#13

The third annual conference of Transformative Research Areas (A),
"Multimessenger Astrophysics"
18-20 November 2025, Naruko, Japan

Current status of the near-ultraviolet imager SCUID

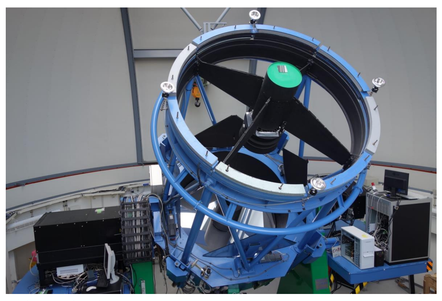
***Akitaya, H.*[1,2,3,*], *Morokuma*[1,2], *T., Kawabata, K. S.*[3]**

1: Astronomy Research Center, Chiba Institute of Technology
2: Planetary Exploration Research Center, Chiba Institute of Technology
3: Hiroshima Astrophysical Science Center, Hiroshima University
*: E-mail: akitaya@perc.it-chiba.ac.jp; WWW page: https://www.arc.it-chiba.ac.jp/

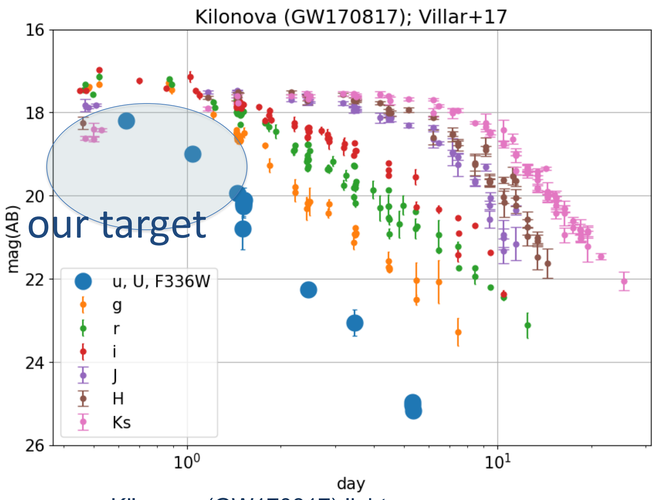
[1] Introduction

- We are developing an imager, ***SCUID***, with a high throughput at near-ultraviolet (NUV) wavelengths (300-400 nm; ~u-band), for a ground-based telescope (1.5-m Kanata telescope at Higashi-Hiroshima Observatory, Japan).
- Our concept
  - Develop an imager with optimized throughput for the NUV wavelengths to advance cutting-edge NUV astronomy.
  - Assess current NUV observing conditions quantitatively. (atmospheric transparency, sky brightness, etc.)

SCUID allows us to detect NUV emission from various transient objects, for example, a kilonova from a neutron star merger (as GW170817) closer than 130 Mpc within a day after its collapse.



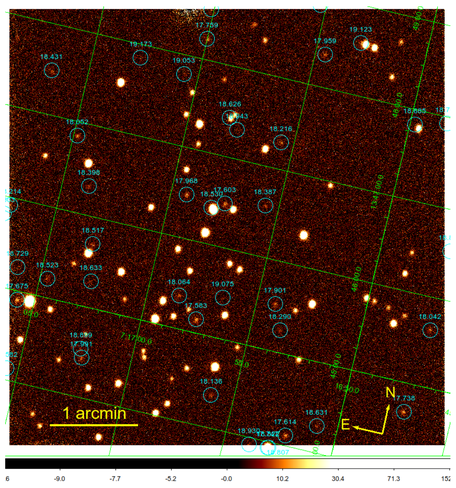
Kanata telescope.



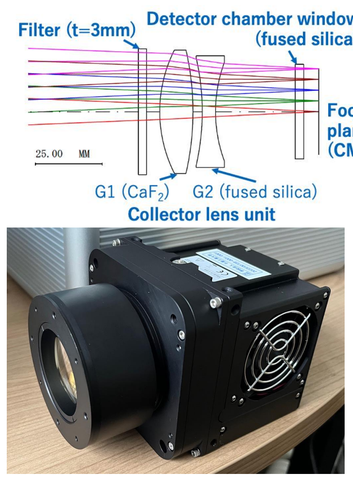
Kilonova (GW170817) light curve.

