Promotion of time-domain astronomy with coordinated observations

HiZ-GUNDAM

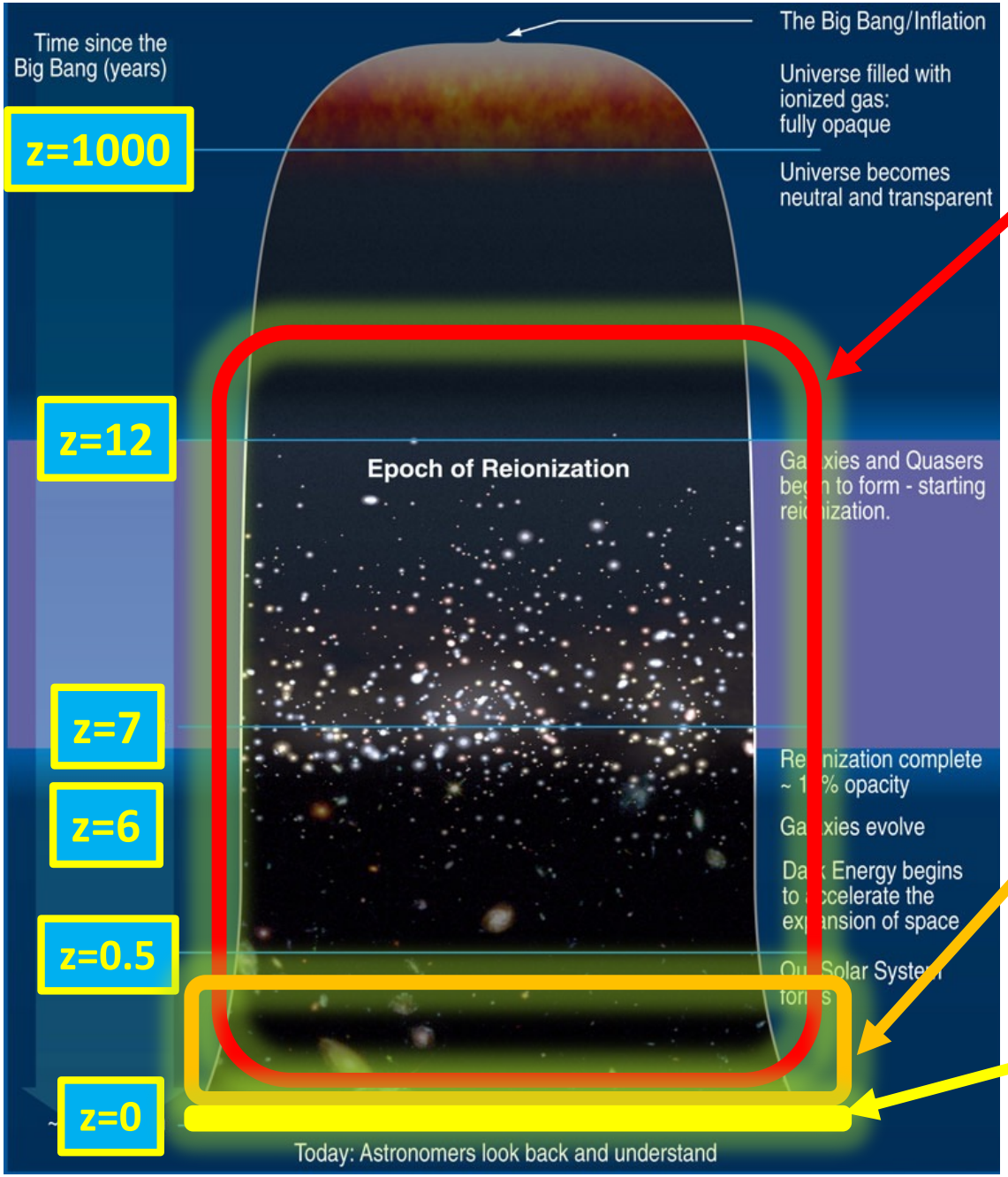
High-z Gamma-ray bursts for Unraveling the Dark Ages and Extreme Space Time Mission

D. Yonetoku[1,2], A. Doi[2], T. Mihara[3], T. Sakamoto4, M. Arimoto[1], K. Tsumura[4], H. Matsuhara[2], S. Gunji[6], T. Sawano[1], on behalf of HiZ-GUNDAM Collaboration

