Subaru and Roman Space Telescope

Goal:

- share Roman status
- share Synergistic observation status
- Discussion
  - Compatibility with PFS SSP after 2027
  - Balance of Dark/Bright night
  - Front-loading
  - Expanding Keck exchange time?

<agenda>

Roman Status:	Sumi	5min
Synergy WS intro:	Sumi	5min.
Subaru schedule:	Koyama	5min.
Synergy WS result:	Sumi	10min.
Discussion	Yamada	15 min.

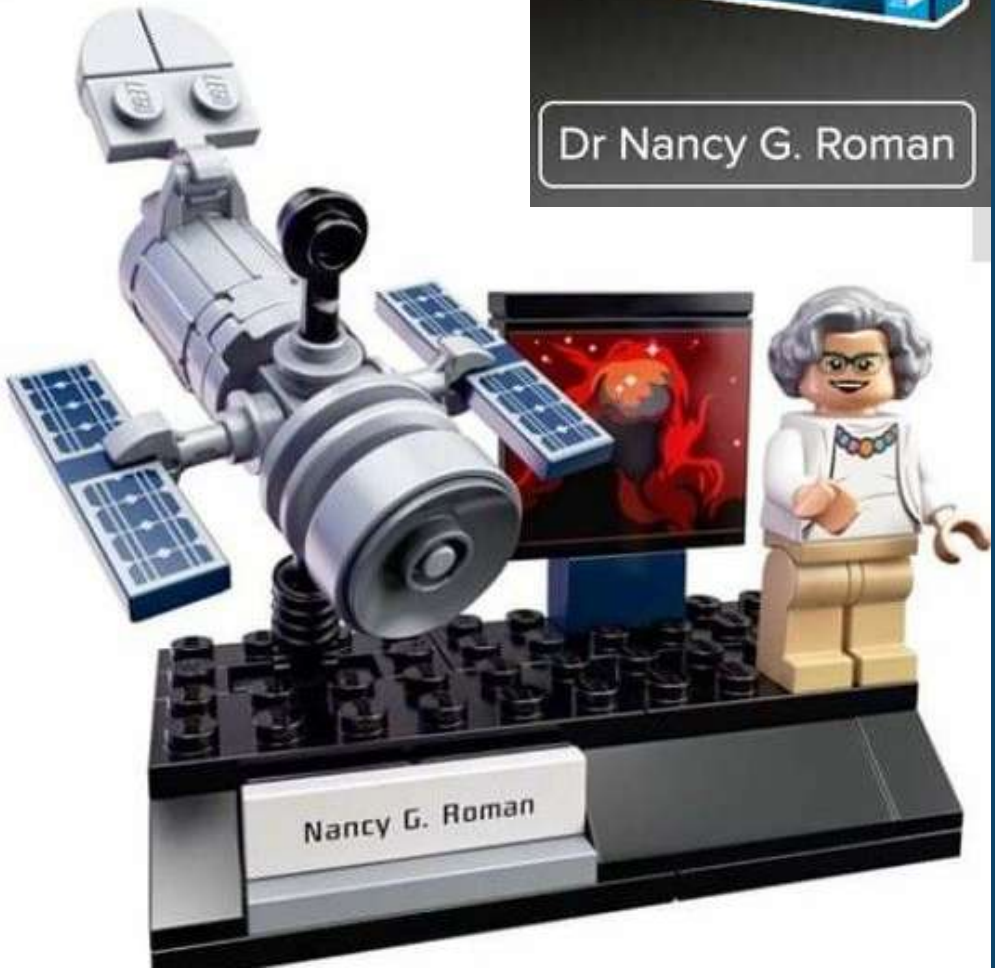
Takahiro Sumi (Osaka U.) and JAXA Roman team

