

A night landscape featuring a starry sky with long exposure light trails, a snow-capped mountain range in the distance, and a town with lights reflected in a body of water in the foreground.

Subaru Telescope

Director's Report

CFHTUM 2016

Nobuo ARIMOTO
Subaru Telescope

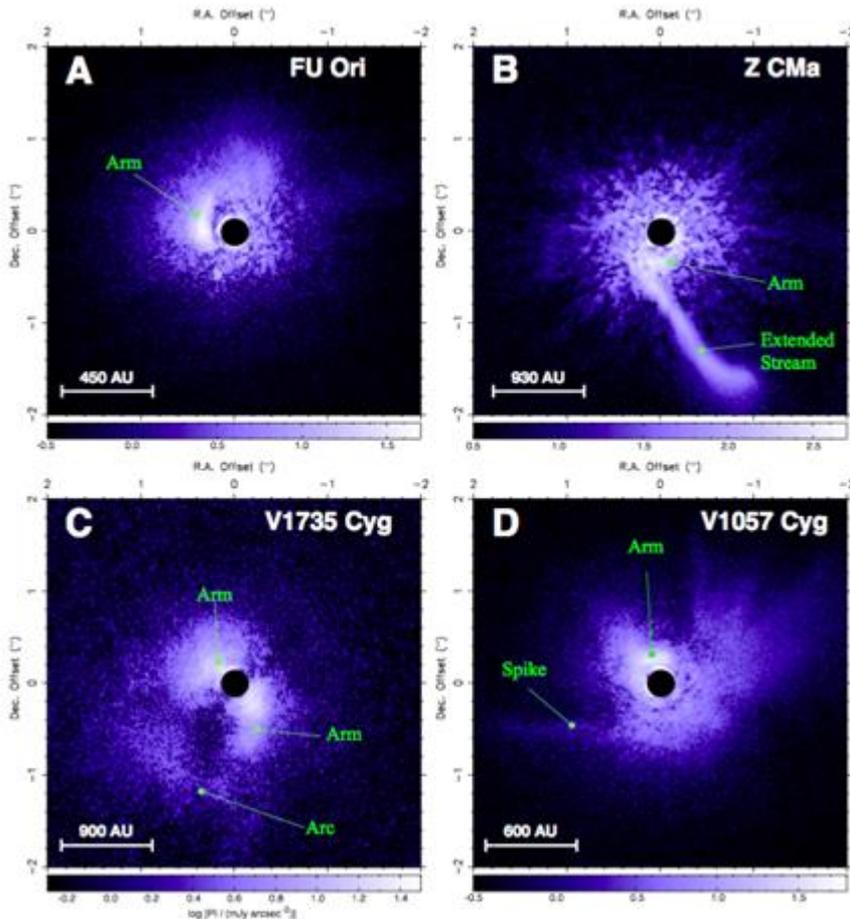
© H.Fujiwara (2015)



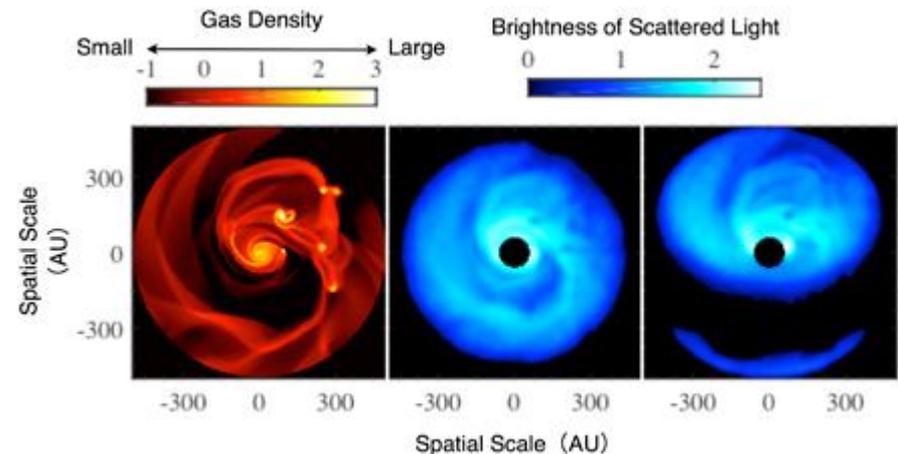
Subaru Telescope Science Topics

Subaru Telescope

Subaru-HiCIAO Spots Young Stars Surreptitiously Gluttonizing Their Birth Cloud (Liu et al. 2016)



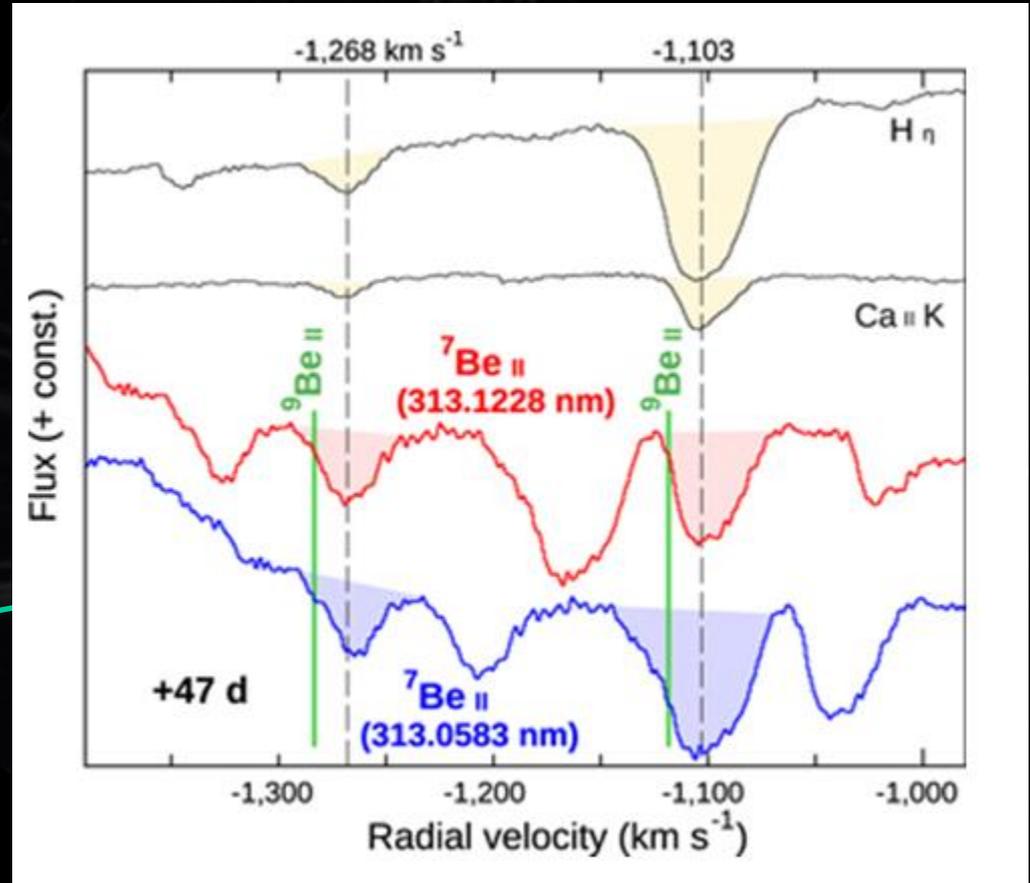
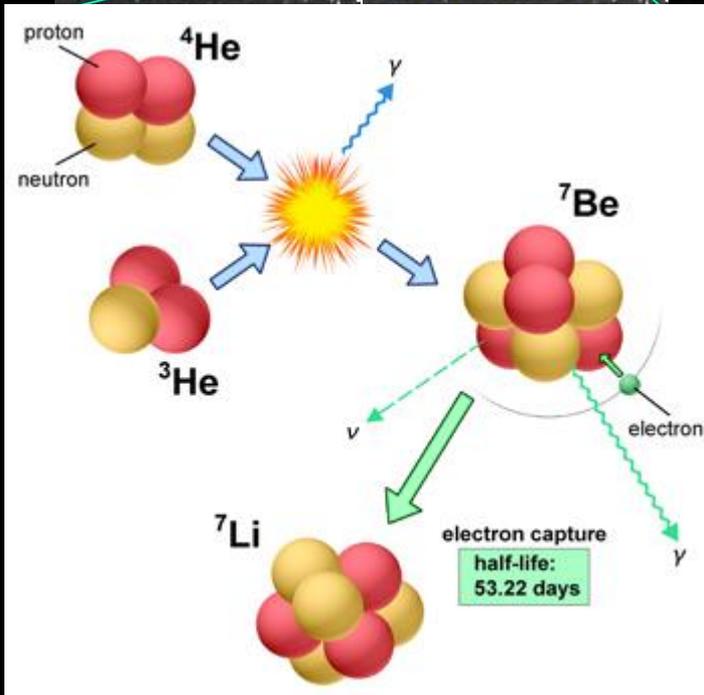
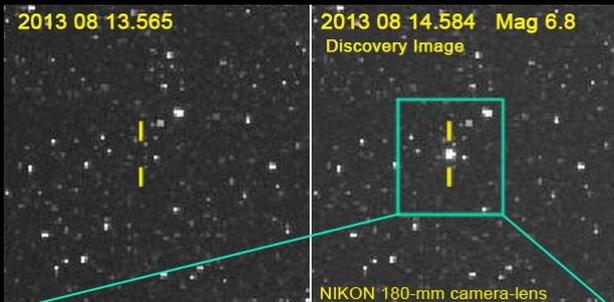
Images made from computer simulations based on one theory for violent growth of a star. (Left) Simulations of the motion of circumstellar materials falling onto a baby star. (Middle and right).



