GRB (detection, localization, slew, follow-up) with rapid communication to the community via the NASA General Coordinates Network (GCN; Barthelmy et al. 1998) was in place. However, the configuration continued to improve gradually, with, in particular, a lowering of the slew threshold in 2024 December, the implementation of automatic Target of Opportunity (ToO) requests for the X-ray follow-up of GRBs detected and localized by the coded mask telescope ECLAIRS onboard SVOM with the X-Ray Telescope (XRT; Burrows et al. 2005) onboard Swift in 2025 February, and the Follow-up X-ray Telescope (FXT) onboard Einstein Probe (EP; Yuan et al. 2022) in 2025 April. The GRB detection rate by ECLAIRS and the Gamma-Ray Monitor (GRM) onboard SVOM during this period is discussed in Section 2. The already excellent efficiency of the afterglow detection and follow-up and redshift determination for GRBs localized by ECLAIRS is presented in Section 3. Section 4 shows with a few examples that these early detections are very encouraging regarding the capacity of SVOM to fully characterize GRBs of various types and to develop the use of GRBs as cosmological probes, and Section 5 is the conclusion.

2. GRB Detection Rates Onboard SVOM

Two wide-field of view instruments can trigger on GRBs onboard SVOM: the coded mask telescope ECLAIRS working in photon counting mode in the 4–150 keV range, with a field of view of 2 sr (Godet et al. 2026), and the GRM in the 15 keV–5 MeV range, with a field of view of 2.6 sr for each of its three gamma-ray detectors (GRDs; Sun et al. 2026). During

the first 9.3 months of the SVOM mission, from the launch on 2024 June 22 to the end of the scientific validation phase at the end of 2025 March, 86 GRBs were detected onboard SVOM,²⁵ including 36 GRBs also detected by the Gamma-ray Burst Monitor (GBM; Meegan et al. 2009) onboard Fermi, 16 by the Burst Alert Telescope (BAT, Barthelmy et al. 2005) onboard Swift, 10 by Konus (Aptekar et al. 1995) onboard Wind, and 7 by the Wide-field X-ray Telescope (WXT) onboard EP (Yuan et al. 2022). About one-quarter of these early GRBs were detected only by SVOM.

As illustrated in several examples in Section 4, the combination of ECLAIRS and GRM allows to measure the spectrum of the GRB prompt emission from 4 keV to 5 MeV. In the future, it is expected that the large field of view of the SVOM Ground-based Wide Angle Camera (GWAC) will allow extending the characterization of the prompt emission to the optical range in a few cases (Xin et al. 2026). We now focus on the GRB detections by the two gamma-ray instruments onboard the SVOM satellite.

2.1. ECLAIRS Onboard Triggers

ECLAIRS can trigger on many combinations of timescales, energy bands and zones in the detector plane, using either the count rate (Count Rate Trigger or CRT, searching for a count excess over background, on time intervals from 10 ms to 20 s) or images (Image Trigger or IMT, searching for transient sources in sky images on timescales from 20 s to 20 min) (Schanne et al. 2026). For most GRBs, several alert packets are thus produced onboard SVOM and then transmitted immediately to the ground thanks to the SVOM very high frequency (VHF) network (Cordier et al. 2026b). The CRT trigger is always followed by the reconstruction of its sky image to search for a transient source, yielding the reported signal-to-noise (SNR) in the initial notice and circular that are sent to the NASA GCN to report the detection of a new GRB. During the first 9.3 months following the launch, 29 GRBs were detected by ECLAIRS onboard SVOM, including 18 SVOM-only triggers. All these GRBs were localized within a few arcmin, with a median statistical error of $7'$, to which a $2'$ systematic error must be added in quadrature. Figure 1 shows for these 29 first GRBs the distribution of the timescale and energy band of the alert packet received first by the VHF network (hereafter “first alert”) and of the alert packet with the best SNR among all those received (hereafter “best SNR alert”). The impact of the longest timescales (to be compared to the maximum timescale of 32 s used by Swift/BAT, Barthelmy et al. 2005) is clearly seen, with 45% (resp. 7%) of the best SNR alerts (resp. first alerts) corresponding to large timescales (40.96, 81.92 and 163.84 s). The low-energy threshold at 4 keV of ECLAIRS is significantly lower than that of previous missions, which has

²⁵ There were also 18 on-ground detections, not discussed here.

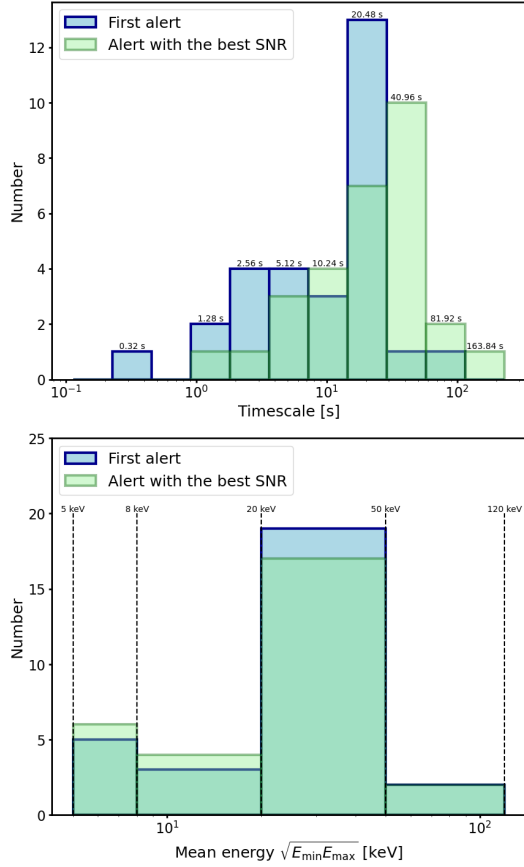


Figure 1. ECLAIRs onboard trigger. Distribution of the timescale (top) and energy band (bottom) of the first and best SNR alert for the first 29 GRBs detected onboard by ECLAIRs.

also a clear impact: in 21% of cases, the best SNR alert is obtained in the 5–8 keV energy band. As discussed below, this gives access to the poorly known population of softer GRBs (XRRs or XRFs). As the fraction of time with an active onboard trigger has increased from 44% up until 2024 November to 75% from 2024 December to 2025 March, these early detections lead to an expected rate of at least 48–52 GRBs yr^{-1} detected and localized by ECLAIRs onboard SVOM during the scientific operations.

2.2. GRM Onboard Triggers

The GRM can trigger on three timescales (0.1, 1 and 4 s), only if the signal is above threshold in at least two of the three GRDs and only if ECLAIRs has not triggered first. This led to 77 GRBs detected onboard in the first 9.3 months, among which 26% are also detected by ECLAIRs. This corresponds to an expected rate of ~ 100 GRBs yr^{-1} detected onboard, and an expected total rate of ~ 130 GRBs yr^{-1} taking into account on-ground triggers and ECLAIRs first triggers. GRBs detected by both instruments ECLAIRs and GRM offer the best

Table 1
Efficiency of the Follow-Up of the First SVOM GRBs

	#	Afterglow		Redshift
		X-rays	Visible/NIR	
GRM-only	57	17 (30%)	12 (21%)	11 (19%)
ECLAIRs (all)	29	28 (97%)	20 (69%)	13 (45%)
ECLAIRs (slew)	16	16 (100%)	13 (81%)	9 (56%)

Note. The table reports the number of afterglow detections in X-rays and visible/NIR (by SVOM instruments or others, see the details for the first 13 ECLAIRs GRBs with a measured redshift in Table 2), as well as the number of measured redshifts for the GRBs detected onboard SVOM during the 9.3 months following the launch: GRBs with a GRM-only onboard trigger and GRBs with an ECLAIRs onboard trigger, with a focus on the cases where the trigger was followed by an automatic slew of the satellite.

characterization of the prompt emission, with a spectral coverage from 4 keV to 5 MeV.