2021/3/5, Subaru Users Meeting FY2020 @online

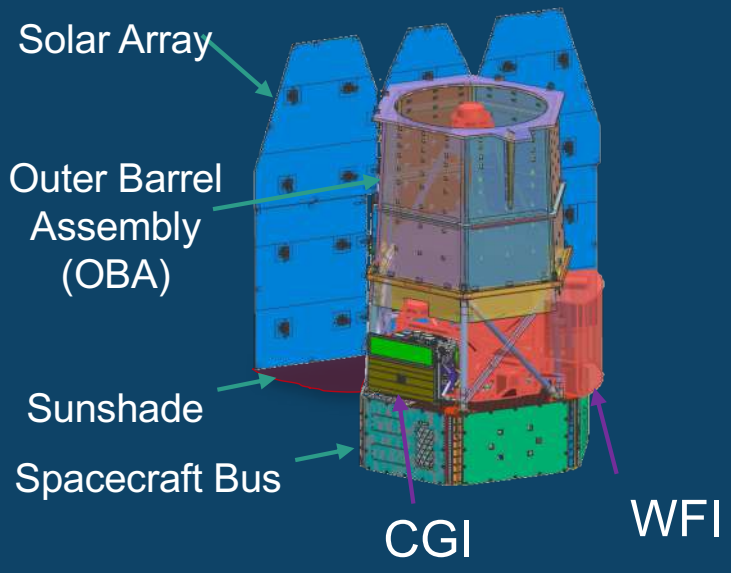
Nancy Grace Roman Space Telescope

(May 2020 NASA renamed from WFIRST)

Nancy G. Roman became NASA's first Chief of Astronomy in1959. known as the "Mother of Hubble" for her foundational role in planning the Hubble Space Telescope.



Roman Space Telescope



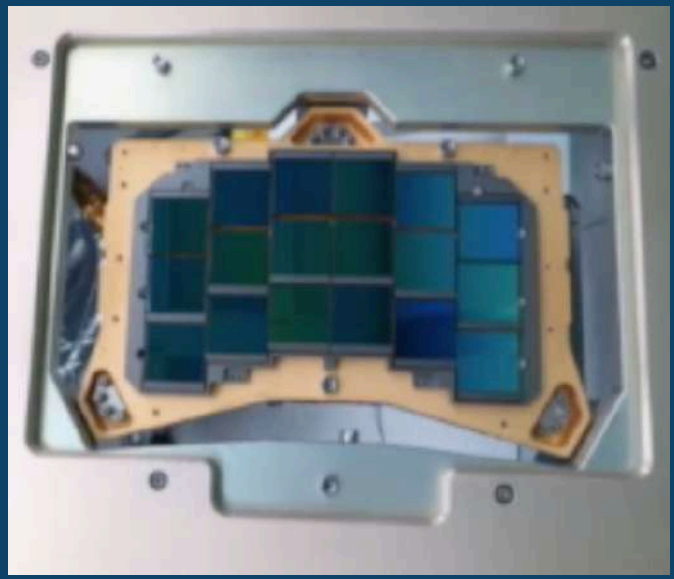
Diameter: 2.4m
Wavelength: λ =0.6−2.3 μ m
Wide Field Inst. (WFI) (FOV:0.281deg.^{2})
Coronagraph Inst. (CGI)(tech demo)
Orbit: L2
Mission life time: 5.3 years: 10years goal
Serviceable

Science (observation time):

- Dark Energy/Modified Gravity(～2.5yr)
  - **High Latitude Survey (HLS)(galaxy distribution)**
  - IaSNe survey
- Exoplanets：
  - Microlensing exoplanet search (～1.2yr)
  - Direct observation by coronagraph(～0.3yr)
- **Guest Observer(25%,1.5yr)**

Roman Space Telescope Status

- **Advanced to phase C in Feb. 2020**
- **Mission Critical Design Review in Sept 2021**
- **Flight hardware**
  - **Telescope (L3Harris):** Primary and secondary mirrors have been refigured, polished and coated;
  - Coronagraph relay optics polished and coated
  - **Wide Field Instrument (GSFC/Ball)**
  - Passed WFI CDR
  - Completed installation and alignment of all 18 engineering test unit (ETU) sensor chip assemblies (SCA) on the ETU mosaic plate
  - 17 out of 18 flight candidates SCAs in hand
  - Added new F213 filter (1.95-2.3) micron – now have imagining filter covering entire spectral range supported by mirrors/detectors