(1: Kanazawa Univ, 2: ISAS/JAXA, 3: RIKEN, 4: Aoyama Gakuin Univ, 5:Tokyo City Univ, 6: Yamagata Univ)

NAOJ Future Planning Symposium 2023 @ NAOJ (2023/11/07 – 08)

Time Domain Astronomy



- Gamma-Ray Burst (GRB)
  - First Stars (Pop-III)
  - Cosmic Reionization
  - Chemical Evolution
- Gravitational Wave (Short GRB?)
  - NS-NS, NS-BH (+ BH-BH)
  - kilonova
- TeV/PeV neutrino
- SN Shock Breakout
- Tidal Disruption
- Fast Radio Burst
- AGN etc.
- Stellar Flare
- Galactic Transients

HiZ-GUNDAM (High-z Gamma-ray bursts for Unraveling the Dark Ages Mission)

Competitive M-class
HiZ-GUNDAM

Mission : Time Domain Astronomy
"**Exploration of the early universe**" and "**Multi-messenger astronomy**"

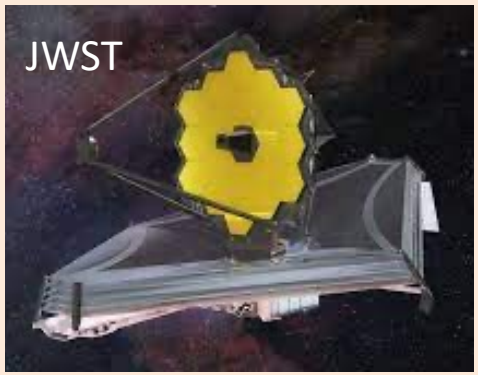
Observation strategy
(1) Discovery of GRBs/transients with the wide field X-ray monitor
(2) Automatic repointing
(3) Identification of counterpart with the near infrared telescope
(4) Alert message
(5) Spectroscopic observation with large area telescopes

We will discover treasured targets from a large amount of transient sources, and provide them as important targets to large area telescopes. We will promote "early space exploration" and "MM astronomy" with all the power of astronomy.

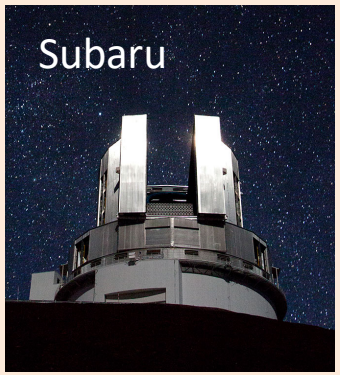
Alert

Wide Field X-ray Monitor
- Lobster Eye optics
- pnCCD

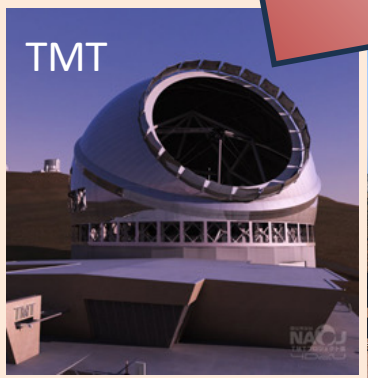
Near Infrared Telescope
- 5-band photometry

