HiZ-GUNDAM

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

ガンマ線バーストを用いた初期宇宙・極限時空探査計画
HiZ-GUNDAM

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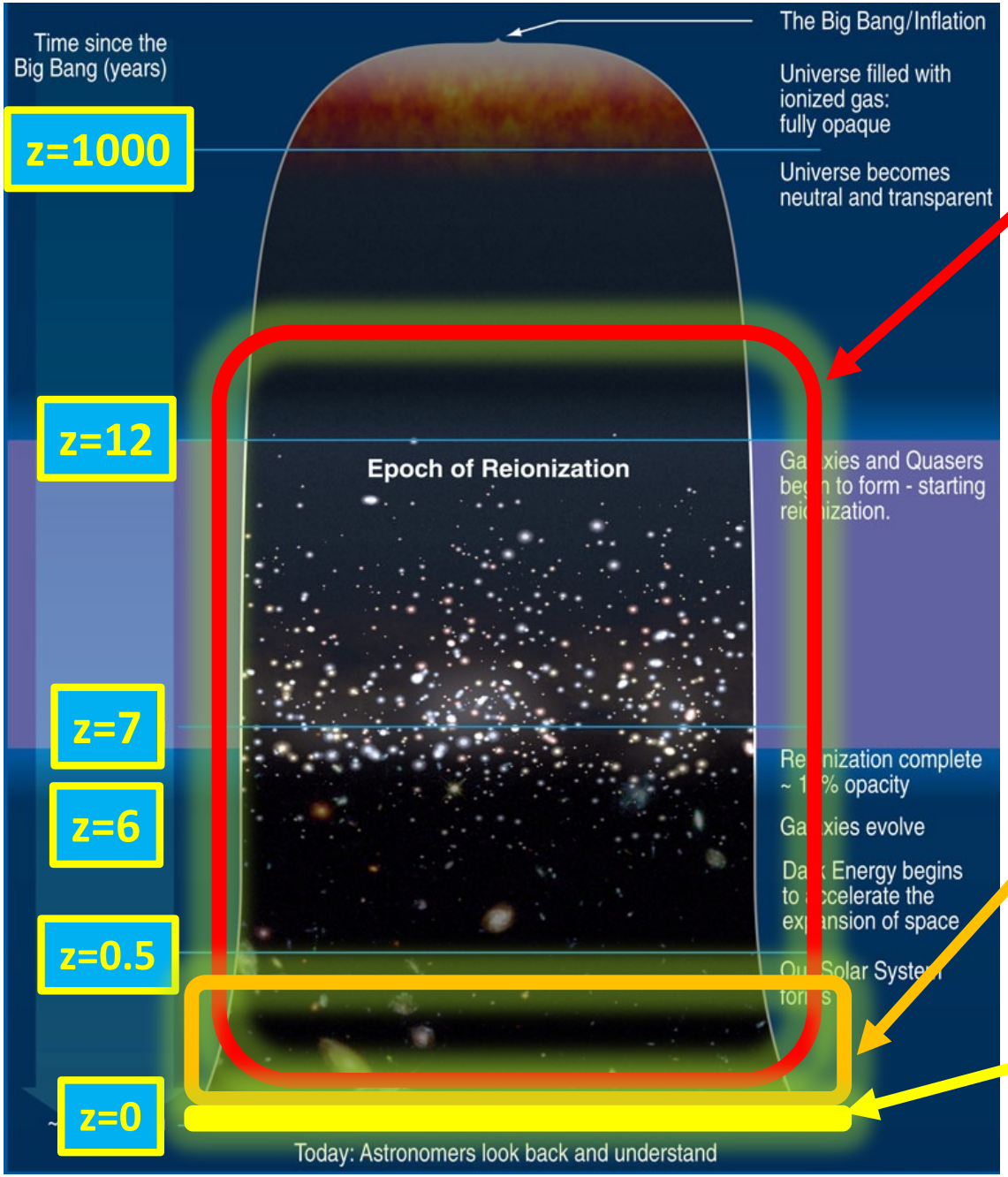
- Competitive M-class mission (Epsilon mission) in JAXA
- Launch target is ~2030

ASJ Annual Meeting @ Nagoya University (2023/09/20 – 22)

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 : Promotion of Time Domain Astronomy

