

NASA's Roman Space Telescope*

*with a lot of French people inside



Clément Ranc (IAP/Sorbonne Université)
& Arthur Vigan (LAM/CNRS)

2026-04-02 - ExoSystèmes V, Paris



Nancy Grace Roman was NASA's first Chief of Astronomy

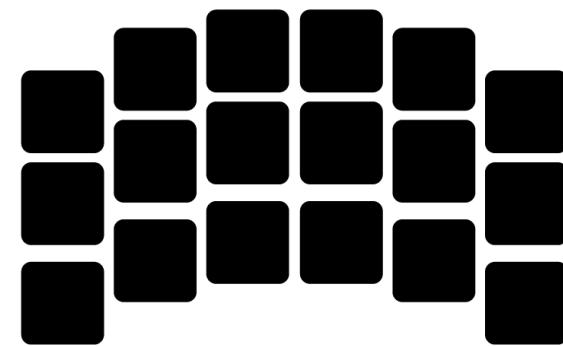
appointed 1959



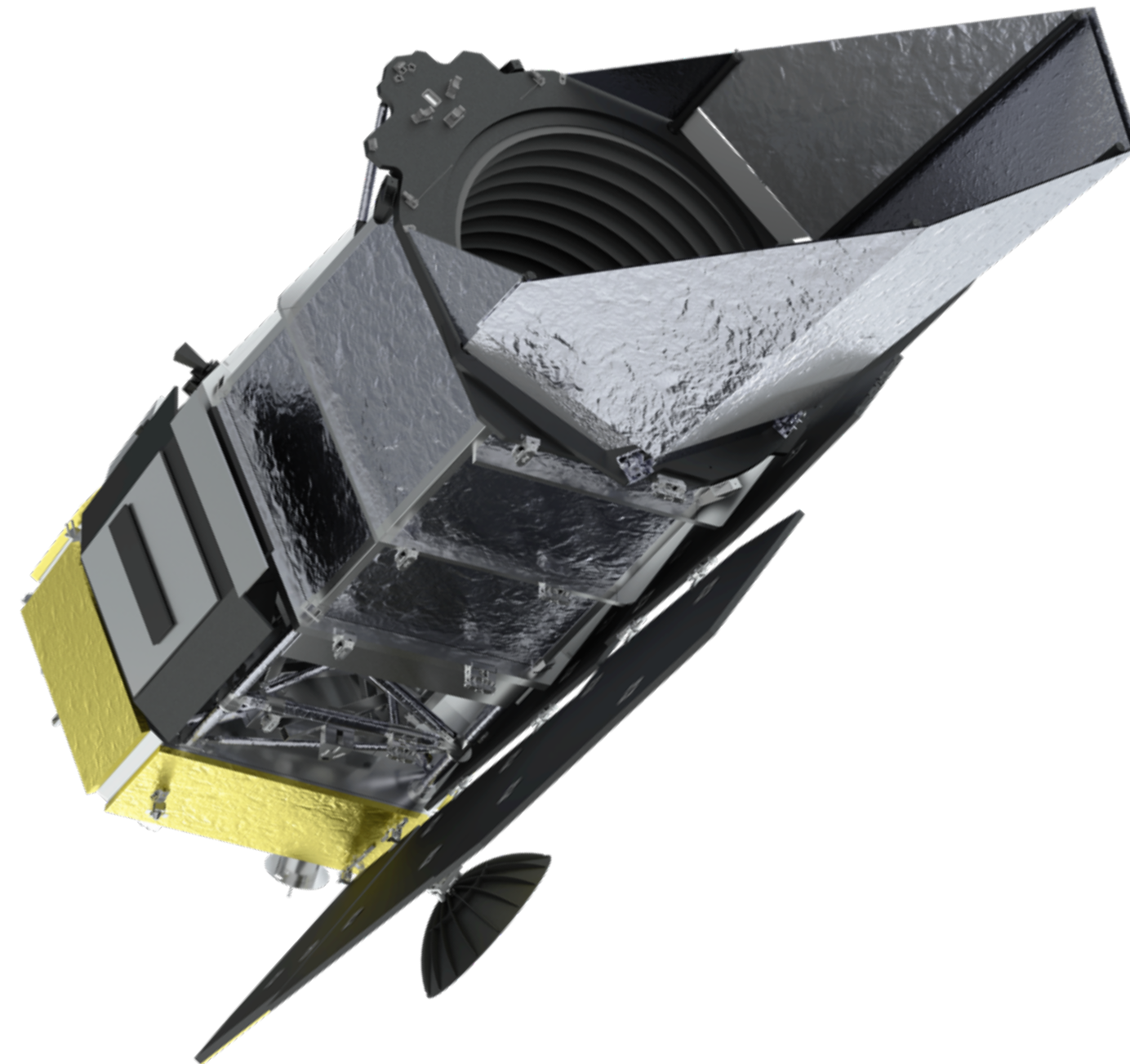
The Nancy Grace Roman Space Telescope

- Formerly known as **WFIRST-AFTA** (Wide-Field Infrared Survey Telescope - *Astrophysics Focused Telescope Assets*): 2010 decadal survey recommendation
- Based on a 2.4m (HST-like) telescope, very wide field... initially for reconnaissance

Wide Field Imager (WFI)



- Fully-fledge instrument
- 0.28 square degree FoV
- Photometric survey over 300 méga-pixels
 - Dark matter (→ Euclid)
 - **Exoplanet microlensing**



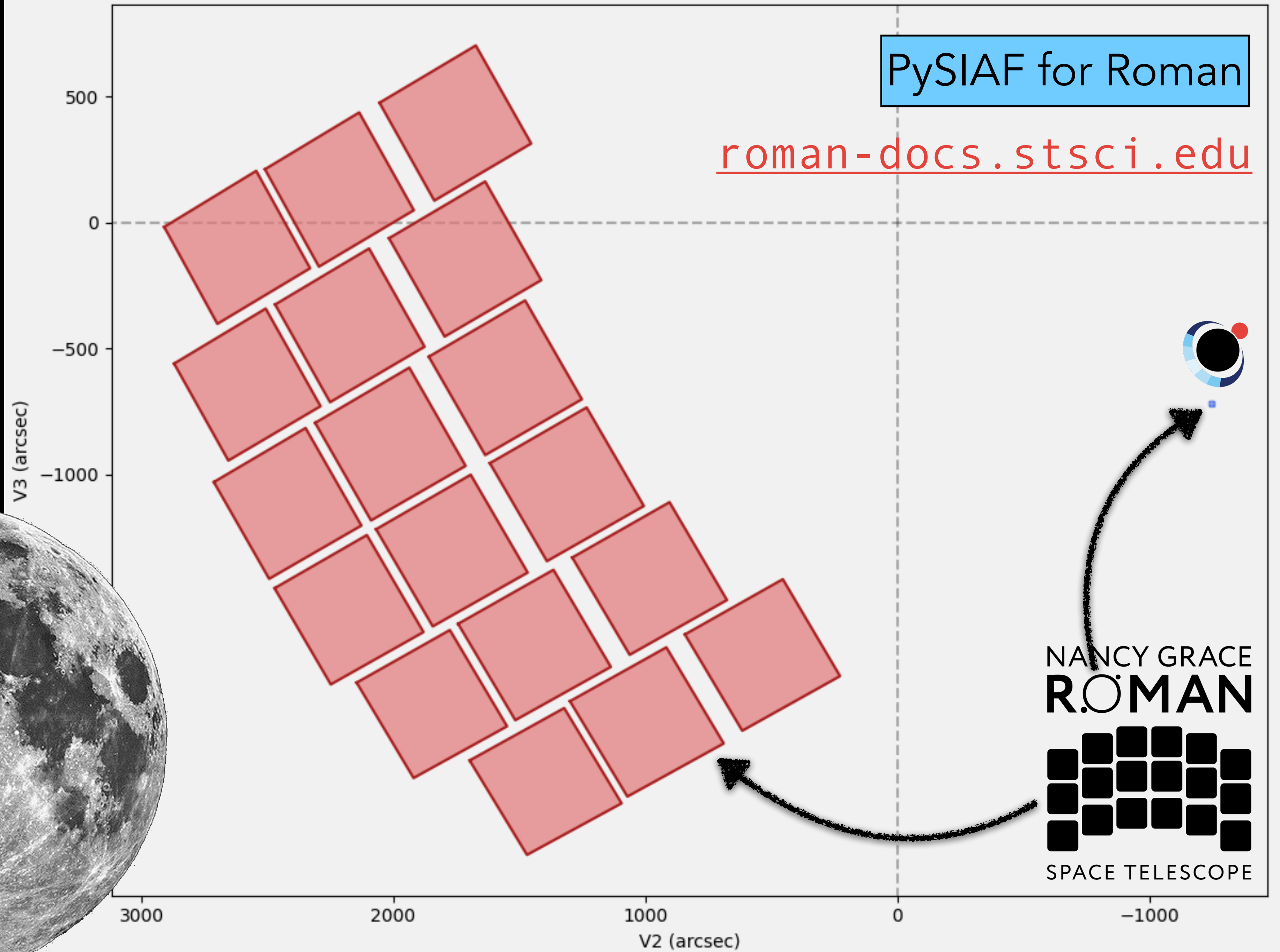
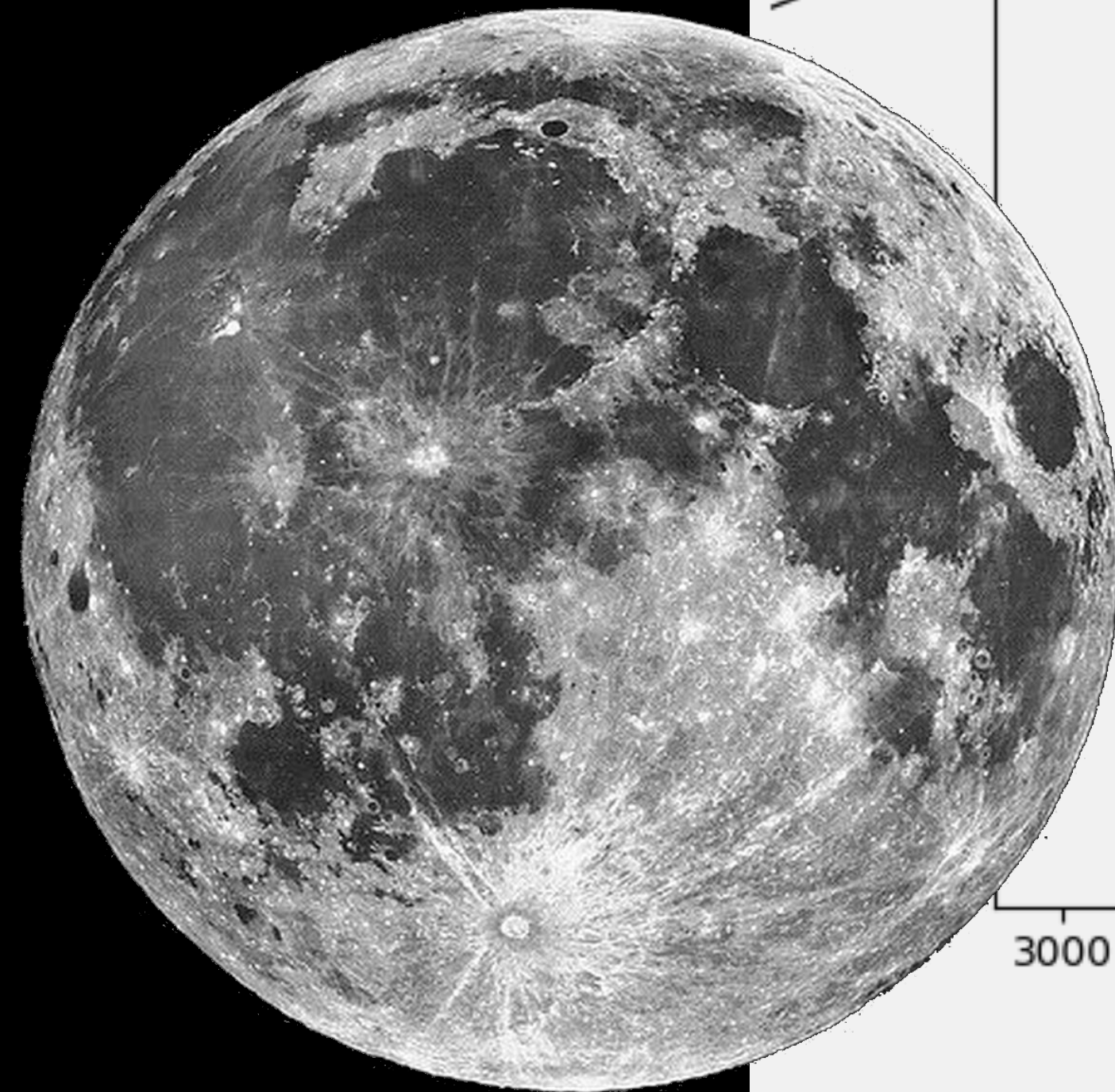
Coronagraphic instrument (CGI)

- Technological demonstrator
- State-of-the-art **exoplanet imaging**
- Concept maturation for HWO
- **But also unique science!**

