# International Participation for WFIRST: Japanese Perspective

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#### In 2015

 March: WFIRST SDT Final Report (NASA)
 Potential interest of Japanese contribution was presented.

September: A Letter from Director Paul Hertz
 -- asking Japanese interests formally --

 December: WFIRST Working Group formed in Japan Science contact: T. Yamada(ISAS/JAXA), T. Sumi (Osaka U), M.Tamura (U Tokyo/NAOJ) Programmatic contact: Prof. M. Fujimoto (ISAS)

#### Potential Japanese Contribution Package

1. Subaru WFIRST Synergy Observations with HSC/PFS

2. Providing Polarimetry Unit for Coronagraph (Optional: Polarimetry Compensation Unit)

3. Ka-band Data Downlink Station in Japan

4. Coordinated Ground-based Activities

Subaru WFIRST Synergy Observations with Hyper Suprime-Cam (HSC) and Prime Focus Spectrograph (PFS)

#### Hyper Suprime-Cam (HSC)

Nearly 1/3 Survey Speed of LSST
D = 8.2 m FOV phi=1.5 deg
Instrumental PSF 0".3
Mostly seeing limited imaging at Mauna Kea

- High QE in Red (40 % @ 1 micron)

- Operational since 2014/03

#### Sample Image from HSC Survey Wide



3 hours to cover ~ 20 deg^2

#### On-Going HSC Strategic Survey

Layer	Depth	Total Area	Ttime total	fields
DEEP	g < 27.5, r < 27.1 i < 26.8, z < 26.3, y < 25.3	26.9deg <sup>2</sup>	9.9h / 1.8deg <sup>2</sup> FoV	ELAIS N1 eCOSMOS, XMM-LSS, DEEP2-3
WIDE	g < 26.5, r < 26.1 i < 25.9, z < 25,1, y < 24.9	~1400 deg <sup>2</sup>	1h / 1.8deg² FoV	Equator
Ultra Deep	g < 28.1, r < 27.7 i < 27.4, z < 26.8, y < 26.3	3.6deg <sup>2</sup>	66h / 1.8deg² FoV	UDS COSMOS

Well calibrated stable data by 2024
 Unique Narrow-Band filter observations



- Wide field: ~1.3 deg diameter
- Highly multiplexed: 2400 fibers
- Quick fiber reconfiguration: ~60-90 sec (TBC)
- Optical-NIR coverage: 380-1260nm simultaneously
- Developed by *international* collaboration, under the initiative of *Kavli IPMU*

Schedule

 Aiming to start science operation from 2019, as a facility instrument on Subaru.

# Uniqueness of Subaru

 Earlier: HSC, before LSST is stably operated
 Deeper: HSC, before LSST sky is deepened by recurrent observations
 Wide-field Spectroscopy with PFS
 HSC Narrow Band Filters

Northern Hemisphere



# Subaru WFIRST Synergy Observations with HSC/PFS

Subaru deep and wide optical photometry and spectroscopic data ready by the time of launch Useful for WFIRST early sciences

Calibration of photo-z (PFS)

Narrow-Band (HSC)

# Notes

Japanese Subaru community is very positive and supportive 2015/12 Presentation at Subaru Advisory Committee 2016/01 Presentation and Discussions in Subaru Users' Meeting (w/ J. Rhodes) 2016/04 focused workshop is planned (Tokyo) Plans under discussion WFIRST Synergy Survey in 2020's - HSC SSP Survey Data (public by middle 2020's) - PFS SSP Survey Data (partially public by 2024) - New Survey coordinated with HLS/SNe Deep Part of WFIRST field is welcome to the North WFIRST Specified Time Allocation

#### Notes: We need,

# Close discussions with Subaru community SAC / UM Initiative of Subaru Telescope

It is not easy to secure a certain large number of nights in the middle of 2020's NOW.

 Collaboration with HSC / PFS SSP (international) team already formed

## 2. Polarimetry Capability for WFIRST Coronagraph Instrument



#### Polarized Light from Planets and Disks

# Development for Polarization Compensation System

![](_page_13_Figure_1.jpeg)

#### Ka and S-band Ground station in Japan

WFIRST orbit

- Inclined geosynchronous: High Data rate to a dedicated ground station
- L2: Thermal stability. Lower radiation. Need multiple science downlinks per day
- If L2 chosen, Japan can provide
  - Ka-band (26GHz) Data downlink (need 270Mbps daily in 11.5hr)
     New Usuda station 54m class (operational in 2019).
     (need to add 26GHz capability which is not in current plan)
  - S-band uplink/downlink for navigation and emergency contact enhancements

 $\rightarrow$ Existing Uchinoura station 20m, 34m

![](_page_14_Picture_8.jpeg)

Uchinoura 20m

![](_page_14_Picture_10.jpeg)

Uchinoura 34m

# **Potential Japanese Contribution Package**

#### 3. Ka-band Data Downlink Station in Japan

#### Ka and S-band Ground station in Japan,

Ground stations in Japan can compensate currently planned

- Existing Near Earth Network (NEN) S/Ka band 18 m antenna at White Sands
- New ~12 meter antennas at Punta Arenas

Especially important for microlensing exoplanet search and any other high data rate GO program

![](_page_16_Figure_5.jpeg)

## 4. Coordinated Ground-based Activities

#### Microlensing Survey for Exoplanets

- Development of WFIRST Data Reduction Pipeline
- HSC/Subaru multicolor imaging of potential WFIRST target fields for Preselection of the Target Fields

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- Plan for 1.8m IR Telescope at SAAO for Precursor IR microlensing survey for better WFIRST field preselection and Concurrent observation for lens mass measurements via microlensing parallax.
- Ground-based High Contrast Observations
  - Observing WFIRST targets
  - Spectroscopy
  - Longer Wavelength
  - Monitoring

#### Summary

We are interested in WFIST project and would like to contribute by

- Subaru Wide Field Imager/Spectrograph
- Polarimeter Unit for Coronagraph
- Ka-band downlink Station
- Coordinated ground-based activities

Discussions underway by the leadership of ISAS/JAXA in collaboration with Japanese universities and institutes.