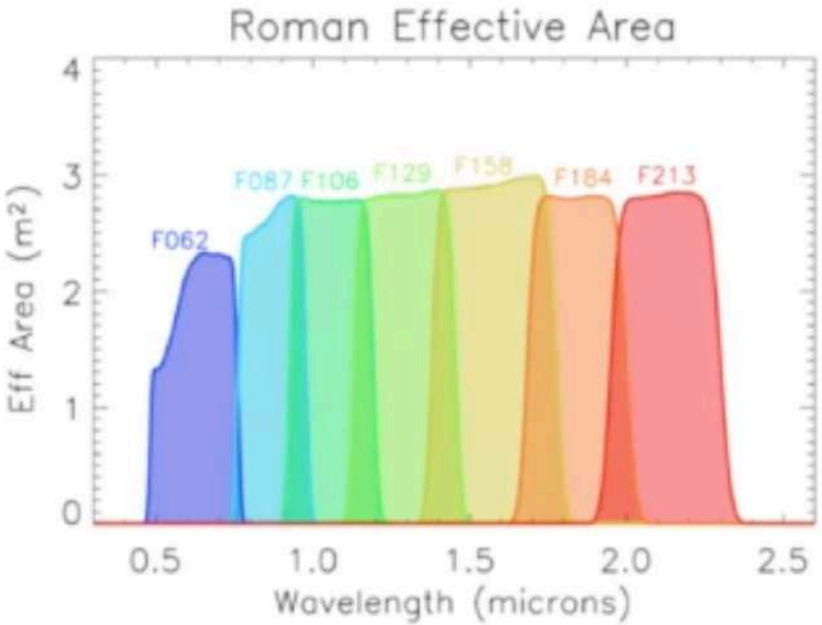
Roman Space Telescope Status

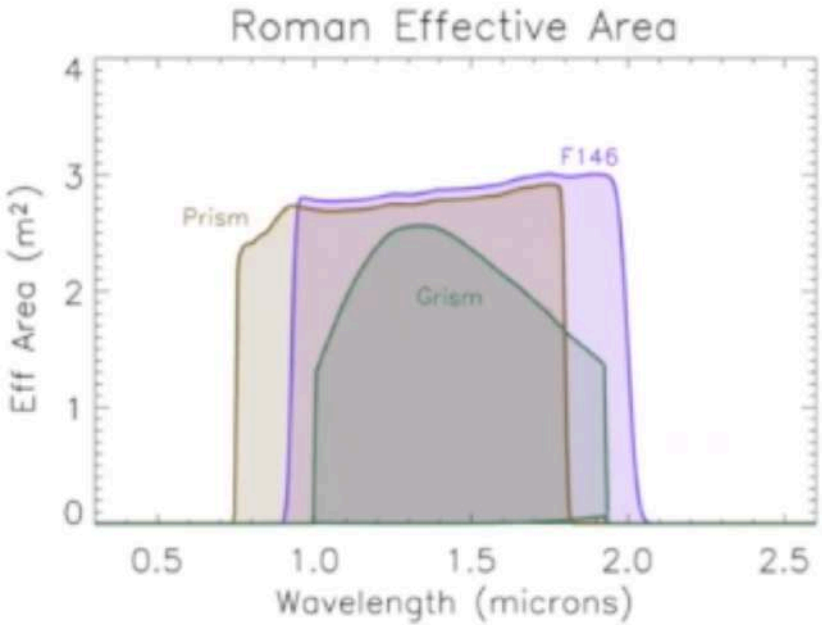
Added new F213 filter (1.95-2.3) micron

ROMAN SPACE TELESCOPE

Wide Field Instrument: Filters/Dispersers

- Imaging capability is ~1 sq. deg. per day at any band to 5σ AB depth of F062=29.6, F087=29.2, F106=29.1, F129=29.1, F158=29.1, F184=28.5, F213=27.2, F146=29.4.
- Spectroscopy via prism (0.6-1.8μm, *R*~100, ~24AB) and grism (1.0-1.9μm, *R*~600, ~22AB)





Roman Space Telescope Status

- **Coronagraph (JPL)**
  - Deformable mirror technology has been demonstrated
  - Two flight actuators in hand
  - CGI CDR April 2021
- **Spacecraft (GSFC)**
  - Procurement of flight subsystems well underway
  - Mechanical Hardware Engineering Development Units (EDUs) nearly complete
- **Ground system CDR July 2021**

- **On track for launch in mid 2020's**

Subaru-Roman Synergistic Observations Workshop IV

Plan Synergistic observation utilizing the 100 nights of Subaru to enhance Roman science and enable new, joint science projects.