Circumstellar structures of young stars

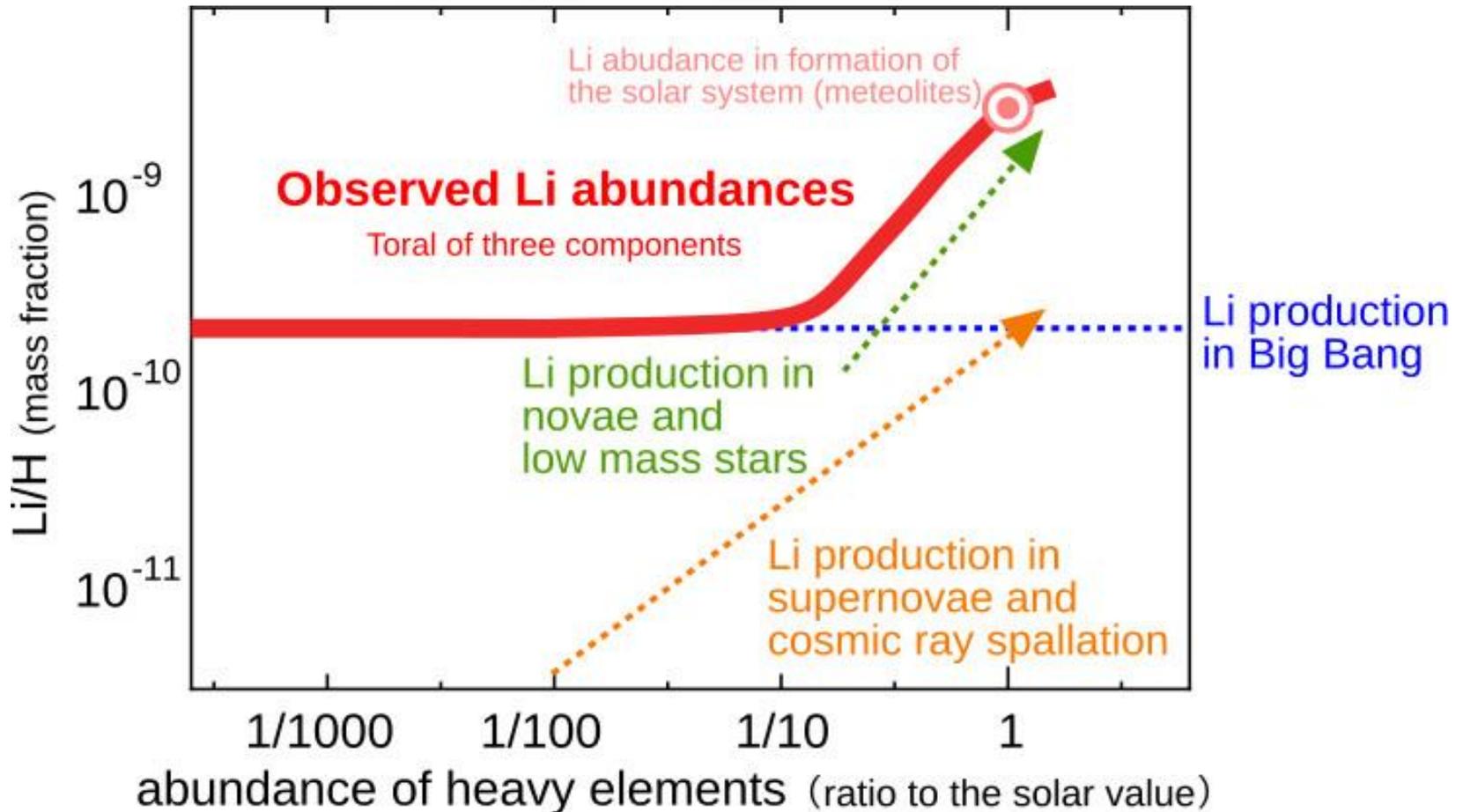
Subaru Telescope

Classical Nova Explosions are Major Lithium Factories in the Universe (Tajitsu et al. 2015)



Classical novae are strong candidates as suppliers of Li in the universe.

Schematic Evolution of Li^7 in the Universe



Subaru Telescope

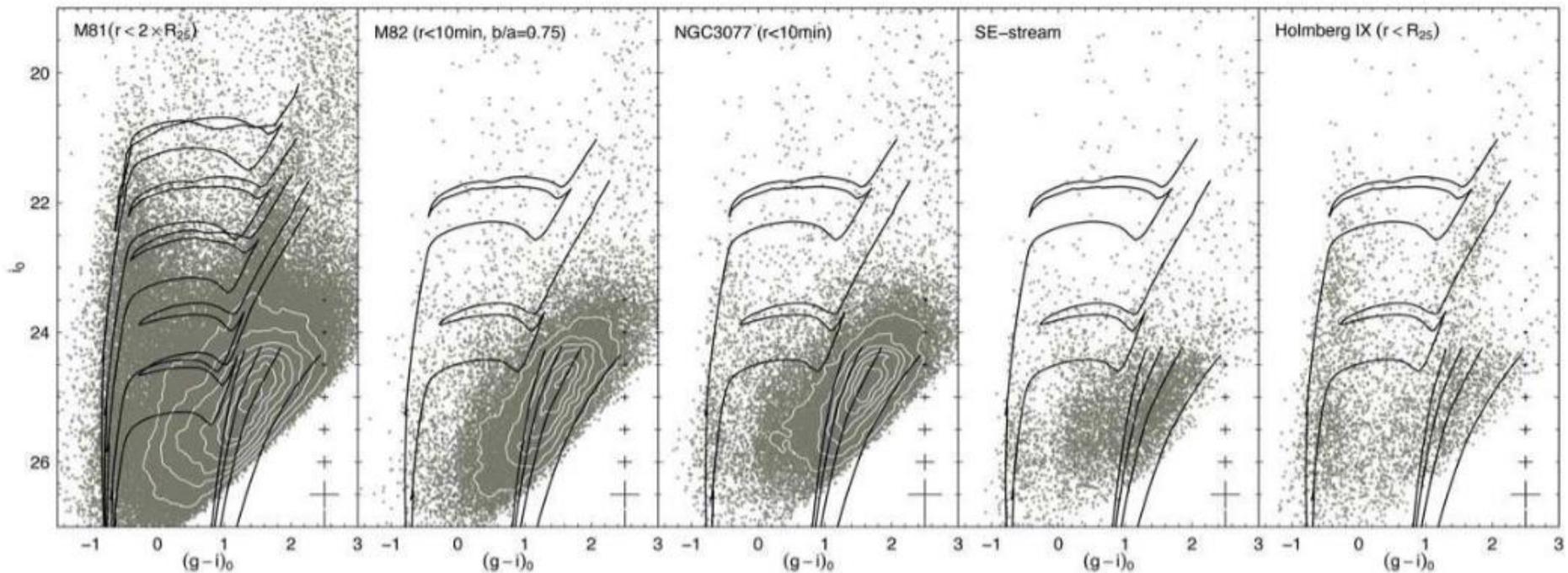
**The Ghostly Remnants of Galaxy Interactions Uncovered
in a Nearby Galaxy Group M81**

Okamoto et al. (2015)



Subaru Telescope

The Ghostly Remnants of Galaxy Interactions Uncovered in a Nearby Galaxy Group (Okamoto et al. 2015)