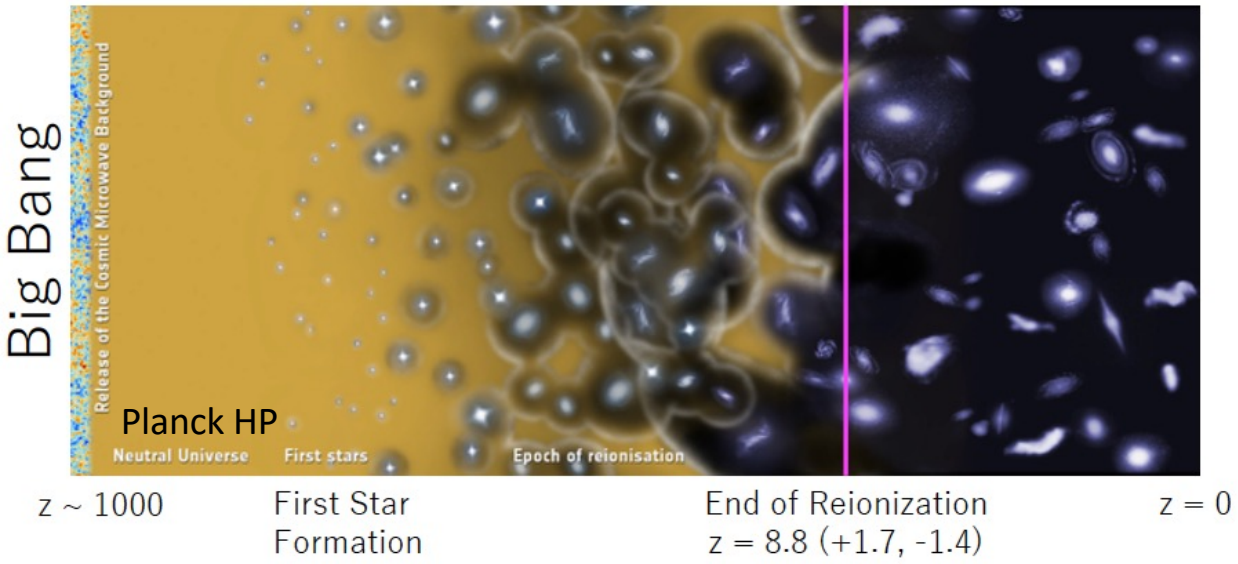
Combination of X-ray and NIR

Key Science 1: Multi-Messenger Astronomy

Blackhole formation and evolution,
Energy transition from gravity to particle/radiation

(1) High energy transients associated with GW/ν
(2) Energy transition from Gravitational energy to Jet → Cocoon → Kilonova and particles
(3) Abundance of Heavy elements (>> Fe)
Diversities of kilonova and E-M counterpart

Key Science 2: Exploration of early universe with GRB



Selection of High-z GRBs,
Rapid spectroscopic obs.
with large area telescopes

(1) GRB rate at z > 7
(2) Cosmic reionization history
(3) Chemical evolution
(4) Survey of Pop-III GRBs

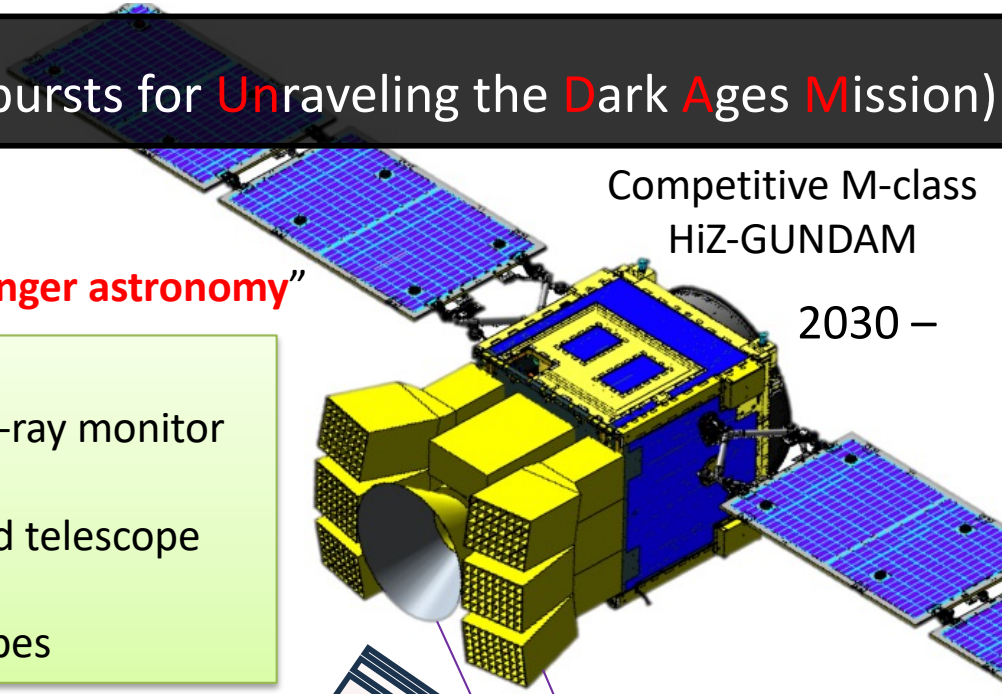
HiZ-GUNDAM (High-z Gamma-ray bursts for Unraveling the Dark Ages Mission)

