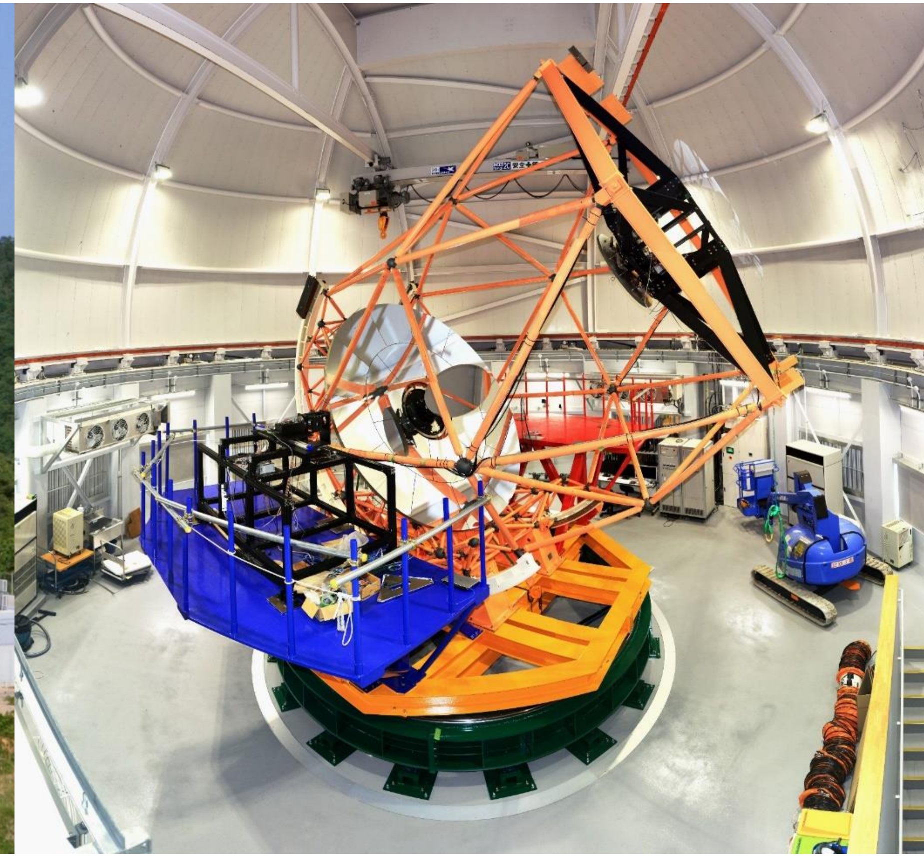
Kyoto 3.8m Seimei Telescope



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Overview

A new telescope nearly completed (under fine adjustment):

The diameter = 3.8m.

18 segmented mirrors.

Quick move for ToOs.

First instrument:

Fiber-fed IFU low resolution spectrograph (Kools-IFU). ~19 mag.

Site:

Okayama observatory (western part of Japan).

Operation:

Kyoto U. & NAOJ. 50% University, 50% Japanese astro community.

Aims:

Science (ToO), Education (obs & instrumentation)

Key Science (examples)

- **Transients and ToO observations.**
- Exoplanets.
- Stellar flares and activities.

- Note:
  - High contrast AO camera and high-dispersion spectrograph not ready yet. Transient science is the key in the initial operation phase.

A list of Interests (as usual)

