DESHIMA 2.0/ASTE

DESHIMA's quick follow-up system for submillimeter transient events

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on behalf of DESHIMA Team

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DESHIMA

Cosmology with Nanotechnology

DESHIMA: World's 1st integrated superconducting spectrometer

DESHIMA = **DE**ep **S**pectroscopic **HI**gh-redshift **MA**pper

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出島

Dejima/Deshima

DESHIMA 2.0 Executive Board:
Akira Endo (PI), Yoichi Tamura (co-PI), Jochem Baselmans, Kotaro Kohno, Paul van der Werf

- **Hardware:** Jochem Baselmans (PM)
  - WP1 DESHIMA 1.0 results: Akira Endo
  - WP2 Optics Design: Nuria Llombart
  - WP3 Hardware: Robert Huiting
  - WP4 On-chip Spectrometer: Jochem Baselmans
  - WP5 Lab Demonstrator: Kenichi Karatsu
- **Software & Calibration:** Tatsuya Takekoshi (PM)
  - WP1 Data Formats: Akio Taniguchi
  - WP2 Data Analysis Software: Akio Taniguchi
  - WP3 Calibration: Tatsuya Takekoshi
  - WP4 CSV Plan: Akira Endo
  - WP5 Qlook System: Tatsuya Takekoshi
- **Commissioning & Science Verification:** Akira Endo (PM)
  - High-z galaxies: Tom Bakx, Matús Rybak
  - SZ effect: Kenichi Karatsu