Competitive M-class
HiZ-GUNDAM

2030 –

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

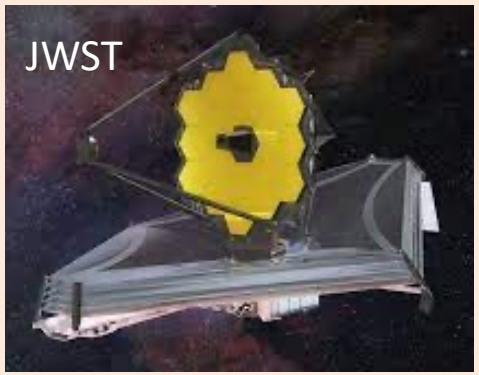


Wide Field X-ray Monitor
- Lobster Eye optics
- pnCCD

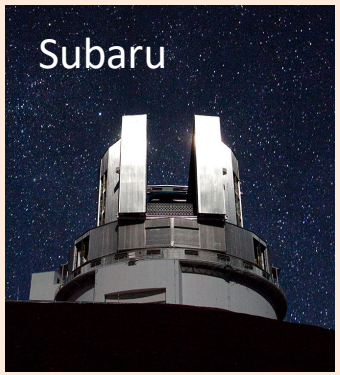
Near Infrared Telescope
- 5-band photometry

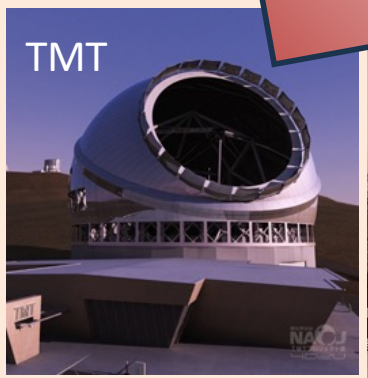
We will discover treasured targets from a large amount of transient sources, and provide them as important targets to large area telescopes. We will promote "early space exploration" and "MM astronomy" with all the power of astronomy.