M81

M82

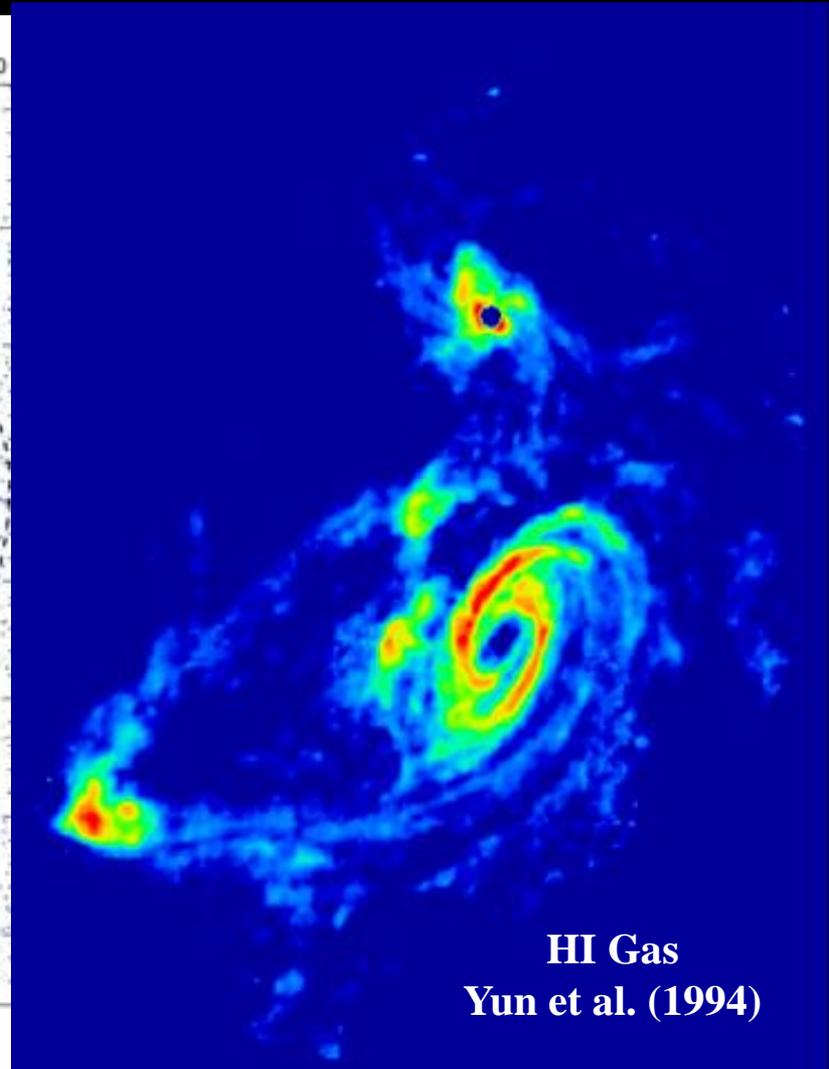
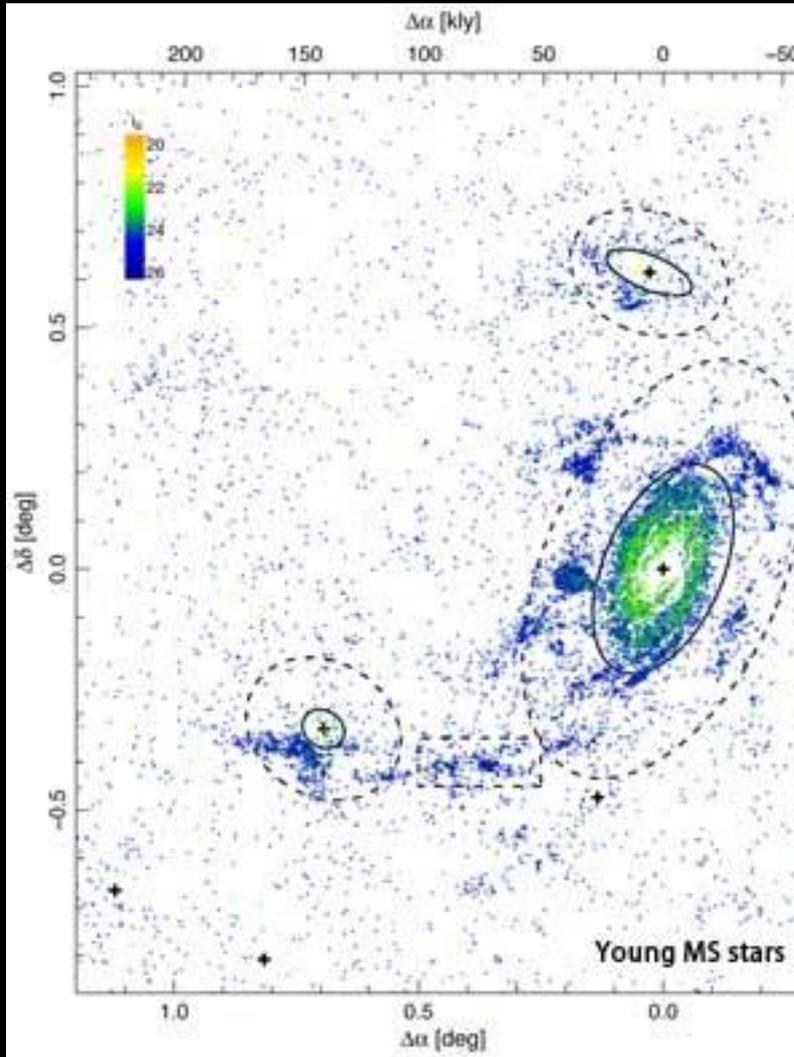
NGC3077

SE-stream

Ho IX

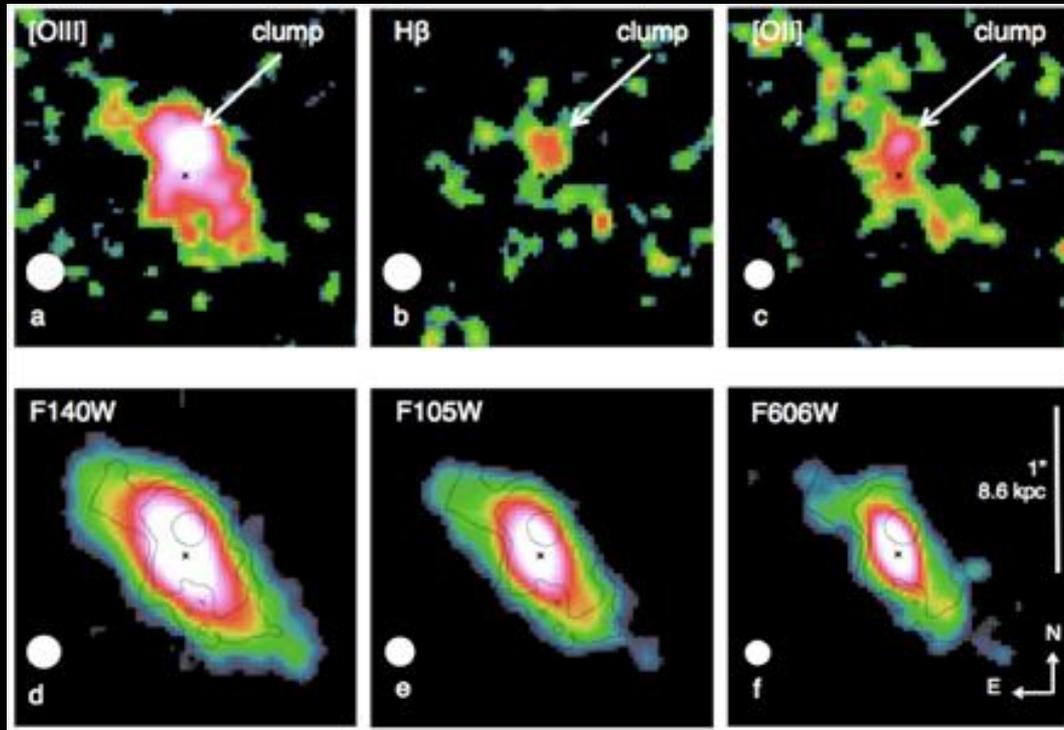
Subaru Telescope

Young main-sequence (MS) stars and red-giant branch (RGB) stars around M81, M82, and NGC 3077



Subaru Telescope

Discovery of an Extremely Young Stellar Clump in the Distant Universe (Zanella et al. 2015)



A group of French researchers discovered the birth cry of a massive star-forming clump in the disk of a very distant galaxy. This giant clump is less than 10 million years old, and it is the very first time that such a young star-forming region is observed in the distant Universe.