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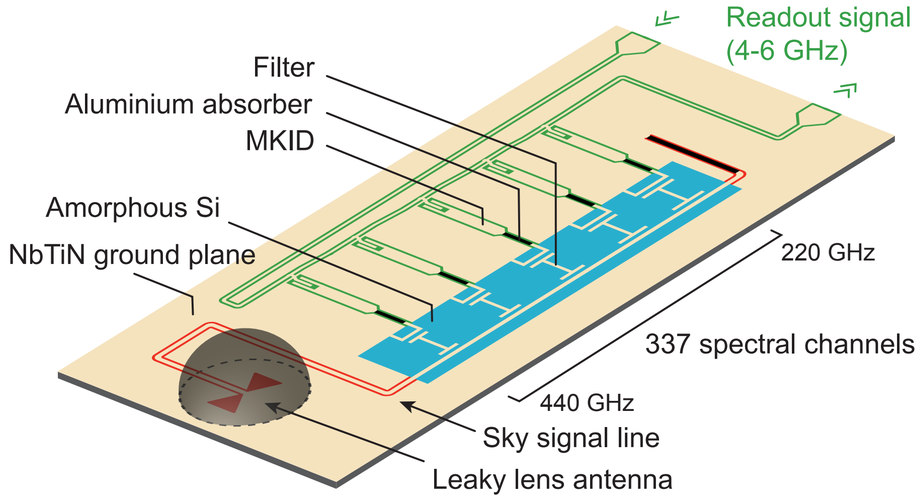
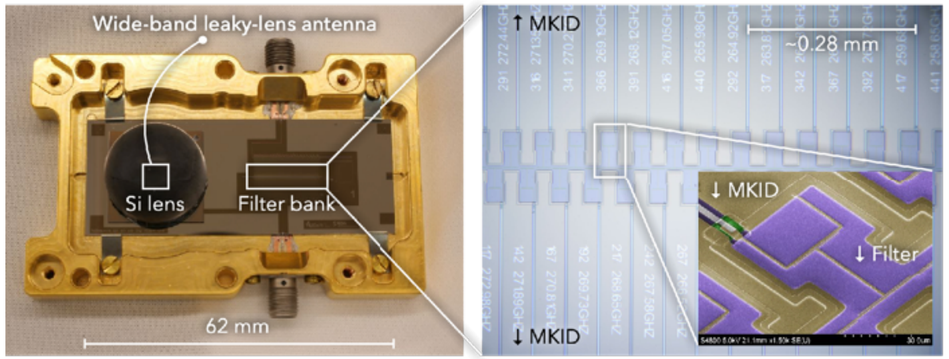
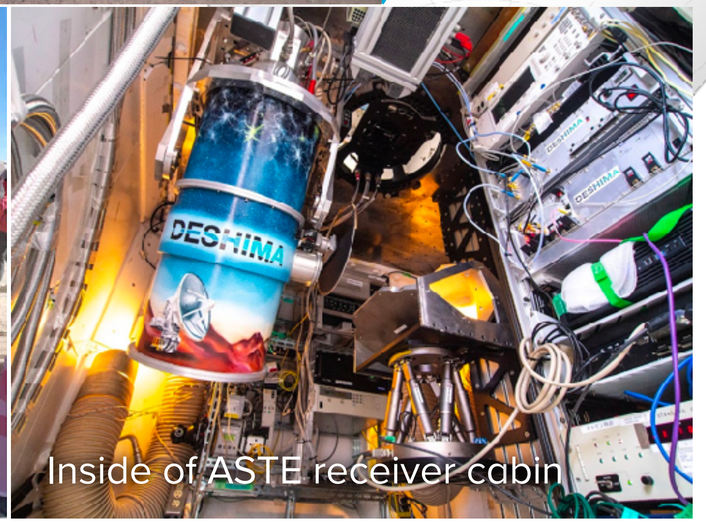
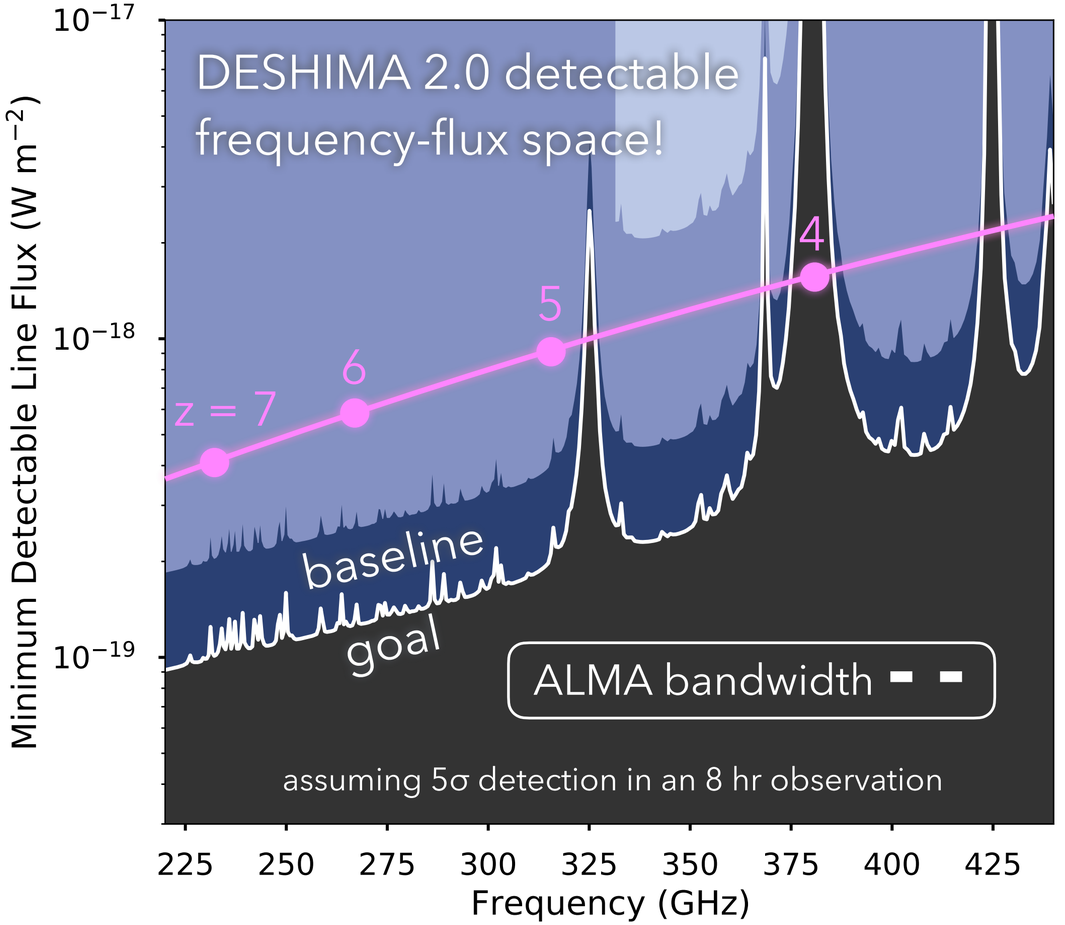