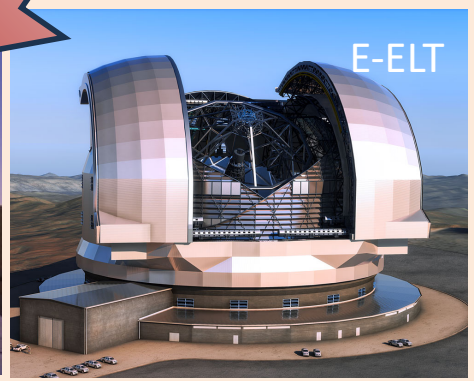
Alert

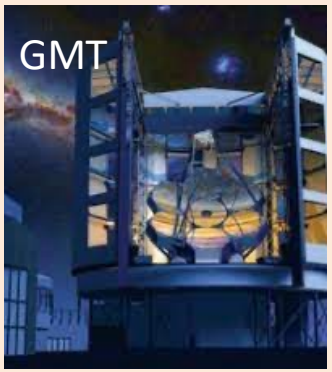


Space telescope









8m-class

Future 30m-class

Down Selection Result

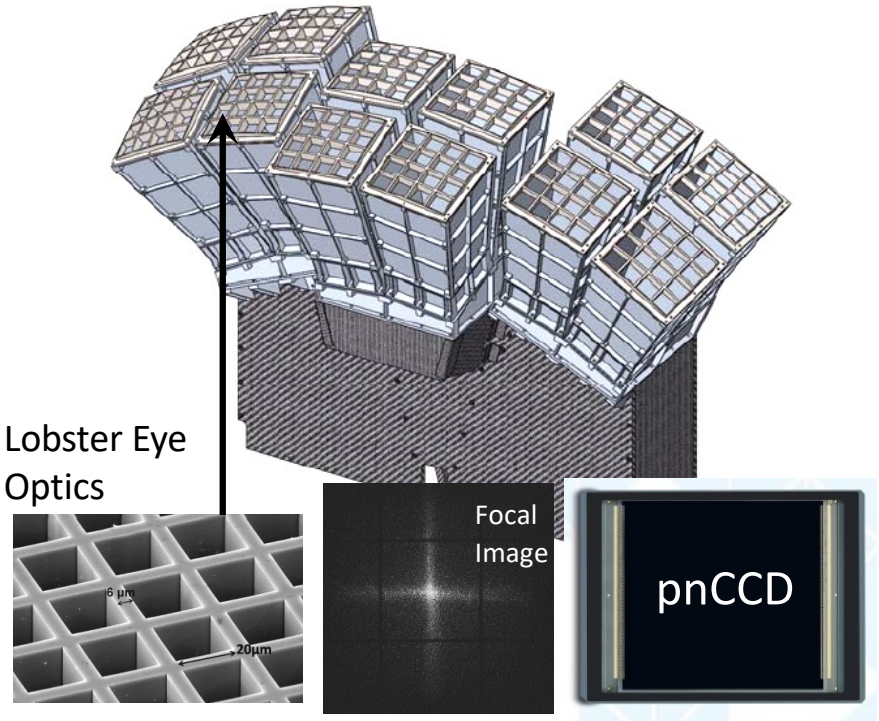
- Down selection review in Apr. – June, 2023
- We are not selected but **still surviving.**
- Down selection review again in the end of FY2023.
  - Satellite specialized for downlink alert.
  - Realtime uplink alert will not be supported.
    (delayed uplink in normal operation is in our scope.)

    - Several methods are being considered in parallel.
      (KSAT, Comm. satellite network (Inmarsat etc.), SVOM-VHF)

  - The mission scope should be extended to
    the acquisition of scientific results from the large telescope.

    - Establish ”Follow-up team” in HiZ-GUNDAM
    - Start discussing with large area facilities and users.

Wide Field X-ray Monitor

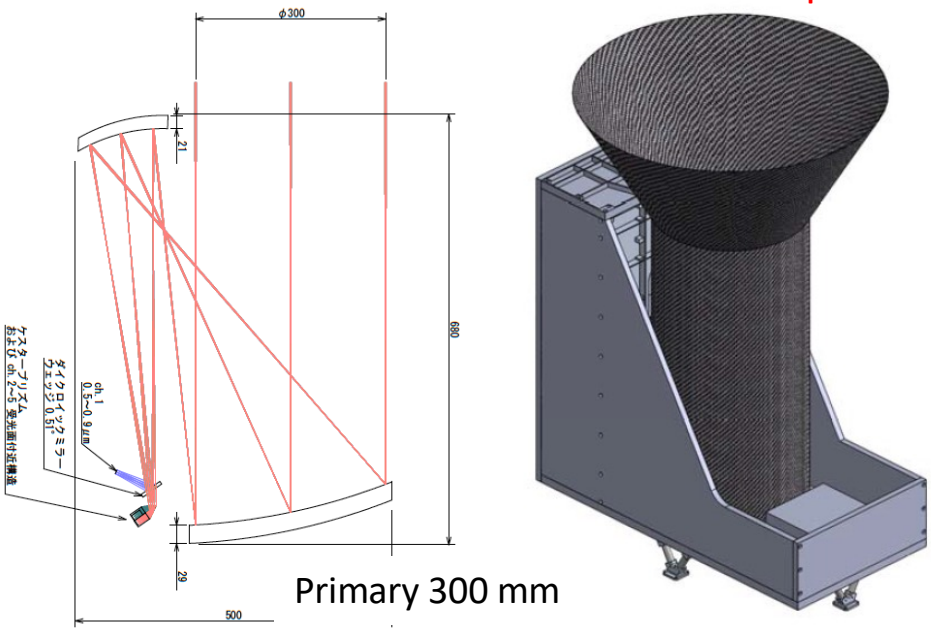


9/21(Thu.) V326b: Sugimoto's talk
9/22(Fri.) V349a: Goto's talk

Items	Parameters
Energy band (keV)	**0.4 – 4 keV**
Telescope type	Lobster Eye Optics
Number of Unit	6
Field of View	**> 0.5 str (6 units)**
Number of modules	16
Sensitivity	**1e-10 (erg/cm2/s) For 100 sec**
Position accuracy	3 arcmin