A

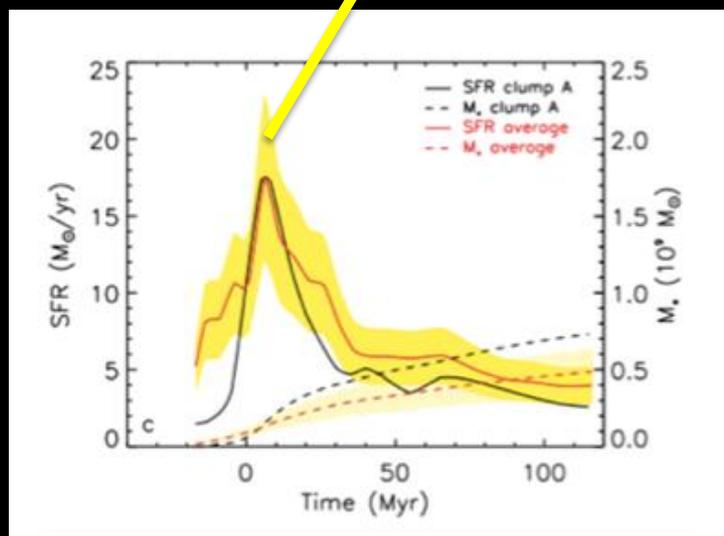
Bulbe

Etoiles déjà formées

A

Bulbe

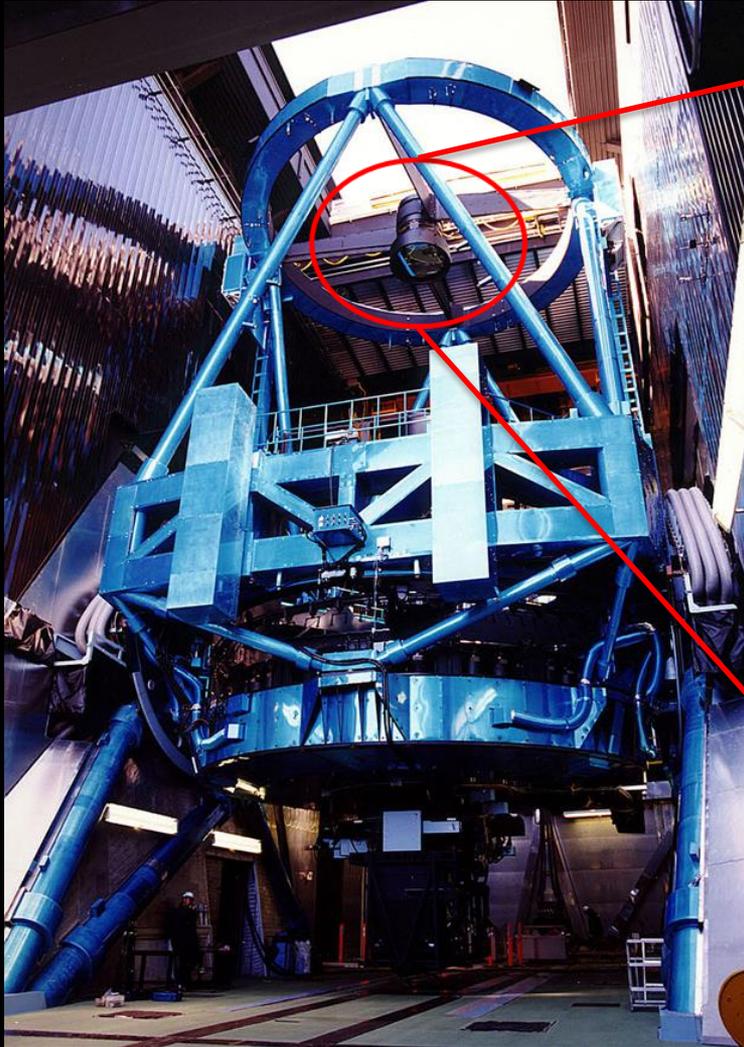
Etoiles en formation (SFR)





Subaru Telescope New Instruments

Hyper-Suprime-Cam (HSC)



HSC

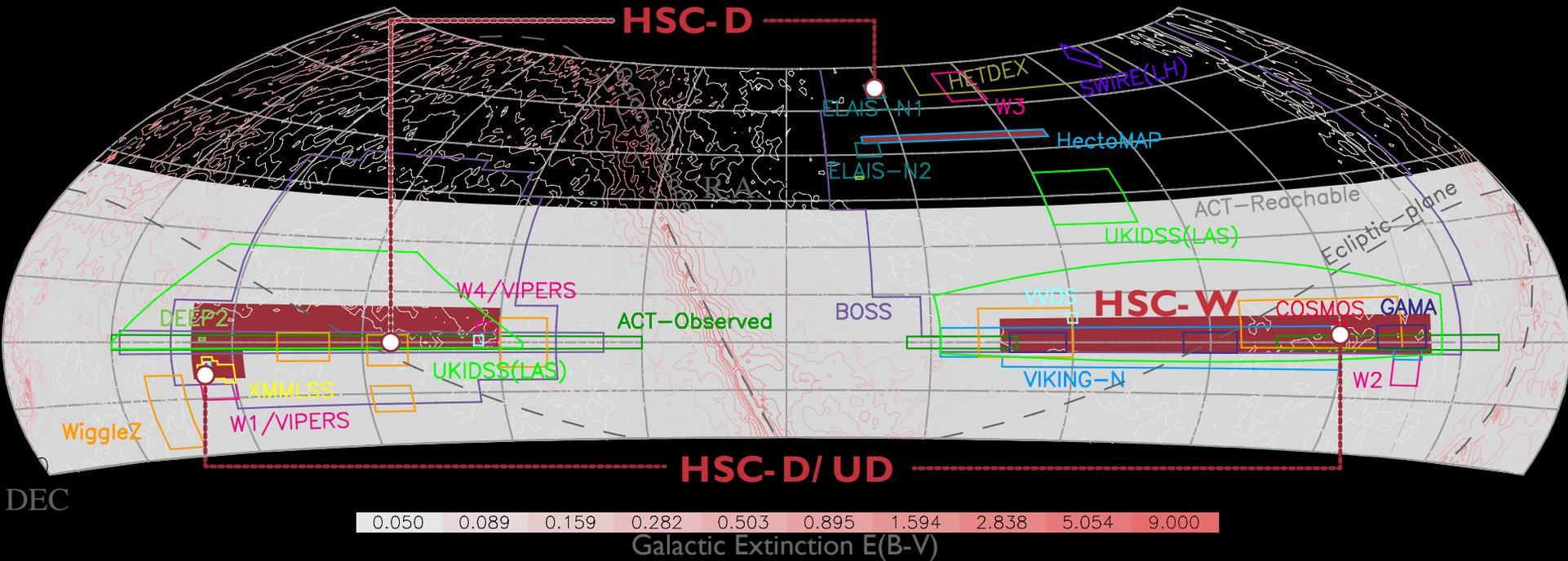
Wide Field

- Quicker, Wider



HSC
Field of View

HSC Survey Area



- **HSC Survey Area**
 - Include the previous surveys
 - Little absorption by dust
 - Observable whole year

**Subaru Strategic Program
2014–2018
300 Nights**

Prime Focus Spectrograph

PFS

... in Prime focus unit "POpt2" with Wide Field Corrector "WFC".

Spectrograph system (SpS)
On the forth floor

Tertiary mirror floor (IR side)

4 spectrographs

Fiber cable

Fiber cable

Prime Focus Instrument

Wide-field corrector



2400 fibers steered by positioners

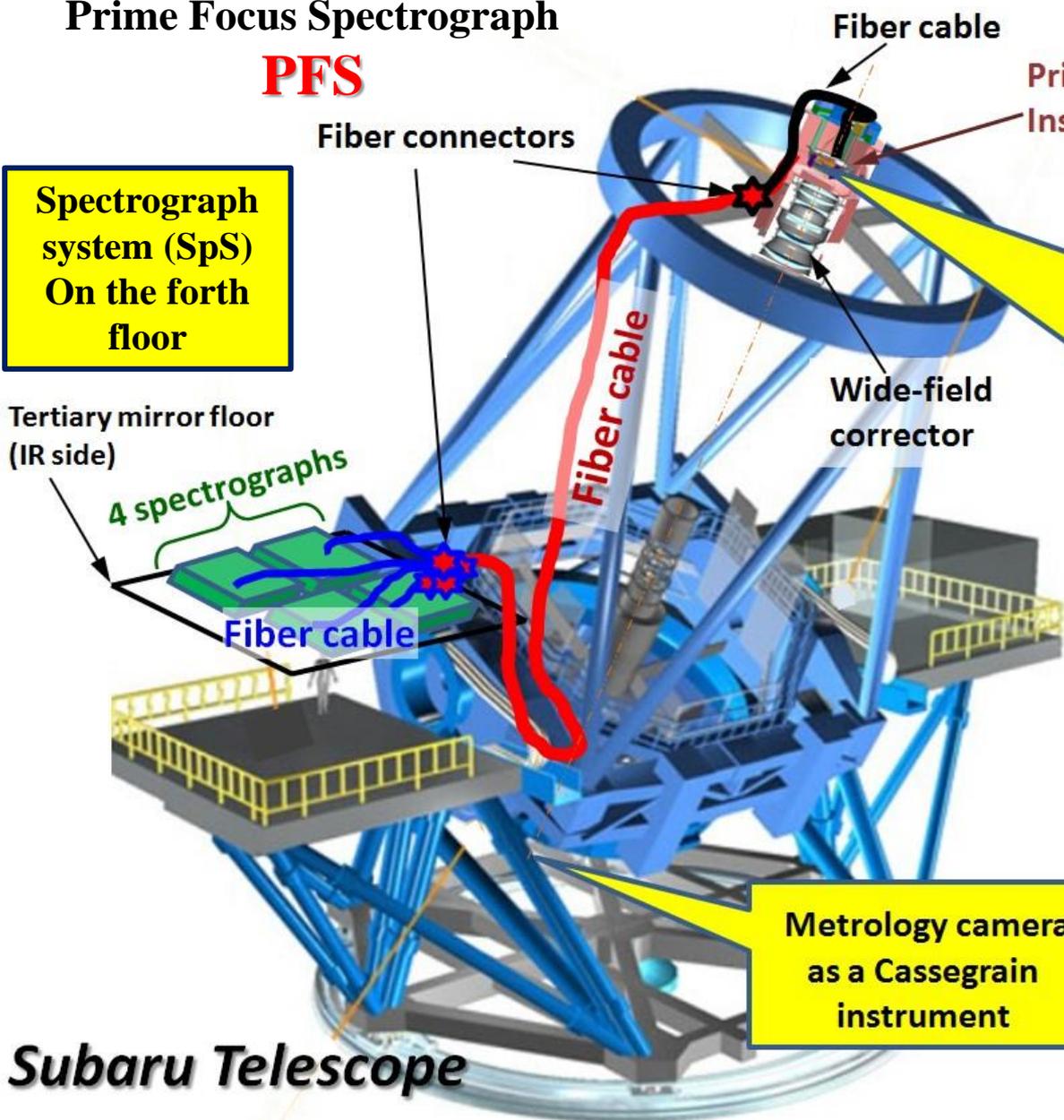
POpt2 & WFC will be shared with Hyper Suprime Cam (HSC).

