

## 近紫外線カメラSCUID

### 東広島天文台かなた望遠鏡での本格運用

Commissioning of the near-ultraviolet imager SCUID on the Kanata telescope at Higashi-Hiroshima Observatory.

千葉工業大学 天文学研究センター

秋田谷 洋, 諸隈智貴

広島大学 宇宙科学センター

川端 弘治

Hiroshi Akitaya, Tomoki Morokuma (Chiba Tech), Koji S. Kawabata (Hiroshima Univ.)

# 11<sup>th</sup> Workshop in December 2022

14:00	高効率な近紫外線観測に向けた観測環境調査と観測装置構想	秋田谷 洋	千葉工業大学
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## 高効率な近紫外線観測に向けた 観測環境調査と観測装置構想

千葉工業大学 惑星探査研究センター  
秋田谷 洋・諸隈 智貴

共同研究者:  
川端 弘治 (広島大), 浦川 聖太郎 (日本スペースガード協会),  
谷津陽一 (東工大)

2022-12-22

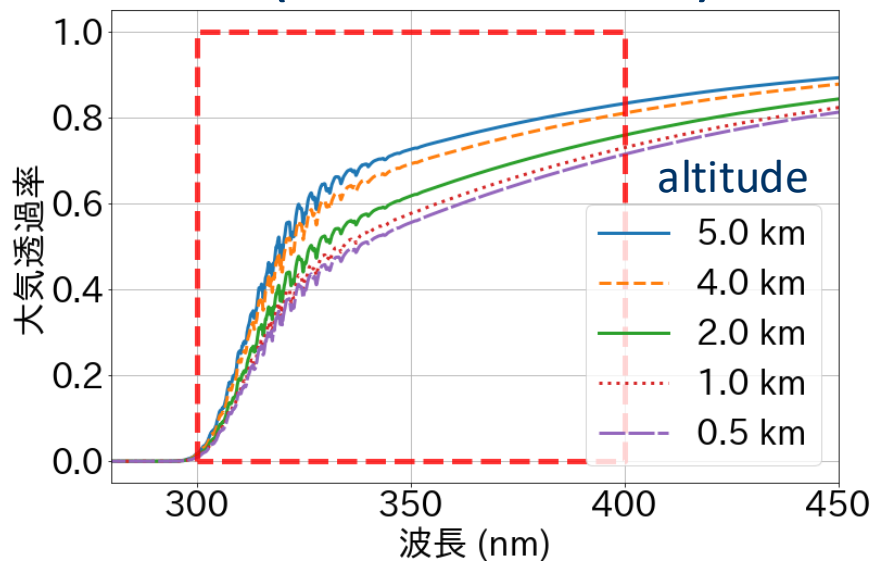
第11回 可視赤外線観測装置技術WS2022

- 「近紫外線(=300-400nm~u-band)観測」を目指して、
  1. 「この波長に絞った観測装置」
  2. 「低コスト・短期間で製作」して、
  3. 「手近な望遠鏡に装着して早期に観測」  
します。
- 「基礎検討」「観測環境調査」「外部資金確保」を進めています。-
- 2-3年内の装置製作・観測実施を目指します。

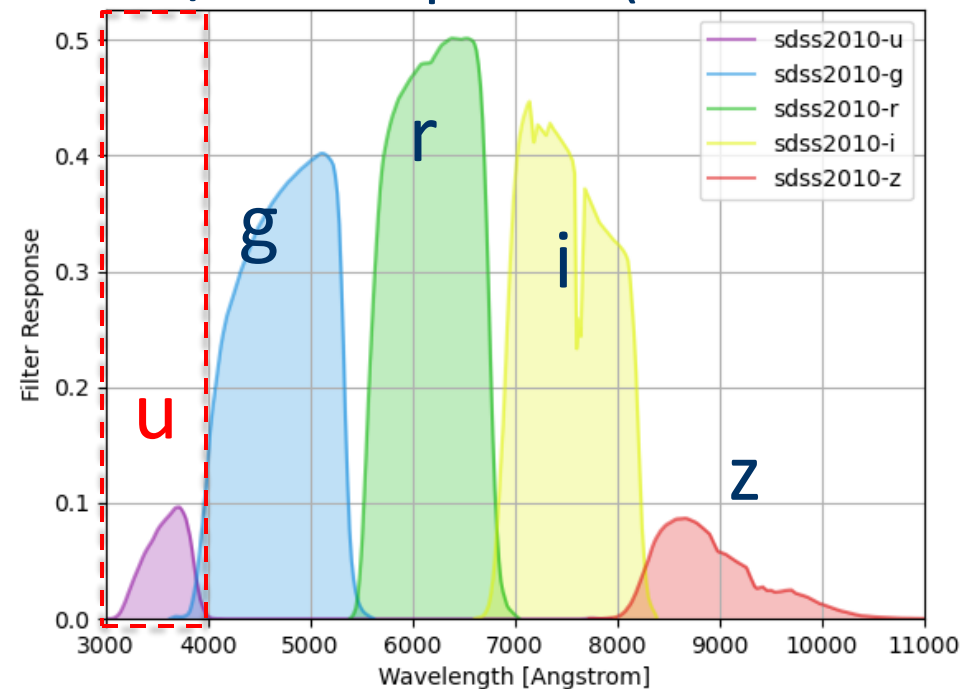
# Near-ultraviolet (NUV) wavelengths : 近紫外線