Near Infrared Telescope

5-band simultaneous photometry



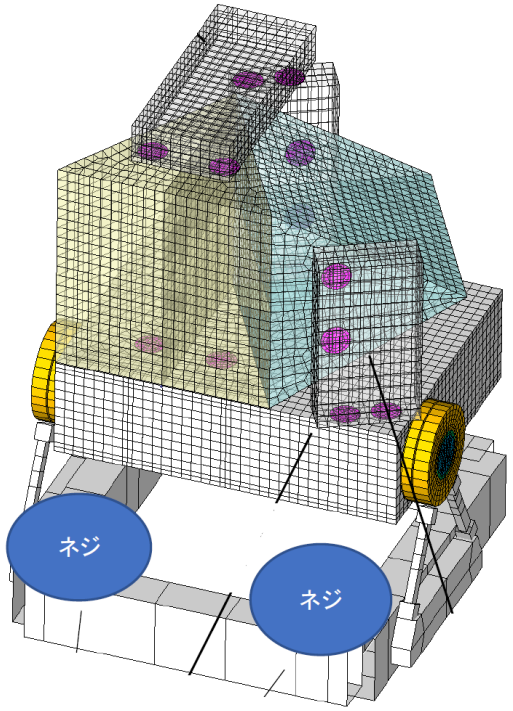
Items	Parameters				
Telescope type	Offset Optics				
Aperture size	**30 cm**				
Focal length	183.5 cm				
F number	F6.1				
Field of view	15 arcmin × 15 arcmin				
FoV per pixel	2 acsec × 2 arcsec				
Image size	3 pixel × 3 pixel				
Integration time	10 minutes (2 minutes x 5 frames)				
Observation 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)			