	DESHIMA 1.0	**DESHIMA 2.0**
Frequency	332–377 GHz	**220–440 GHz**
$N_{channels}$	49	**347**
Instrument efficiency	2%	**8–16%**
on-source fraction	8%	**30–40%**
Reference	Endo+2019, *Nature Astron.*	**In progress (now!)**

DESHIMA 2.0

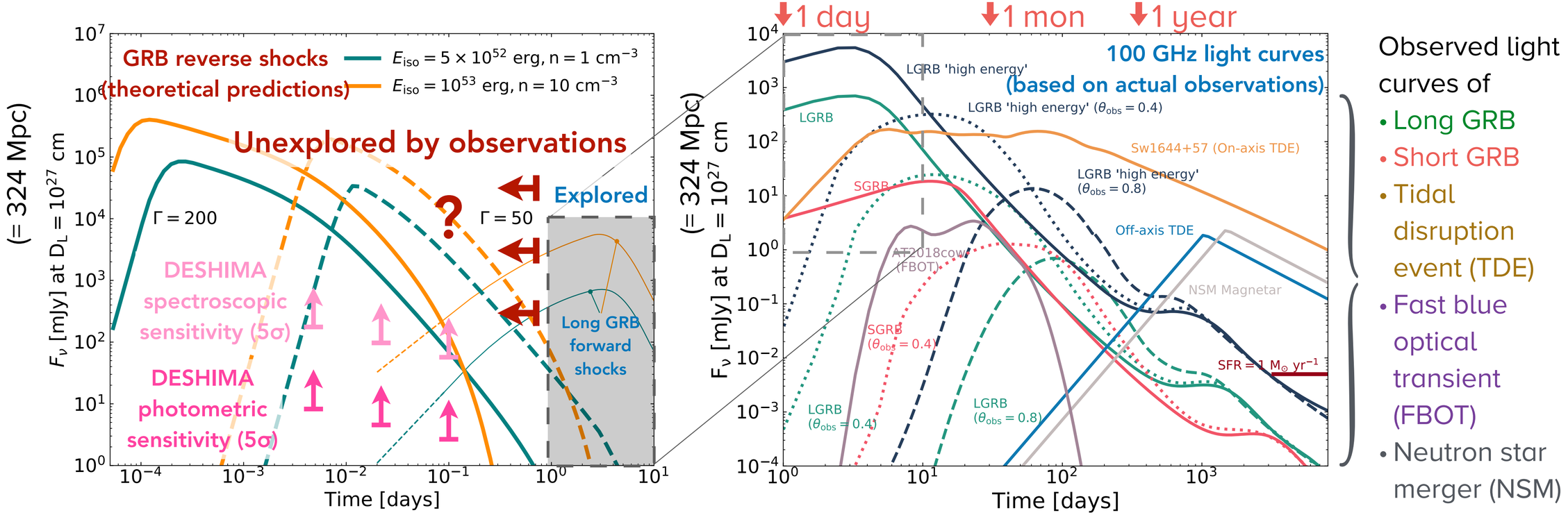




- Ready for detection of the atomic carbon lines from bright high-z galaxies

Radio (mm/submm-wave) transient sky

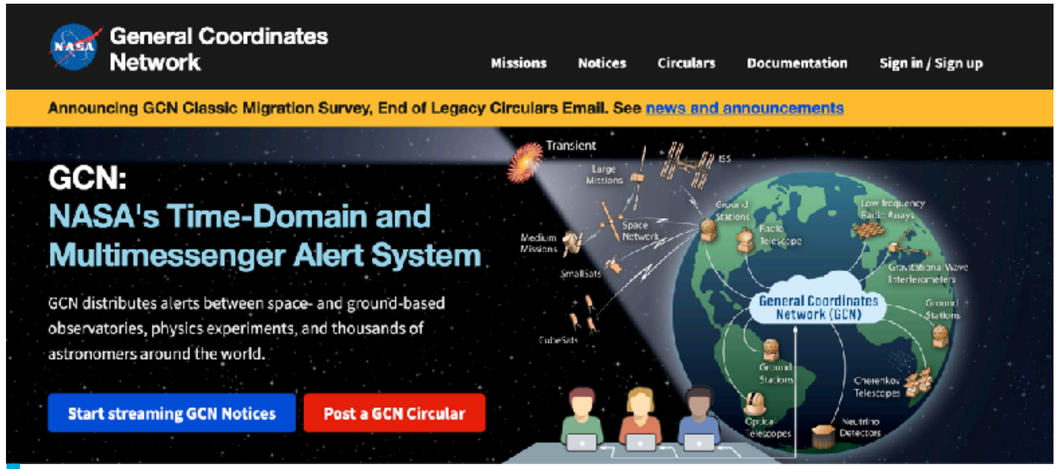
- Intraday (< 24 hr) sub/mm-wave events were unexplored. (but see also, Urata+2014)