- 300-400 nm, ~u-band
- The shortest edge of the atmospheric window

Atmospheric transmission model (LOWTRAN 77)



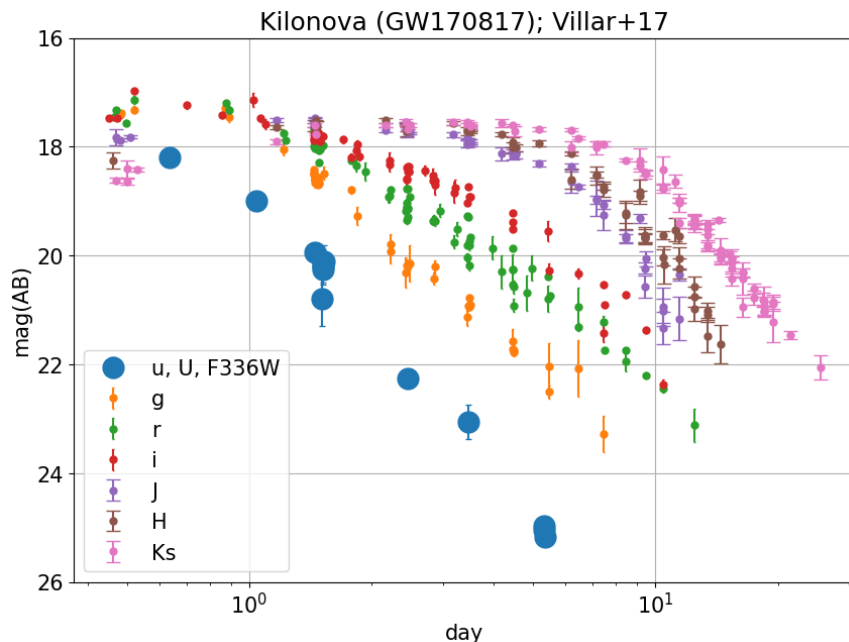
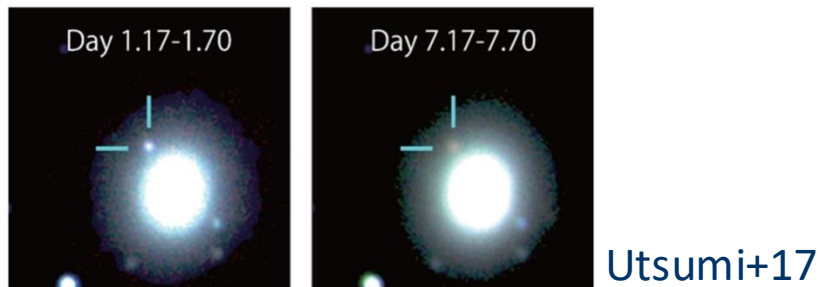
SDSS response w/ atmosphere (airmass=1.3)