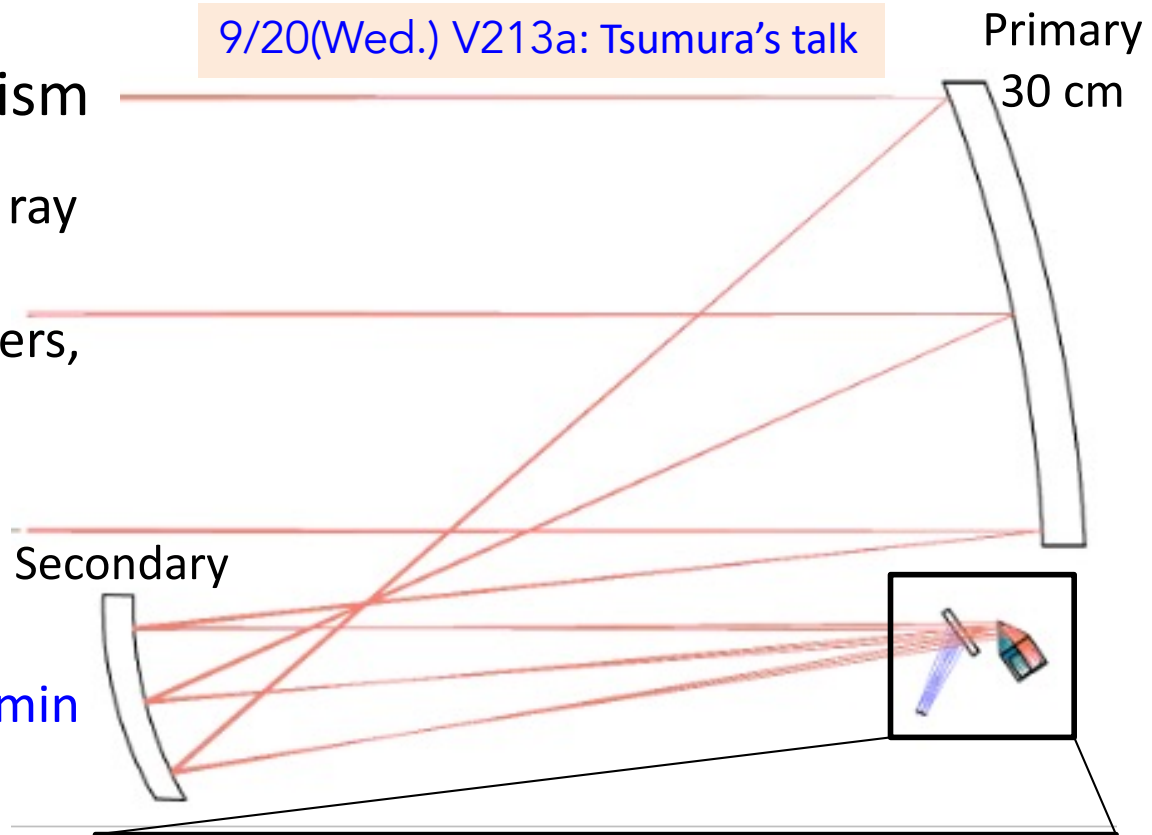
NIR Telescope and Kösters Prism

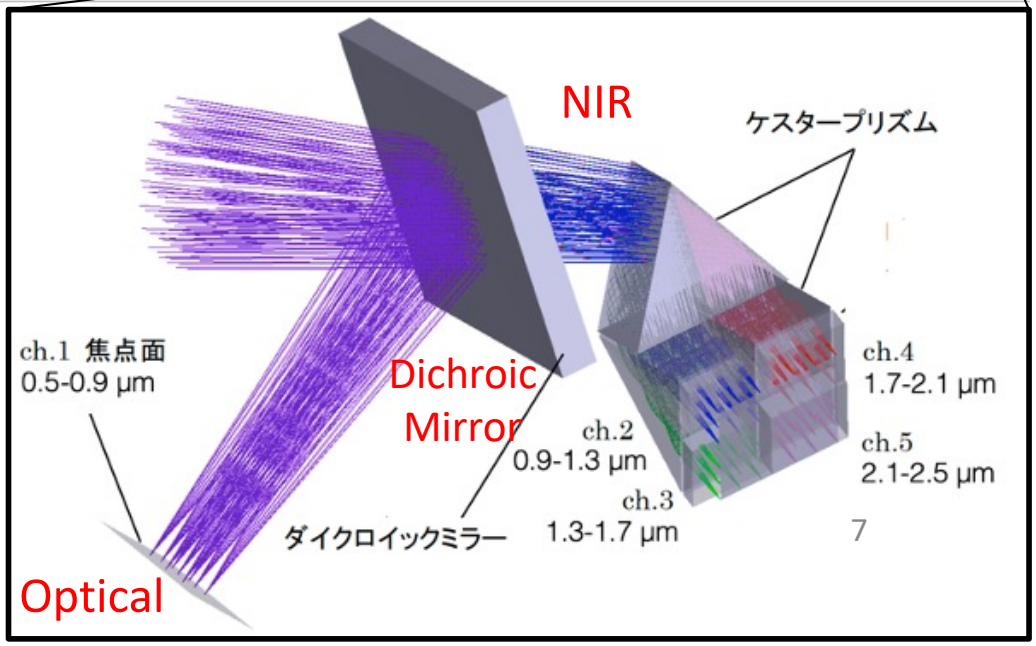
9/20(Wed.) V213a: Tsumura's talk

- Dichroic mirror divide optical/NIR ray
- Kösters Prism
  consists of prisms and beam splitters,
  divides the NIR ray into 4-band
- Imaging with a single detector
- We use 2-dimensional prism