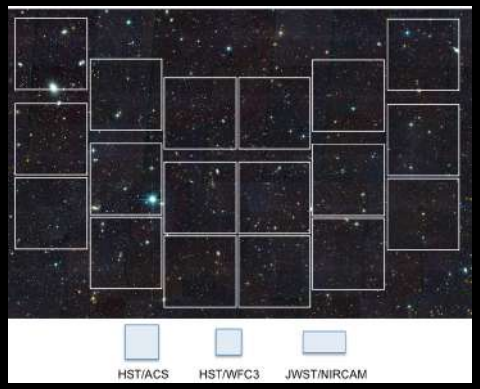
Subaru-Roman Synergistic observation Steering Group:

Toru Yamada (JAXA Roman Representative)　Chair
Takahiro Sumi (PI of the JAXA Roman study team)
Yusei Koyama (Subaru Telescope Representative)
Tadayuki Kodama (Liaison to the Subaru SAC)
David Spergel (Roman WFI Adjutant Scientist)
Julie McEnery (Roman Project Scientist)
Jason Rhodes (Roman Deputy Project Scientist)
Alice Shapley (RSIG representative)
SOC: Daisuke Suzuki (Osaka U.)

2021/2/17–18, Subaru–Roman Synergistic Observations Workshop IV@online

Synergy of Wide Field View

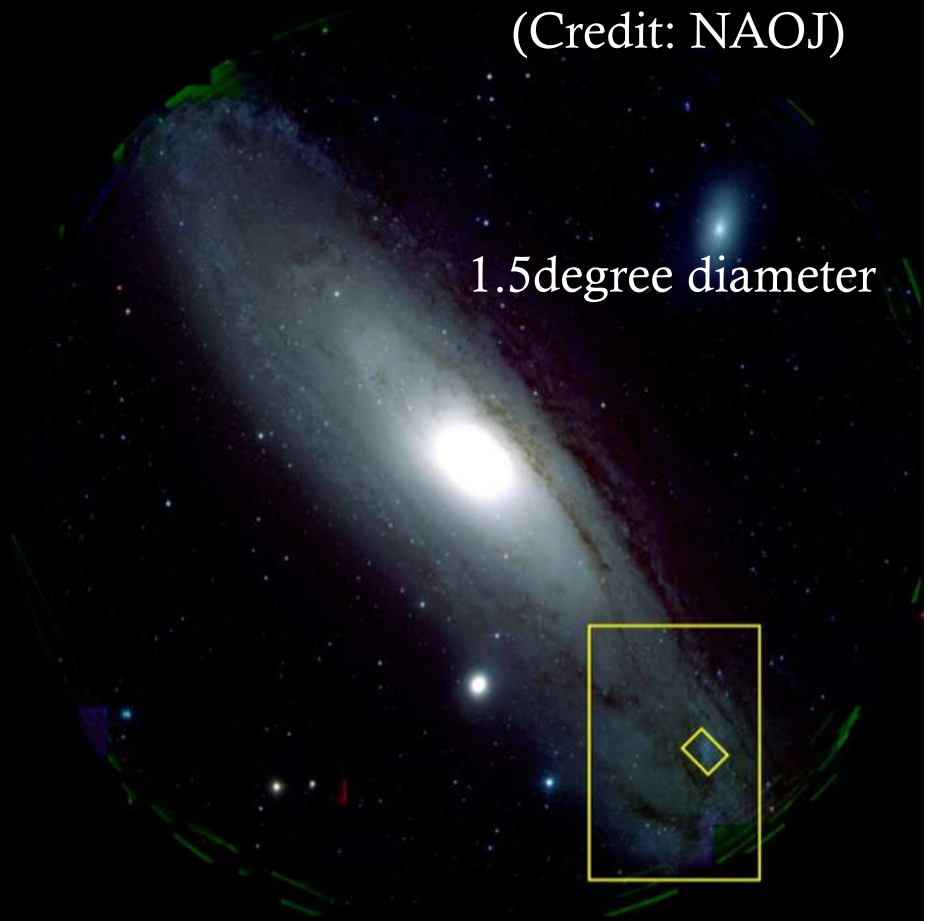
Typical Apparent Diameter of the Moon (0.5 degrees)



Roman WFI
0.28deg^2

Suprime-Cam
Image Release
September 2001

(Credit: NAOJ)



Hyper Suprime-Cam
Image Release
July 2013

Roman's wide-band imaging has good synergy with Subaru's multi-band capability.