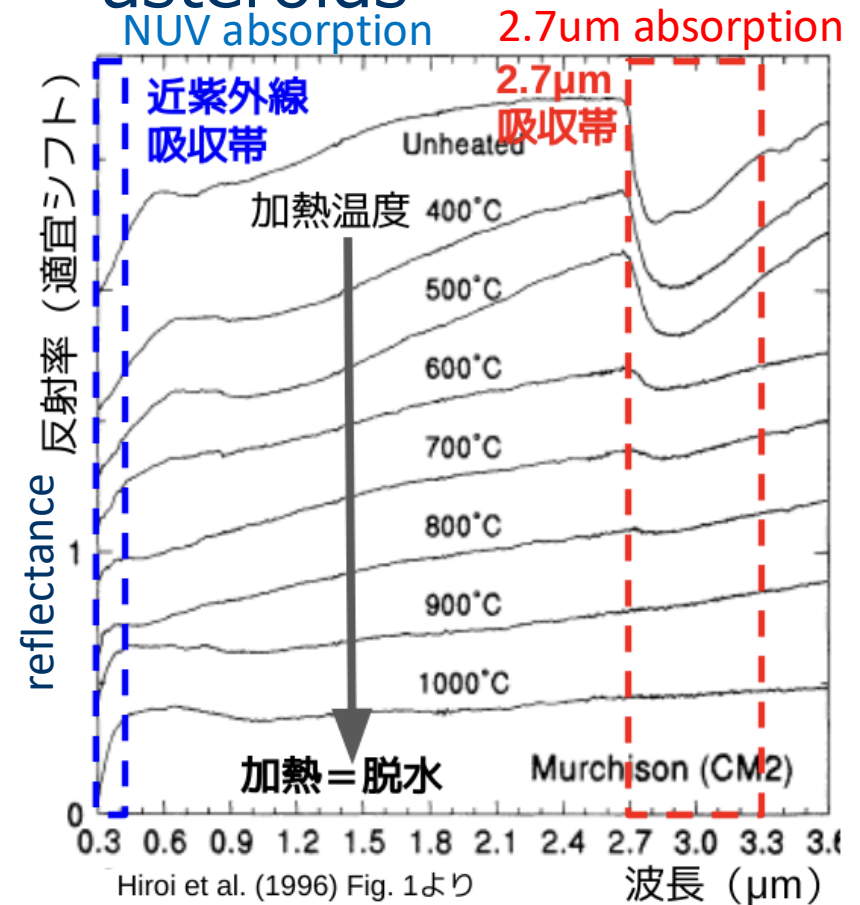
Speclite Developers (2025), Doi+2010

# NUV light in recent topics

## □ Kilonovae



## □ Dehydration in C-type asteroids



## □ Stellar flares, supernovae, various transient objects, ...

# Our concept for the NUV image SCUID

- Develop an imager with **optimized throughput for NUV wavelengths** to advance cutting-edge NUV astronomy      **「NUV効率に特化した装置」**
- Assess current NUV observing conditions quantitatively (atmospheric transparency, sky brightness, etc.)      **「NUV観測環境を定量評価」**  
= Dispel the belief such as "NUV observation is unsuitable in humid, cloudy Japan."

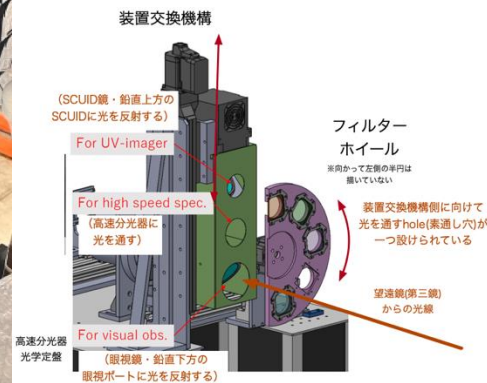
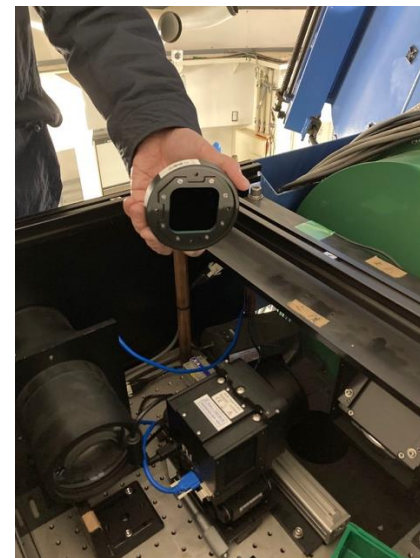
→

- Develop and install the near-UV camera SCUID on the Kanata Telescope

**「近紫外線カメラSCUID@かなた」**

# History of the development of SCUID

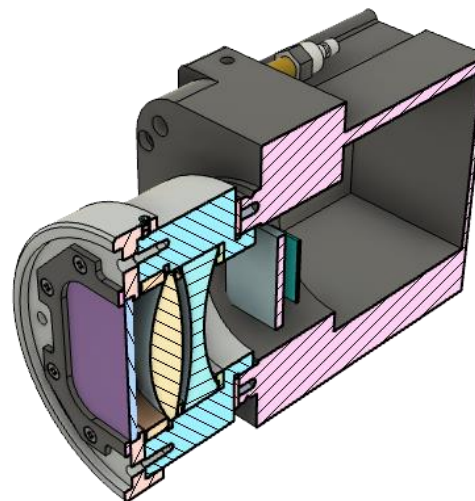
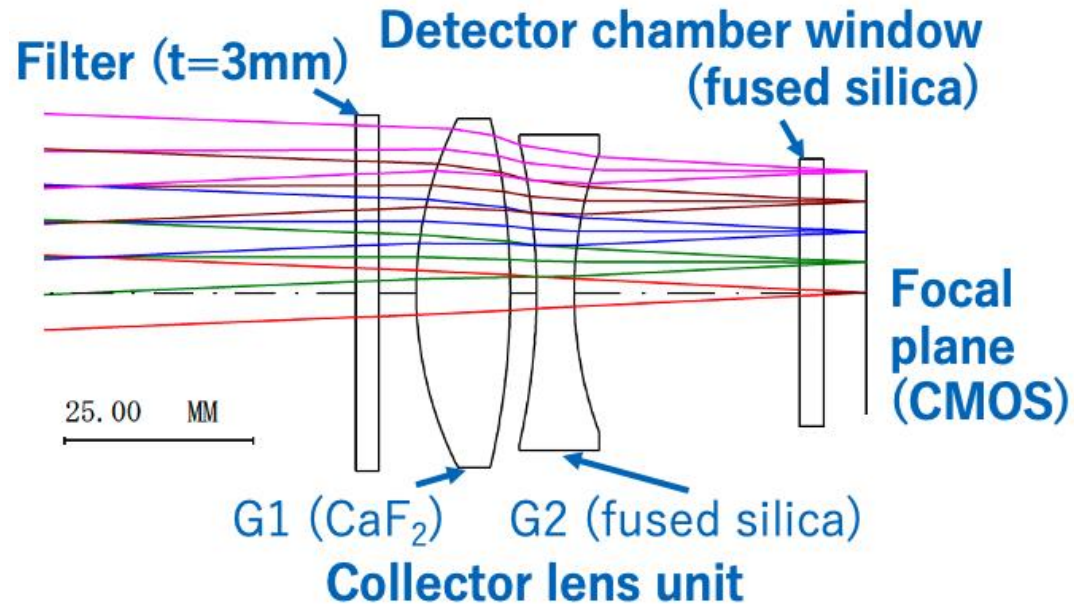
- 2022~
  - Project initiated, design
- 2024/3 (1.5年前)
  - First on-sky observation** at the Kanata Nasmyth focus (with partial configuration)  
→ Akitaya+24, Proc. SPIE
- 2025/10 (先月)
  - Filter turret / instrument exchanger unit installed  
→ Now capable of **full remote control**