Metrology camera as a Cassegrain instrument

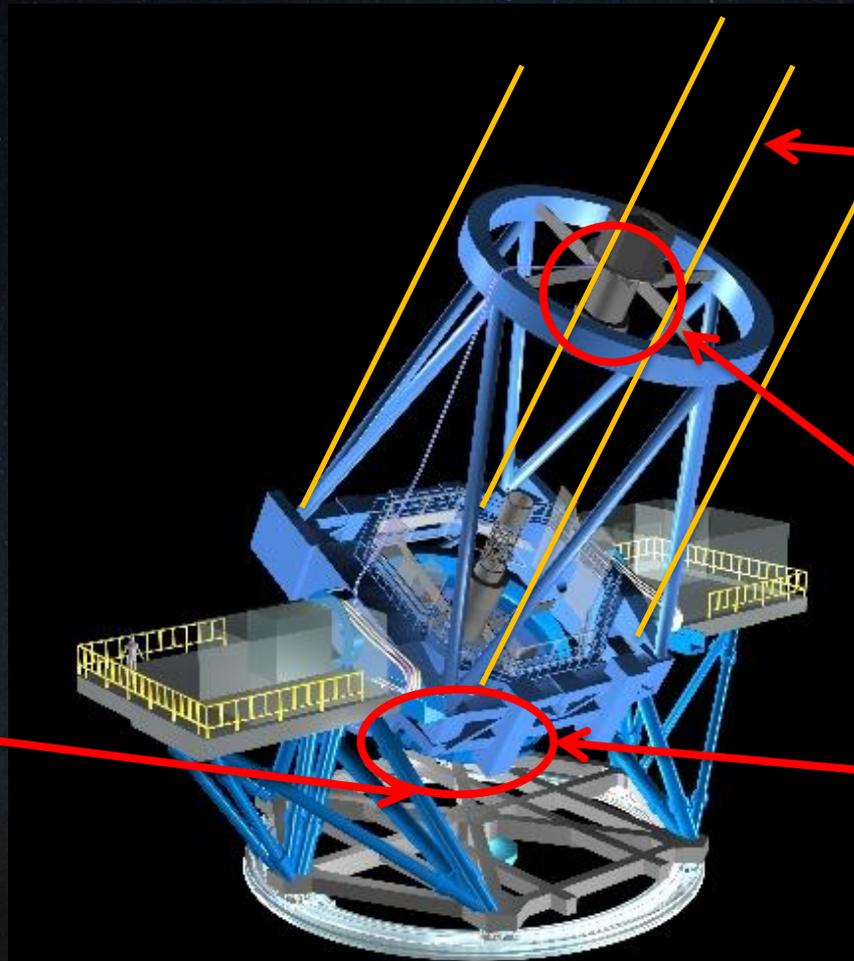
Software system

Calibration system

Subaru Telescope



ULTIMATE (GLAO)-Subaru



4 Lasers
(side irradiation)

**Deformable
secondary
mirror**

**Wave front
sensor**

NIR inst.

**14' FoV
Wide-field Camera**

Science of ULTIMATE Subaru

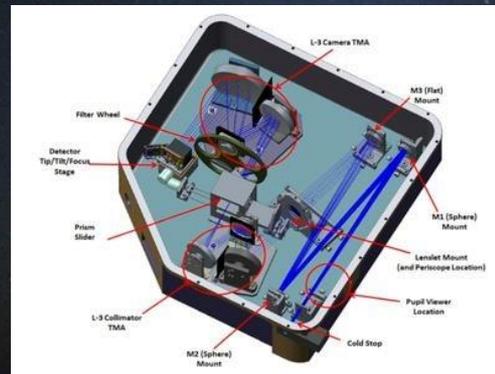
- Dissect the Galactic Evolution of the Golden Age
 - Sample of a few 1000 galaxies at $1 < z < 3$ - morphology, dynamical structure, physical parameters, environmental effects, internal motion of stars/gas, AGN contribution, heavy elements distribution
- Discover Galaxies at the Edge of the Universe
 - Search for highest-redshift galaxies with highly sensitive narrow band imaging ($z > 10$)
 - Discover galaxies at $z > 7.5$, physical process of cosmic re-ionization
- → **Subaru Original Samples for TMT**
 - Sampling of the most interesting targets cannot be done by HSC + PFS alone.
- Improvement of Telescope Performance - contributing to various science

PI-type Instruments for Exoplanets

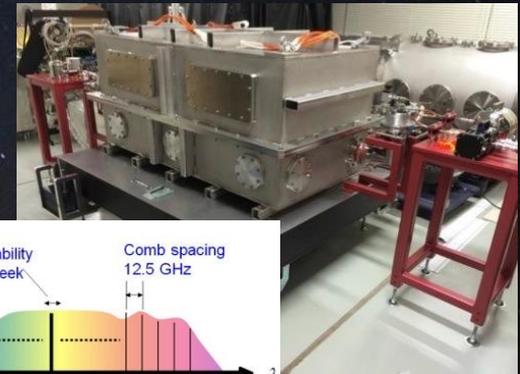
- **SCE_xAO: Coronagraphic Extreme-AO (direct imaging)**
- **CHARIS: Integral Field Spectrograph (discover and characterization)**
- **IRD: Near-IR High-dispersion Spectrograph (Earth-mass planets around M-dwarfs)**



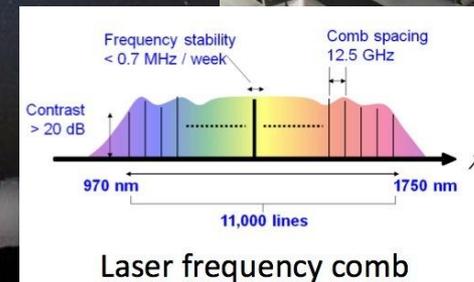
SCE_xAO



CHARIS



IRD



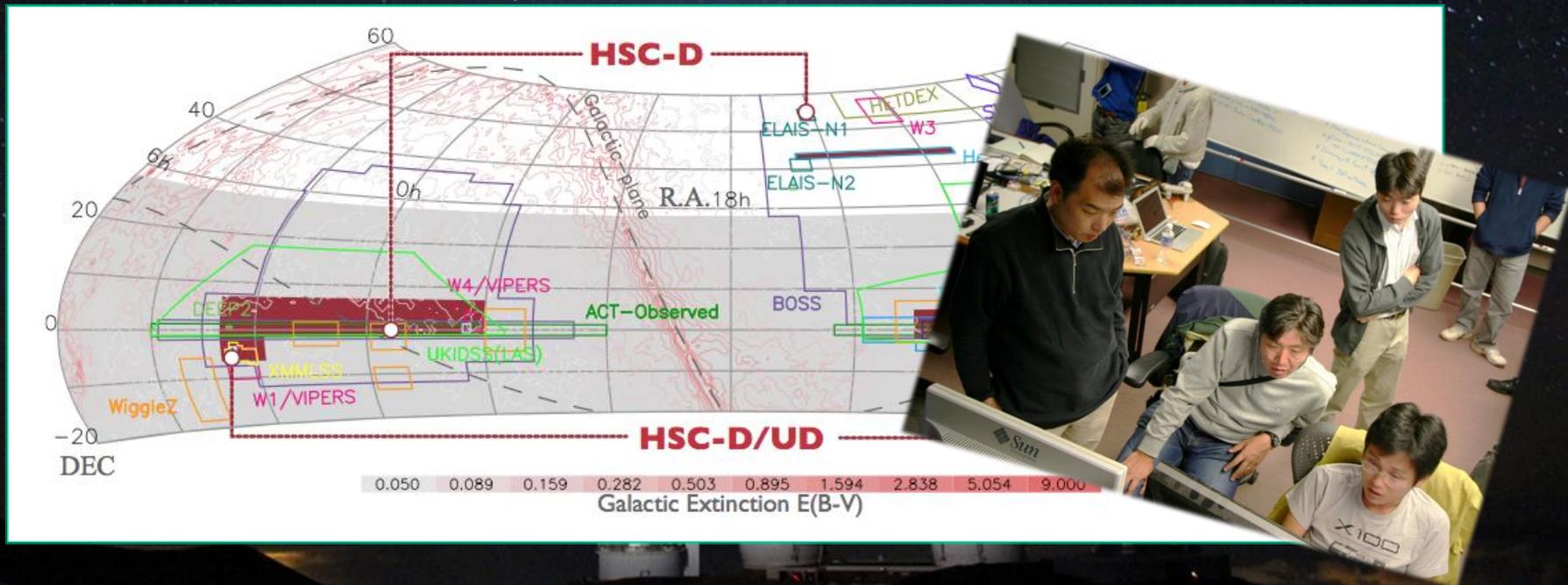
Subaru SSP ③

HSC Subaru Strategic Program

“Wide Field imaging with Hyper Suprime-Cam”

“Cosmology and Galaxy Evolution”

S.Miyazaki (PI) 300 nights (2014 - 2018)



Subaru SSP ④

IRD Subaru Strategic Program

“Search for the Earth in Habitable Zone

T.Kotani (PI) 150 nights (2017 - 2021)



1. Detection of habitable Earth-like planets around nearby M dwarfs

- Minimum Success
 - Detection of at least 1, one Earth-mass planet in their HZ
- Full Success
 - Unveiling frequency and properties of habitable Earth

Number of Detection



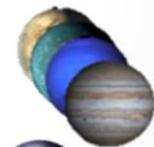
× >1



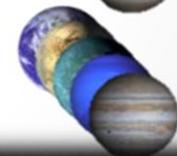
× >10

2. Statistical understandings of planet formation around low-mass stars

- Minimum Success
 - 25 > Super-Earth - Jupiter-mass planets around low-mass stars
- Full Success
 - 50 > planets including Earth-mass planets