3. Characterizing SVOM GRBs: Afterglow, Host Galaxy and Redshift

3.1. An Already Efficient Follow-Up Strategy

SVOM has developed a complex observational strategy to fully characterize the GRBs detected and localized onboard. This strategy involves (i) a fast transmission of the GRB alerts to the ground via a VHF network (Cordier et al. 2026b), (ii) the slew of the satellite to detect, localize and follow the afterglow in X-rays with the Microchannel X-ray Telescope (MXT; Götz et al. 2026) and in the visible with the Visible Telescope (VT; Qiu et al. 2026), (iii) a rapid reaction with SVOM on-ground follow-up telescopes (GFTs), i.e., the C-GFT in China (Wu et al. 2026), and COLIBRI (also called FM-GFT) in Mexico (Basa et al. 2026), favored by the anti-solar pointing of SVOM, and (iv) a fast dissemination of the alerts to the community via notices and circulars on the NASA GCN (Claret et al. 2026; Louvin et al. 2026). The follow-up of SVOM GRBs benefits from several partnerships with other facilities. This includes automatic ToO requests for a follow-up in X-rays by Swift/XRT (since 2025 February) and EP/FXT (since 2025 April). After the immediate reaction to an alert, internal ToOs are used for the long-term follow-up of the afterglow with SVOM/VT, allowing in many cases to get a deep and well-sampled lightcurve, as illustrated below by a few examples. SVOM ToOs (Cordier et al. 2026a) are also used to react to external GRB alerts. In 2025, this procedure allowed the first detection of the optical counterpart by SVOM/VT in eight cases, where the initial localization was provided by EP/WXT or Swift/BAT.

The SVOM follow-up strategy was gradually implemented after the launch. Automatic slews started only in 2024 October, leading to a fraction of 55% of GRBs with an onboard ECLAIRs trigger followed by a slew during the first

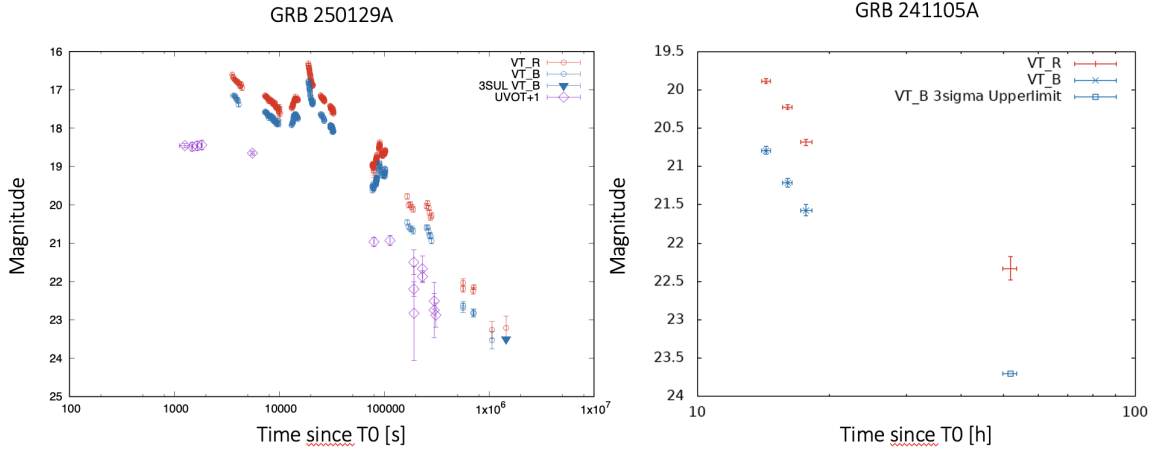


Figure 2. Follow-up observations of two Swift/BAT GRBs by SVOM/VT. Left: VT observations of the afterglow of the LGRB 250129A (red and blue symbols). Swift/UVOT observations (purple) are shown for comparison. Figure adapted from Chen et al. (2026, in preparation). Right: VT observations of the afterglow of GRB 241105A, contributing to the multi-wavelength follow-up from X-rays to radio discussed in Dimple et al. (2025).

9.3 months, which has increased to 73% since 2024 December when the ECLAIRs threshold SNR to request a slew was lowered. Table 1 summarizes the afterglow detections and redshift measurements that were achieved in the first 9.3 months following GRB detections onboard SVOM.

3.1.1. SVOM GRM-only GRBs Localized by External Missions

The full characterization up to the redshift determination is achieved in 19% of the 57 GRM-only GRBs, corresponding to common triggers with Swift/BAT (8/11 GRBs) and EP/WXT (3/11 GRBs). The already significant impact of SVOM on the afterglow follow-up of GRBs detected and localized by other satellites, especially thanks to the sensitivity of the VT, is illustrated with two examples in Figure 2. GRB 250129A (left panel) is an LGRB at $z = 2.151$ (Schneider et al. 2025c), detected by Swift/BAT (Beardmore et al. 2025a). The initially bright visible counterpart was followed by the Ultra-Violet/Optical Telescope (UVOT; Roming et al. 2005) of Swift, covering the early phase from 0.3 to 4.7 hr after the trigger (Siegel et al. 2025), and a second epoch up to 3 days. SVOM/VT observations started less than 1 hr after the trigger, and lasted for more than two weeks, revealing a complex variable lightcurve, with several flares. Combined with the X-ray lightcurve, which shows also flares, these observations will bring new constraints on the origin of the strong variability in the afterglow phase (Chen et al. 2026, in preparation, see also Akl et al. 2026). GRB 241105A (right panel) is a short burst with extended emission, detected by Fermi/GBM (Fermi GBM Team 2024d) and Swift/BAT (DeLaunay et al. 2024). SVOM/VT observations from 14.2 hr to 2.16 days reveal a rapidly decaying lightcurve of the afterglow initially detected by the Gravitational-wave Optical Transient Observer (GOTO; Julakanti et al. 2024) and undetected by Swift/UVOT. This is a significant contribution to the characterization of this GRB

belonging to a rare class, a fraction of which could be associated with mergers (see Section 4.1). In this specific case, the high redshift and the properties of the host galaxy rather point toward a collapsar origin (Dimple et al. 2025).

In addition to SVOM/VT, the follow-up of external GRBs also strongly benefits from the two SVOM/GFTs. This is illustrated in Figure 3 for GRB 240825A, a classical LGRB detected by Fermi/GBM and Swift/BAT (Fermi GBM Team 2024b; Gupta et al. 2024). SVOM/C-GFT started to observe only 66 s after the trigger. This constitutes the earliest optical observations within a very rich multi-wavelength dataset, enabling a detailed modeling of the afterglow including the early contribution of the reverse shock (Wu et al. 2025).