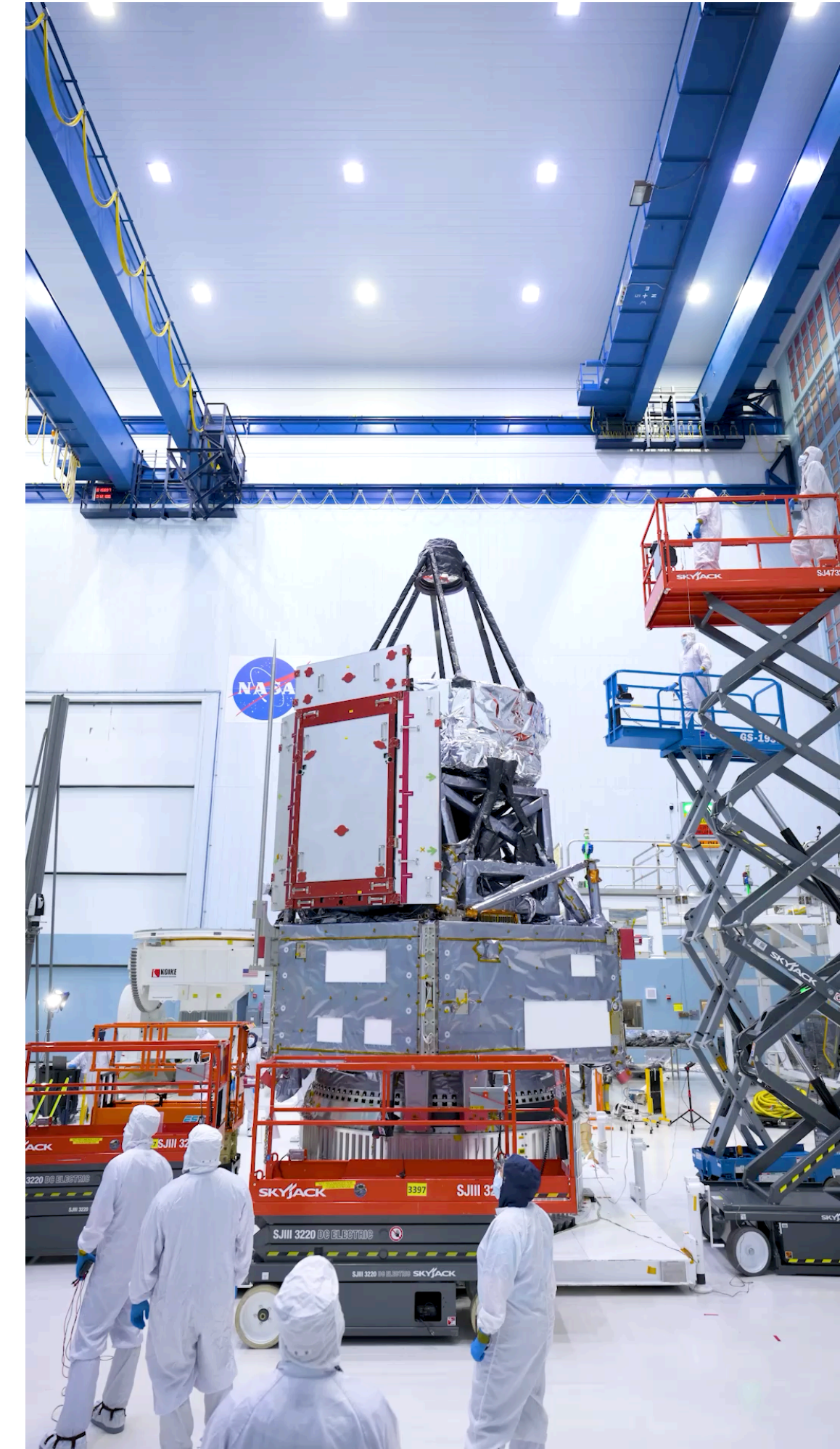
Two extreme fields of view

PySIAF for Roman

roman-docs.stsci.edu



Roman is complete!



ON TRACK FOR AN
~~EARLY~~ ~~SEPTEMBER~~ ~~FOR~~ AN
~~OCTOBER~~ 2026
LAUNCH DATE!

The Roman Space Telescope Coronagraph: A new era for the direct imaging of exoplanets



Arthur Vigan (LAM/CNRS)

With contributions from Vanessa Bailey, Julien Girard, Schuyler Wolff, and the Roman CPP

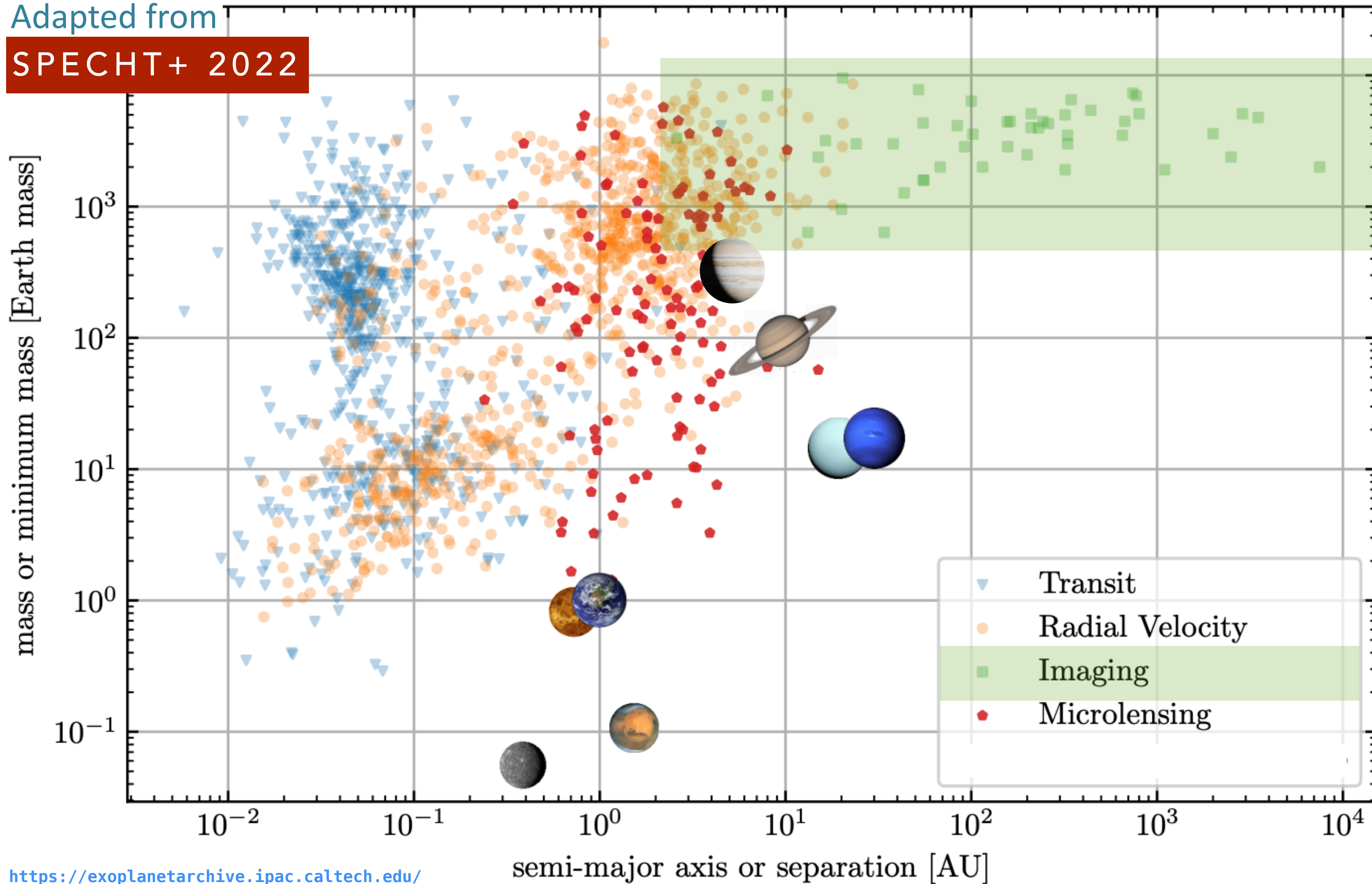
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Exoplanet imaging: Roman in context



Adapted from
SPECHT+ 2022



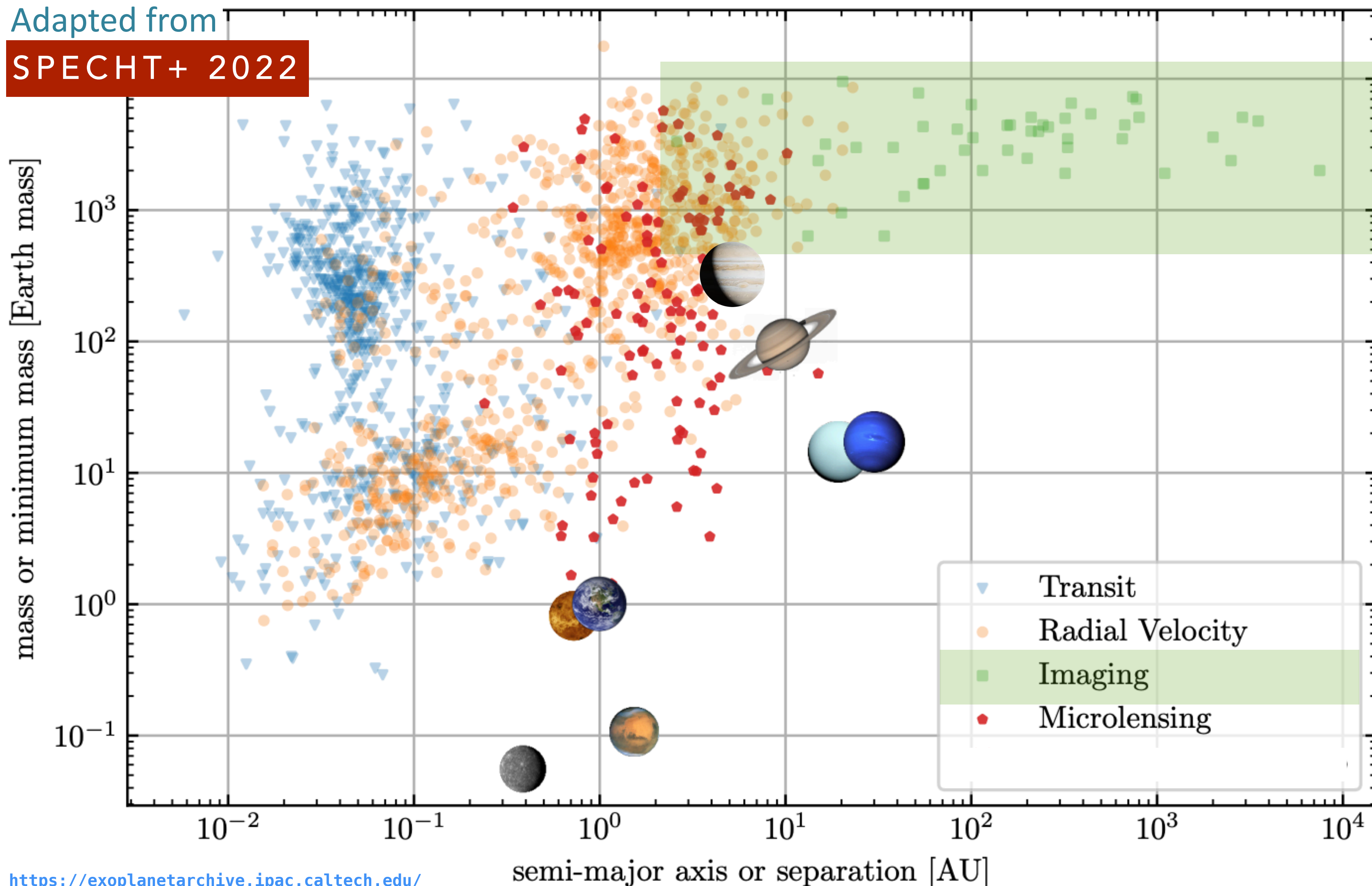
Angular resolution

Contrast



Exoplanet imaging: Roman in context

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SPECHT+ 2022



Diameter or baseline

Inner-planets

Reflected light planets (VIS)

Angular
resolution

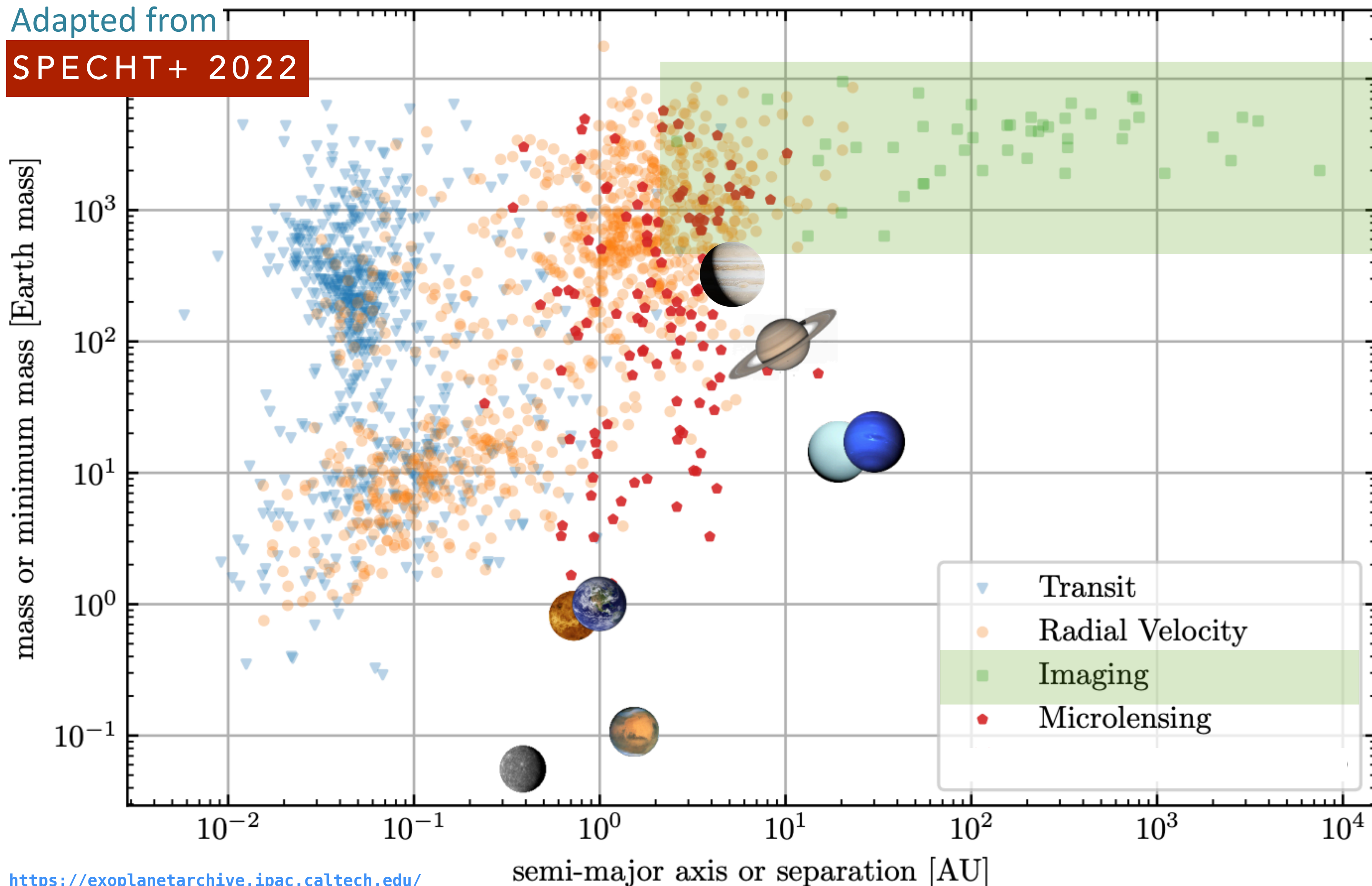
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Diameter or baseline