- Afterglow from reverse shock of long GRBs should be bright ***even at redshift*** $z \gg 1$ (Inoue+2007)
- ***Physical properties*** (e.g., B, n_e) of a GRB jet can be imprinted in the sub/mm spectrum of synchrotron emission from GRB reverse shocks. ***No interstellar scintillation*** unlike low-freq radio.

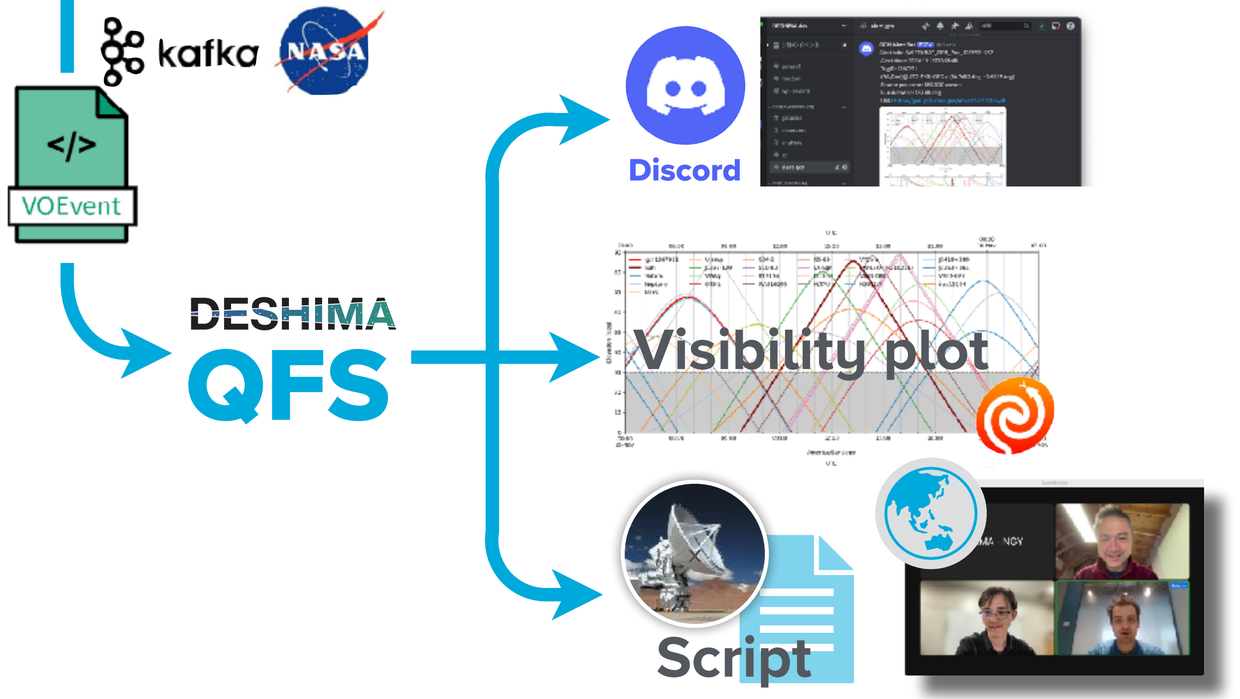


Observed light curves of
- Long GRB
- Short GRB
- Tidal disruption event (TDE)
- Fast blue optical transient (FBOT)
- Neutron star merger (NSM)