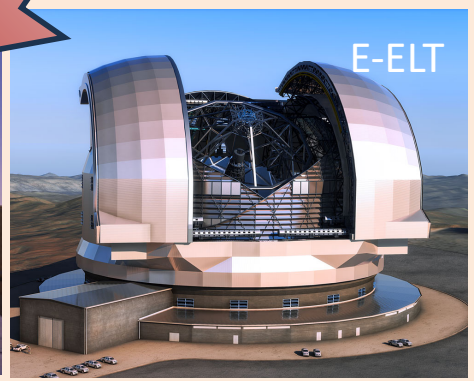


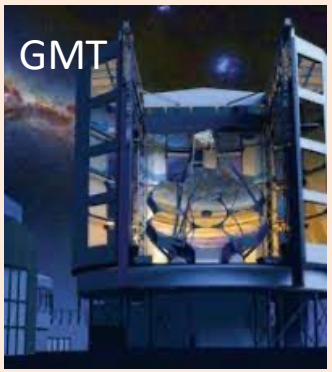
Space telescope



8m-class

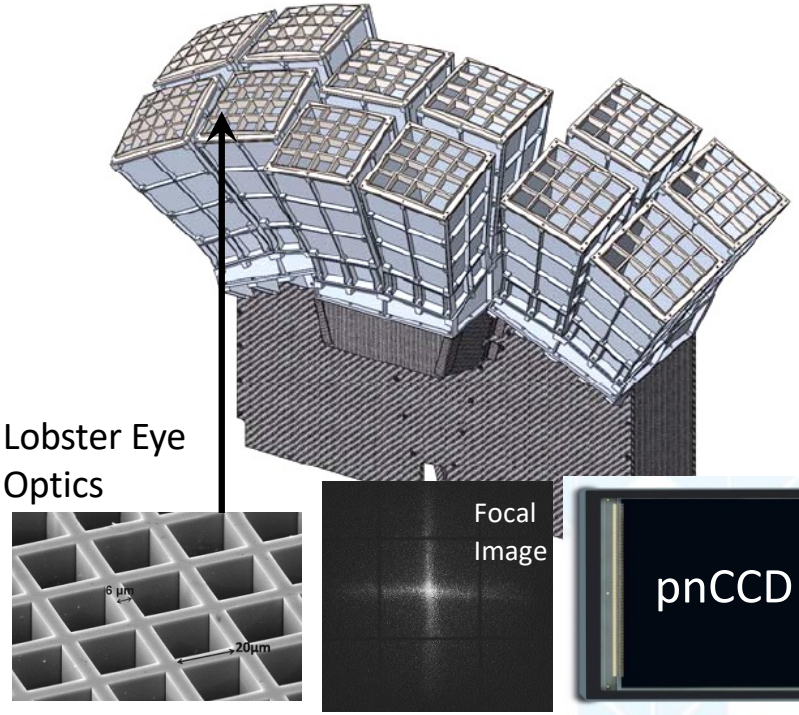






Future 30m-class

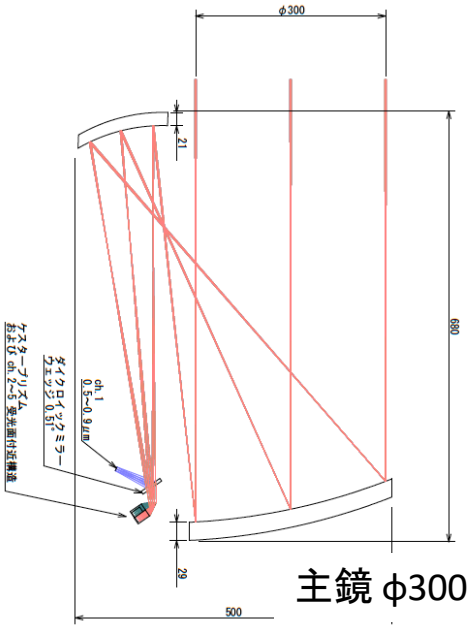
Wide Field X-ray Monitor



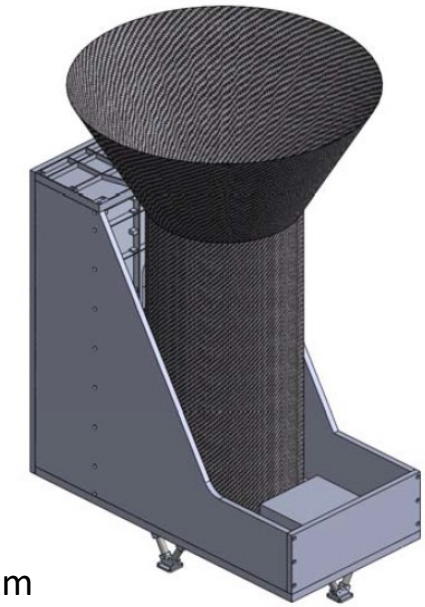
Items	Parameters
Energy band (keV)	**0.4 – 4 keV**
Telescope type:	Lobster Eye Optics
Optics aperture	240 x 320 mm^2
Number of Unit	6
Field of View	**> 0.5 str (6 units)**
Focal length	300 mm
Focal plane detectors	pnCCD array
Number of modules	16
Sensitivity	**1e-10 (erg/cm2/s) For 100 sec**
Position accuracy	3 arcmin