Japanese Contribution “Package” for Roman

■ JAXA Roman-J team （Team leader: T.Yamada, PI：Sumi）

1. Subaru-Roman Synergy Survey
   (100nights from 2025)
   1. photo-z calibration (PFS etc.)
   2. Narrow band filters (HSC etc.)

   2016/11：Director of Subaru telescope and Subaru SAC、
   agreed to the Commitment

2. Contribution to Coronagraph Instrument
   - Polarimetry capability
   - c

2020/03 JAXA-NASA LOA signed.

3. Ka-band Data Downlink Station in Japan

4. Ground base microlensing data sharing（MOA）
   pre/concurrent Ground microlensing obs.
   with new 1.8m (PRIME) telescope

JAXA Roman team members joined to SIT

Roman

24 SIT member, 10 Domestic member

1. “COSMOLOGY WITH THE WFIRST HIGH LATITUDE SURVEY” (Chair: Olivier Dore)
   Masahiro Takada (U.tokyo, IPMU), Hironao Miyatake (Nagoya U.), Tomomi Sunayama(Nagoya U.)
2. “OPTIMIZING THE WFIRST TYPE IA SUPERNOVA SURVEY” (Ryan Foley)
   Naoki Yasuda (U.tokyo, IPMU) Takashi Moriya (NAOJ) Yuji Urata (National Central University, Taipei)
3. "INVESTIGATING THE NATURE OF DARK ENERGY USING TYPE IA SUPERNOVAE WITH WFIRST-AFTA SPACE MISSION” (Saul Perlmutter)
   Nao Suzuki (U.tokyo, IPMU), Tomoki Morokuma (U.Tokyo, IoA)

Exoplanet Microlensing

4. "PREPARING FOR THE WFIRST MICROLENSING SURVEY: SIMULATIONS, REQUIREMENTS, SURVEY STRATEGIES, AND PRECURSOR OBSERVATIONS” (Scott Gaudi)
   Takahiro Sumi (Osaka U.), Daisuke Suzuki (Osaka U.), Naoki Koshimoto (U.Tokyo), Kento Masuda (Osaka U.)

Exoplanet Coronagraphs

5. “ OPTIMIZING WFIRST CORONAGRAPH SCIENCE”(Bruce Macintosh)
   Motohide Tamura (U. Tokyo/ABC), Taichi Uyama(Caltech/IPAC), Naoshi Murakami (Hokkaido U.)
6. "HARNESSING THE POWER OF THE WFIRST-CORONAGRAPH: A COORDINATED PLAN FOR EXOPLANET AND DISK SCIENCE”(Margaret Turnbull)
   Taro Matsuo (Nagoya U.), Satoshi Ito(ISAS/JAXA)

Guest Investigator (GI)/Guest Observer (GO) science

7. "WFIRST EXTRAGALACTIC POTENTIAL OBSERVATIONS (EXPO) SCIENCE INVESTIGATION TEAM”
   (Brant Robertson)
   Tadayuki Kodama (Tohoku U.), Takashi Moriya (NAOJ) Kimihiko Nakajima (NAOJ), Rhythm Shimakawa （NAOJ）

8. “WINGS: WFIRST INFRARED NEARBY GALAXY SURVEY”(Benjamin Williams)
   Masayuki Tanaka (NAOJ),Sakurako Okamoto (NAOJ)

9. “ARCHIVAL RESEARCH CAPABILITIES OF THE WFIRST DATA SET “(Alexander Szalay)
   Yusei Koyama (NAOJ) , Hisanori Furusawa(NAOJ),Masao Hayashi (NAOJ/Subaru), Tsuyoshi Terai (NAOJ/Subaru)
10. “COSMIC DAWN WITH WFIRST” (James Rhoads)
    Masami Ouchi (U. Tokyo, ICRR/NAOJ) Yuichi Harikane (NAOJ/UCL), Daisuke Yonetoku (Kanazawa U.) Masafusa Onoue（MPIA）
11. “RESOLVING THE MILKY WAY WITH WFIRST” (Jason Kalirai→Jason Tumlison)
    Noriyuki Matsunaga (U.Tokyo IoA) Shogo Nishiyama (Miyagi Kyoiu U) Riku Urago (Kagoshima U.)