× >25



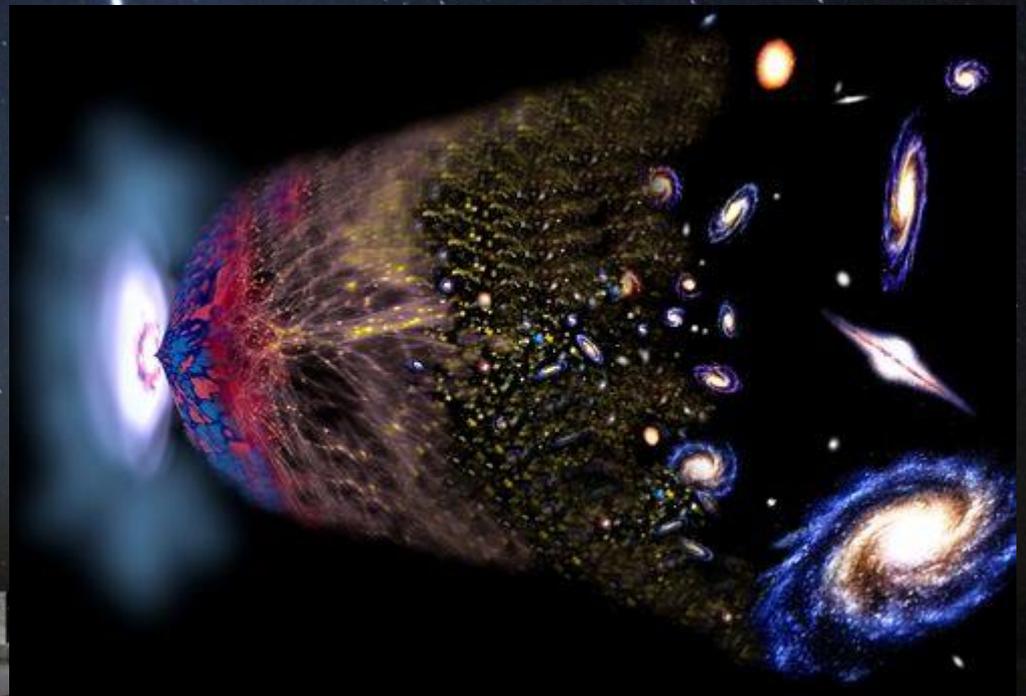
× >50

Subaru SSP ⑤

PFS Subaru Strategic Program

“Cosmology, AGN & Galaxy Evolution,
and Galactic Archaeology”

H.Murayama (PI) 300 nights (2019 - 2023)



Next Subaru SSP ?

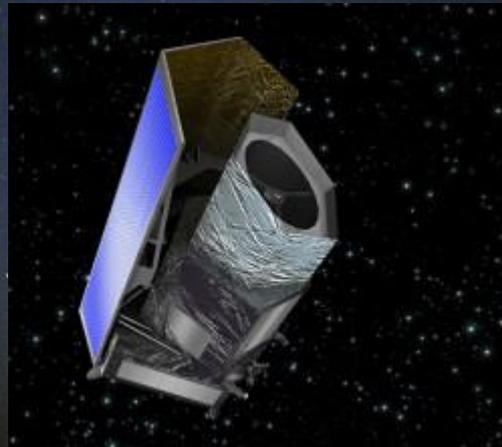
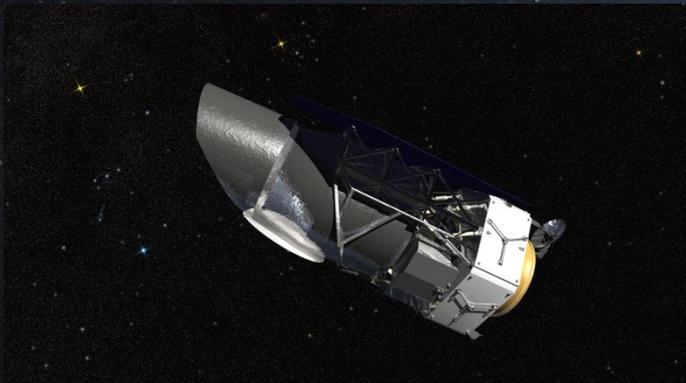
Subaru Strategic Program

“Synergy with the Space Missions”

T.Yamada (PI) WFIRST 100-400 nights (2025 – 2030)

Euclid 100 nights (2019 – 2022)

N.Narita (PI) TESS 40 nights (2017 – 2020)



Keck/Gemini Time Exchange

Gemini-N/S
minimum 5 nights

Keck-I several nights
Keck-II several nights
LGS-AO maximum 2 nights

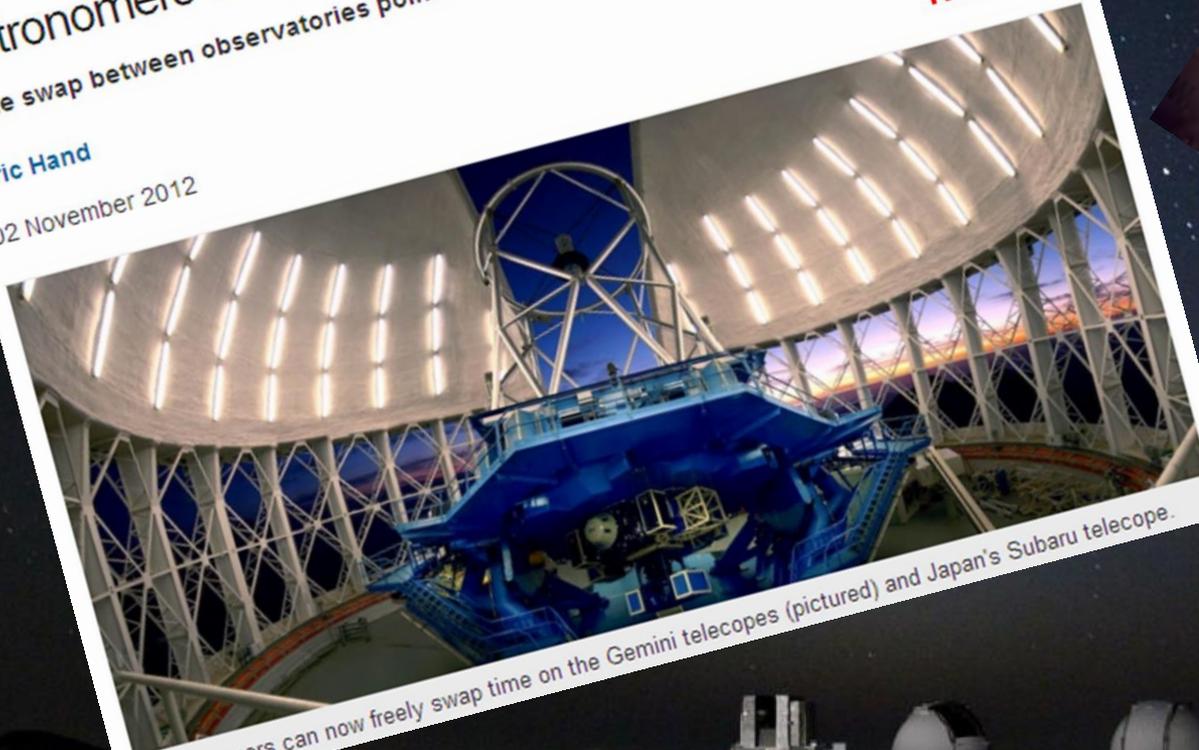
Astronomers set up telescope timeshare

Time swap between observatories points to closer collaboration among large telescopes.

Nature

Eric Hand

02 November 2012



Astronomers can now freely swap time on the Gemini telescopes (pictured) and Japan's Subaru telescope.



Time Exchange with Gemini

Subaru users will be allowed to apply for time through Gemini's monthly Fast Turnaround scheme (URL). The scheduled time will be recorded throughout a semester and added to the time offered on Subaru to Gemini users in the subsequent semester(s).

Subaru and Gemini will enable large/intensive programs from each other's community through their respective schemes and applying through their respective time allocation committees.