Near Infrared Telescope

5-band simultaneous photometry



主鏡 φ300 mm

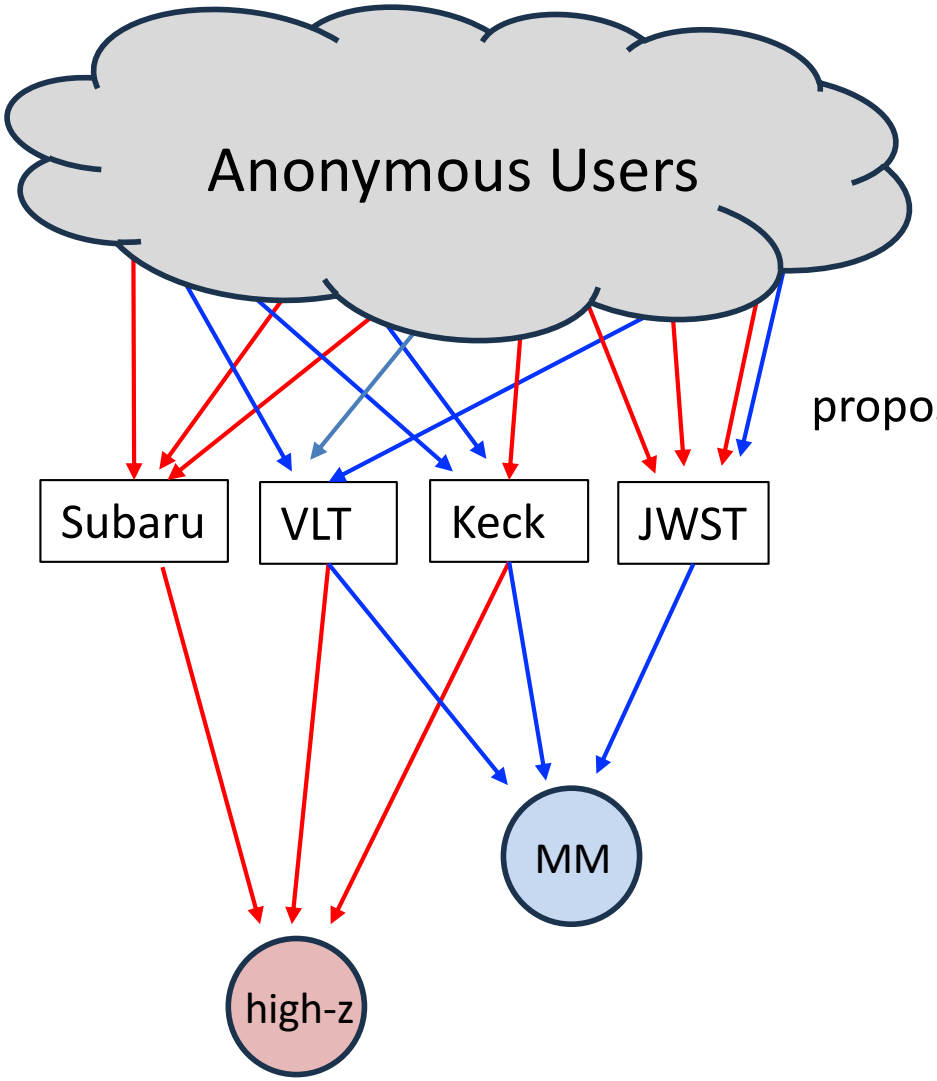


Items	Parameters				
Telescope type	Offset Optics				
Aperture size	**30 cm**				
Focal length	183.5 cm				
F number	F6.1				
Field of view	15 arcmin × 15 arcmin				
FoV per pixel	2 acsec × 2 arcsec				
Image size	3 pixel × 3 pixel				
Integration time	10 minutes (2 minutes x 5 frames)				
Observation Band (μm)	0.5–0.9	0.9–1.3	1.3–1.7	1.7–2.1	2.1-2.5
Limiting Magnitude mag (AB)	21.0	20.6	20.3	20.2	20.1
Focal detector	HyViSi	HgCdTe (H1RG)			