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Angular resolution

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Coronagraph/WF control

Post-processing

Stability (space)

Sensitivity (space)

Lower mass planets

Cold start/GI planets

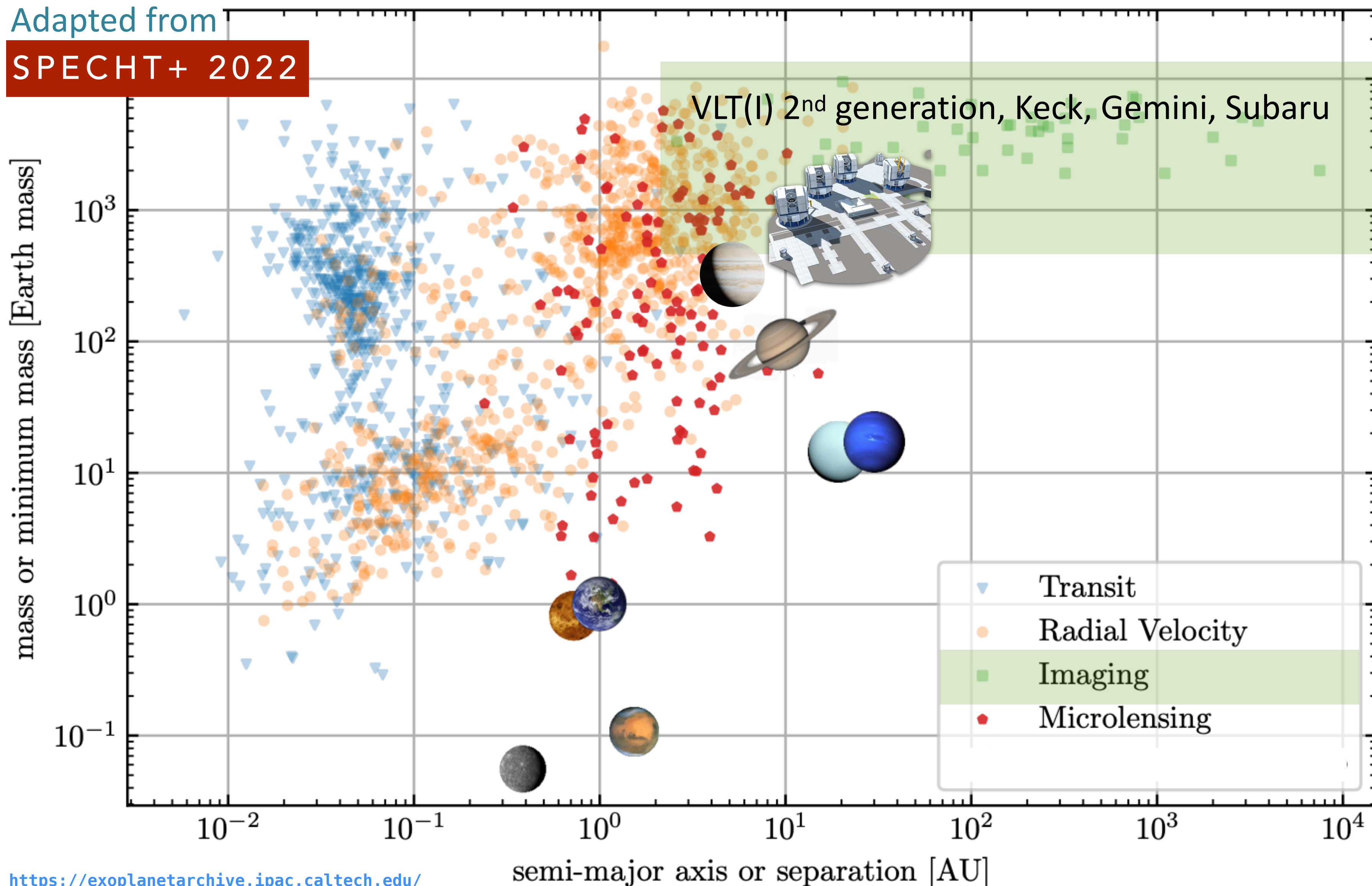
More mature systems



Exoplanet imaging: Roman in context

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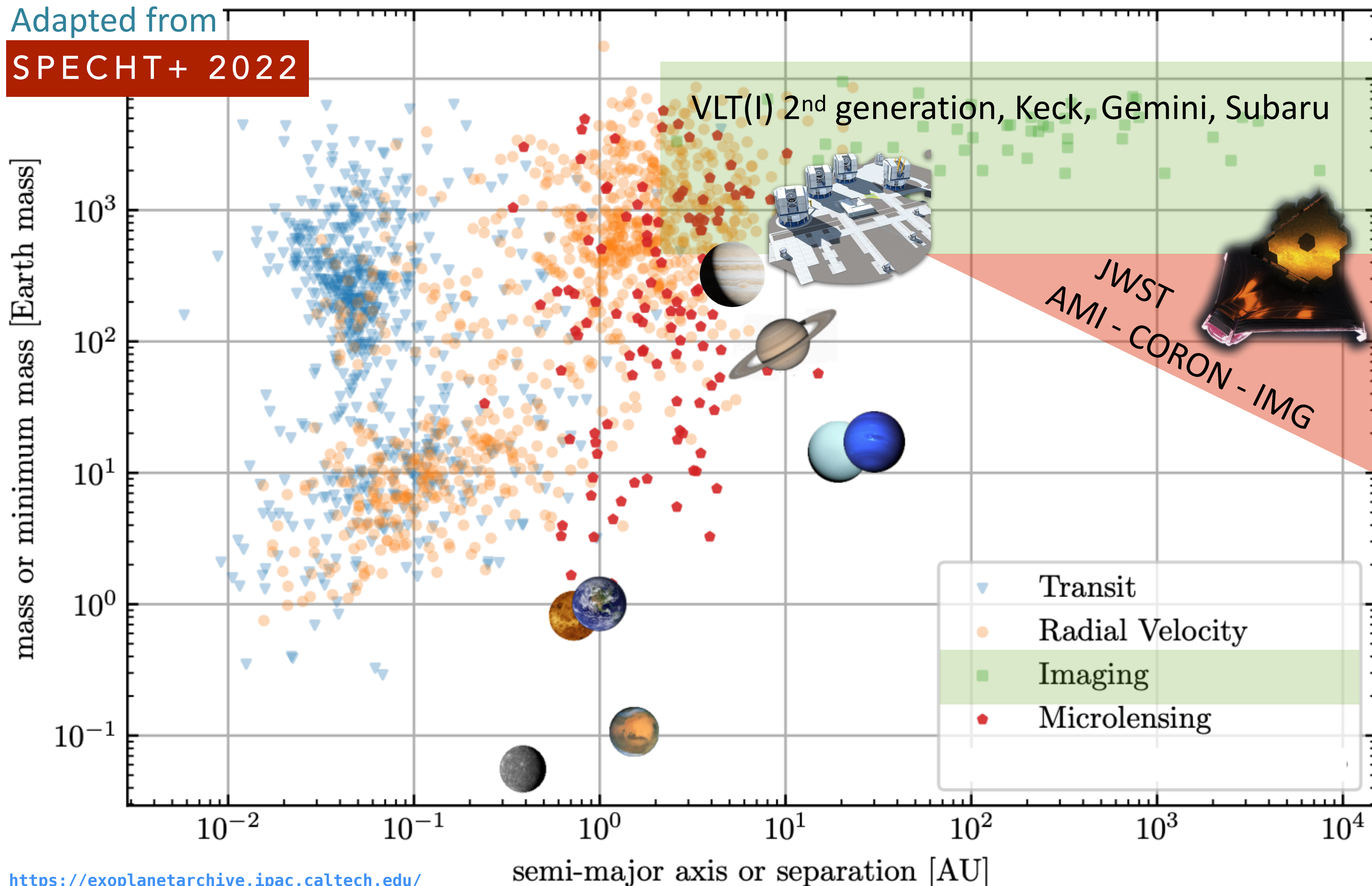
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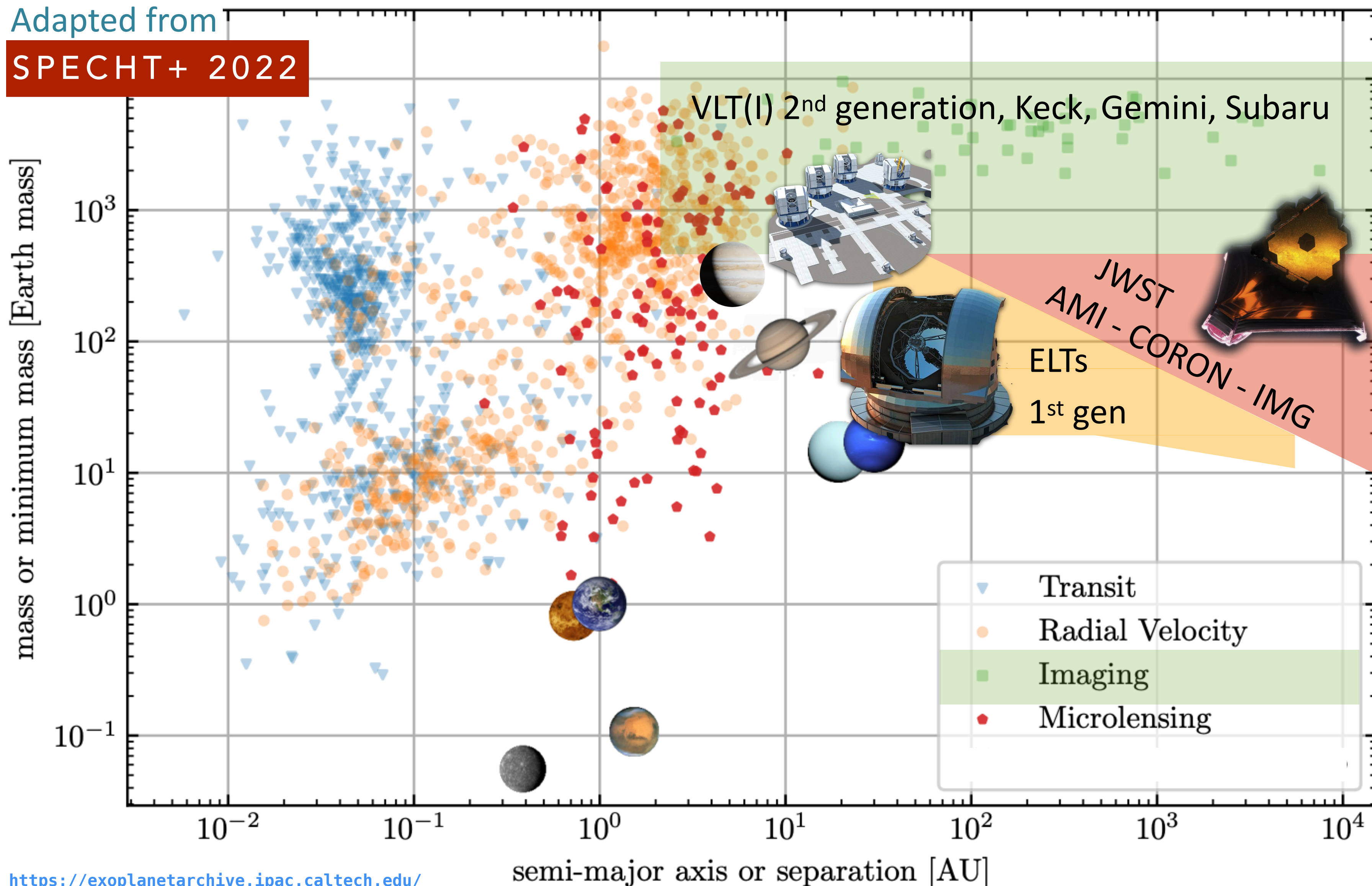
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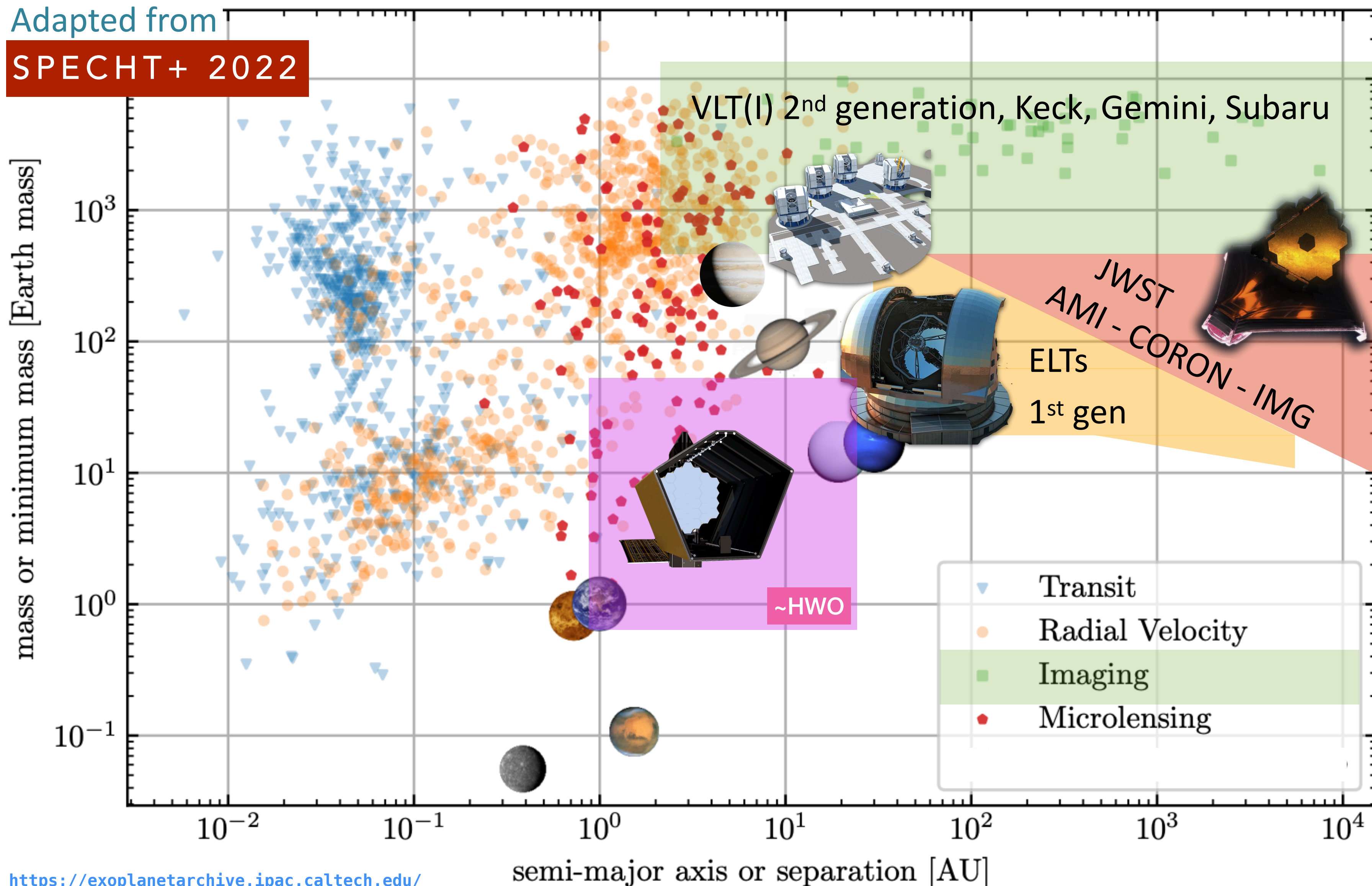
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Exoplanet imaging: Roman in context