- No. of NIR focal detector: 3 → 1
- Field of view: 34 arcmin → 15 arcmin





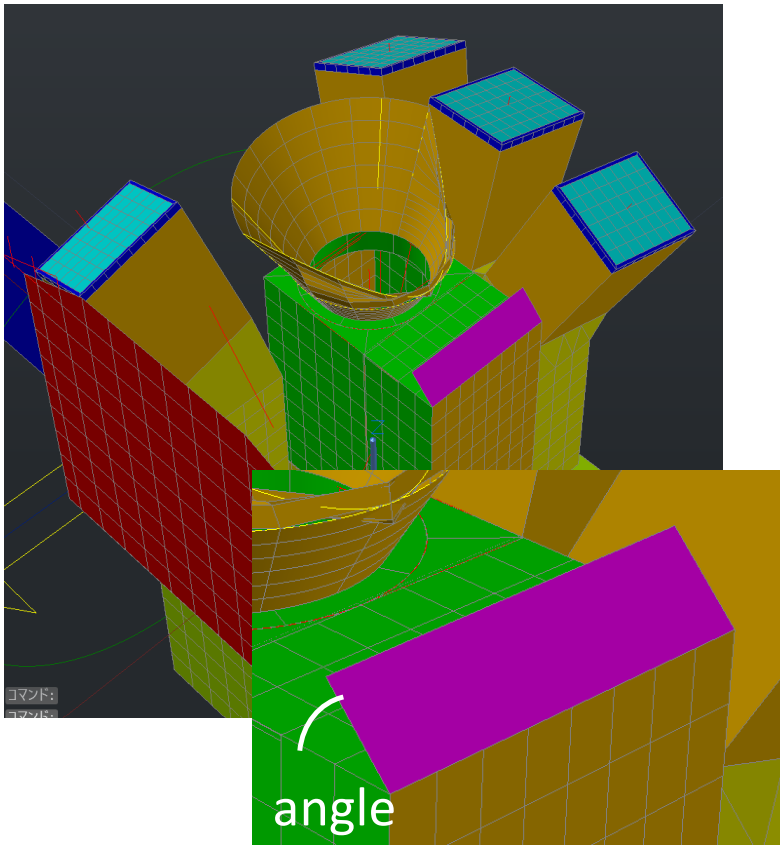


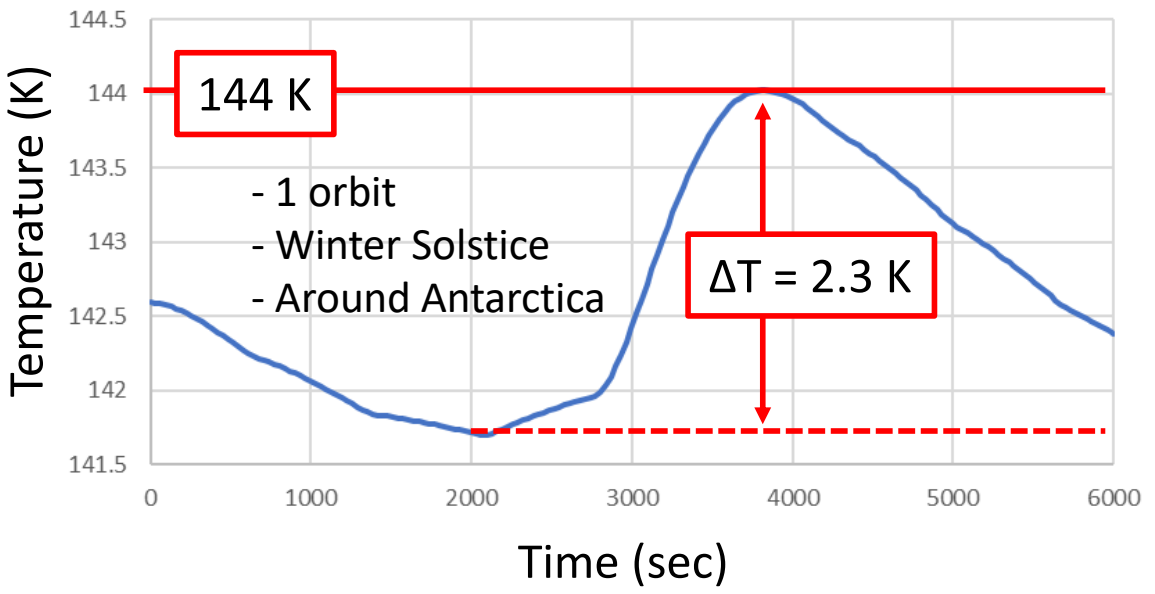
9/20(Wed.) V214a: Haruki Fukui's talk

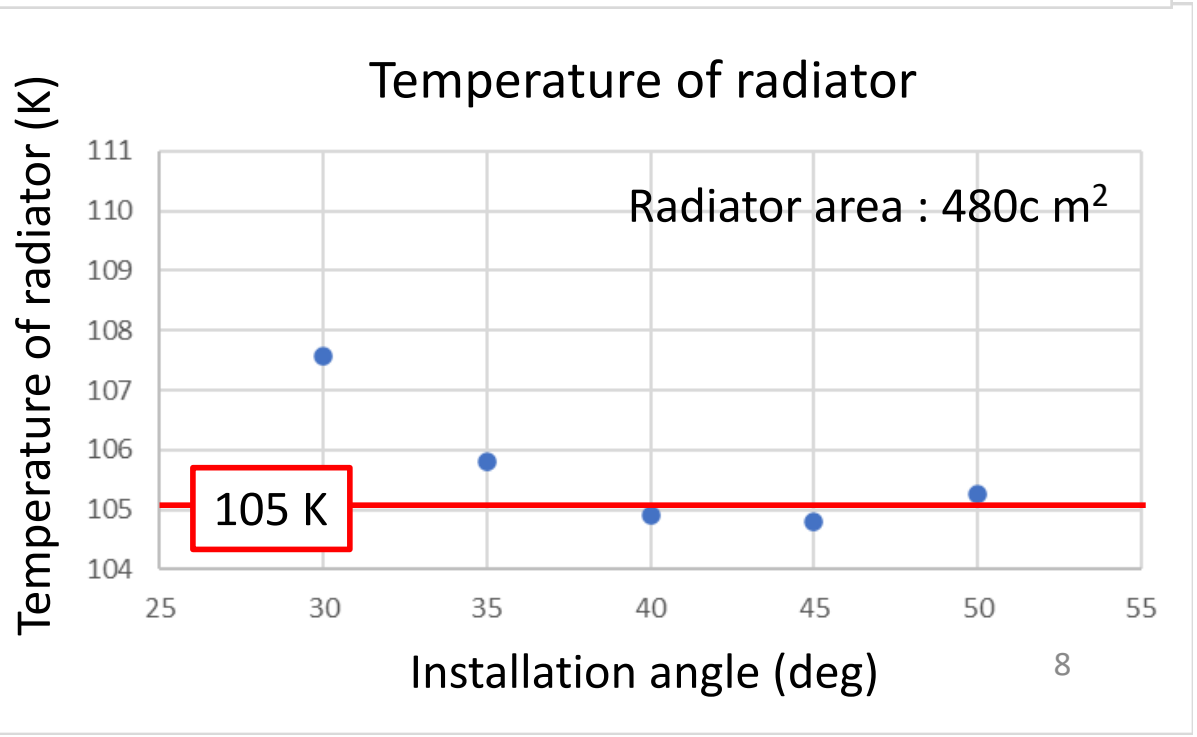
Thermal Design of NIR telescope

Requirement
- Telescope : T < 200 K
- Image sensor : T < 120 K

- Passive cooling
  (No mechanical refrigerator)
- Worst case estimation



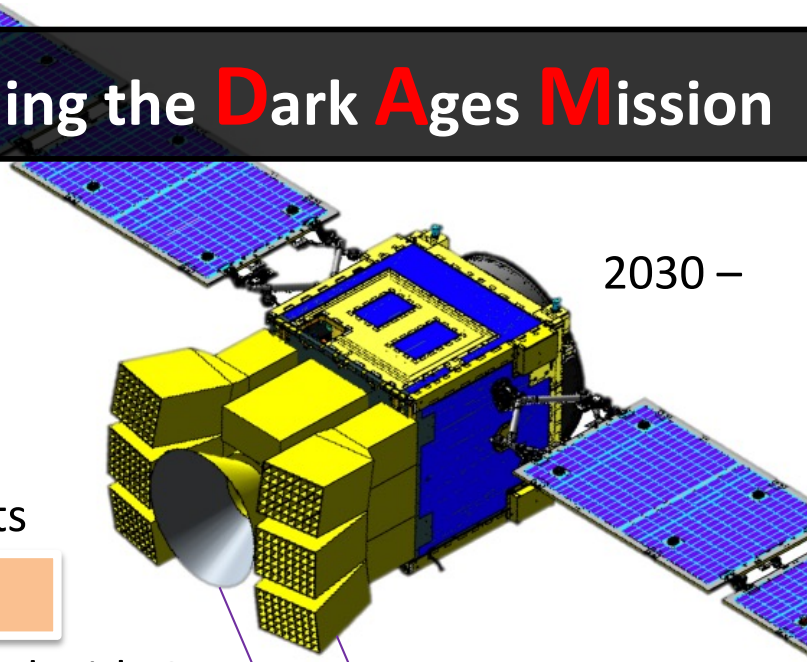




High-z Gamma-ray bursts for Unraveling the Dark Ages Mission

Mission Aim: Strong Promotion of
"**Time Domain**" & "**Multi-Messenger Astronomy**".

2030 –



Key Science1: Probing the Early Universe

- Detection of high-redshift GRBs ($9 < z < 12$)
- Probing the reionization history and first metal elements

Key Science2: Progress of Gravitational Wave Astronomy

- Localization of X-ray transient and macronova associated with GW
- Energy transition from jet – cocoon – kilonova

Observation Strategy

(1) Discovery of high-energy transient with Wide Field X-ray Monitor
(2) Automatic/Comprehensive follow-up with Near Infrared Telescope
(3) Sending Quasi-Realtime Alert Messages
(4) Spectroscopy with Large Area Telescopes for selected events

Wide Field X-ray Monitor

- Lobster Eye Optics
- CMOS imaging sensor

Near Infrared Telescope

- Offset Gregorian Optics
- simultaneous 5-band photometry

Wide Field X-ray Monitor

Items	Parameters
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Limiting mag (AB) 10 min, S/N=10	21.0	20.6	20.3	20.2	20.1

Kanazawa University Satellite 「KOYOH X線突発天体監視速報衛星」

- 50cm/50kg class micro satellite
- Mission payloads (wide field X-ray imaging detector T-LEX, Gamma-ray detector KGD）
- Selected as JAXA’s innovative satellite program
- Launch in Nov. 2023