Keck Strategic Meeting

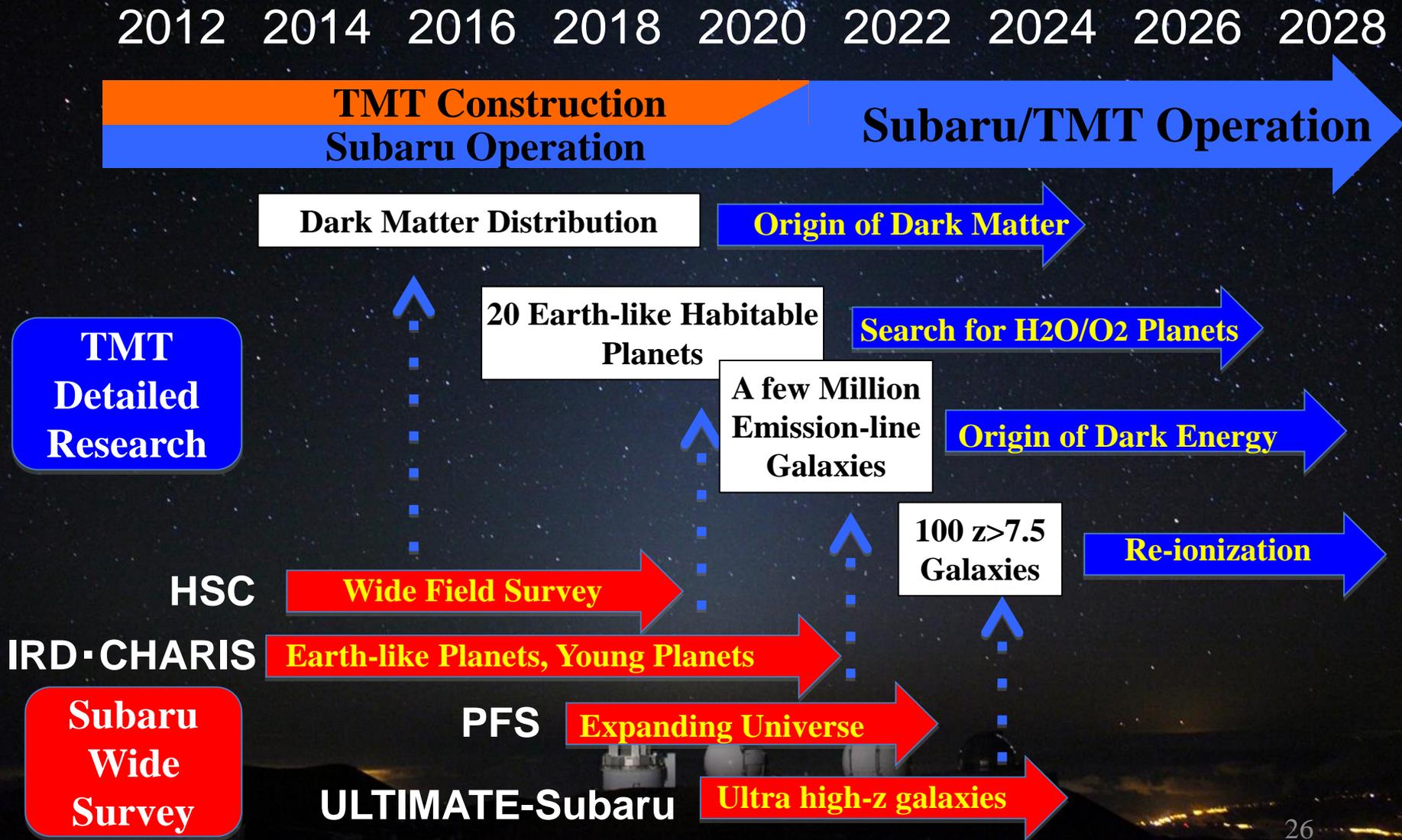
2014/09/28-29@California

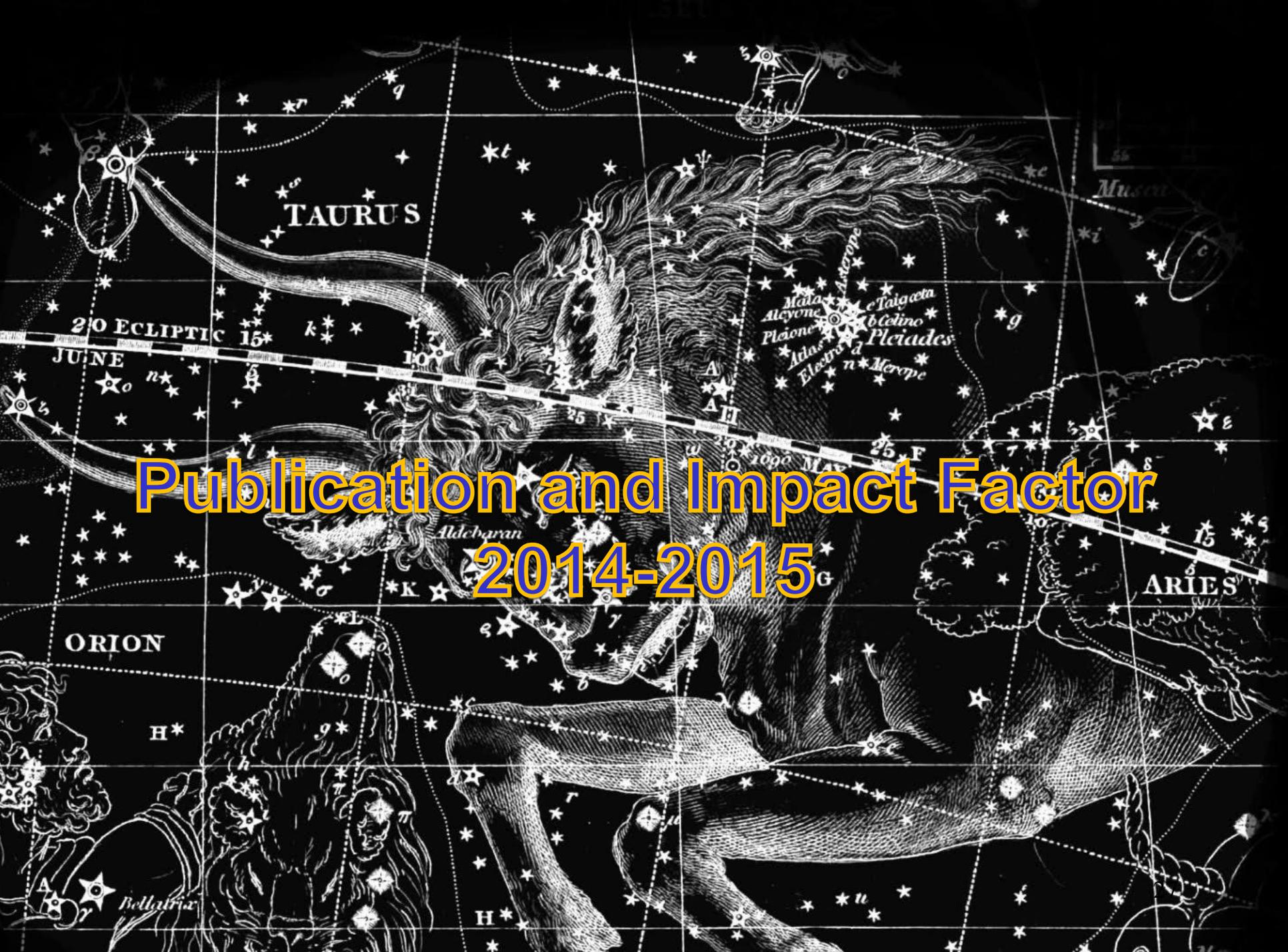
Subaru – Keck Synergy Meeting

2015/01/16 @ NAOJ

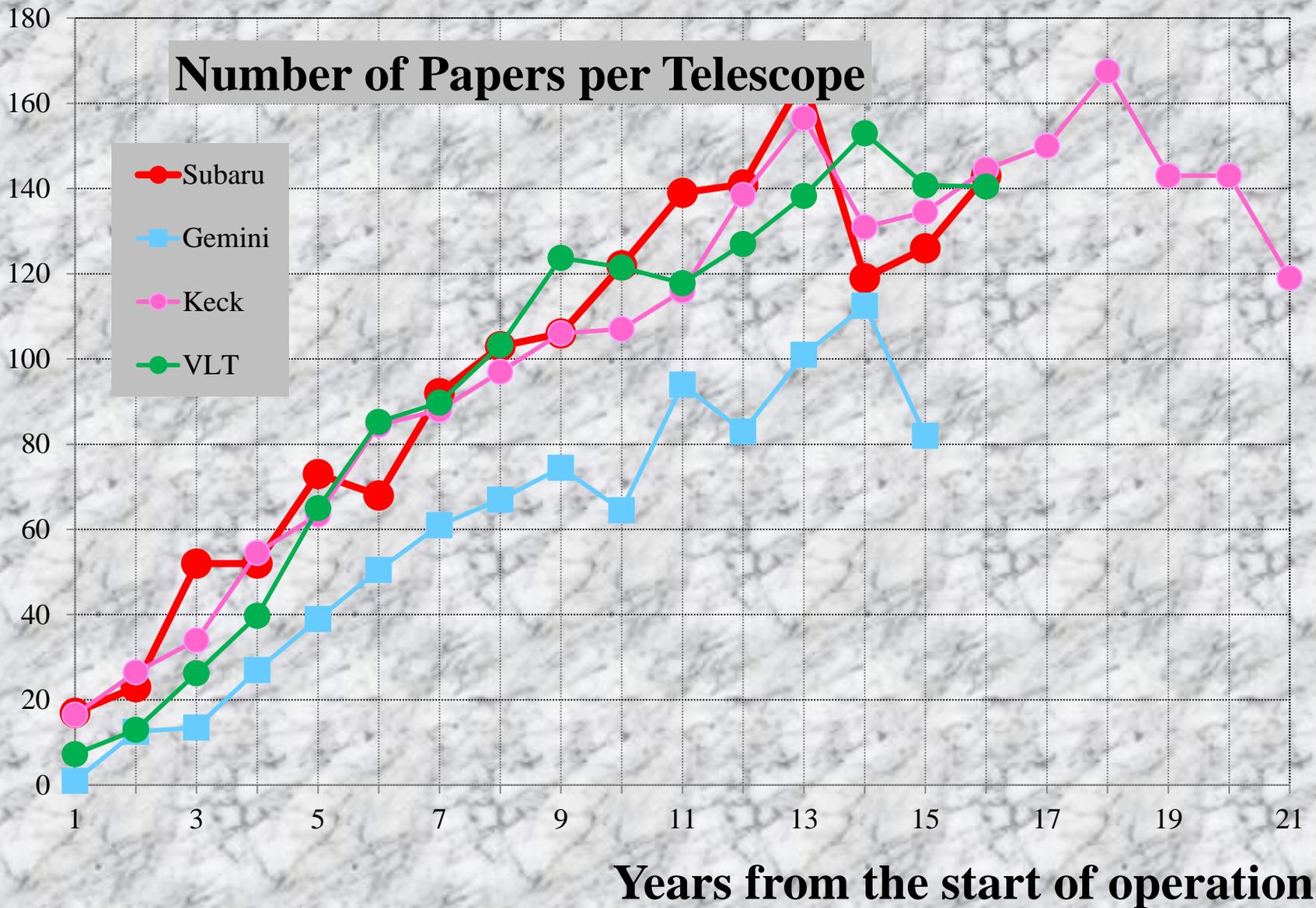
- **Increase time exchange nights to 20 nights maximum per semester**
- **Promote collaborative research projects by Subaru and Keck**
- **Develop instruments jointly**
- **Provide opportunities to deepen two communities' mutual understanding**