Quick follow-up system

- NASA's General Coordinate Network (GCN)
- DESHIMA/ASTE ***autonomous*** quick followup system (QFS)
  - Retrieves GCN/SWIFT alerts
  - Posts to Discord channel
  - Generates and posts visibility plots
  - Creates an observation script and sends it to ASTE system
- Actual telescope operation is done ***manually*** by an observer (human) in charge
  - Elevation must be > 30 deg, Sun separation must be > 25 deg ➔ ***60-70% of the sky in 24 hr***





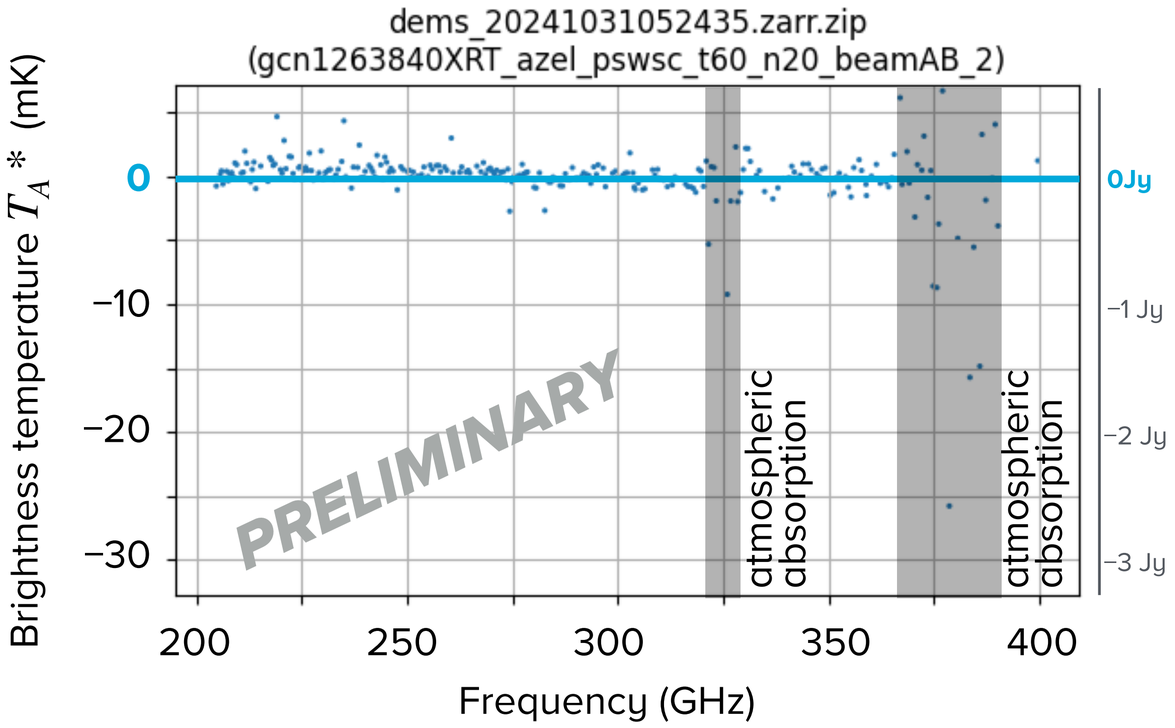
GRBs we've observed so far

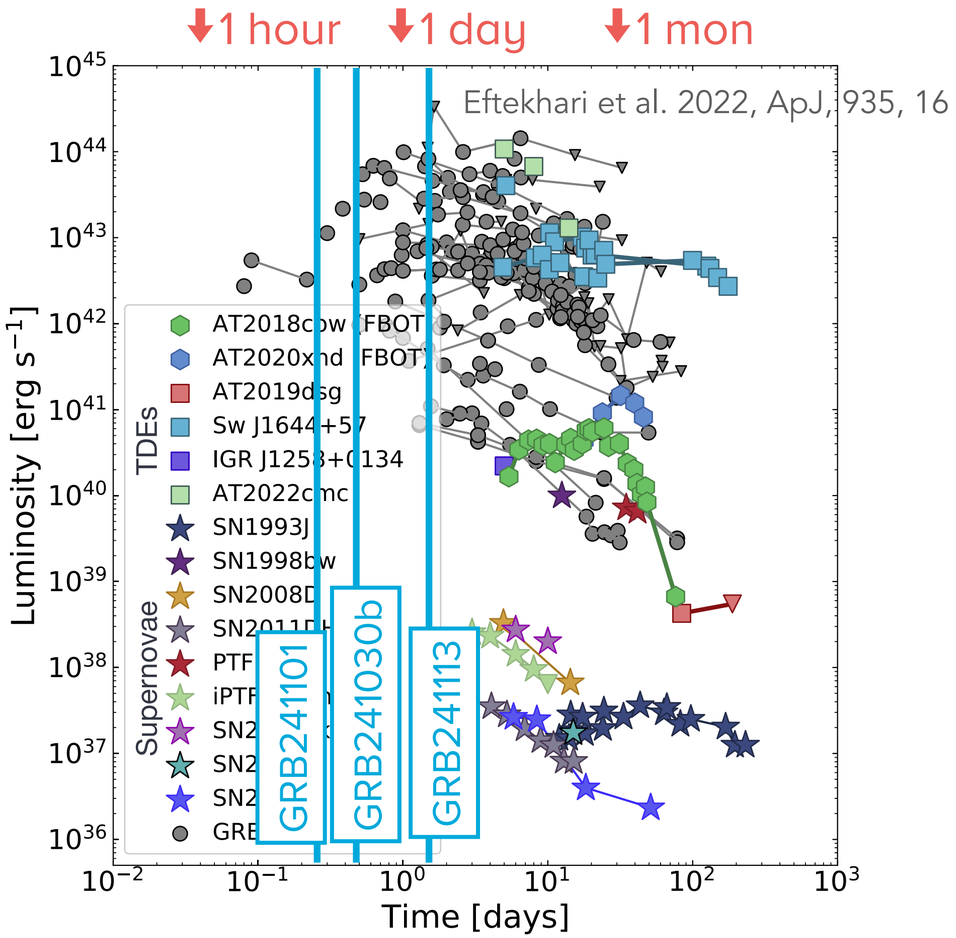
- List of *SWIFT* GRBs we observed in the past ~1.5 months.
- We can even go shorter if the burst is accessible immediately (EL > 30°).

Name	GCN #	Triger time (UTC)	Executed?	Start time (UTC)	Time after burst (hr)	*SWIFT* detect.
GRB241002	1257556	2024-10-02 00:50	No (north)	-	-	
GRB241006	1258721	2024-10-06 21:58	No (windy)	-	-	
GRB241010	1259578	2024-10-10 10:05	No (sun, windy)	-	-	
GRB241025	1262165	2024-10-25 01:36	No (north)	-	-	
GRB241026	1262764	2024-10-26 22:42	No (north)	-	-	
GRB241030A	1263718	2024-10-30 05:48	No (north)	-	-	