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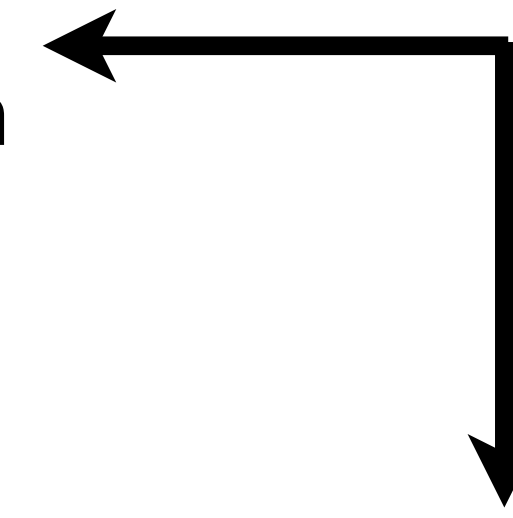


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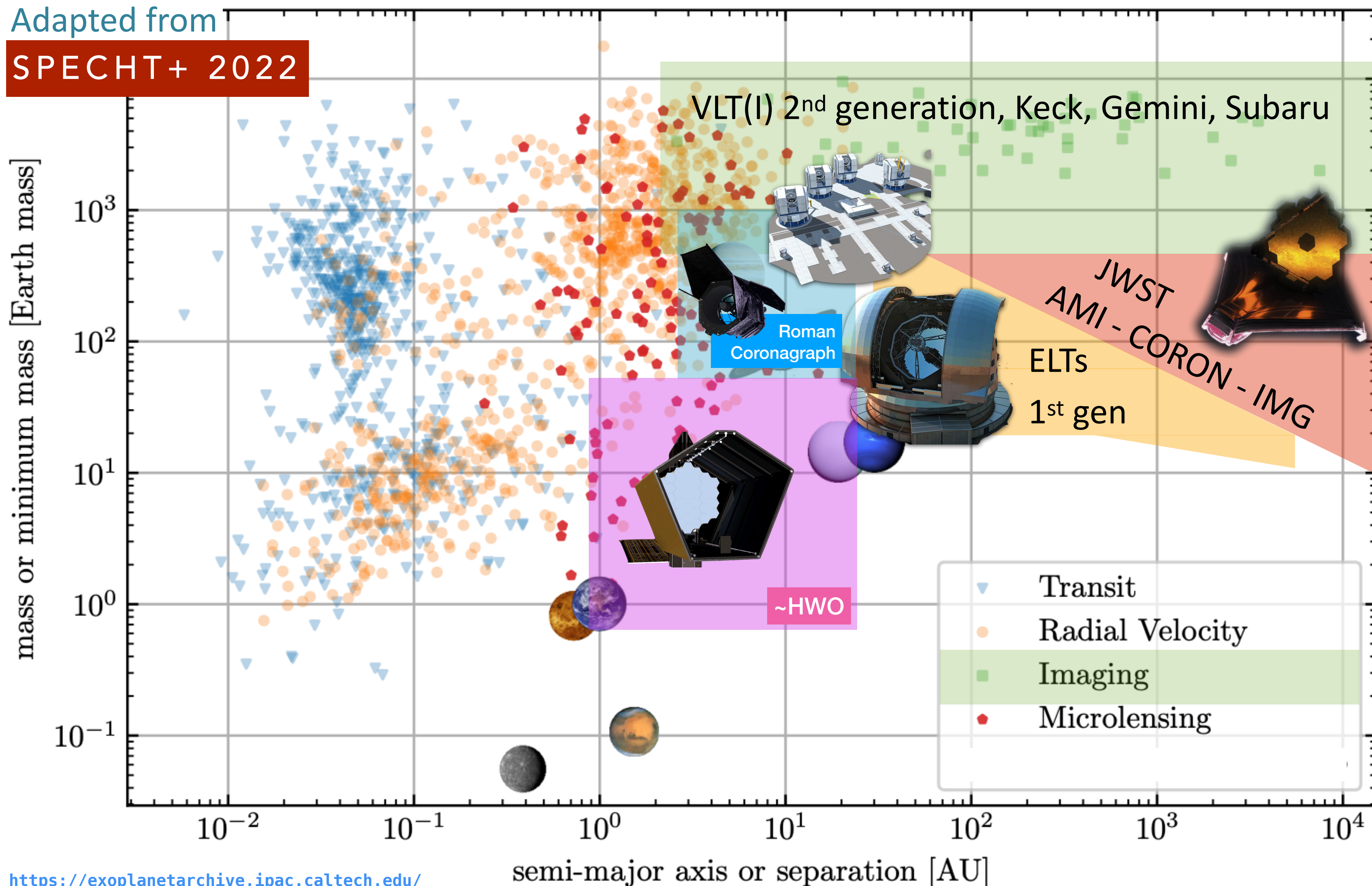
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Exoplanet imaging: Roman in context

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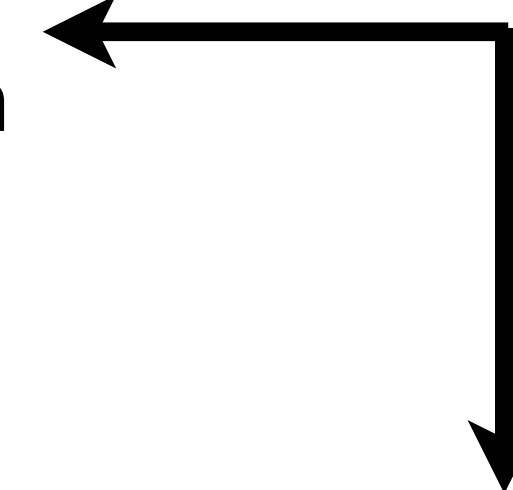


Diameter or baseline

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Reflected light planets (VIS)

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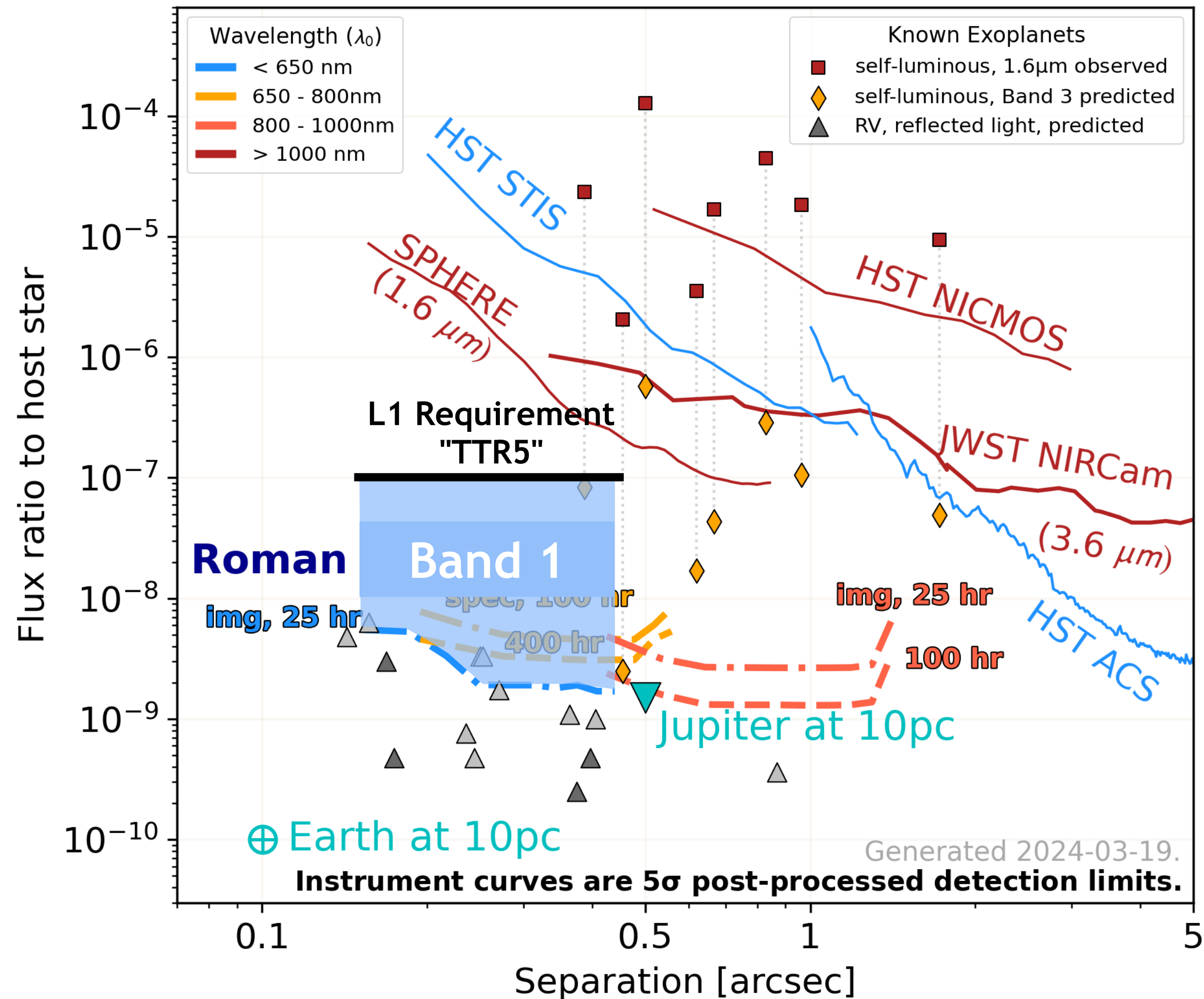
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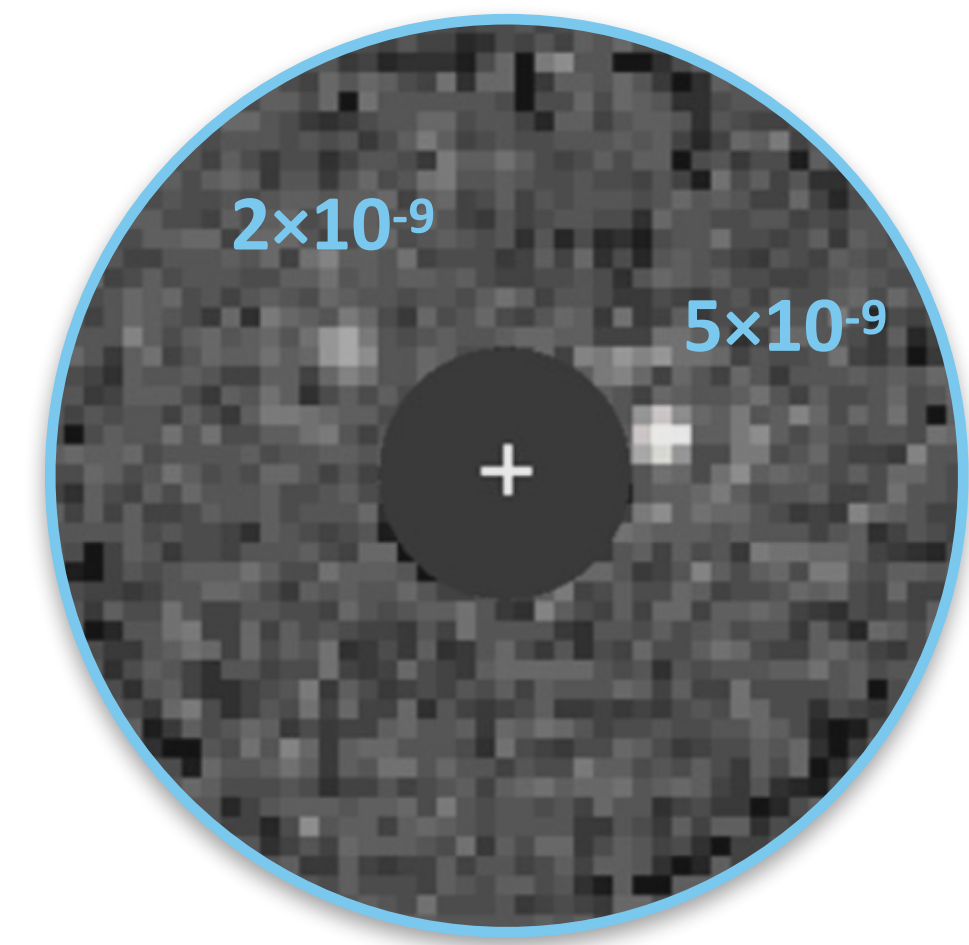
More mature systems



A totally new contrast regime



- Expected contrast for $V \sim 5$ stars
 - $< 10^{-7}$ (TT5 = level 1 requirement)
 - $\sim 10^{-8} - 10^{-9}$ (predicted / goal)
- 1 000 times better than current facilities!
- Tech goal: technology maturation for HWO
- Science goal: image "Jupiters" @ 10-20 pc in reflected light!