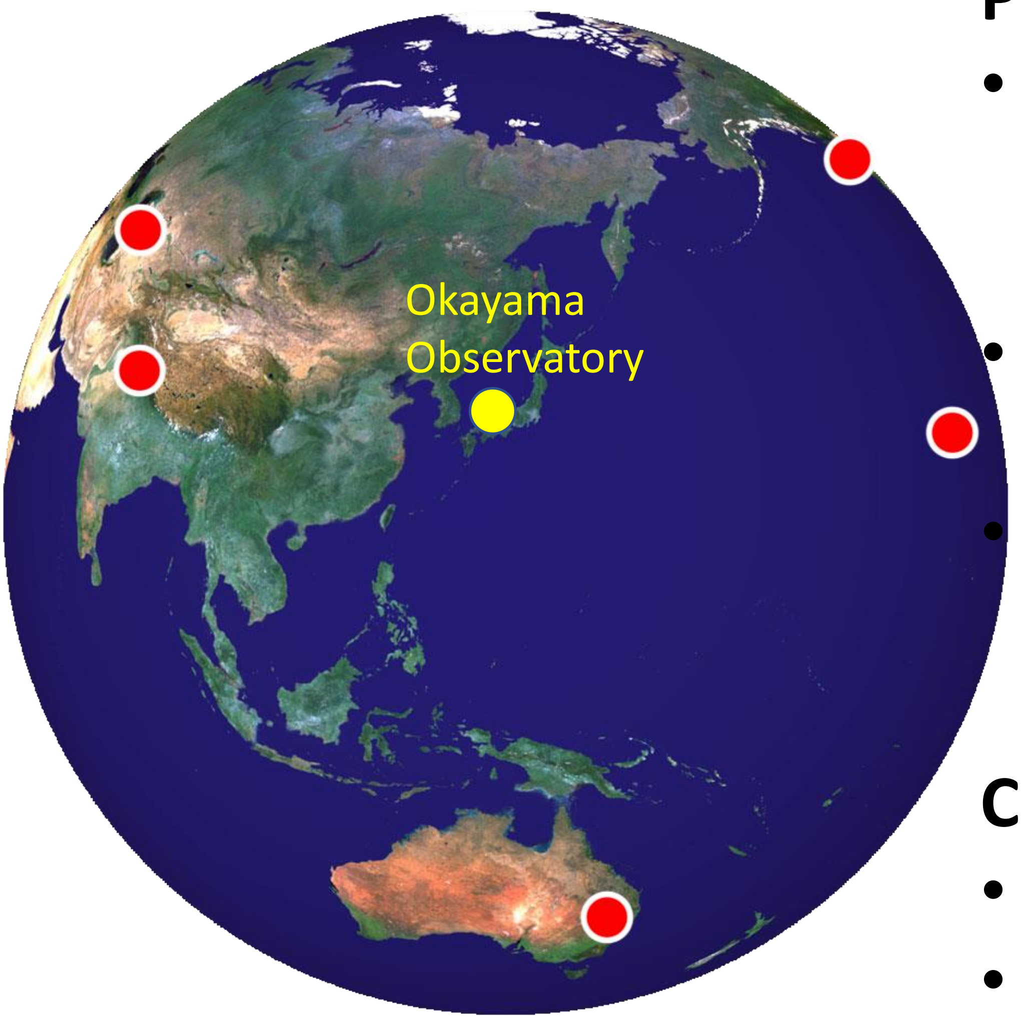
- Gravitational wave counterparts.
- Gamma-ray bursts.
- X-ray binaries.
- Magnetar bursts.
- Supernovae and extragalactic transients.
- Novae.
- Dwarf novae.
- Luminous Red novae.
- Stellar flares.
- Unknown objects and phenomena…..

Maeda responsible for extragalactic transients within the Kyoto University.

Telescope

• Main mirror diameter	3.78m
• F ratio of the main mirror	1.3
• Optical system	Ritchey-Chretien
• Second mirror diameter	1.1m
• Final F ratio	6.0
• Scale at the focus	9.09"/mm
• Focus size	12'φ (w/o correction lense)
	1° φ (with correction lense)

Site: Okayama Observatory



Distribution of mid and large size multi-purpose telescopes

Pros:

- (134.6 deg, +34.6 deg) => Filling the sky coverage for transients.
- Observable night fractions: ~ 50% (best in summar-fall).
- Seeing: 1-1.5” (best in spring & fall).

Cons:

- Bright sky (in optical).
- Altitude = 400m (not typo).

Telescope time & operation

- ~ 50% for Kyoto University.
- ~ 50% for open use (within Japanese community) through NAOJ.
- Public education, outreach, maintenance delivered from the University time and NAOJ time, half-half.
- Also a part of the OISTER collaboration.
- Will start Science run from February 2019.
- The operation in the initial phase (~ 2019) will ne limited in several ways (time, ToO capability, etc).
    - First run: Feb – June 2019.
    - ~ 30 nights for open use, ~ 30 night for the University.
    - Basically visitor mode, but a ToO proposal possible.
    - No ToO allowed across the different time allocations (between the open-use and University).

OISTER collaboration

- Telescope networks within Japan (+ south Africa + Chile).
- Kyoto Telescope can also be activated through the OISTER (i.e., open-use + Kyoto University + OISTER).