GRB241030B	**1263840**	**2024-10-30 18:34**	**Yes**	**2024-10-31 04:30**	**9.9 hr**	**BAT, XRT**
GRB241101	**1264304**	**2024-11-01 05:41**	**Yes**	**2024-11-01 13:46**	**6.1 hr**	**BAT only**
GRB241113	**1267501**	**2024-11-13 07:48**	**Yes** (cloudy)	**2024-11-14 22:21**	**39.3 hr**	**BAT, XRT**
GRB241115	1267921	2024-11-15 13:18	No (cloudy)	-	-	

GRBs we've observed so far (example)

- **GRB241030b** (9.9 hr after the burst)





Integration ~ 10 min

➔ We find no meaningful signal, although intensive effort for better calibration is being made.

Summary & Future

- DESHIMA 2.0: World's 1st integrated superconducting spectrometer, which now allows for a quick followup of submm-wave transient events, such as reverse shock of gamma-ray bursts at high redshift.
  - Operations continue till early December 2024 (and we may move to another telescope in the future).
- Successive TIFUUN (THz Integral Field Unit w/ Universal Nanotechnology) project
  - TIFUUN = "focal plane array of DESHIMA"
  - Currently, our scope only includes *SWIFT* followup but can be expanded to multi-messenger followups when TIFUUN is online.
  - Future 50-m class single dish telescope LST/AtLAST.