The Roman Coronagraph: maturing key technologies



The Roman Coronagraph: maturing key technologies

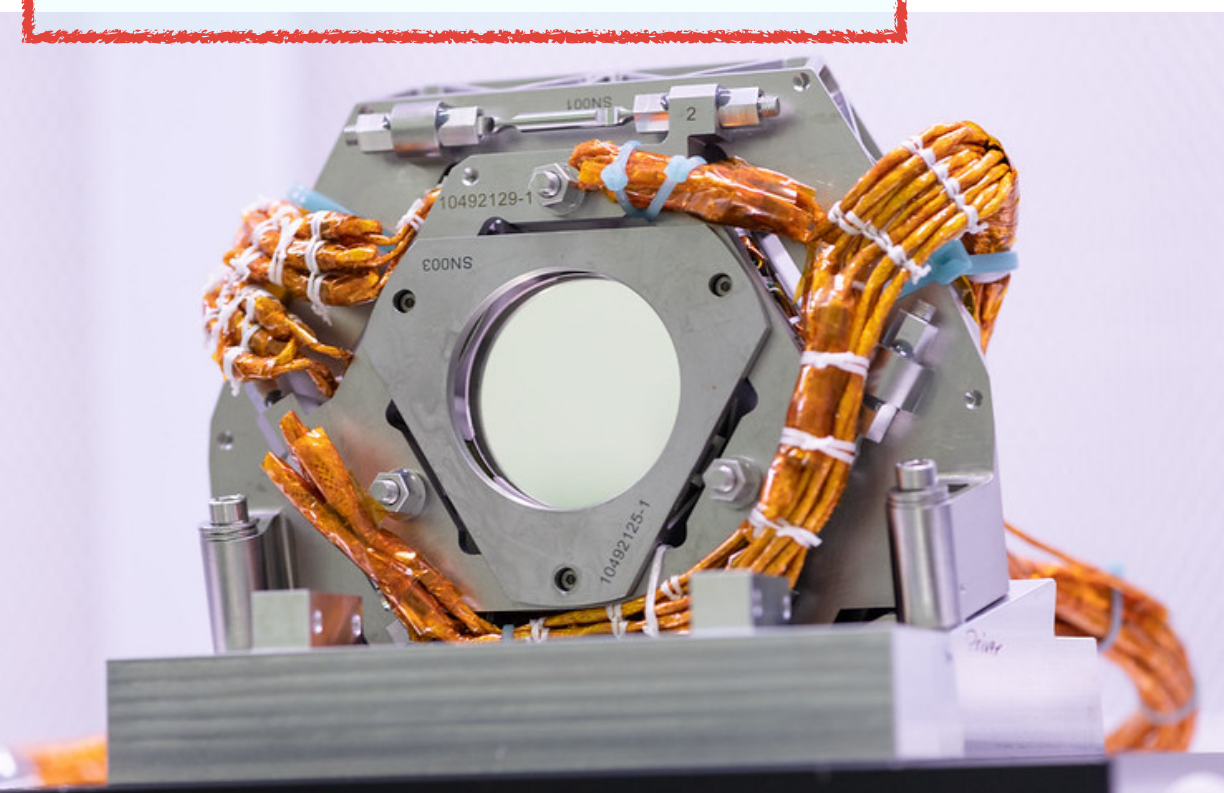


Large-format
deformable mirrors

*Extreme wavefront
control to better
than 10 pm RMS*



Ultra-precise
wavefront sensing
& control



The Roman Coronagraph: maturing key technologies



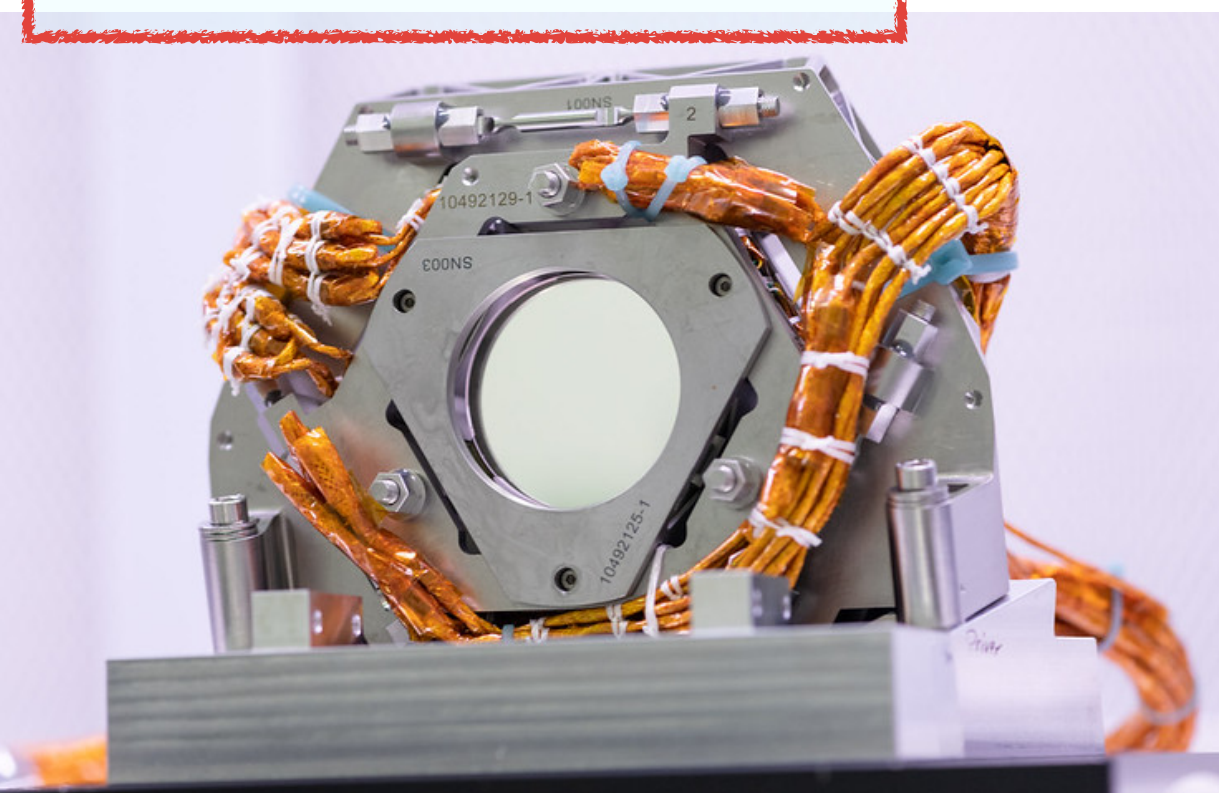
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*Extreme wavefront
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*Suppress starlight by
~100 million*

Ultra-precise
wavefront sensing
& control



High-performance
coronagraphs and
pupil masks



The Roman Coronagraph: maturing key technologies

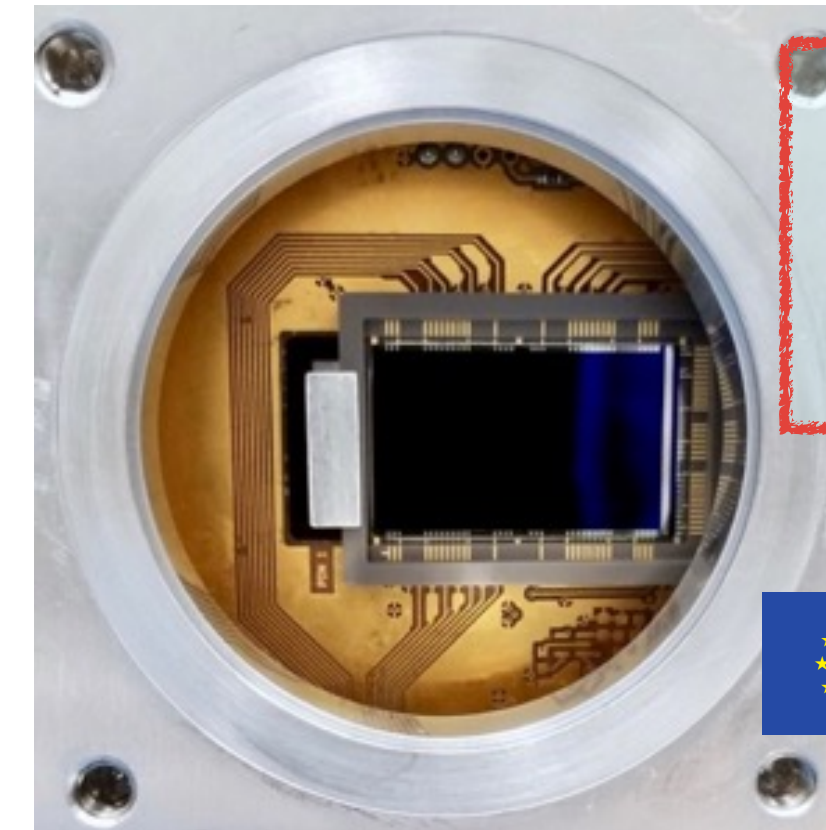


Large-format
deformable mirrors



*Extreme wavefront
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than 10 pm RMS*

Ultra-low noise
photon-counting
EMCCDs



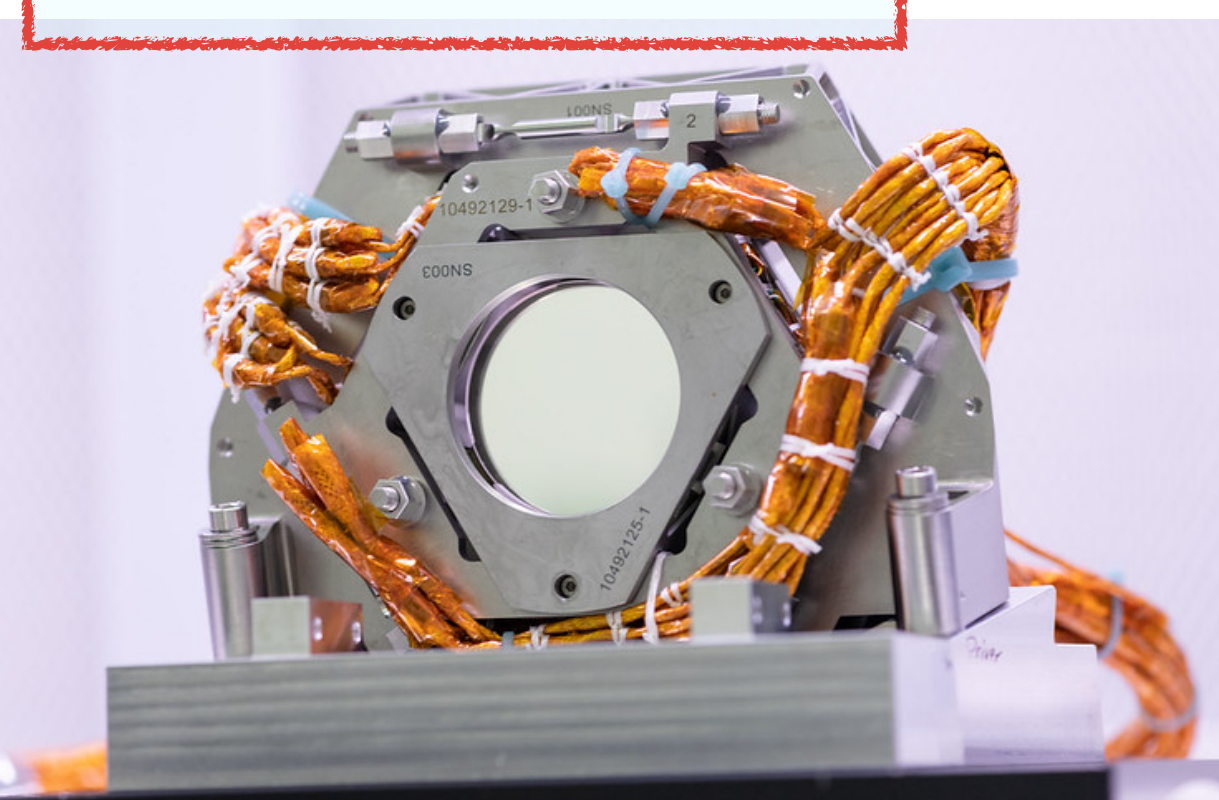
*Count individual planet
photons as they arrive
(1 per 10-100 sec)*

*Suppress starlight by
~100 million*

High-performance
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The Roman Coronagraph: maturing key technologies