3.1.2. SVOM GRBs Detected by ECLAIRs

As expected, the best follow-up efficiency is achieved for ECLAIRs onboard triggers followed by an automatic slew, which corresponds to 16 GRBs during the first 9.3 months. The X-ray afterglow was detected for all these events, thanks to the MXT (8/16), the Swift/XRT (16/16) and EP/FXT²⁶ (6/16). The visible or near-infrared (NIR) afterglow was detected in 81% of cases, with 12/16 detections by the VT (and four early deep upper limits), and 4/16 detections by the SVOM/GFTs (and three early upper limits). Finally, the redshift of the GRB was measured in 56% of cases thanks to SVOM partners, especially with the Very Large Telescope (VLT) at the European Southern Observatory (7/13; Stargate collaboration), the Gran Telescopio Canarias (GTC; 5/13) and the Nordic Optical Telescope (NOT; 2/13). Several of these well characterized GRBs are discussed in the next section.

²⁶ Automatic ToO requests for EP/FXT have started right after the beginning of the observation period discussed in the present article.

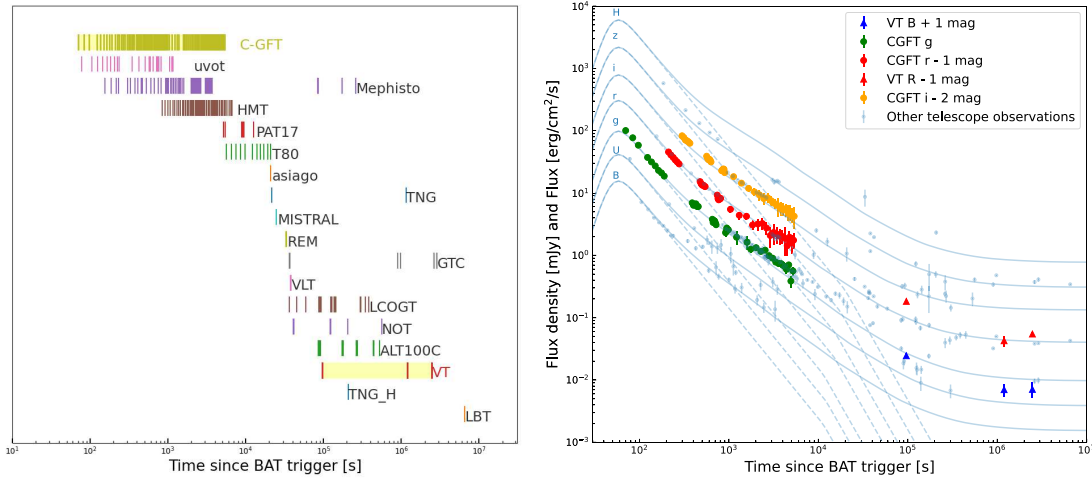


Figure 3. Follow-up observations of GRB 240825A by SVOM/C-GFT and SVOM/VT. Left: timeline of the observations of this GRB in the visible (see Wu et al. 2025 and references therein). SVOM/C-GFT provides the earliest observations. Right: resulting afterglow lightcurve, adapted from Wu et al. (2025), where the two component model (forward and reverse shock) shown in blue lines is discussed.

As only 13 of the 20 ECLAIRs GRBs with a detected visible/NIR afterglow have a known redshift (see Table 1), the redshifts of some of the remaining GRBs may still be measured in the future via late host galaxy spectroscopic observations, as already done in one case (GRB 250328A; Saccardi et al. 2026). Among the four cases with early deep upper limits by the VT, one GRB has been confirmed as a high-redshift GRB (see Section 4.4).

3.1.3. Optimizing the Follow-Up Strategy

As discussed in more detail in Cordier et al. (2025), there are a number of well identified key factors where progress can still be made to further improve this already very good follow-up efficiency. In particular, (i) the compliance with the nominal pointing law avoiding the Galactic plane has been much better since the start of scientific operations than in the early months; (ii) the fraction of automatic slews following ECLAIRs triggers has increased since 2024 December and can still be optimized; (iii) the automatic ToO requests to Swift/XRT and EP/FXT following ECLAIRs triggers is now fully operational.

Progress on some other aspects will take longer: (i) the delay to identify possible counterparts in early VT images or to compute early deep upper limits that may identify high-redshift candidates could be reduced, especially if the number of available X-band stations is increased to download the full data more rapidly to the ground; (ii) early NIR photometry, allowing photometric redshift measurements or the detection of high-redshift events, should be enhanced in late 2026 thanks to the new camera CAPturing Gamma-ray burst InfraRed

Emission (CAGIRE) observing in J - and H - bands at COLIBRI (Basa et al. 2026).

3.2. Redshift and Other Properties of Fully Characterized SVOM GRBs

As illustrated in Section 4, the prompt emission of the first 29 ECLAIRs GRBs is well characterized. They correspond either to very soft events detected only by ECLAIRs (8/29) or classical GRBs detected by ECLAIRs+GRM, with a spectral coverage from 4 keV to 5 MeV. The afterglow is detected in X-rays and visible/NIR for more than two-thirds of this sample, and already 13/29 (45%) of GRBs have a redshift measurement. These thirteen GRBs and their properties are listed in Table 2 and their redshift distribution is displayed in Figure 4. This still small sample covers a broad range of redshift, from $z = 0.238$ to $z \simeq 7.3$, and includes one SGRB with extended emission, two soft GRBs that can probably be classified as XRFs, and ten classical LGRBs with a median redshift of 2.9. As shown in Table 2, their host galaxy was detected in 6/13 cases. In the 7/13 other cases, an upper limit for the host galaxy was obtained using the galaxy catalogs from the Legacy Survey and Pan-STARRS1. Finally, an associated supernova was detected in two cases, thanks to follow-up observations with the James Webb Space Telescope (JWST). As illustrated with a few examples in Section 4, this already shows the capacity of SVOM to fully characterize a wide diversity of GRBs, constraining their progenitors and probing their physics, and to use GRBs to study the high-redshift Universe.