- Optics
  - Simple corrector lenses
  - FOV 5' x 5' (0.14"/pix)
- Filters
  - SDSS u, u-short, u-long, (+ g, r, R~40 grating)
- Detector
  - CMOS Gpixel GSENSE400 BSI UV
  - 2048 x 2048 pixels; 11  $\mu\text{m}/\text{pix}$ ,
  - 45-70% QE at NUV
  - FLI KL400-UV camera module
- Telescope
  - 1.5m Kanata telescope at Higashi-Hiroshima Observatory (HHO)

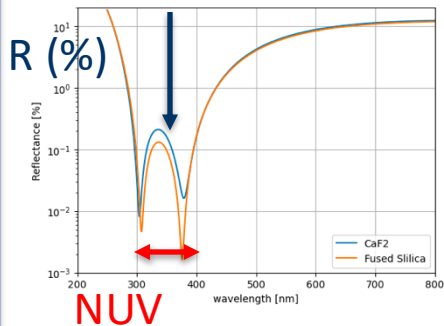
# Design



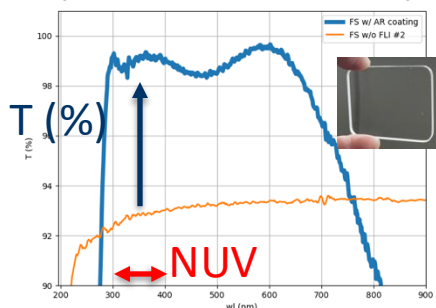
©PHOTOCROSS

# NUV throughput maximized

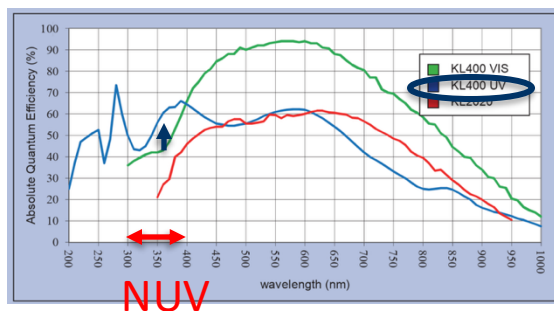
AR coating (lenses)



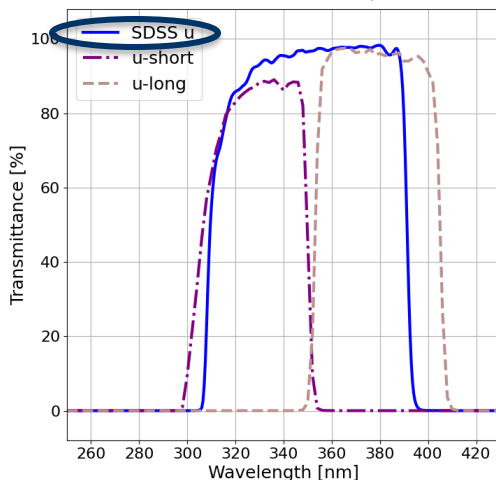
AR coating (detector window)