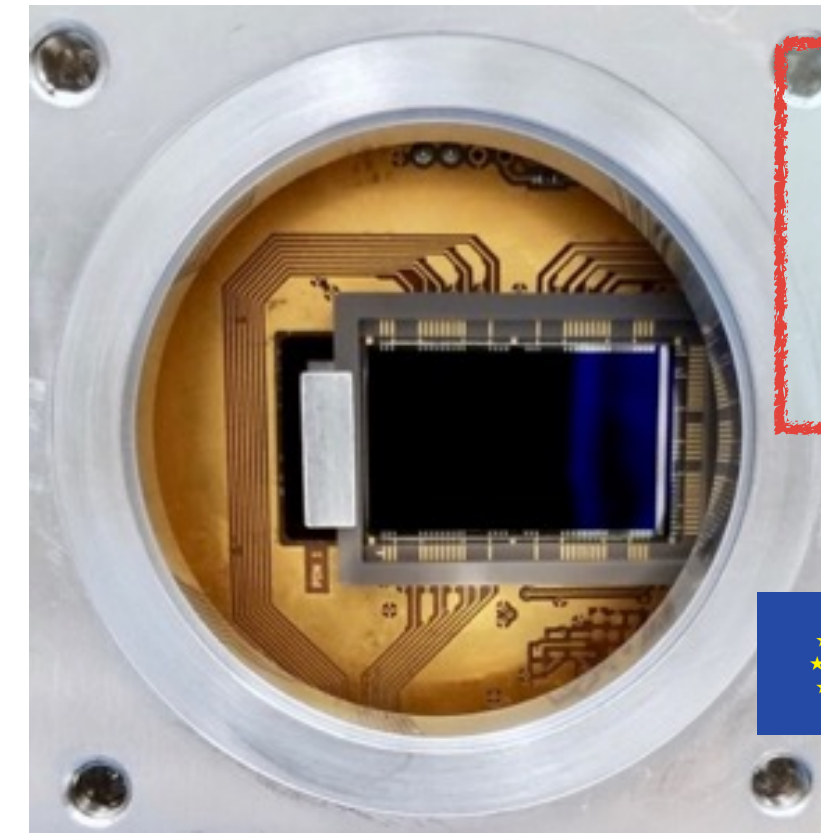
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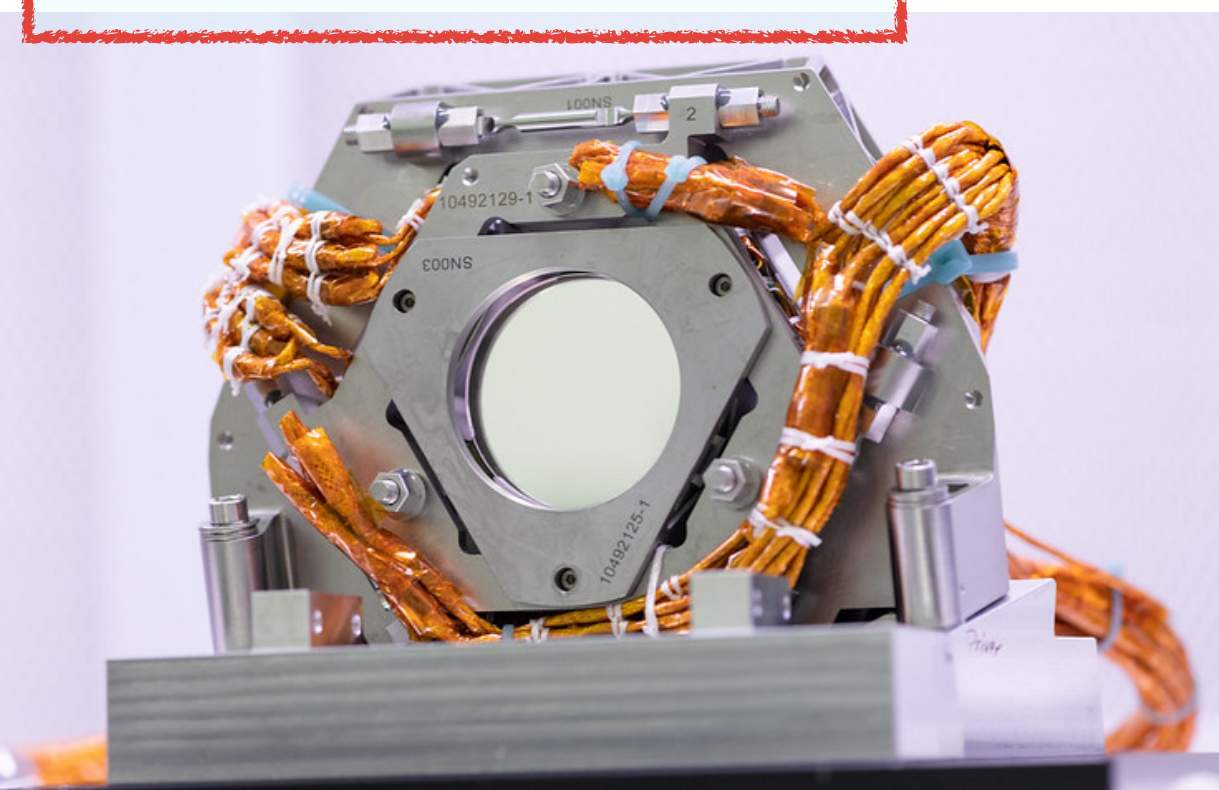
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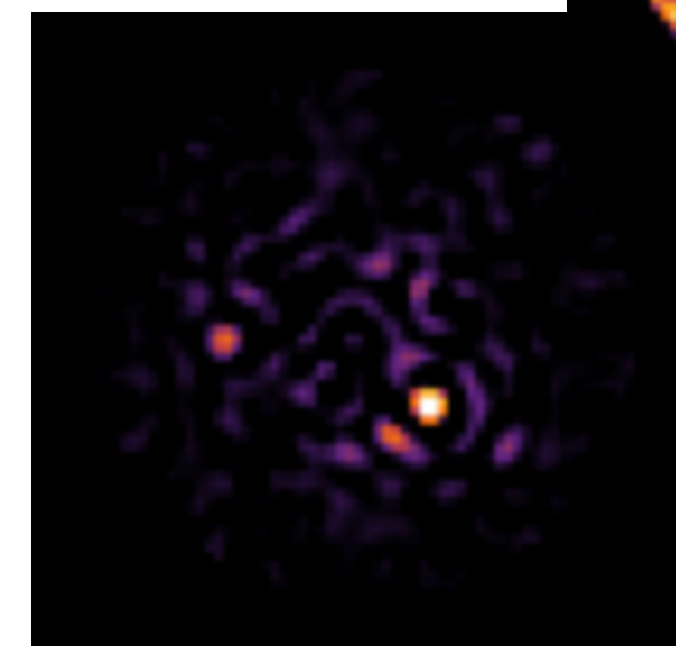
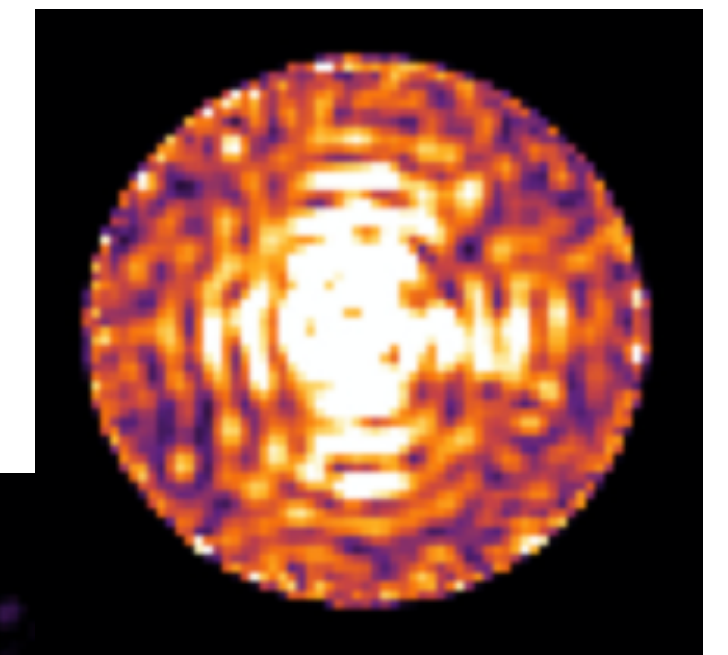
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High-performance
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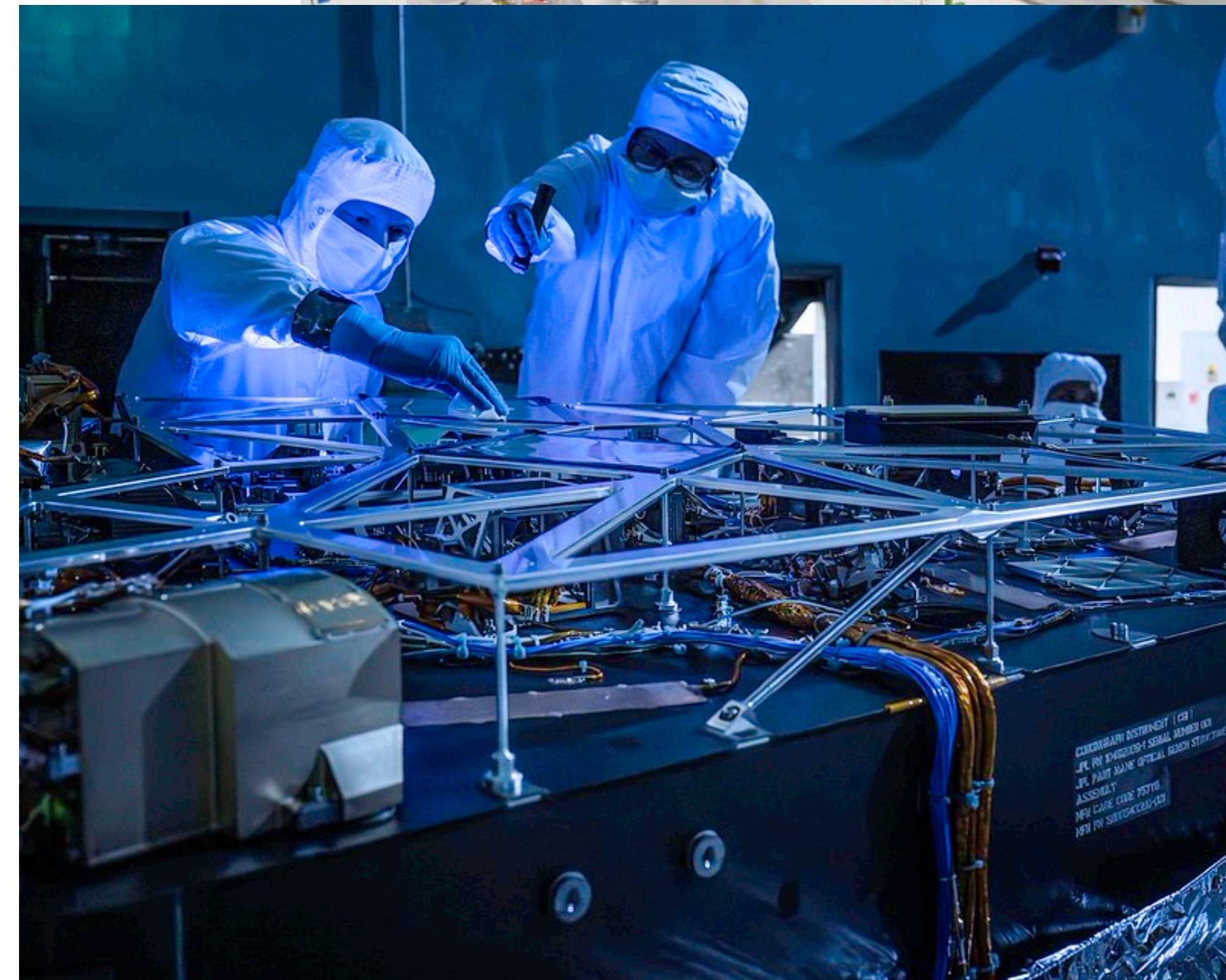
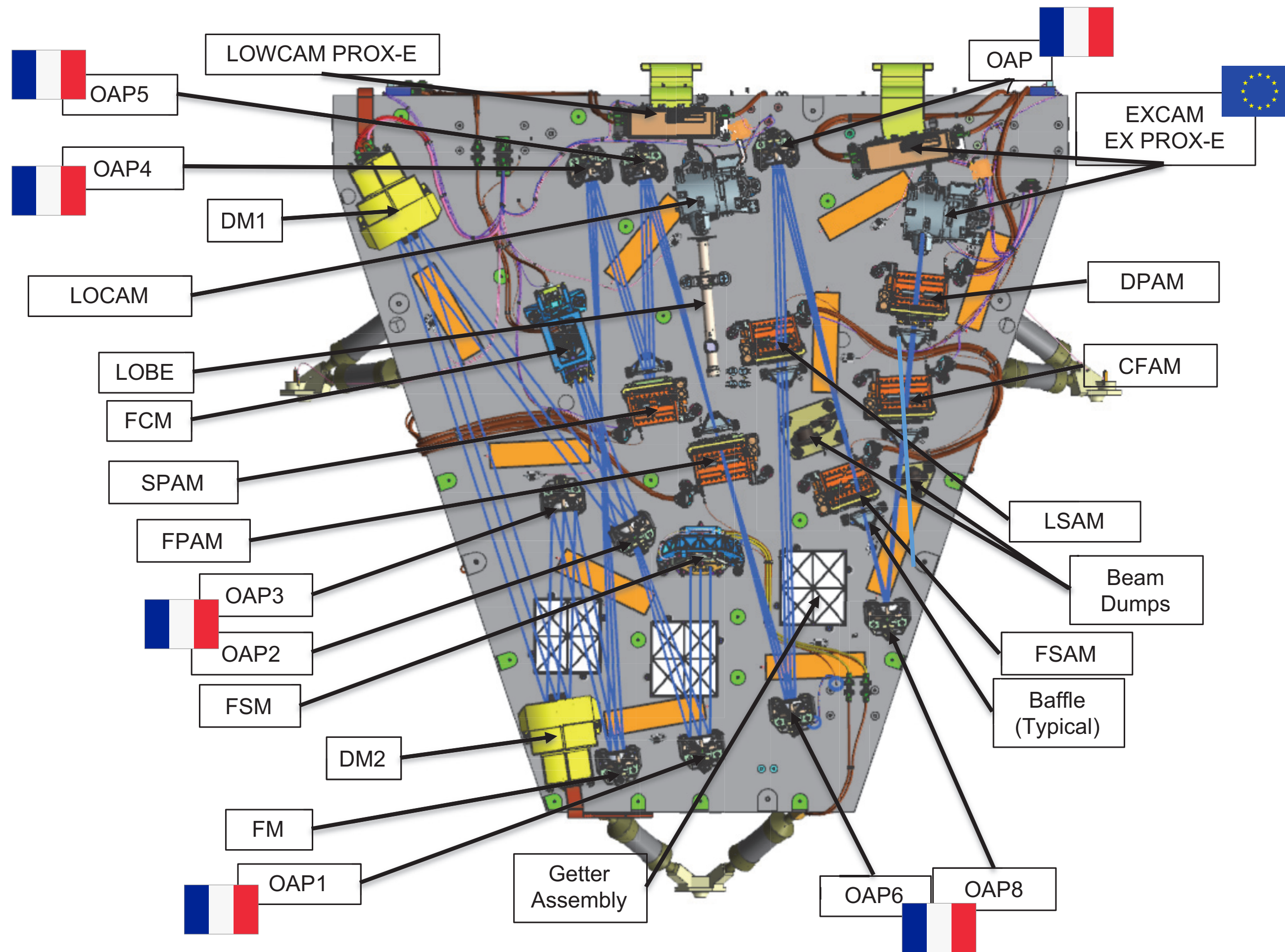