Table 2
The First Fully Characterized GRBs Detected by SVOM/ECLAIRs

GRB	Preliminary	Prompt: SVOM				Prompt: Other		X-ray Afterglow						Visible/NIR Afterglow					
Name	Classification	ECLAIRs	GCN	GRM	GCN	Inst.	GCN	MXT	GCN	XRT	GCN	FXT	GCN	VT	GCN	GFTs	GCN	Other	GCN
240821A	SGRB+EE	X	37220	X	37226	GBM	37219	...	...	X	37249	X	37316	UL	37243	...	...	Gemini N	37319
241001A	XRF	X	37655	...	...	...	...	...	...	X	37725	X	37809	X	37695	...	...	LCO	37673
241209B	LGRB	X	38478	X	38478	Konus	38537	...	...	X	38525	X	38632	X	38516	...	...	...	...
250103B	LGRB	X	38797	X	38797	BAT	38796	...	...	X	38796	...	...	X	38813	...	...	...	...
241217A	LGRB	X	38594	X	38594	WXT	38606	X	38594	X	38599	X	38606	X	38600	...	...	...	...
241030B	LGRB	X	37984	X	38002	GBM, BAT	37980; 37981	...	...	X	37981	...	...	X	37999	...	...	Nanshan	37985
250329A	LGRB	X	39916	X	39916	...	...	X	39916	X	39924	...	...	X	39917	COLIBRI	39915	...	...
250327B	LGRB	X	38888	X	H. Yang et al. (2026, in preparation)	Konus	39978	X	38888	X	38895	...	...	X	38890	COLIBRI	39897	...	...
250317B	XRF	X	39752	...	...	...	...	X	39752	X	39763	...	...	X	D.-H. Zhao et al. (2026, in preparation)	COLIBRI	39754	...	...
250205A	LGRB	X	39154	X	A. Saccardi et al. (2026, in preparation)	GBM, WXT	39171; 39165	X	39154	X	39161	X	39165	X	A. Saccardi et al. (2026, in preparation)	COLIBRI	39162	LT	39156
250103A	LGRB	X	38786	X	38786	GBM	38806	UL	38786	X	38849	...	...	X	38802	C-GFT (UL)	38791	...	...
250314A	LGRB	X	39719	X	39719	...	...	UL	39729	X	39734	X	39739	UL	39728	...	...	NOT	39727
250328A	LGRB	X	39910	X	...	...	...	...	...	X	39967	...	...	X	39936	COLIBRI	39920	...	...
GRB	Redshift	Telescope	GCN	Host galaxy	Reference	Supernova	Reference												
Name	z			Detection		Detection													
240821A	0.238	VLT	37731	GTC	F. Daigne et al. (2026, in preparation)	...	...												
241001A	0.573	VLT	37677	UL (Legacy Survey)	Dey et al. (2019)	JWST	GCN 37867												
241209B	0.575	GTC	38646	UL (Legacy Survey)	Dey et al. (2019)	...	...												
250103B	1.416	VLT	38820	Legacy Survey	Dey et al. (2019)	...	...												
241217A	1.879	VLT	38637	Legacy Survey	Dey et al. (2019)	...	...												
241030B	2.82	GTC	38004	UL (Pan-STARRS1)	Chambers et al. (2016)	...	...												
250329A	2.91	VLT	39918	UL (Legacy Survey)	Dey et al. (2019)	...	...												
250327B	3.035	NOT	38893	UL (Legacy Survey)	Dey et al. (2019)	...	...												
250317B	3.44	GTC	39769	UL (Legacy Survey)	Dey et al. (2019)	...	...												
250205A	3.55	GTC	39160	UL (Legacy Survey)	Dey et al. (2019)	...	...												
250103A	4.01	GTC, NOT	38809; 38814	Legacy Survey	Dey et al. (2019)	...	...												
250314A	≈7.3	VLT	39732	JWST	Levan et al. (2025)	JWST	Levan et al. (2025)												
250328A	1.250	VLT	44399	VLT	44399	...	...												

Notes. X: detected; UL: upper limit. Instruments: BAT: Swift/BAT; GBM: Fermi/GBM; Konus: Konus-Wind; WXT: EP/WXT; XRT: Swift/XRT; FXT: EP/FXT.

In the last columns (“Other”), the first detection of the visible/NIR afterglow is reported when it is not by an SVOM telescope: Gemini North (Gemini N), Las Campanas Observatory (LCO), Liverpool Telescope (LT), Nordic Optical Telescope (NOT).

Redshift/Telescope: telescope where the redshift was measured. VLT: Very Large Telescope; GTC: Gran Telescopio Canarias; NOT: Nordic Optical Telescope.

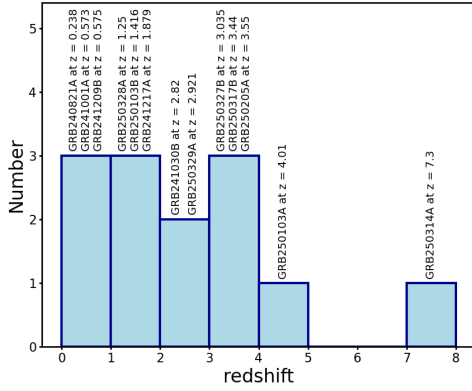


Figure 4. Redshift distribution of the first 13 ECLAIRs GRBs with a measured redshift (references are provided in Table 2).

4. Exploring the Diversity of the GRB Population with SVOM

4.1. SVOM Early View on Short GRBs

It is believed that most SGRBs are type-I GRBs associated with binary neutron star mergers (Zhang et al. 2007). Among them, a particular class of interest consists of SGRBs followed by an extended emission, as this additional episode of emission may bring new constraints on the post-merger evolution of the central source. A well studied example of such a GRB was detected by Swift in 2006 (GRB 060614, Gehrels et al. 2006) but the sample of well characterized events in this class remains small (see, e.g., Kaneko et al. 2015). However, it is difficult to reach a high level of confidence in a merger origin when only the prompt emission is available. It was anticipated that SVOM will increase the available sample as ECLAIRs is sensitive to the extended emission, which is usually softer than the initial short hard GRB (Wei et al. 2016). This is illustrated by the detection of GRB 240821A. As seen in Figure 5, the lightcurve shows a first bright and variable episode lasting less than 2 s, well detected by ECLAIRs and GRM. This initial spike is followed by a softer emission for at least 50 s, still with possible variability. As shown in Figure 6, this weaker emission is softer but remains non-thermal. Thanks to an efficient follow-up, this GRB was fully characterized (see Table 2). The ongoing analysis of the properties of the weak afterglow and of the host galaxy seems to point to a merger origin. This would make GRB 240821A an ideal case for probing the post-merger physics by studying the properties of the extended emission. This will need to be confirmed in the forthcoming paper (F. Daigne et al. 2026, in preparation).

4.2. SVOM Early Exploration of the Softer GRBs

Thanks to the low-energy threshold at 4 keV of ECLAIRs, it is expected that SVOM will characterize the population of soft GRBs revealed by the Satellite per Astronomia X (BeppoSAX;

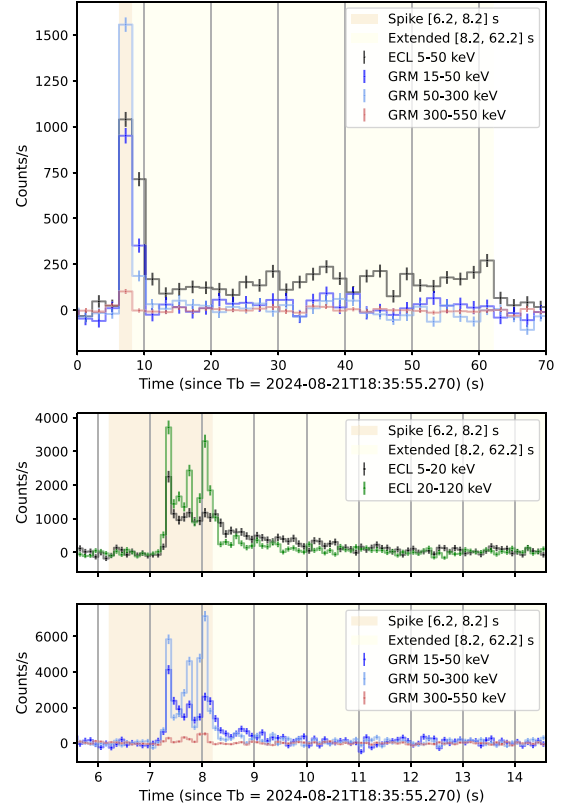


Figure 5. GRB 240821A, a fully characterized SGRB with extended emission: lightcurve. Top: ECLAIRs and GRM background-subtracted lightcurves over the whole duration of the GRB, using a time binning of 2 s. Middle and bottom: ECLAIRs and GRM lightcurves, focusing on the first phase of the GRB, with a time binning of 0.1 s. In all panels, the time intervals used for the spectral analysis of the spike and the extended emission in Figure 6 are indicated. Figures adapted from F. Daigne et al. (2026, in preparation).