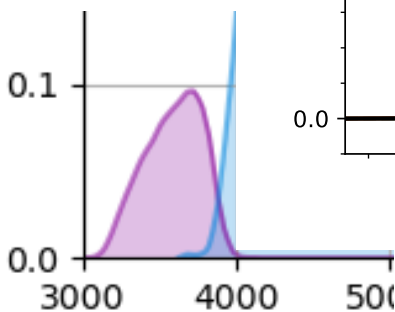
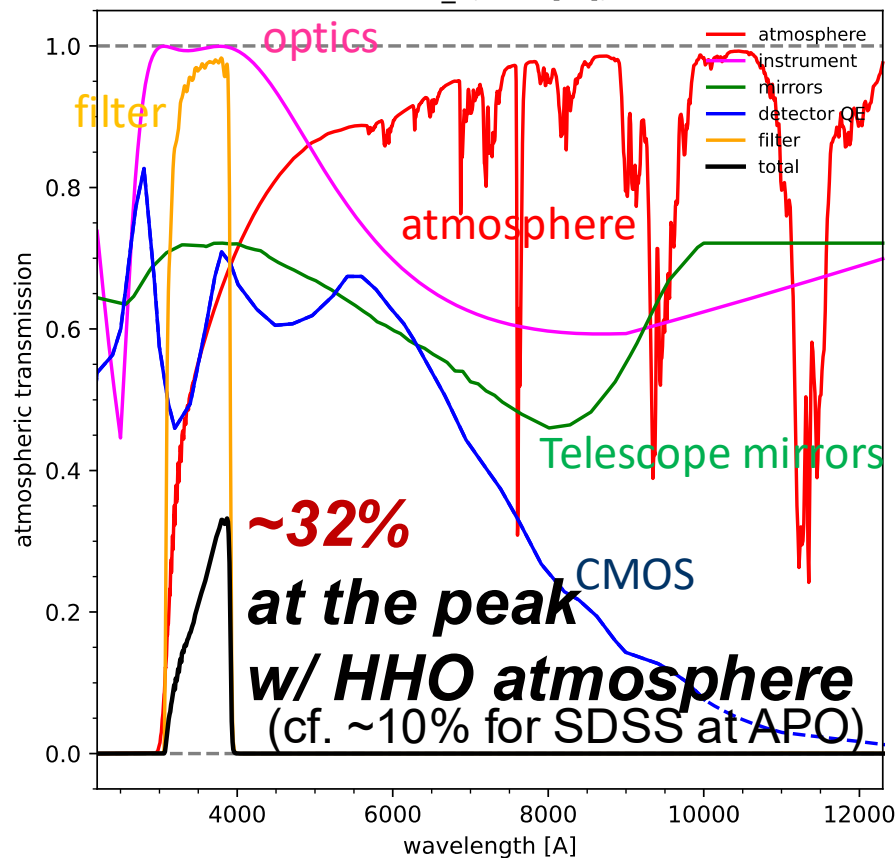
Detector QE



Optimized u-band filter  
(By Asahi-spectra;  
朝日分光)