The activities continue with New science teams

Expected timeline.

YEAR		
2017	1st Workshop	Collecting ideas, broad interest
2018	2nd Workshop	Possible programs ➔ summarized in WP
2019	3rd Workshop as a session in Subaru 20th Meeting	Possible programs in various different science fields
2020	Preliminary proposal development	development of preliminary 'candidate programs'
2021	4th Workshop NASA Roman Science Team(s) Solicitation	
2022 TBD	Consolidating the Program	Front-loading program?
2023 TBD	Proposal Planning, Teaming	
2024 TBD	Final Proposal Submission	The proposal of the consolidated program will be reviewed by Subaru Advisory Committee
2025 TBD	Scheduling	

White Paper of Synergistic observation

Enabling Breakthrough Science with the Subaru Telescope and the Wide Field Infrared Survey Telescope (WFIRST): A White paper for Subaru and WFIRST Communities

April 25, 2019

Editors: Jason Rhodes[1] (Jet Propulsion Laboratory, California Institute of Technology), Takahiro Sumi[2] (Osaka University)

Also submitted to: US Decal survey

Principal Editors: Jason Rhodes, T.Sumi

Executive Summary: D. Spergel, T. Yamada

http://www.ir.isas.jaxa.jp/WFIRST_Subaru_II/TALKS/WFIRST_Subaru_April25.pdf

User Name: wfirst

Password: subaru

Required nights and conditions in WP2019.

Category/Topic	Instrument	N req.	condition
Microlensing parallax	HSC	13.5	Bright
Microlensing NIR spec. ToO	IRD	11.2-15	Bright
Microlensing NIR concurrent	ULTIMATE	3.4	Bright
CGI Support	SCExAO/ CHARIS	18	Bright
CGI Support /Doppler	IRD	7	Bright
SNe Follow-up	PFS	25	Dark
SNe Live Spectroscopy	PFS	20	Dark
Deep Field Ultra-Deep	HSC	33	Dark
Deep Field SNe Fields Imaging	HSC	8	Dark
Deep Field SNe Fields Spectra	PFS	8	Dark
Deep Field SNe Fields NB	HSC/PFS	6-10	Dark
Cosmology sp redshift calib.	PFS	25-50	Dark
Cosmology IB redshift calib.	HSC	60	Dark
Nearby Galaxies Pre-im. Halo	HSC	10	Dark
Milky Way Bulge HV	PFS/ULTIMATE	4.5	Dark
Milky Way Bulge stars	IRD	15	Bright
Solar System TNO	HSC	6	Dark
Solar System Minor Body/Irr	HSC	10	Dark
Irregular Satellites	HSC	6	Dark
total		321.4	

- Total required **312** nights is three times more than reserved 100 nights (100 nights are not enough!)
- 78% of required time is in Dark night with HSC/PFS.
- Several programs have overlapping. Should be Combined/shared.
- Completion of the PFS Subaru Strategic Program (SSP: a large program up to 360 night) is delayed to 2027. Most of Dark nights will be available after this.
- Due to the fact that PFS-SSP is expected to start in 2023A and last until 27B, Dark nights with HSC will be relatively more available in 2022 (A,B) before SSP starts.
- front-loading of a part of our Subaru-Roman Synergistic program in this time slot may be worth considering.

front-loading of a part of our Subaru-Roman Synergistic program in this time slot may be worth considering

There is time constraint….

2021/2/17-18 This WS
2021/2/19 Subaru SAC
2021/3/3-5 Subaru Users Meeting (we are here)
5 March 10:30 - 11:10 Subaru & Roman Space Telescope
2021/Fall submit proposal
2022A,B front-loading observation