Heise et al. 2001) and the High Energy Transient Explorer 2 (HETE-2; Sakamoto et al. 2005) and currently also explored by EP (see, e.g., Gao et al. 2025). Depending on their spectral properties, these events are often classified as XRRs and XRFs (Barraud et al. 2003; Sakamoto et al. 2008). This characterization is an important goal for SVOM, as this population shows some diversity and their origin and precise connection to GRBs are highly debated. In particular, it is unclear whether the origin of the unusual properties of these GRBs is due to external (high redshift, off-axis view) or intrinsic reasons (dirty fireball, shock breakout of a mildly relativistic jet, etc.). In the second case, the properties of the relativistic ejecta leading to a weak and soft emission remain to be understood. In some cases, it is even expected that the dominant mechanism for the prompt emission may be different, such as a shock breakout as in the example of XRF 080109 (Soderberg et al. 2008).

GRB 241001A is a first example of a soft GRB detected by ECLAIRs that can be classified as an XRF. As shown in

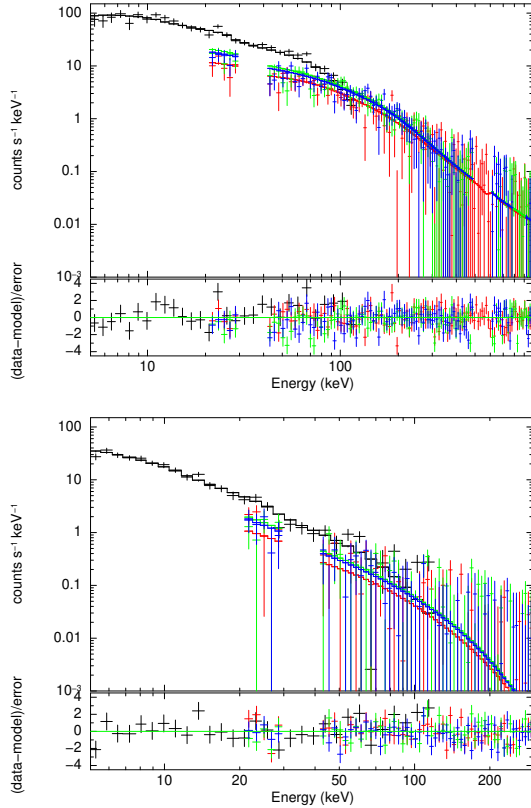


Figure 6. GRB 240821A, a fully characterized SGRB with extended emission: joint ECLAIRs+GRM spectral analysis. Top: spectral analysis of the initial spike. The best fit model is a Band function with photon indices $\alpha_1 = -0.68^{+0.07}_{-0.07}$ and $\alpha_2 = -1.76^{+0.07}_{-0.08}$, and a break energy $E_b = 109^{+15}_{-19}$ keV. As the high-energy photon index is $\alpha_2 > -2$, the peak energy cannot be measured but is at higher energy than the detected break. Bottom: spectral analysis of the extended emission. The best fit model is a power-law with an exponential cutoff with a photon index $\alpha = -1.67^{+0.09}_{-0.09}$ and a peak energy $E_p = 25^{+12}_{-9}$ keV. Figures adapted from F. Daigne et al. (2026, in preparation). In both time intervals, the spectral analysis is carried out with the ECLAIRs pipeline (ECPI) for ECLAIRs data using a chi-squared statistics (black) and eclgrm-xband for the three GRDs of GRM using *pgstat* (GRD1: red, GRD2: green, and GRD3: blue) (see Godet et al. 2026; Goldwurm et al. 2026; Piron et al. 2026). The analysis is carried out from 5 keV to 1 MeV for the initial spike, and to 300 keV for the extended emission.

Figure 7 (left), this weak event lasted several seconds with a variable lightcurve and was detected only in the 4–20 keV energy band. Besides, the visible late emission has a typical GRB afterglow evolution (see Figure 7, right). The bump detected by SVOM/VT after 10 days is the signature of an associated type-Ic broad line supernova detected by JWST (see Table 2). This clearly points to a progenitor similar to those of classical LGRBs. As discussed in Schneider et al. (2026), this soft event would very likely not have been detected by Swift/BAT. On the other hand, the afterglow could in principle still be detected at least up to $z = 1$ with the sensitivity of current telescopes. It remains however significantly fainter than the on-axis orphan afterglows detected by the Zwicky Transient

Factory (ZTF; Ho et al. 2022), which may either indicate that GRB 241001A belongs to a different population than ZTF orphan afterglow or that the ZTF survey preferentially selects bright afterglows. Due to the weakness of the prompt emission, the spectral analysis does not allow to distinguish between a thermal or a non-thermal spectrum but shows that the peak energy is of the order of 7 keV and that the burst is under-luminous, with an isotropic equivalent energy $E_{\gamma, \text{iso}} \simeq 7 \times 10^{49}$ erg. The analysis presented in Schneider et al. (2026) points to a collapsar followed by an energetic relativistic ejection, but with low prompt emission efficiency.

GRB 250317B is a second example of an XRF detected by ECLAIRs. As seen in Figure 8 (left), it is again a soft event detected mostly by ECLAIRs below 20 keV. As reported in Table 2 and Figure 8 (right), this event benefited from an excellent multi-wavelength follow-up and has the largest redshift measured for an XRF, $z = 3.44$. The corresponding isotropic equivalent radiated energy is high, $E_{\gamma, \text{iso}} \sim 1.8 \times 10^{52}$ erg, despite a low peak energy in the source frame (D. H. Zhao et al. 2026, in preparation). The early afterglow shows a peculiar behavior, with a late rise of the visible afterglow, that peaks at ~ 6000 s post-trigger, and then decays with a temporal decay index $\alpha \sim 1.7$. On the other hand, the X-ray afterglow starts with an early steep decay, followed by a plateau or shallow phase and then decaying with a temporal decay index close to that observed in the visible. As discussed in D. H. Zhao et al. (2026, in preparation), the visible and late X-ray afterglow lightcurves may indicate that the external medium is highly structured, which would then put new constraints on the mass loss history of the progenitor star during the thousand years before the explosion. Hence, this event is quite different from the previous example of an XRF, GRB 241001A, which illustrates the diversity of the soft GRB population. SVOM observations of these two first examples are promising in terms of its ability to precisely characterize such very soft GRBs.

4.3. SVOM and the Population of Classical Long GRBs

As shown in Table 2, SVOM detects and characterizes many classical LGRBs, a good fraction of them in common with other satellites. Two examples have already been discussed in Section 3.1.1. In particular, GRB 250129A in Figure 2 (left) illustrates how SVOM allows an excellent characterization of the visible afterglow, often revealing a surprising variability that is challenging for the standard external forward shock model.