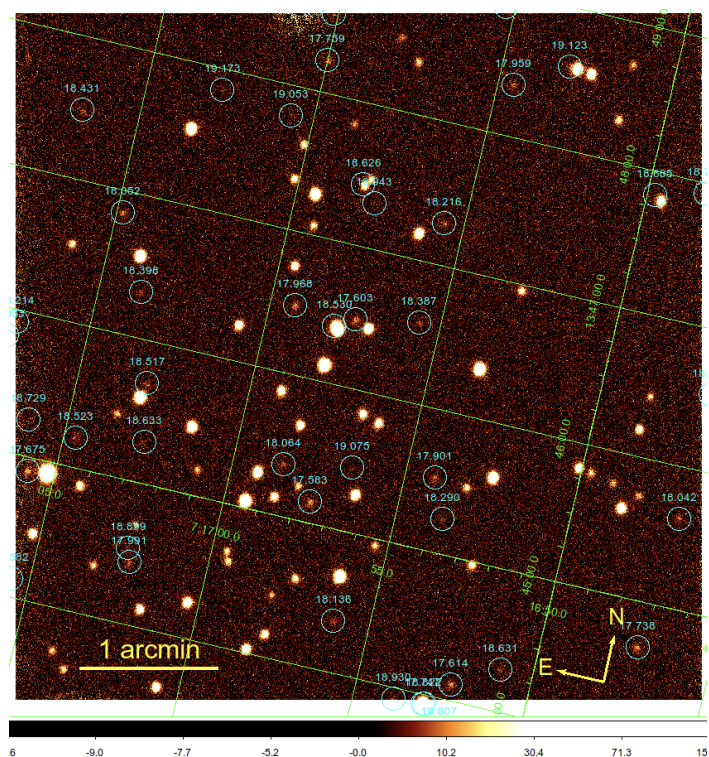
Kanata\_u, 500 [m], u



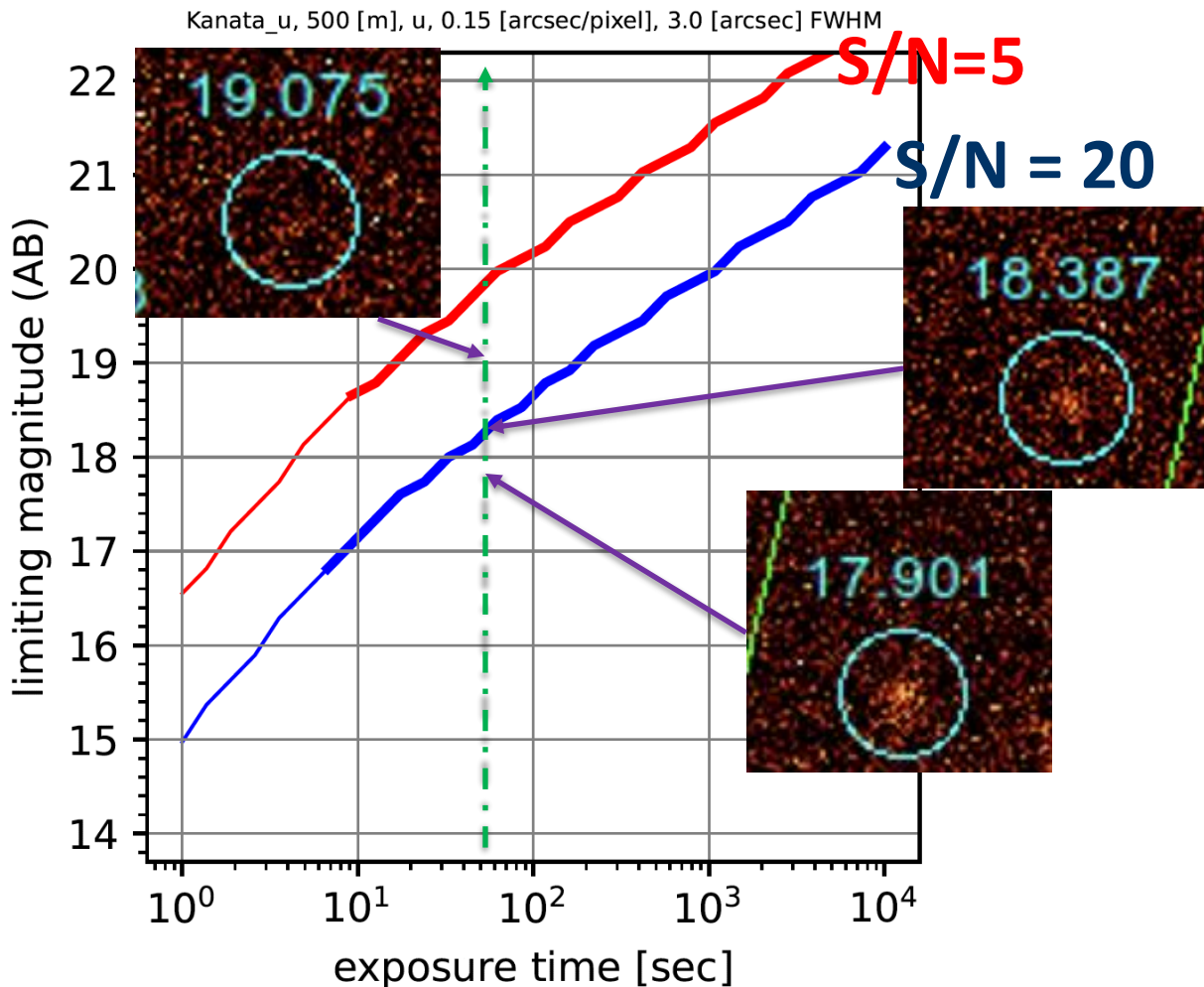


# Image quality and limiting magnitudes

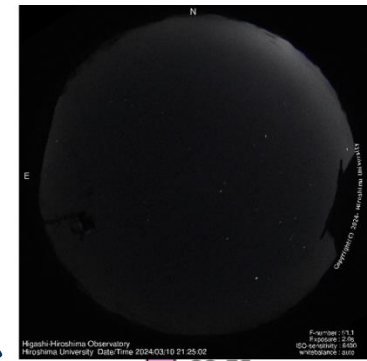
u-band; 60 sec  
seeing  $\sim 3$  arcsec