Strategy of Subaru

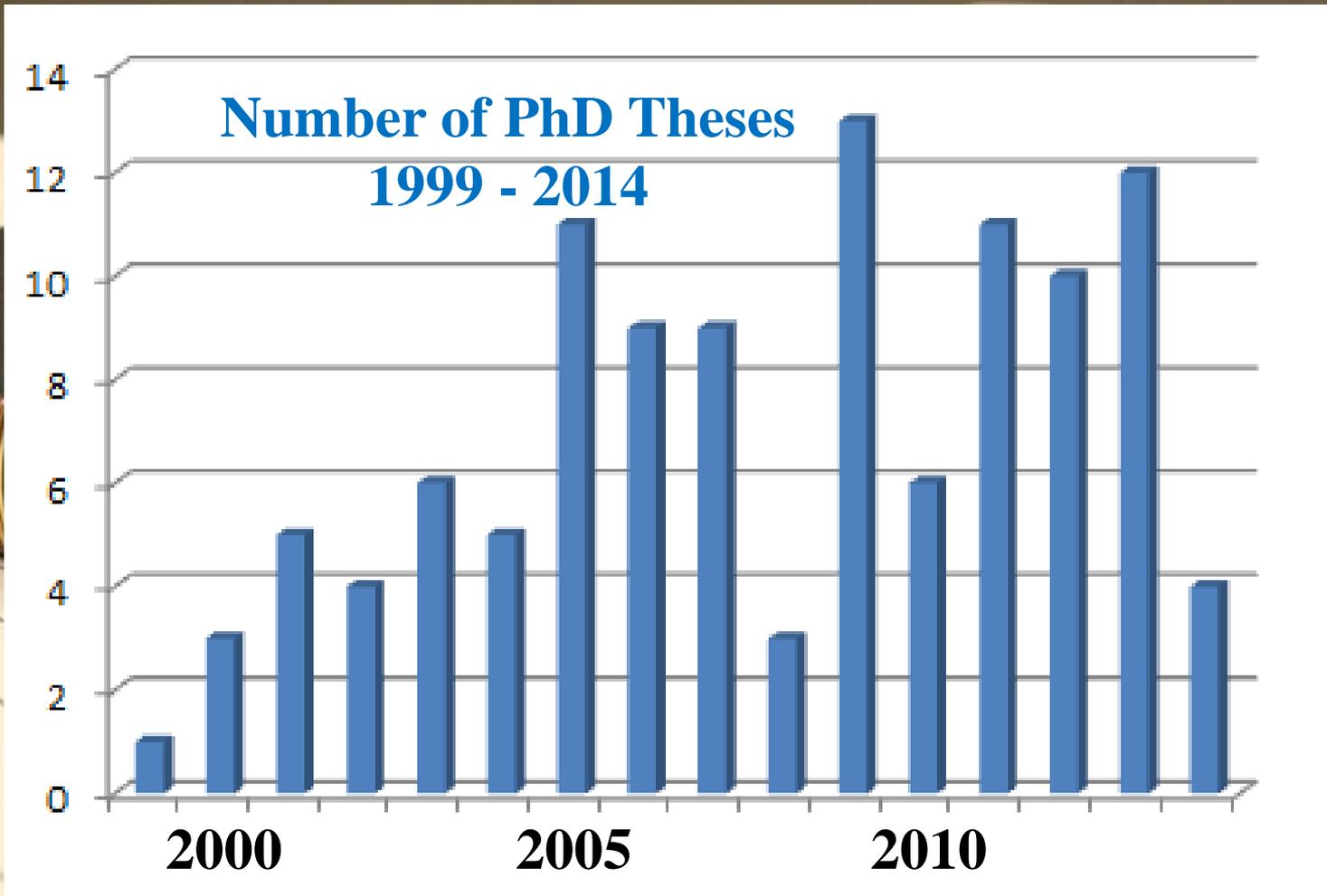




Publication and Impact Factor 2014-2015



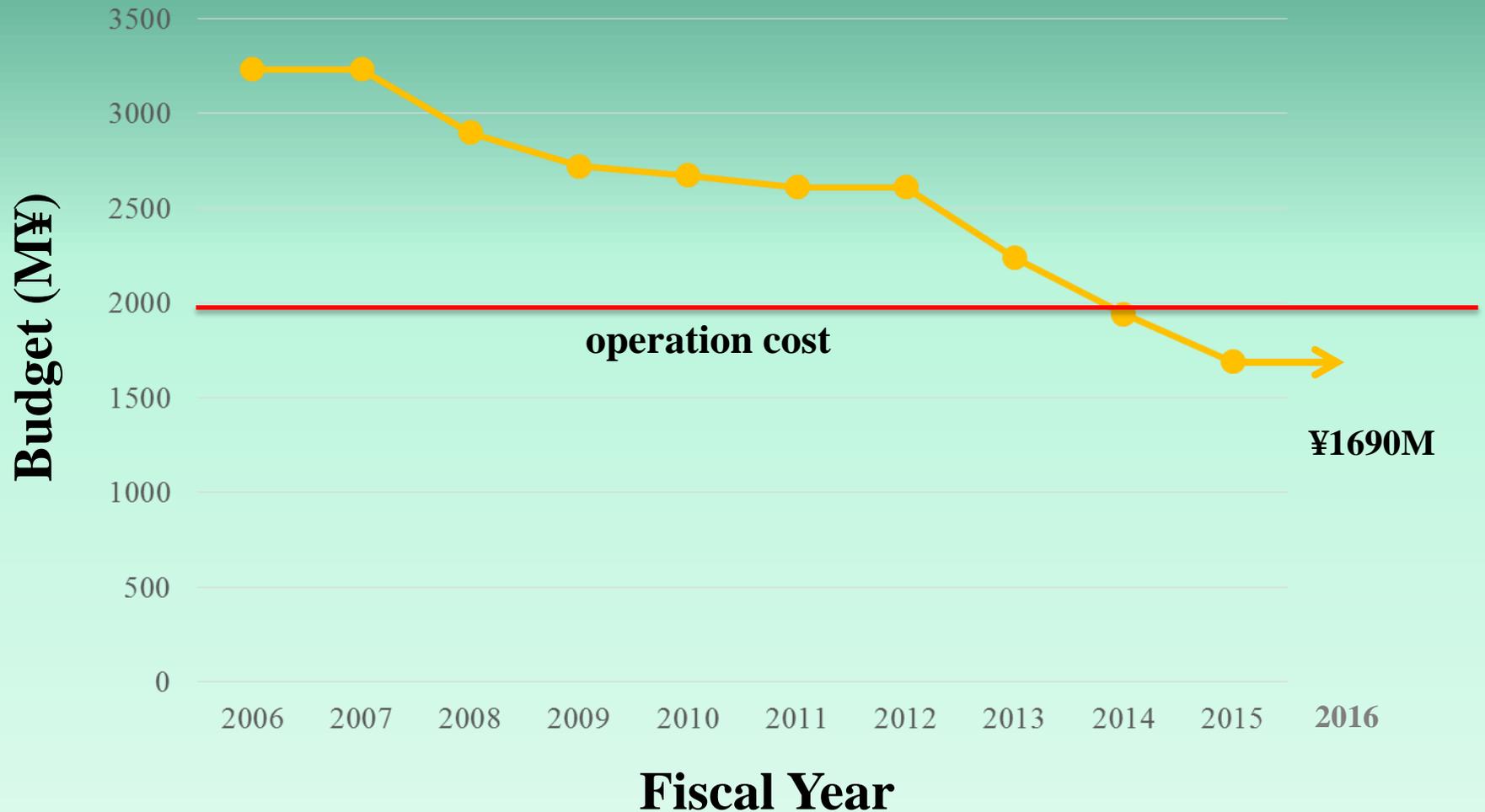
PhD Theses (1999-2014)





DARK CLOUDS AHEAD

Subaru Telescope's Budget Allocated by the Japanese Government



International Cooperation



Decision Making

Current Subaru



Subaru Director



SAC @ Odawara



NAOJ Director General

Decision Making Process

beyond 2018



community



SUBARU BOARD



STC Chair



Subaru Director

-- Subaru Strategy for 2020's -- Space-Ground-Person

2016.1 SUM