The diversity and variability of the afterglows of SVOM LGRBs are also illustrated with the especially interesting case of GRB 241217A. This burst was not only detected by SVOM/ECLAIRs and GRM, but also by Fermi/GBM and EP/WXT (see Table 2). As shown in Figure 9, the end of its very long prompt emission was detected in the X-ray and visible bands with MXT and VT respectively, thanks to the early automatic slew of the SVOM satellite, before the

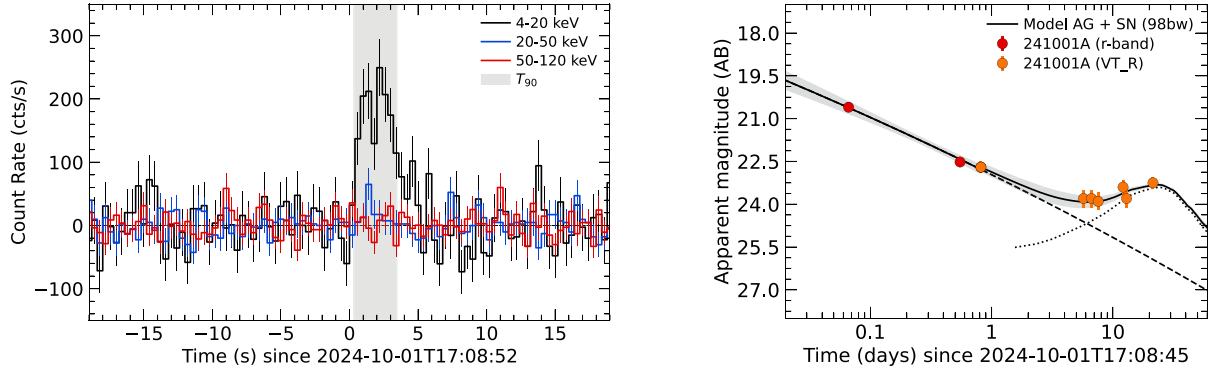


Figure 7. GRB 241001A, a fully characterized XRF. Left: ECLAIRS background subtracted lightcurve using only pixels of the detector plane illuminated by the burst. The burst is well detected in the 4–20 keV energy band (black) but not at higher energy. The shaded region corresponds to the interval of $T_{90} = 3.14 \pm 0.18$ s (4–20 keV). Right: visible afterglow lightcurve, observed by the Las Campanas Observatory (LCO) network, VLT/X-shooter and SVOM/VT (see references in Table 2). The lightcurve is modeled by the sum of an afterglow component and a supernova. The afterglow is fit by a powerlaw with a temporal decay index $\alpha = 0.81 \pm 0.06$. The supernova component corresponds to the type-Ic broad line supernova associated with GRB 980425 (Galama et al. 1998), shifted to the redshift $z = 0.573$ of this GRB. Figures adapted from Schneider et al. (2026).

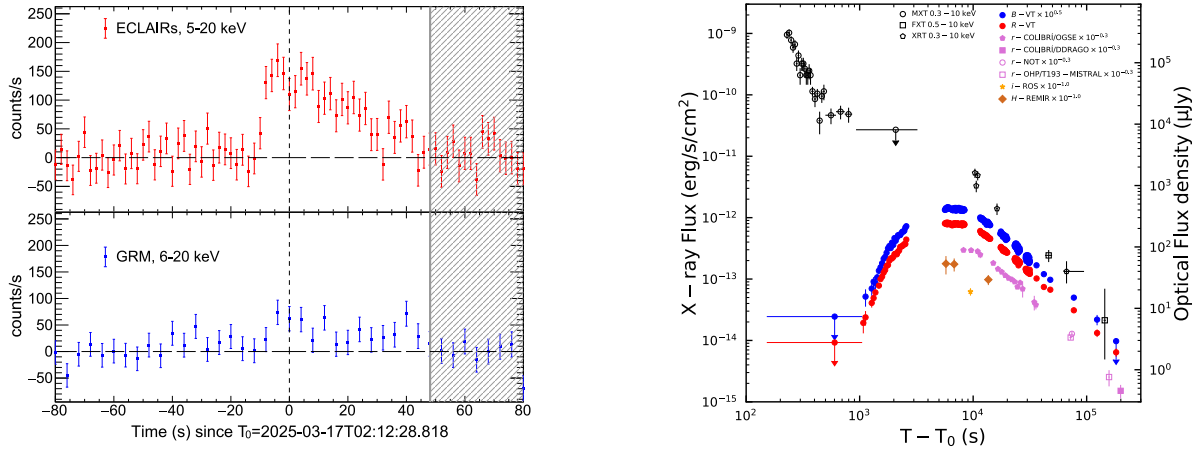


Figure 8. GRB 250317B, an XRF at large redshift with an unusual early afterglow. Left: background-subtracted lightcurve in ECLAIRS (top) and GRM (bottom). Right: afterglow lightcurve in X-rays (black symbols) and visible (colored symbols). In addition to the references in Table 2, the observations by the NOT, the Multi-purpose INSTRUMENT for Astronomy at Low-resolution (MISTRAL) at the T194 telescope of Observatoire de Haute Provence (OHP) and the Rapid Eye Mount telescope (REM, visible imager ROS and infrared imaging camera REMIR) are taken from GCN 39770; 39767; 39764. Figures adapted from D. H. Zhao et al. (2026, in preparation).

transition to the afterglow. The latter shows a very peculiar behavior, especially in the visible range, as exhibited by the VT lightcurve in Figure 10. It starts with a very shallow decay phase up to at least $\sim 10^4$ s before probably recovering a normal decay, which, however, is difficult to characterize due to the very low flux at that stage. The early plateau-like phase shows a flare at $\sim 10^3$ s and possibly a second one at $\sim 10^4$ s, very probably also seen in X-rays. As discussed in M. Brunet et al. (2026, in preparation), this very unusual behavior is particularly difficult to interpret in the standard scenario. One possible explanation is that the first phase is dominated by late central engine activity, observed for an exceptionally long duration due to a low-density external environment delaying the normal afterglow.

In addition to such afterglow observations, the combination of ECLAIRS and GRM will also enable detailed spectral analysis of the prompt emission of LGRBs (Bernardini et al. 2017). In particular, the low-energy threshold at 4 keV of ECLAIRS allows to better constrain the shape of the soft gamma-ray spectrum (see the example of the detection of a low-energy break in GRB 250506A, Figure 13 in Godet et al. 2026). This is especially important as different scenarios for the prompt emission (emission of a dissipative photosphere or synchrotron radiation from accelerated electrons above the photosphere) have very different predictions in this energy range.