Discussion in TDAMM

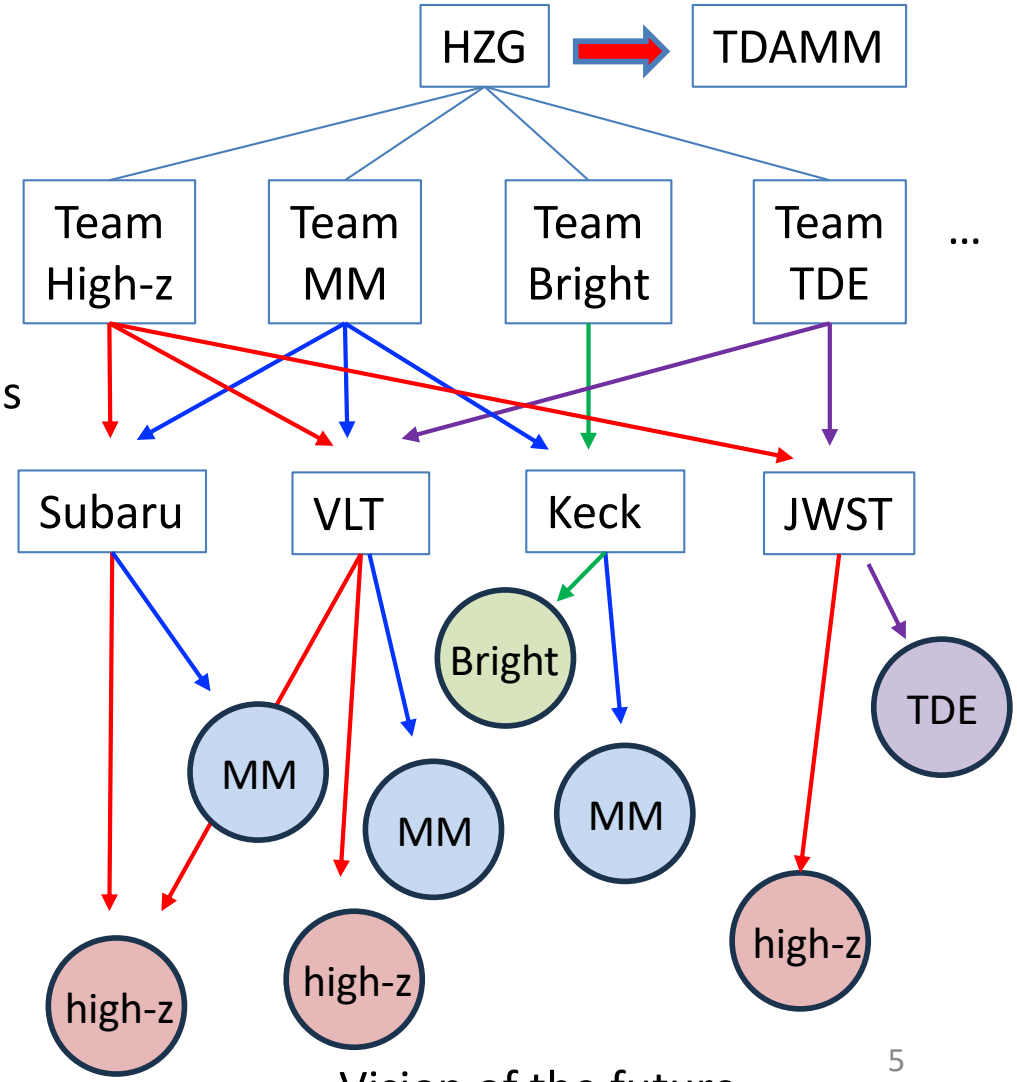
Future Follow-up Observation

- Well-organized follow-up consortium to maximize the science achievements
- Real-time information sharing of observation plans and results