[2] Design and specifications

Telescope	1.5m Kanata telescope (Higashi-Hiroshima Observatory), 2nd Nasmyth
Optics	CaF_2 + fused silica collector lens unit
FoV	5 arcmin × 5 arcmin
Scale	0.14" pixel
Detector	CMOS Gpixel GSENSE400 BSI UV 2048 x 2048 pix, 11µm/pix
Camera module	FLI Kepler KL400
Filters	SDSS u-band (customized), u-short (300-350nm), u-long (350-410nm), SDSS g, r, grating (400 gr/mm)
Throughput	max ~32 % at u-band including expected atmospheric extinction
Limiting mag.	u~20.2 ABmag (S/N=5, 100 sec)



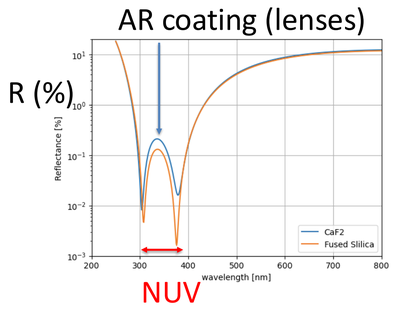
NGC 2355 (u-band, 60 sec) with magnitudes from SDSS DR7.



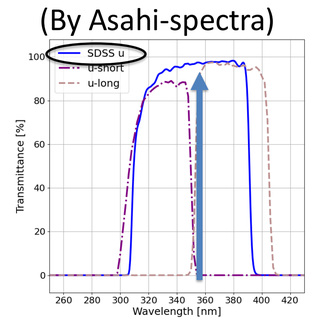
Optical design and optics with camera module

Our novel approach to the efficient NUV instrument

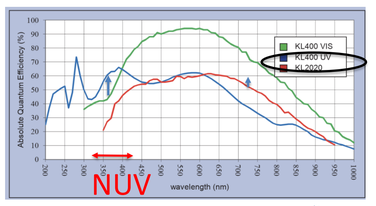
AR coating (lenses)



Optimized u-band filter (By Asahi-spectra)

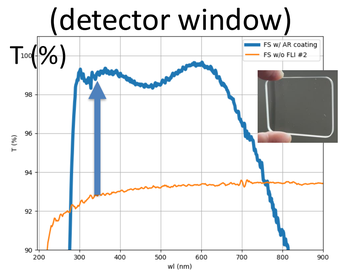


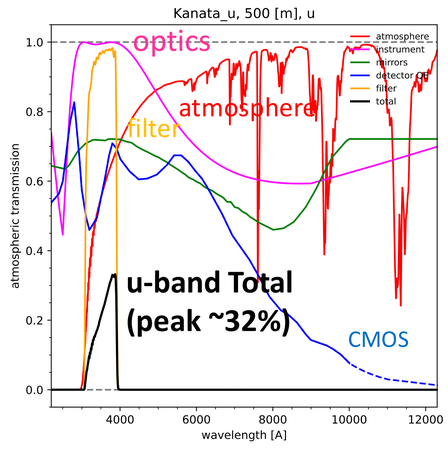
Detector QE



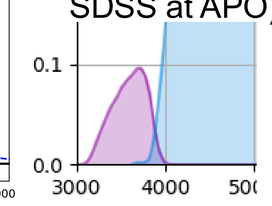
Most efficient components in the NUV were selected

AR coating (detector window)





(cf. ~10% for SDSS at APO)

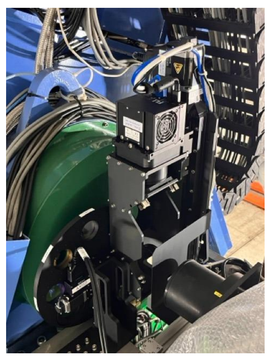


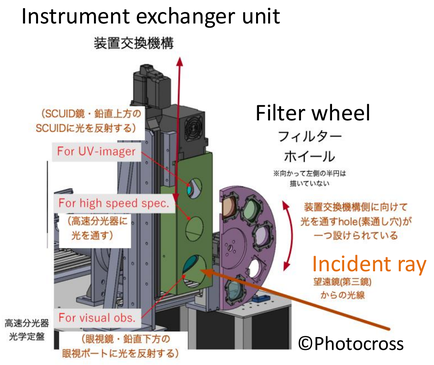
~32 % throughput at u-band peak including the atmospheric extinction

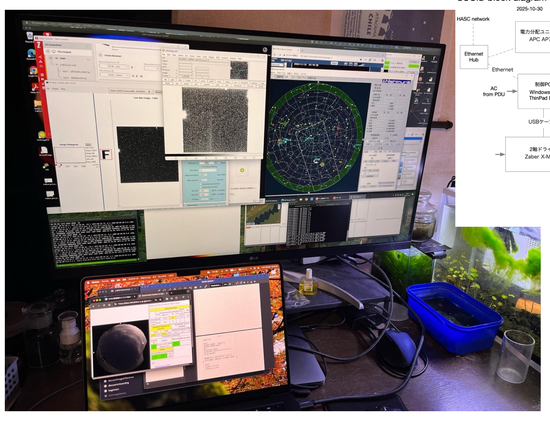
[3] Recent progress

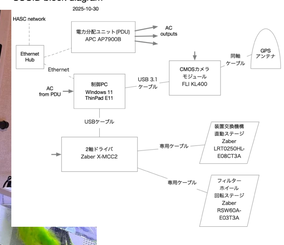
(1) Full remote observation

- Filter wheel and focal plane instrument exchanger unit were installed (October 2025).
- SCUID is now accessible by remote operation.