Open cluster NGC 2169

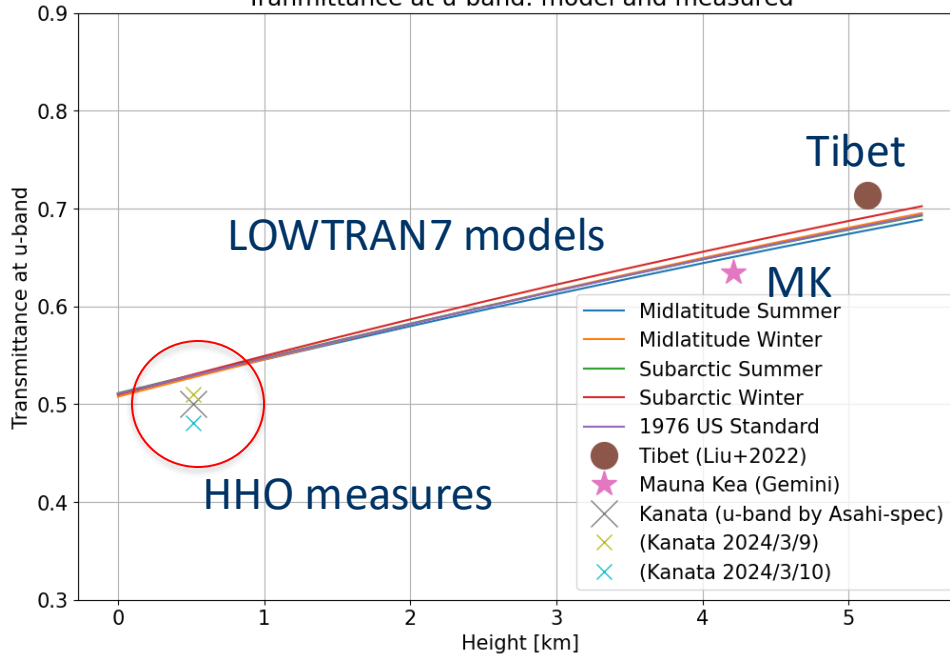


# u-band sky transmittance / brightness at HHO



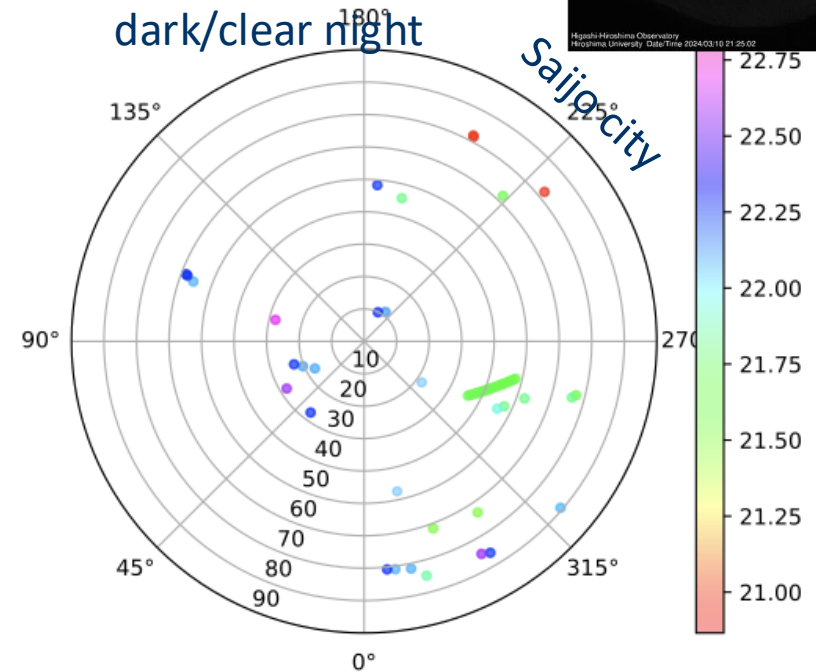
## atmospheric transmittance

Transmittance at u-band: model and measured



**~50 % at HHO**  
**coincident with the model prediction**

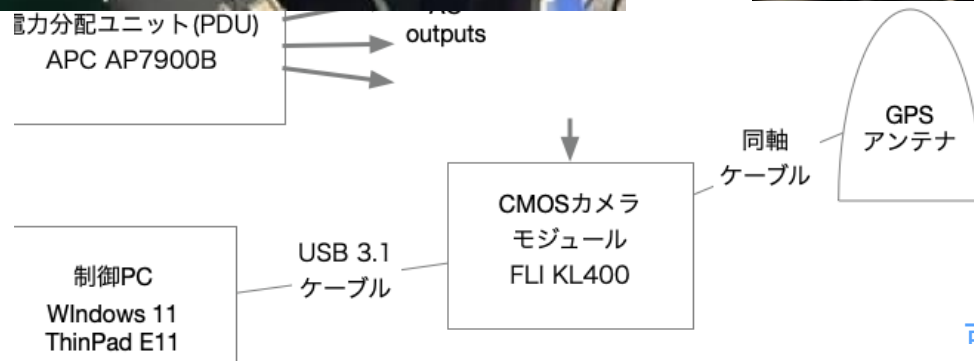
## sky brightness dark/clear night



**~21-22 mag/arcsec<sup>2</sup>**  
 (cf. Mauna Kea 22.2 mag/arcsec<sup>2</sup>)

# High speed observation with absolute time stamps

- ~50 Hz exposures with precise time record by GPS signal

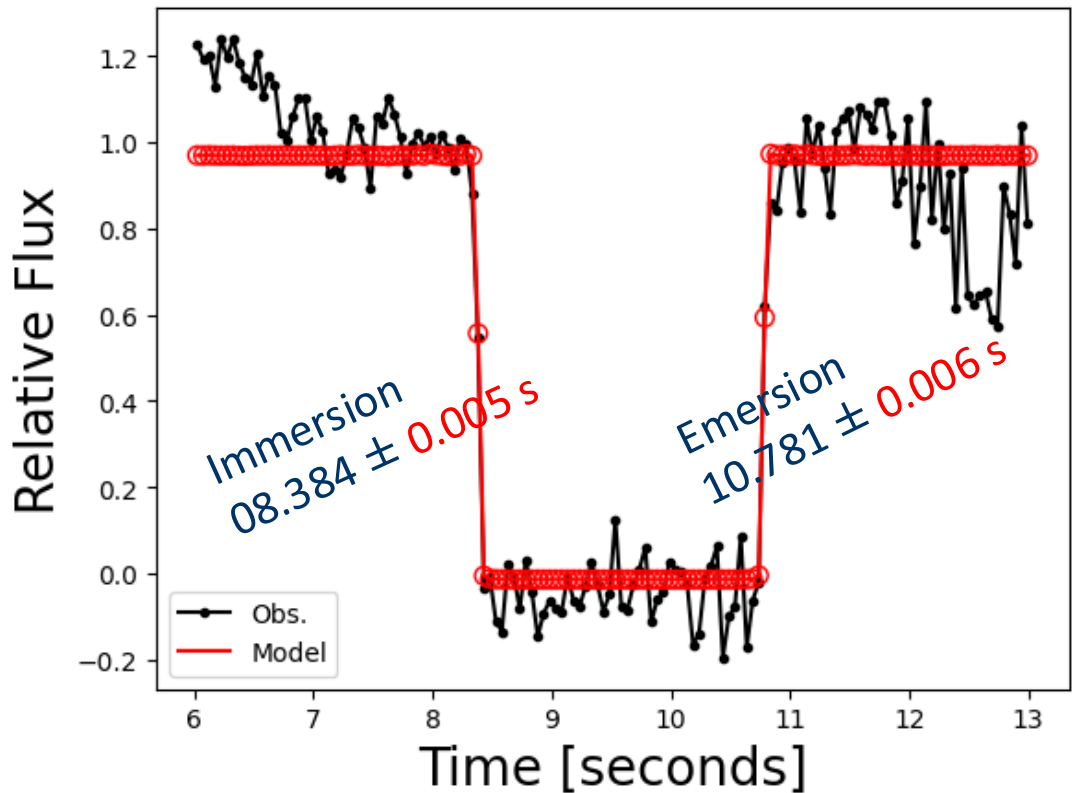




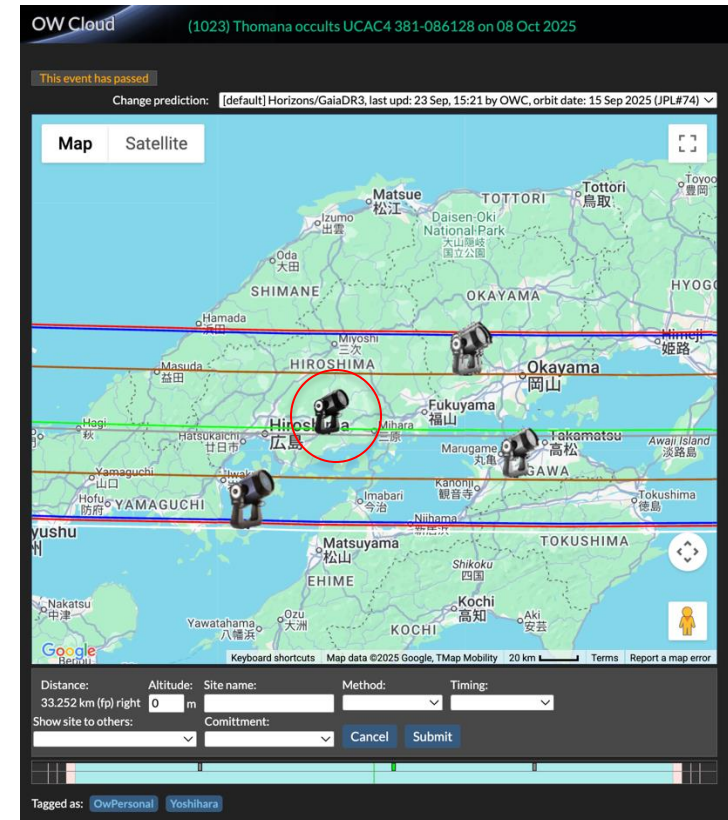
# Asteroidal occultation by (1023) Thomana

- Star: UCAC4 381-086128;  $g = 9.8$  mag
- Asteroid:  $d = 52$  km,  $t_{\text{occult\_max}} \sim 2.6$  sec
- Observation: no-filter, **50 msec (20fps)** exposures;  
(Remote observation from Chiba)

小惑星の掩蔽  
 明日 11(火)  
 當銘さん(九工大)'s talk



from 2025-10-08T09:56:00 UT



<https://cloud.occultwatcher.net/event/1741-1023-248810-647125-U086128/>

可視赤外線観測装置技術ワークショップ2025

# Future prospects

- 2025/11-
  - Slight modification of the instrument exchanger unit
  - **Full operation of the instrument**
  
- 2026-
  - **Linear polarimetry unit** (Wire-grid polarizer and rotatable half-wave plate) will be developed and installed
    - u-band imaging polarimetry



# Summary

- Near ultraviolet imager *SCUID* has been developed.
- *SCUID* is now ready for (full remote) observation on the Kanata 1.5m Telescope
  - High sensitivity imaging at u-band ( $\sim 18-19$  mag)
  - High speed observation ( $\sim 50$ Hz) with absolute time stamps
- Linear polarimetry unit will be appended
- Acknowledgement
  - 東レ科学技術研究助成 (課題番号22-6310), 2023-2025, 代表: 諸隈
  - 科研費基盤(C) (25K07355), 2025-2027, 代表: 秋田谷