Data post-
processing

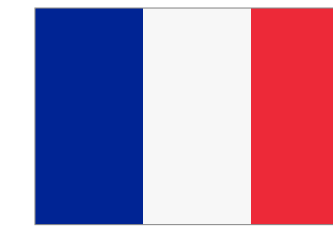


*Detection of planets
>100 millions times
fainter than the star*

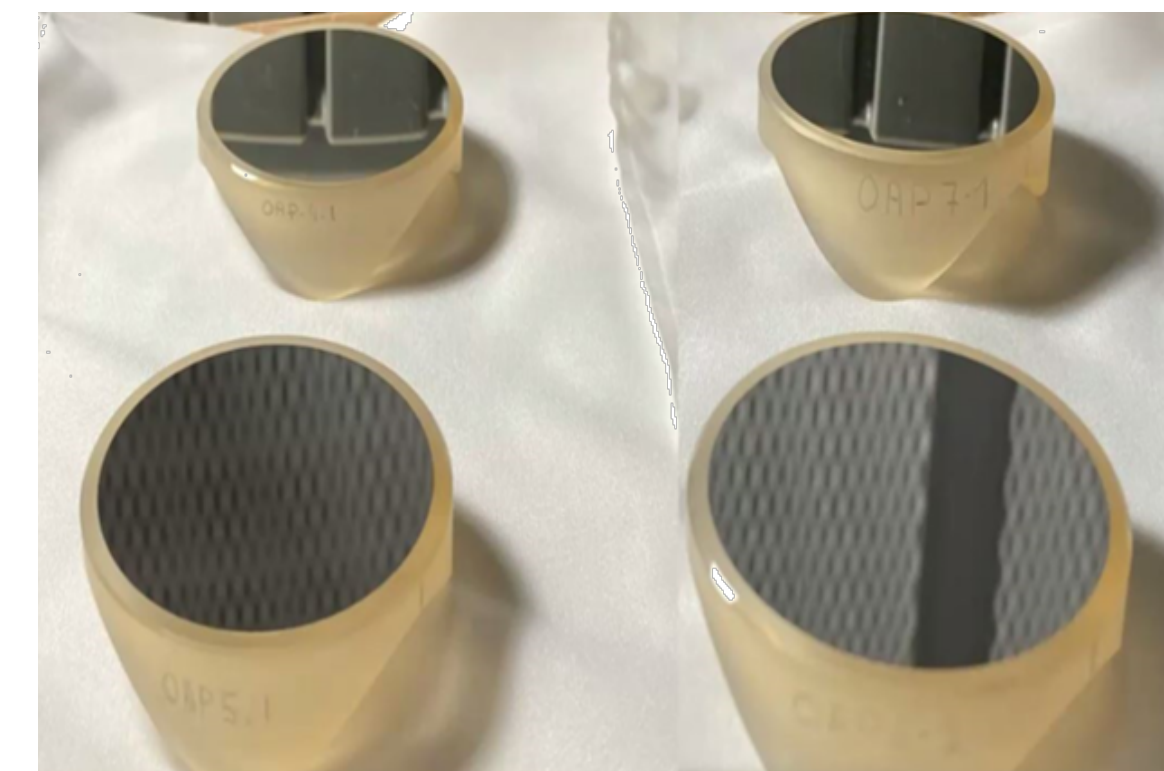
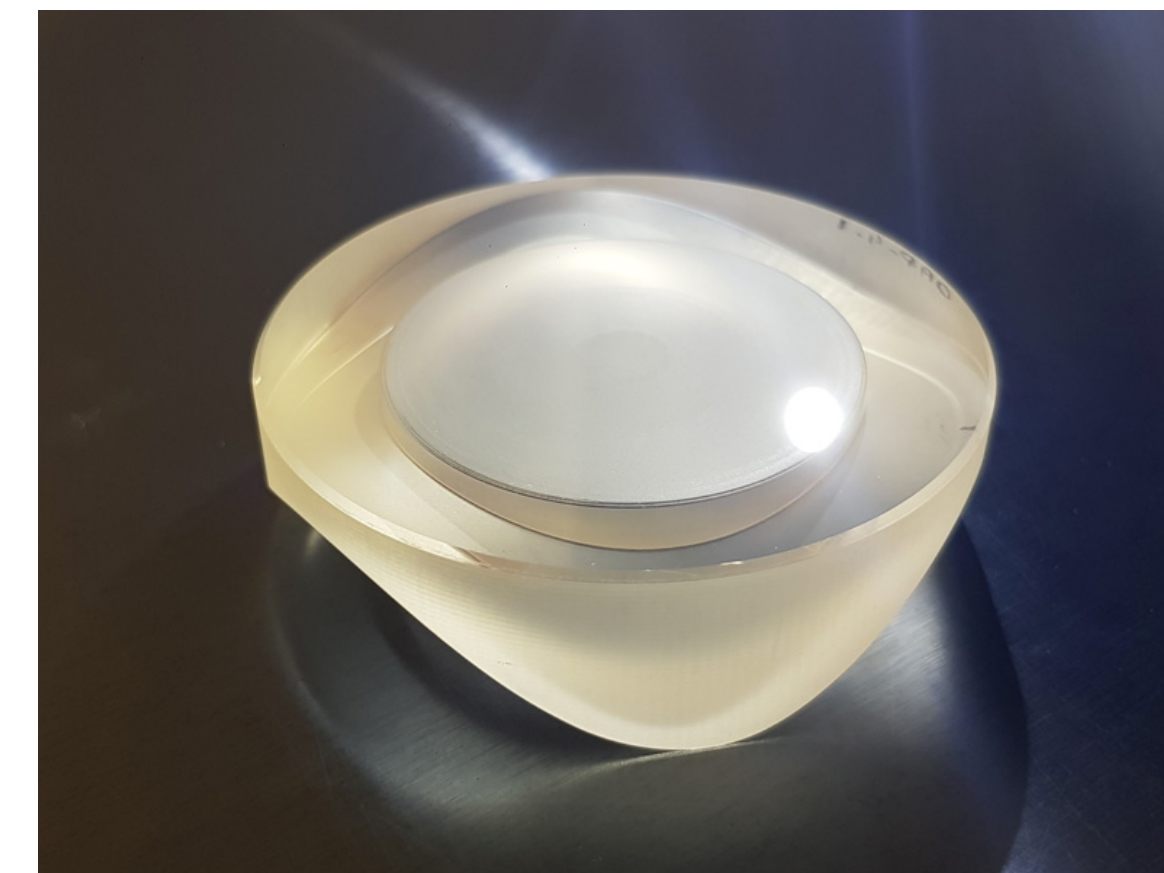
The Roman Coronagraph



French contribution to Roman by CNES



- WFI: software library for the cosmology survey of Roman (common with Euclid)
- CGI: super-polished mirrors
 - All off-axis parabolas of CGI
 - Polished by hand at LAM by M. Marcos
 - Delivered to JPL in 2022



Michel Marcos
Médaille de Cristal 2025



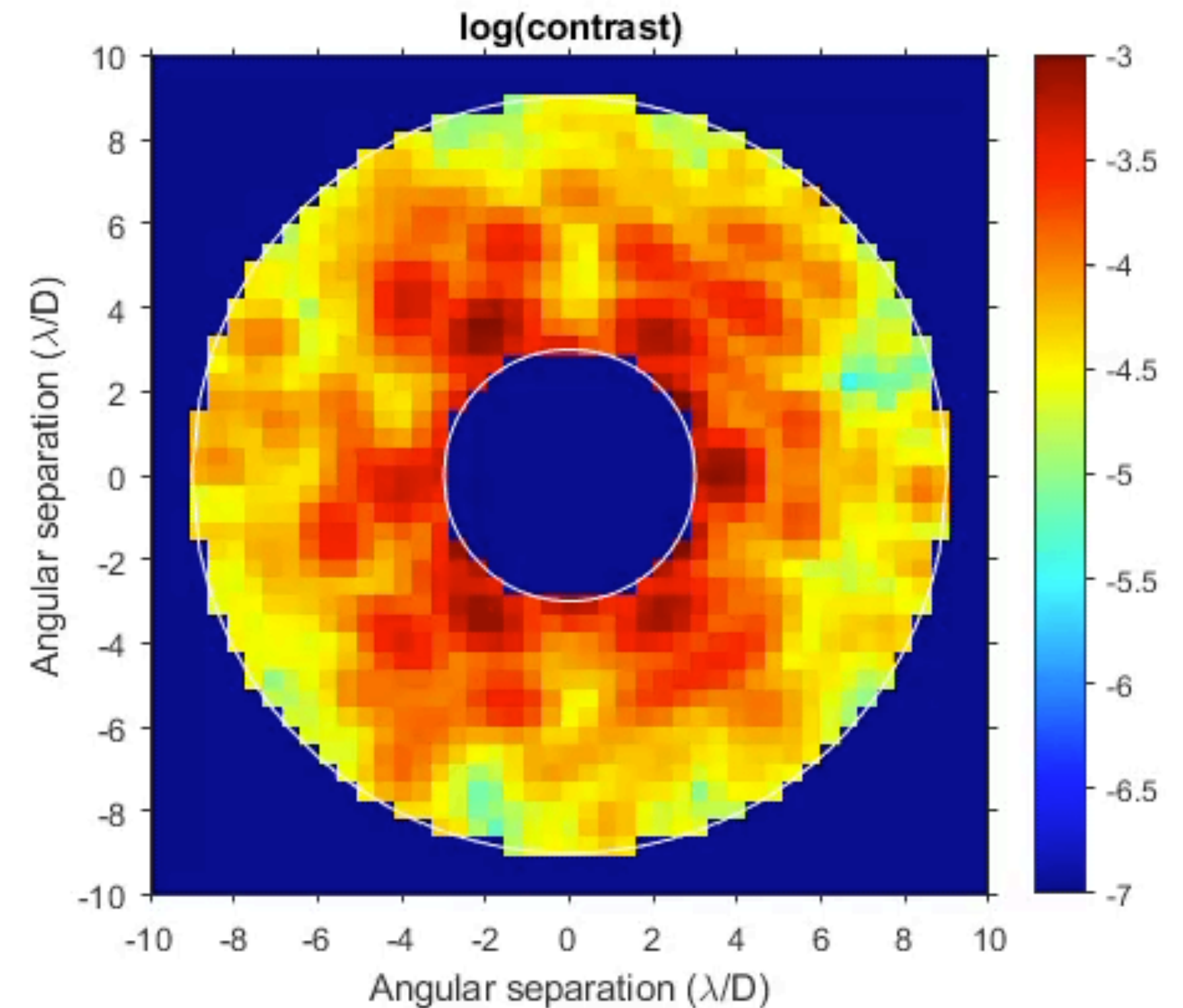
CNES = international partner of the Roman mission



Digging the contrast with deformable mirrors

- Iterative wavefront shaping to obtain a region with enhanced contrast
- Methods already validated
 - Laboratory
 - Ground-based instruments (e.g. SPHERE, Potier et al. 2022)
- Never tested in space!

Real (TVAC) Band1 data
acquired at JPL in March 2024



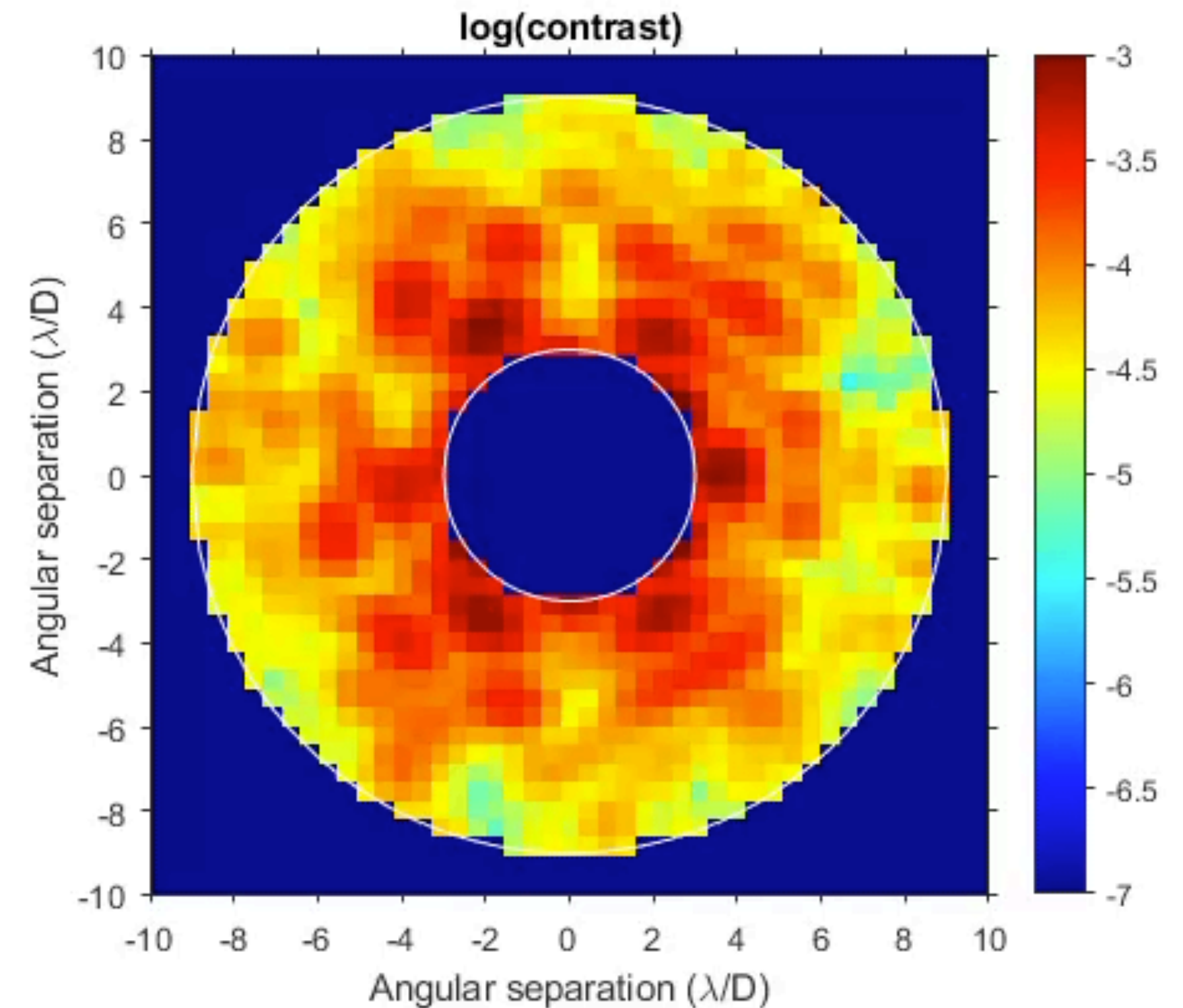
Preliminary raw contrast: $\sim 10^{-8}$ at 6 to 9 λ/D