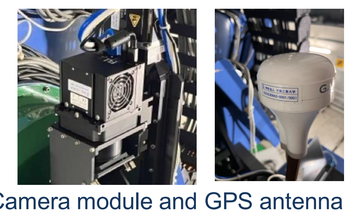
Remote observation of the Kanata telescope and SCUID from Akitaya's home in Chiba. (Nov. 17, 2025)

Ready for full remote operation!

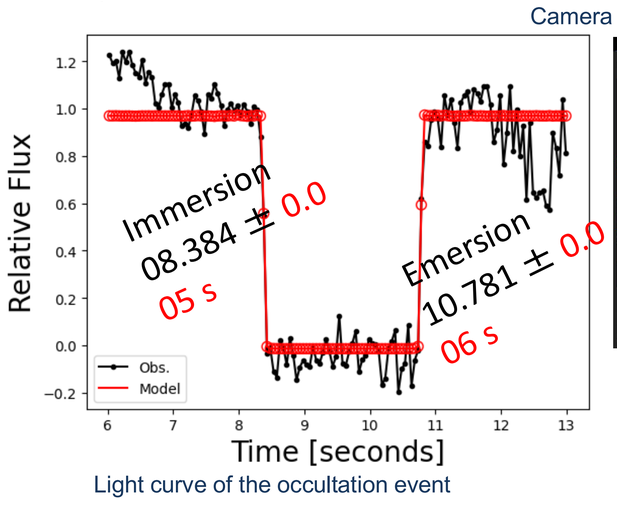
(2) High-speed observation

- CMOS detector is capable of high-speed imaging by 48 fps.
- Absolute time stamps are recorded by a GPS antenna.

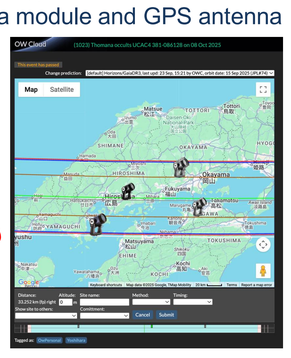
Asteroidal occultation by (1023) Thomana
Star: UCAC4 381-086128; g = 9.8 mag
Asteroid: d= 52 km, t_{occult_max} ~ 2.6 sec
Observation: no-filter, 50 msec (20fps) exposures



Camera module and GPS antenna



Light curve of the occultation event



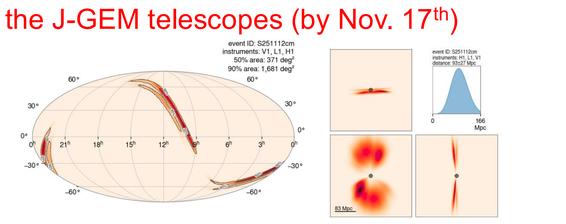
Occultation map of the asteroid

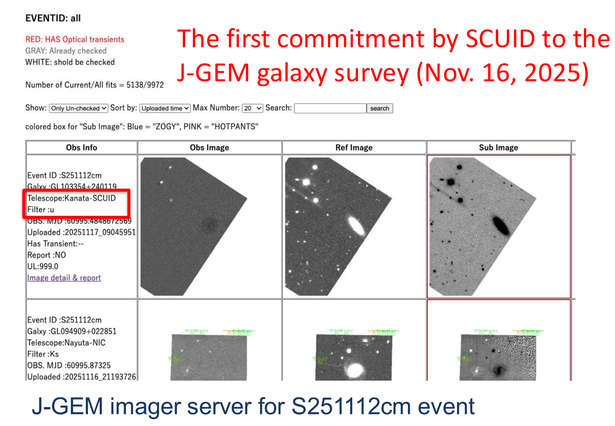
Ready for high speed, time accurate observation!

(3) MMA observation

- LVK GW event S251112cm
  "Properties.HasSSM = 1.0"
  → > 200 galaxies have been surveyed by the J-GEM telescopes (by Nov. 17th)

GCN Circular 42725





The first commitment by SCUID to the J-GEM galaxy survey (Nov. 16, 2025)

J-GEM imager server for S251112cm event

Ready for MMA observation!

[4] Future Prospects

- Development of the sophisticated control and reduction software of the instrument.
- Linear polarimetry unit (a wire-grid polarizer and a rotatable half-wave plate) development and install in 2026.

Acknowledgements

- Toray Science and Technology Grant (project number 22-6310) by Toray Science Foundation, 2023-2025 (PI: Morokuma)
- KAKENHI Grant-in-Aid for Scientific Research (C) (25K07355), 2025-2027 (PI: Akitaya)
- Advanced Technology Center, National Astronomical Observatory of Japan