Overall, the sample of LGRBs detected by SVOM will be particularly useful in advancing our understanding of their

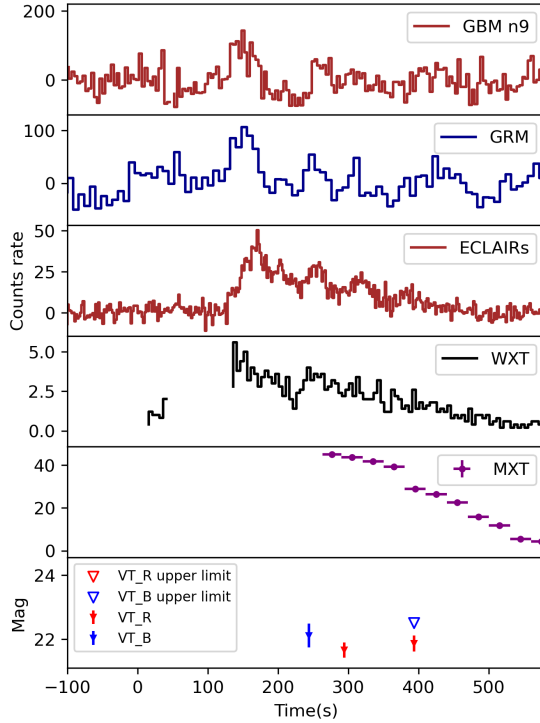


Figure 9. GRB 241217A, a very long GRB with an excellent multi-wavelength coverage from the end of the prompt emission to the afterglow phase: (1) prompt emission. Background-subtracted lightcurves from Fermi/GBM, SVOM/GRM, SVOM/ECLAIRs and EP/WXT, from top to bottom respectively. The two bottom panels show the SVOM/MXT and SVOM/VT lightcurves obtained after the slew of the satellite. See references in Table 2. Figure adapted from M. Brunet et al. (2026, in preparation).

different emission phases, thanks to the precise characterization of their prompt emission and the efficient and systematic multi-wavelength afterglow follow-up and redshift measurement (see Section 3.2 and Table 1).

4.4. SVOM GRBs as Probes of the Distant Universe

An important objective of the SVOM core program is the detection of high-redshift GRBs to probe the distant Universe (Cordier et al. 2025). The low-energy threshold of ECLAIRs is expected to favor the detection of such events (see, e.g., Palmerio & Daigne 2021), and the sensitivity in two channels of VT, including the VT_R channel extending to 1000 nm, allows the early identification of high-redshift candidates (Wang et al. 2020).

The detection of GRB 250314A at $z \simeq 7.3$ is a first major success in achieving this scientific goal (Cordier et al. 2025). This is the third highest spectroscopic redshift ever obtained for a GRB. This brings the sample size of GRBs beyond $z = 7$ to five, with the previous ones dating from 2009 to 2012 (GRB 120923A at $z \simeq 7.8$, Tanvir et al. 2018; GRB 100905A at $z = 7.88$, Im et al. 2012; GRB 090423A at $z = 8.23$, Tanvir et al. 2009;

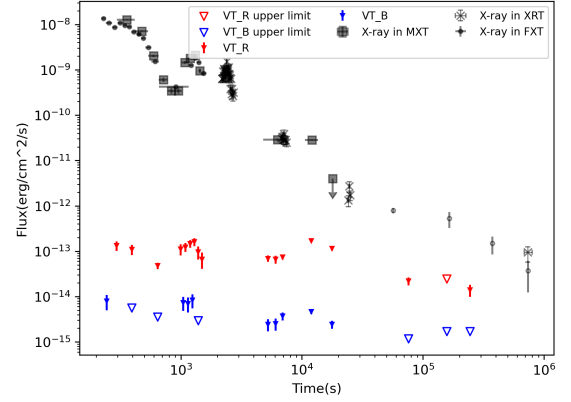


Figure 10. GRB 241217A, a very long GRB with an excellent multi-wavelength coverage from the end of the prompt emission to the afterglow phase: (2) afterglow. Lightcurve in X-rays (black symbols) and visible (red and blue symbols), see references in Table 2. Figure adapted from M. Brunet et al. (2026, in preparation).

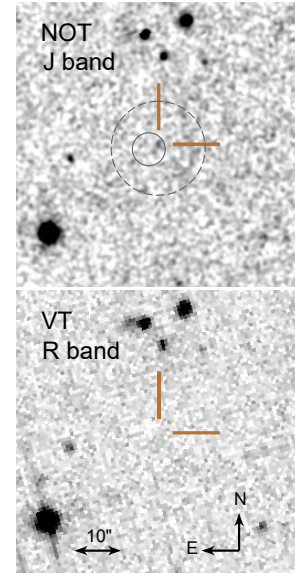


Figure 11. GRB 250314A, a classical LGRB at high redshift ($z \simeq 7.3$): afterglow detection. Bottom: VT image in R-band, obtained by stacking 23 images from the first SVOM orbit following the trigger. No counterpart is identified, leading to an early deep upper limit in the red filter. Top: NOT image in J-band 12.1 hr after the trigger. The NIR counterpart is identified by the two copper-colored lines, well within the X-ray error circle of EP/FXT (dashed line) and Swift/XRT (solid line). Both images have an approximate size of $1' \times 1'$. The NOT image was smoothed. The bottom figure is adapted from Cordier et al. (2025).

Salvaterra et al. 2009; and GRB 090429B at $z \simeq 9.4$, Cucchiara et al. 2011). As expected at such a high redshift, the afterglow was not detected by VT, providing a deep upper limit, but it was detected in the NIR by the NOT telescope (see Figure 11).

The prompt ECLAIRs and GRM lightcurves are shown in Figure 12. Despite a short observed duration in the source rest

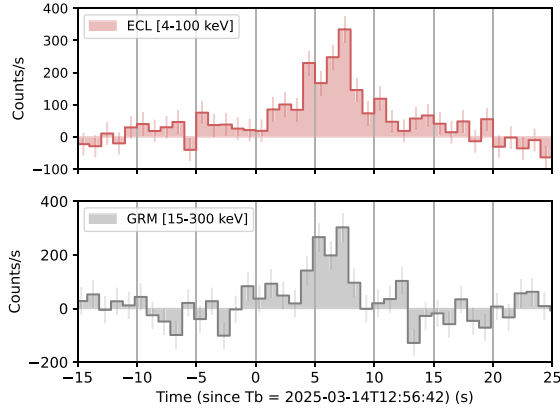


Figure 12. GRB 250314A, a classical LGRB at high redshift ($z \simeq 7.3$): prompt emission. Background-subtracted lightcurves in ECLAIRs in the 4–100 keV energy band (using only pixels of the detector plane illuminated by the burst, top panel) and in GRM in the 15–300 keV energy band (bottom panel) using a time bin of 1 s. Figure adapted from Cordier et al. (2025).

frame, $T_{90}/(1+z) = 1.3^{+0.4}_{-0.2}$ s, which can be interpreted as a “tip of the iceberg” effect expected at such redshifts (Lü et al. 2014; Llamas Lanza et al. 2024), all other properties, including the location of this GRB in the Amati diagram, point toward a type-II GRB associated with the collapse of a massive star (Cordier et al. 2025). This is directly confirmed by JWST observations 110 days after the trigger (13 days rest-frame), which reveal an associated supernova compatible with a type-Ic broad line supernova similar to those associated with LGRBs in the local Universe (Levan et al. 2025). This demonstrates the capacity of SVOM to observe the explosion of an individual massive star during the epoch of reionization.

To fully exploit the scientific potential of such high-redshift GRBs, which remain relatively rare, the follow-up strategy still needs to be optimized. Indeed, the VLT/X-shooter spectra were obtained ~ 17 hr after the trigger in the case of GRB 250314A, and only allow for a redshift measurement, based on the $\text{Ly}\alpha$ break. Cordier et al. (2025) discuss in detail how this delay could be significantly reduced for future similar events, to perform spectroscopy when the source is still bright and to detect metal lines. This implies, in particular, making the deep upper limits obtained by VT available much earlier, which can be achieved with more X-band stations to get all acquired images faster. This also implies improving NIR follow-up capabilities, which should be achieved in 2026 with the start of the Son of X-Shooter spectrograph (SOXS; Schipani et al. 2018) and the commissioning of the CAGIRE camera at COLIBRI (Fortin et al. 2024).