Instruments

1. Optical low resolution 2D spectrograph "KOOLS-IFU" (R=800-2,000, Integrated fiber unit of 128 fibers, ϕ=~15arcsec) (1st instrument; almost completed) [Ohta, Matsubayashi]
2. Optical high time-resolution imager and spectrograph (100 images/sec at maximum, R=20 or 150; under construction)
3. Infrared medium resolution spectrograph (R=2,700; under construction)
4. NIR High contrast camera for direct imaging of exoplanets "SEICA" (imager with extreme AO; under construction)

Instruments (continued)

5. Optical high dispersion spectrograph for exoplanet survey (R=~50,000; modifying)
6. Optical multi-color CMOS imager and spectrograph (under construction) [Maeda, Ohta]
7. Infrared imaging polarimeter (designing)
8. Optical high dispersion spectrograph (R=~100,000; applying for a fund)

<u>All of these instruments will be ON anytime, and we will be able to change the instruments very quickly with rotation of the tertiary mirror and move of the fibers.</u>

ToO capability

- Telescope slew speed: 2-3 degree / sec.
- Instrument change: ~ 1 min if it is on the rotator.
- Minimal Elevation: 25~30 deg.
- Kools-IFU: little overhead for acquisition.

- Aiming at a full (?) ToO automation in a few years time scale.
- Limitation in the initial operation: need an on-site observer.

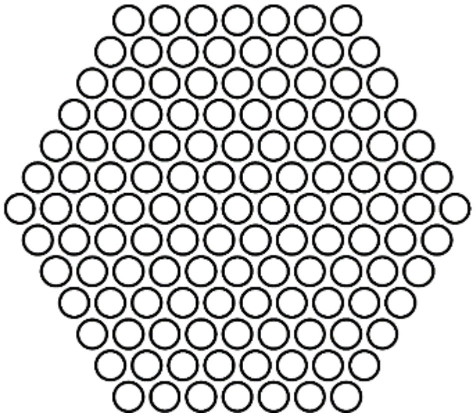
ToO capability - note

- Aiming at a full (?) ToO automation in a few years time scale.
- Limitation in the initial operation: need an on-site observer.
- Several on-site observers related to the transient science.
  - One through the NAOJ budget.
  - Two through the OISTER budget (one from April 2019).
  - One through a Kakenhi Grant budget (PIs: Doi & Maeda) (from Aprial 2019).

Kools-IFU on 3.8m

ファイバー型
可視光面分光装置

Kools-IFU on 3.8m



Grism	VPH-blue	VPH-red	VPH495	VPH683
# of Faibers	127			
FoV for 1 fiber	0.91’’ (diameter)			
FoV for all	14.8’’ (diameter)			
Filling factor	58%			
Wavelength	4000—8900 Å	5800—10200 Å	4300—5900 Å	5800—8000 Å
Resolution	~800	~800	~1200	~2000
Throughput	5.8%	(~6%)	3.4%	(~6%)

Limiting Magnitude w/ Kools-IFU

Glism	VPH-blue	VPH-red	VPH495	VPH683
Magnitude [AB mag]	19.8	19.5	18.6	18.9

Conditions:

- 1800 sec, S/N = 10, $\Delta\lambda$ = 10 Å (low-res) or 4 Å (mid-res) . 1 Å ~ 4 pixels.
- seeing: 1.5” → 95% flux in 7 fibers.
- Background: 19 mag arcsec^{-2}
- 5 pixel summation for the spatial direction.

CMOS multi-band Imager + spectrograph

- Fully funded and under construction (nominal PI: Maeda).
- Operational from 2020 (hopefully).
- Simultaneous observations with 3 arms:
  - Arm 1: g-band.
  - Arm 2: r-band.
  - Arm 3: I or z or y-band.
- Detector = CMOS (for Time Domain).
- ~ 0.3"/pixel, FoV ~ 6 x 11'.

- Future Option: NIR imager+polarimeter (funded: Nagata).
- Future Option: Spectrograph in each arm (fund raising).

Projects for Transients

- The transient science will be a collaborative work between Kyoto researchers and other Japanese researchers, but we are open (and seeking) for international collaboration as well.
- Especially, there has been lots of discussion between Kyoto and Tomo-e people (discovery and rapid follow-up), and also with the OISTER project (maximize the resources).