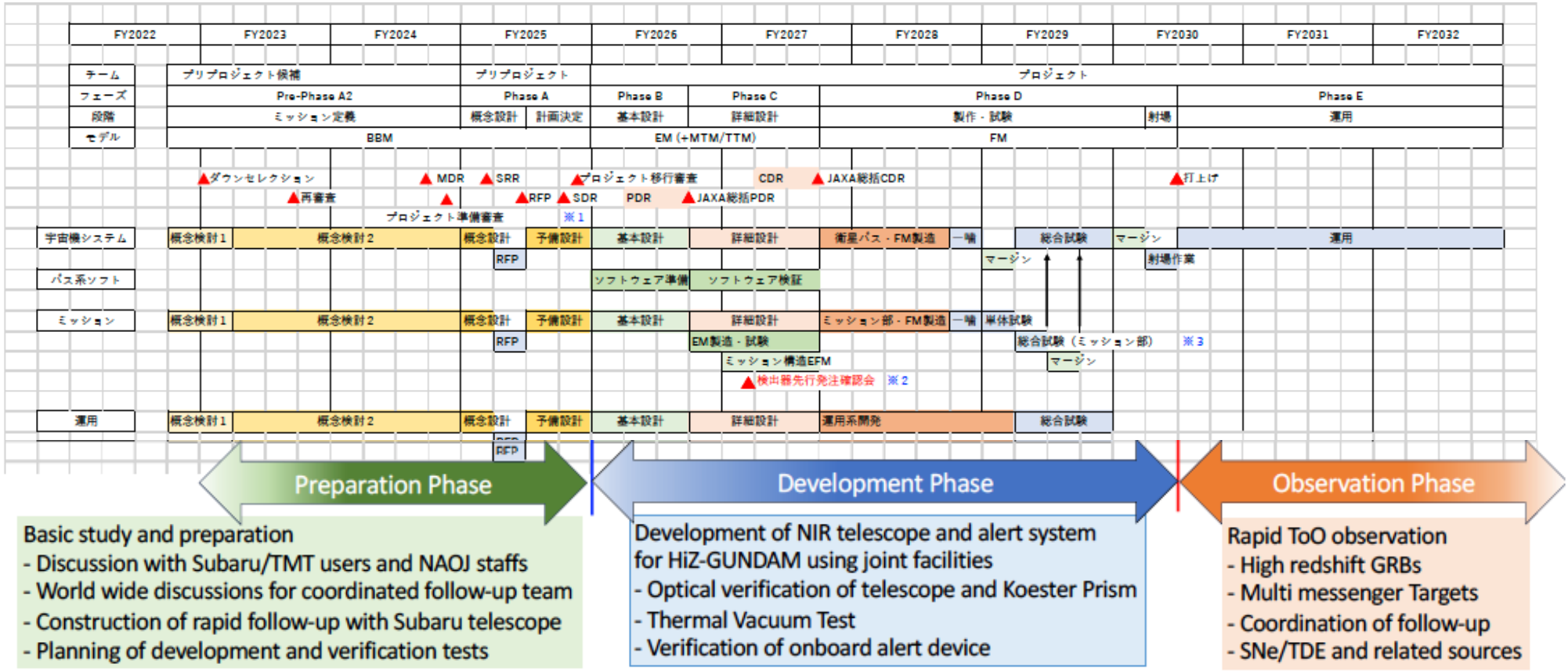
Current Status

proposals



Vision of the future

Schedule

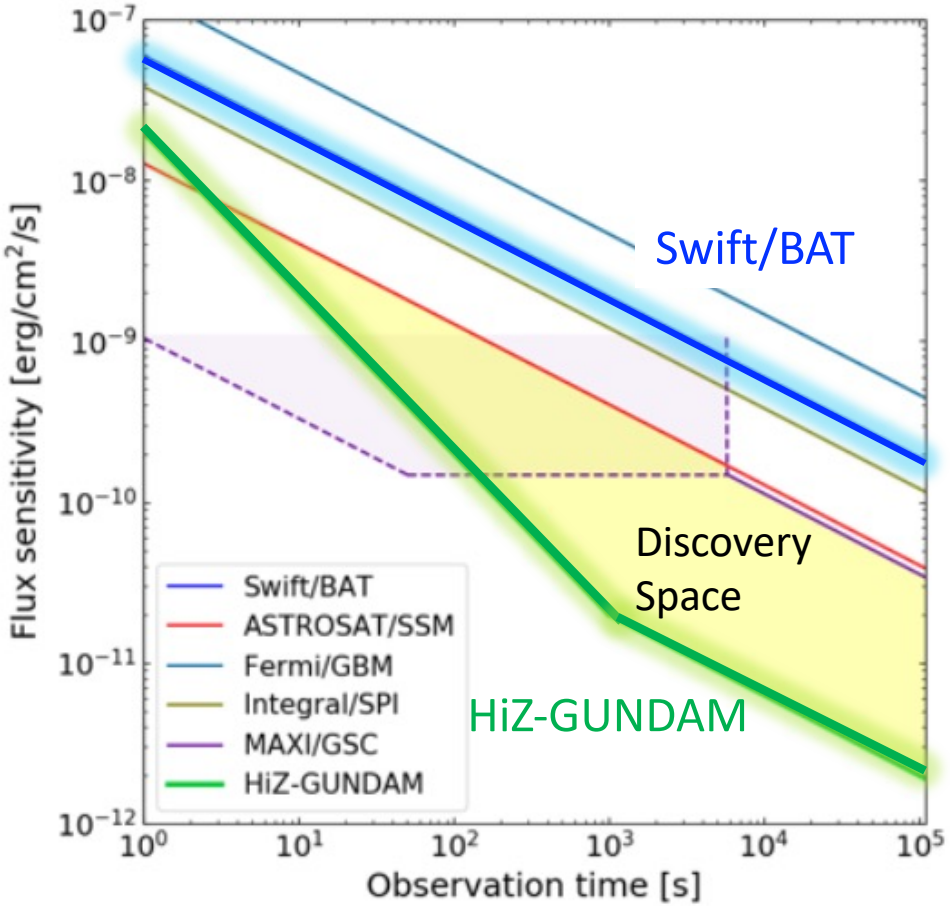


We will perform follow-up observation with large area telescopes, e.g. Subaru, TAO, and future 30-m class telescopes within 1 hour.

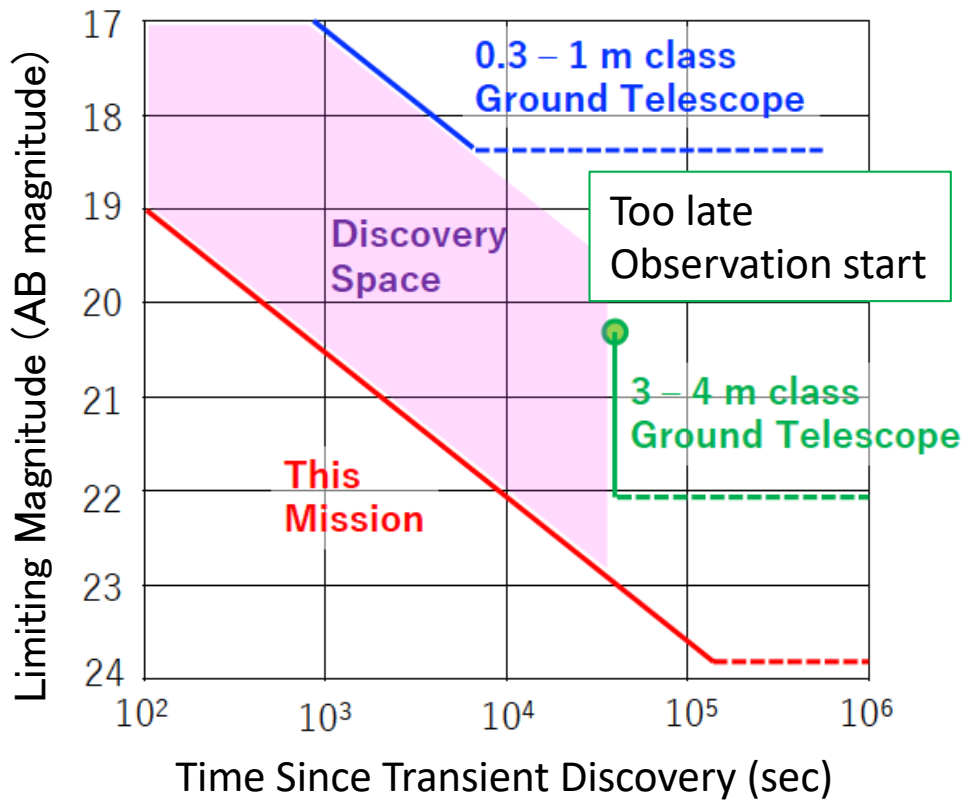
A project (group) that can lead rapid ToO observations is needed.

This is firmly related to the multi-messenger astrophysics group, so we plan to unify our proposal with the Multi-messenger Astronomy Group and work with NAOJ researchers in next year.

Detection Sensitivity and Expected Event Rate



Sensitivity of Follow-up Obs.



X-ray	event/yr
GRB (z>9) best model	~30
GRB (z>9) lower limit	> 10
GW/SGRB prompt	~8
GW/SGRB E.E.	~8
GRB/SGRB	~400
Low-Luminosity GRB	> 5
X-Ray Flash	50

X-ray	event/yr
Tidal Disruption	30
SN Shock Breakout	> 5
Stellar Flare	many
Direct collapse BH	a few
Accretion induced collapse	~10?

Near Infrared	event/yr
afterglow (z>9) best model	28
afterglow (z>9) lower limit	> 10
Kilonova/macronova	~8 + α
Supernovae	40
afterglow of GRB/SGRB/XRF	many
Variable stars	many