5. Conclusion

The first 9.3 months of the SVOM mission have already seen the detection of 86 GRBs. This article illustrates how this sample in construction already explores a wide diversity of GRBs. There is already a clear impact of (i) the low-energy

threshold of ECLAIRs at 4 keV and its capacity to trigger on long timescales. In particular, this gives access to the softer end of the GRB population. In combination with the broad spectral range of the GRM, it also allows for a full characterization of the prompt spectrum; (ii) the optimization of the follow-up sequence, especially with an anti-solar pointing, the excellent sensitivity of VT, the complementary observations by the C-GFT and COLIBRI, and strong partnerships with many other instruments. The synergy with Swift/XRT and EP/FXT to complement MXT X-ray afterglow observations is crucial. The excellent efficiency of the rate of visible/NIR afterglow detections and redshift measurements during the first 9.3 months is promising for the capacity of SVOM to build a sample of fully characterized GRBs. This is illustrated in this article with several examples, including an SGRB with extended emission, two XRFs, and several classical LGRBs, including a high-redshift one. These first detected GRBs will be discussed in more detail in forthcoming papers.

Acknowledgments

The Space-based multi-band Variable Objects Monitor (SVOM) is a joint Chinese-French mission led by the Chinese National Space Administration (CNSA), the French Space Agency (CNES), and the Chinese Academy of Sciences (CAS). We gratefully acknowledge the unwavering support of NSSC, IAMCAS, XIOPM, NAOC, IHEP, CNES, CEA, and CNRS.

S.D.V., B.S., A.S. and S.B. acknowledge the support of the French Agence Nationale de la Recherche (ANR), under grant ANR-23-CE31-0011 (project PEGaSUS).

A.S. acknowledges financial support from the Centre national d’études spatiales (CNES), France (ROR: <https://ror.org/04h1h0y33>) within the framework of the SVOM mission.

This publication made use of data from the Legacy Surveys. The Legacy Surveys consist of three individual and complementary projects: the Dark Energy Camera Legacy Survey (DECaLS; Proposal ID #2014B-0404; PIs: David Schlegel and Arjun Dey), the Beijing-Arizona Sky Survey (BASS; NOAO Prop. ID #2015A-0801; PIs: Zhou Xu and Xiaohui Fan), and the Mayall z -band Legacy Survey (MzLS; Prop. ID #2016A-0453; PI: Arjun Dey). DECaLS, BASS and MzLS together include data obtained, respectively, at the Blanco telescope, Cerro Tololo Inter-American Observatory, NSF’s NOIRLab; the Bok telescope, Steward Observatory, University of Arizona; and the Mayall telescope, Kitt Peak National Observatory, NOIRLab. Pipeline processing and analyses of the data were supported by NOIRLab and the Lawrence Berkeley National Laboratory (LBNL). The Legacy Surveys project is honored to be permitted to conduct astronomical

research on Iolkam Du’ag (Kitt Peak), a mountain with particular significance to the Tohono O’odham Nation.

NOIRLab is operated by the Association of Universities for Research in Astronomy (AURA) under a cooperative agreement with the National Science Foundation. LBNL is managed by the Regents of the University of California under contract to the U.S. Department of Energy.

This project used data obtained with the Dark Energy Camera (DECam), which was constructed by the Dark Energy Survey (DES) collaboration. Funding for the DES Projects has been provided by the U.S. Department of Energy, the U.S. National Science Foundation, the Ministry of Science and Education of Spain, the Science and Technology Facilities Council of the United Kingdom, the Higher Education Funding Council for England, the National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign, the Kavli Institute of Cosmological Physics at the University of Chicago, Center for Cosmology and Astro-Particle Physics at the Ohio State University, the Mitchell Institute for Fundamental Physics and Astronomy at Texas A&M University, Financiadora de Estudos e Projetos, Fundacao Carlos Chagas Filho de Amparo, Financiadora de Estudos e Projetos, Fundacao Carlos Chagas Filho de Amparo a Pesquisa do Estado do Rio de Janeiro, Conselho Nacional de Desenvolvimento Cientifico e Tecnológico and the Ministerio da Ciencia, Tecnologia e Inovacao, the Deutsche Forschungsgemeinschaft and the Collaborating Institutions in the Dark Energy Survey. The Collaborating Institutions are Argonne National Laboratory, the University of California at Santa Cruz, the University of Cambridge, Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas-Madrid, the University of Chicago, University College London, the DES-Brazil Consortium, the University of Edinburgh, the Eidgenössische Technische Hochschule (ETH) Zurich, Fermi National Accelerator Laboratory, the University of Illinois at Urbana-Champaign, the Institut de Ciències de l’Espai (IEEC/CSIC), the Institut de Física d’Altes Energies, Lawrence Berkeley National Laboratory, the Ludwig Maximilians Universität München and the associated Excellence Cluster Universe, the University of Michigan, NSF’s NOIRLab, the University of Nottingham, the Ohio State University, the University of Pennsylvania, the University of Portsmouth, SLAC National Accelerator Laboratory, Stanford University, the University of Sussex, and Texas A&M University.

BASS is a key project of the Telescope Access Program (TAP), which has been funded by the National Astronomical Observatories, the Chinese Academy of Sciences (the Strategic Priority Research Program “The Emergence of Cosmological Structures” grant # XDB09000000), and the Special Fund for Astronomy from the Ministry of Finance. The BASS is also supported by the External Cooperation Program of Chinese Academy of Sciences (grant # 114A11KYSB20160057), and

the National Natural Science Foundation of China (NSFC, grant Nos. 12120101003 and 11433005).

The Legacy Survey team makes use of data products from the Near-Earth Object Wide-field Infrared Survey Explorer (NEOWISE), which is a project of the Jet Propulsion Laboratory/California Institute of Technology. NEOWISE is funded by the National Aeronautics and Space Administration.

The Legacy Surveys imaging of the DESI footprint is supported by the Director, Office of Science, Office of High Energy Physics of the U.S. Department of Energy under Contract No. DE-AC02-05CH1123, by the National Energy Research Scientific Computing Center, a DOE Office of Science User Facility under the same contract; and by the U.S. National Science Foundation, Division of Astronomical Sciences under Contract No. AST-0950945 to NOAO.

The Pan-STARRS1 Surveys (PS1) and the PS1 public science archive have been made possible through contributions by the Institute for Astronomy, the University of Hawaii, the Pan-STARRS Project Office, the Max-Planck Society and its participating institutes, the Max Planck Institute for Astronomy, Heidelberg and the Max Planck Institute for Extraterrestrial Physics, Garching, The Johns Hopkins University, Durham University, the University of Edinburgh, the Queen’s University Belfast, the Harvard-Smithsonian Center for Astrophysics, the Las Cumbres Observatory Global Telescope Network Incorporated, the National Central University of Taiwan, the Space Telescope Science Institute, the National Aeronautics and Space Administration under grant No. NNX08AR22G issued through the Planetary Science Division of the NASA Science Mission Directorate, the National Science Foundation grant No. AST-1238877, the University of Maryland, Eotvos Lorand University (ELTE), the Los Alamos National Laboratory, and the Gordon and Betty Moore Foundation.

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