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Observing modes



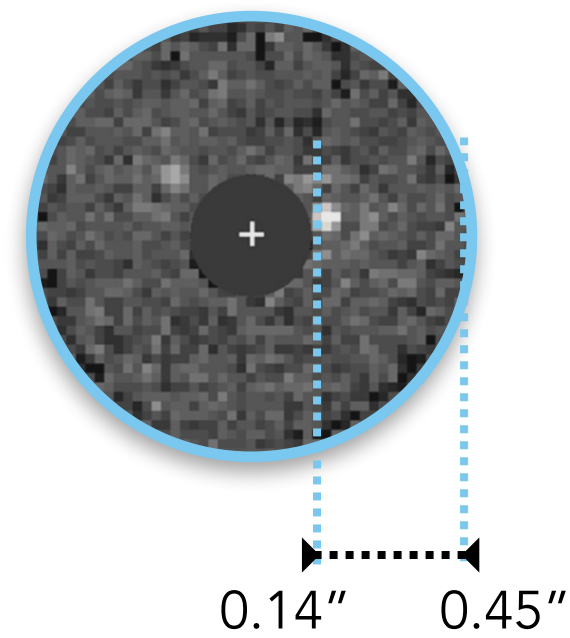
Narrow Field Imaging - HLC

(required)

& polarimetry

(goal)

575 nm
Band 1



**All goal modes are on
best effort basis !**

Credit: Julien Girard

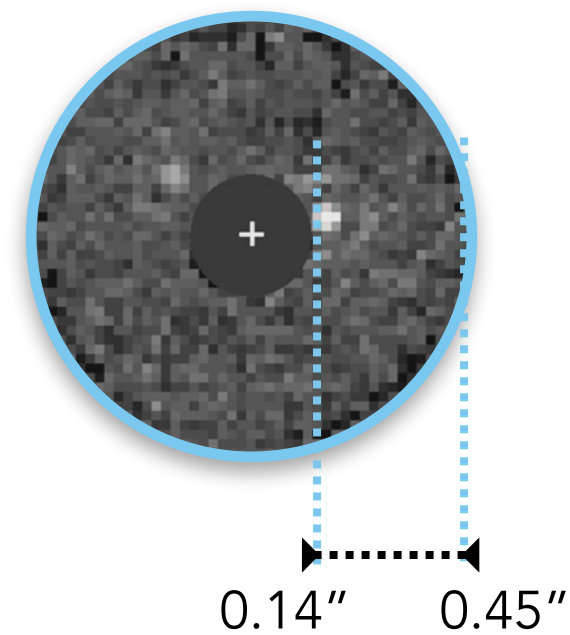
Observing modes



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& polarimetry
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575 nm
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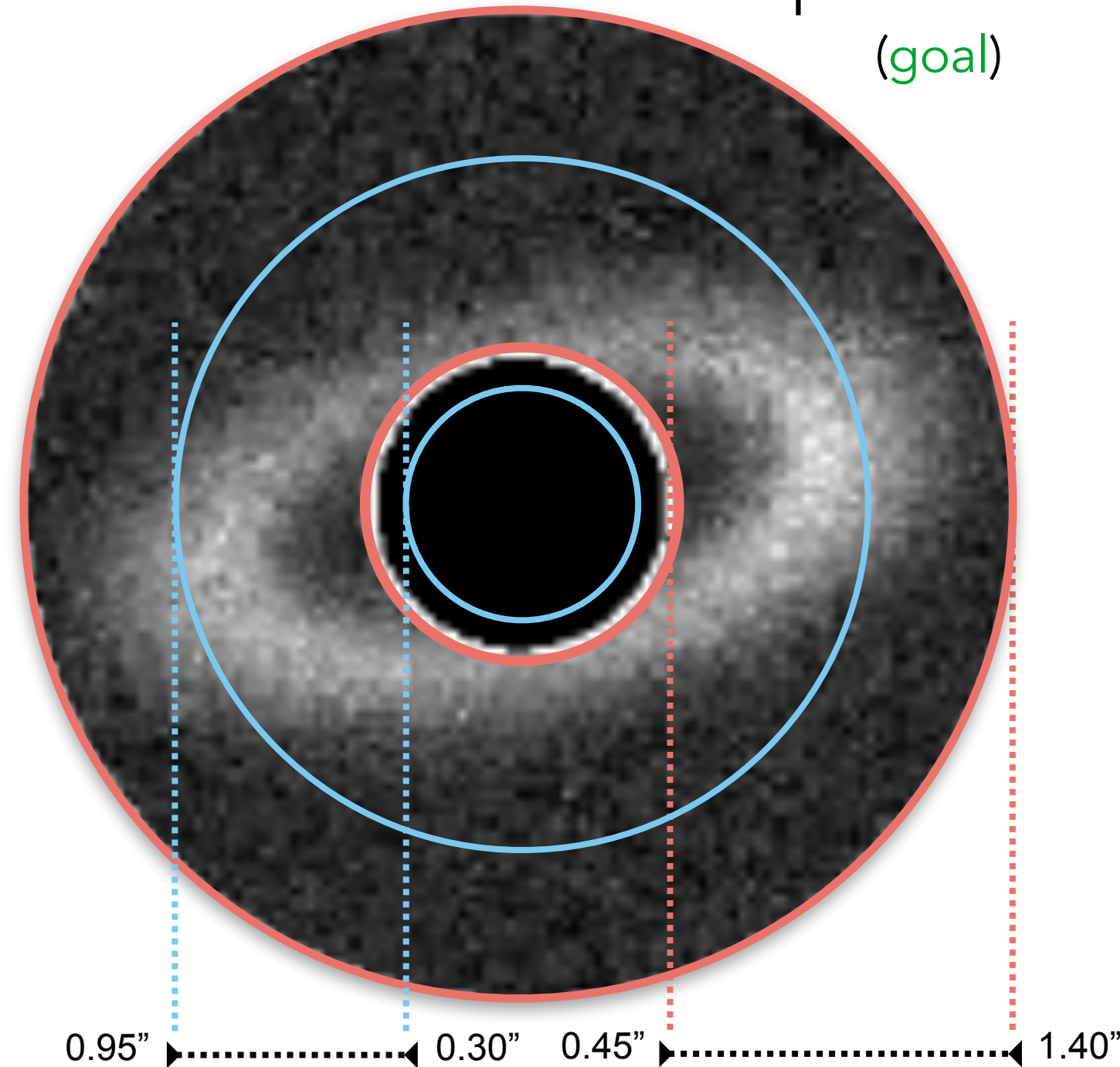


Wide Field Imaging - SPC (goal)

& polarimetry
(goal)

825 nm
Band 4

575 nm
Band 1



All goal modes are on
best effort basis !

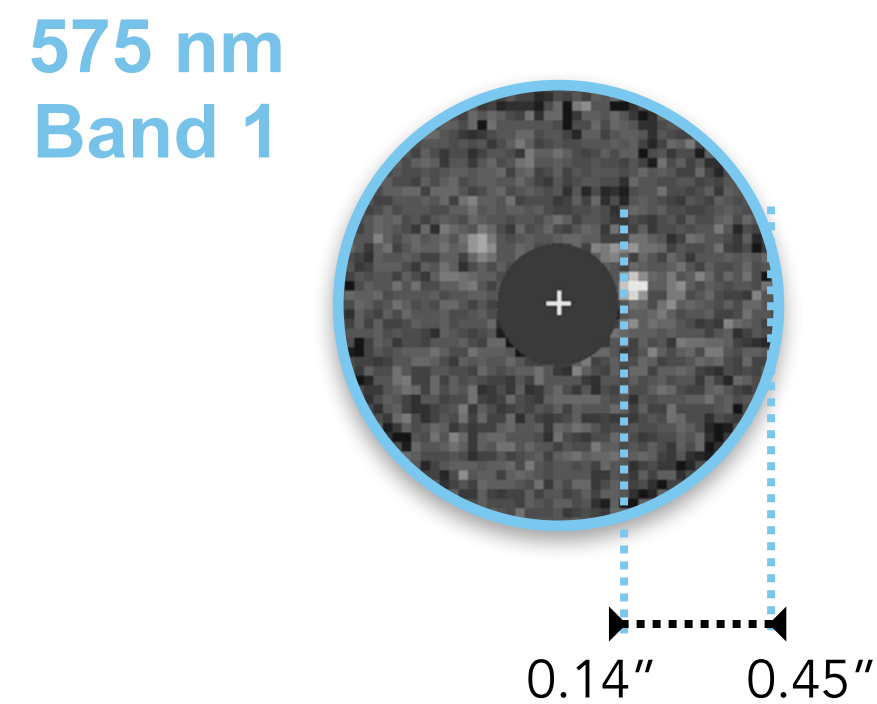
Credit: Julien Girard

Observing modes



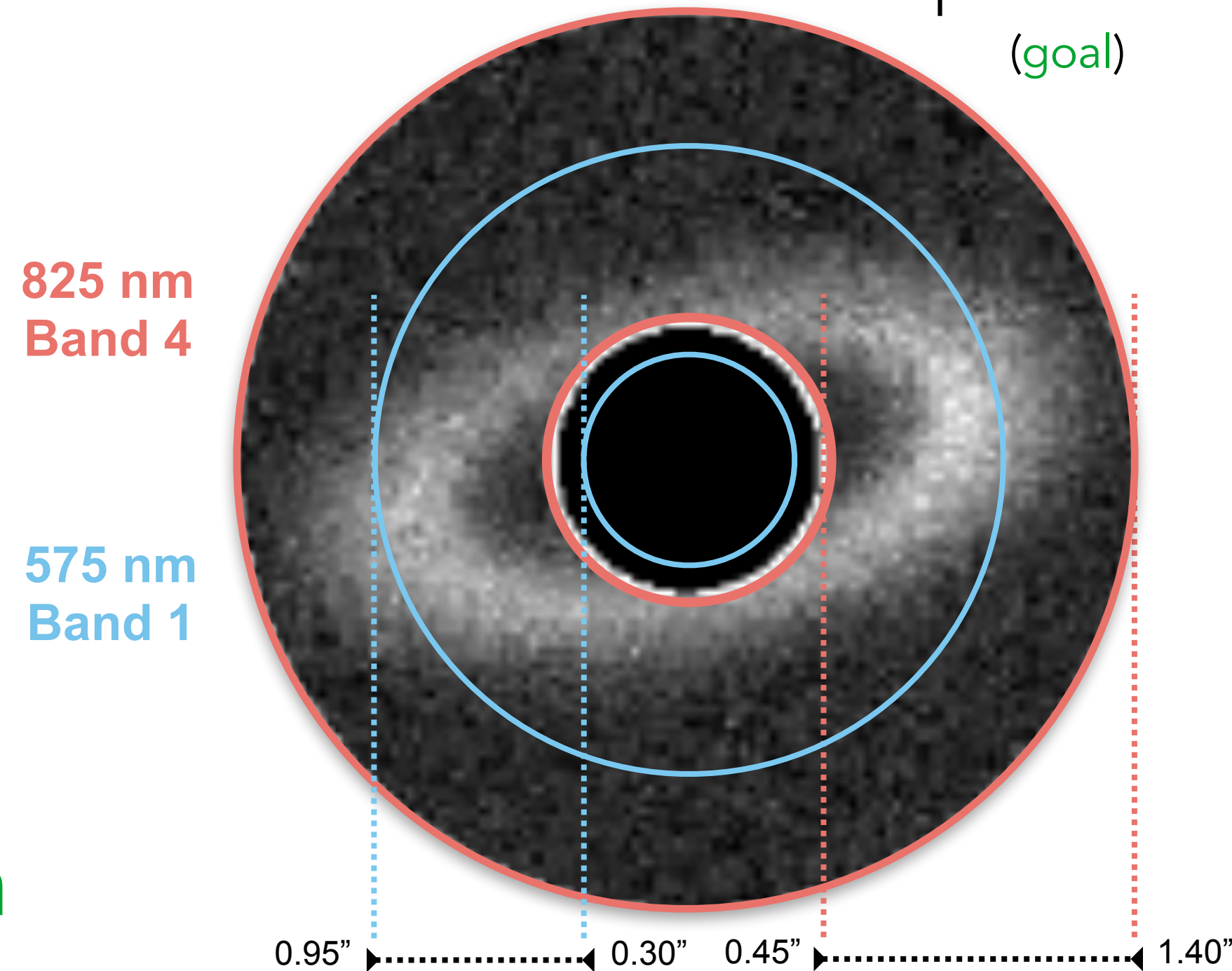
Narrow Field Imaging - HLC (required)

& polarimetry
(goal)



Wide Field Imaging - SPC (goal)

& polarimetry
(goal)



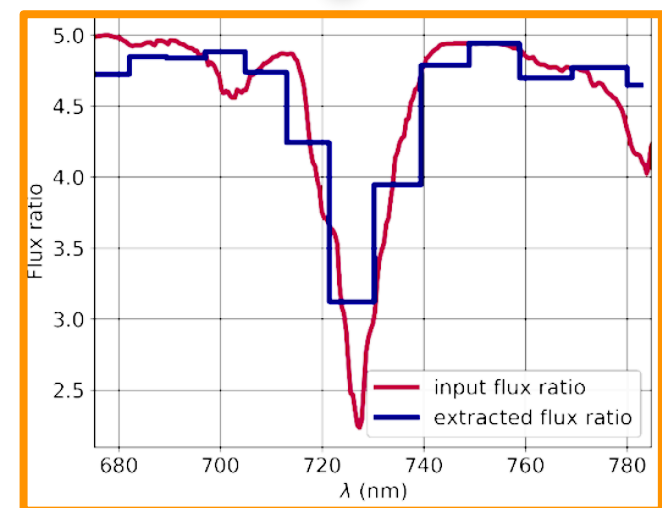
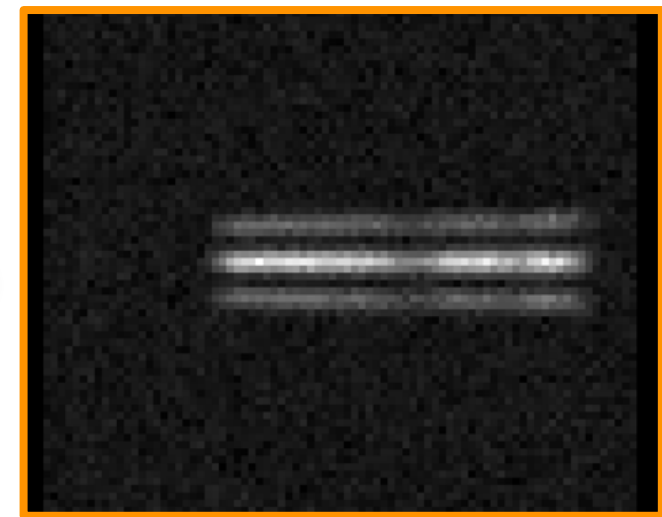
Grism spectroscopy - SPC (goal)

680-780 nm
Band 3

slit

0.18'' 0.55''

2d spectrum



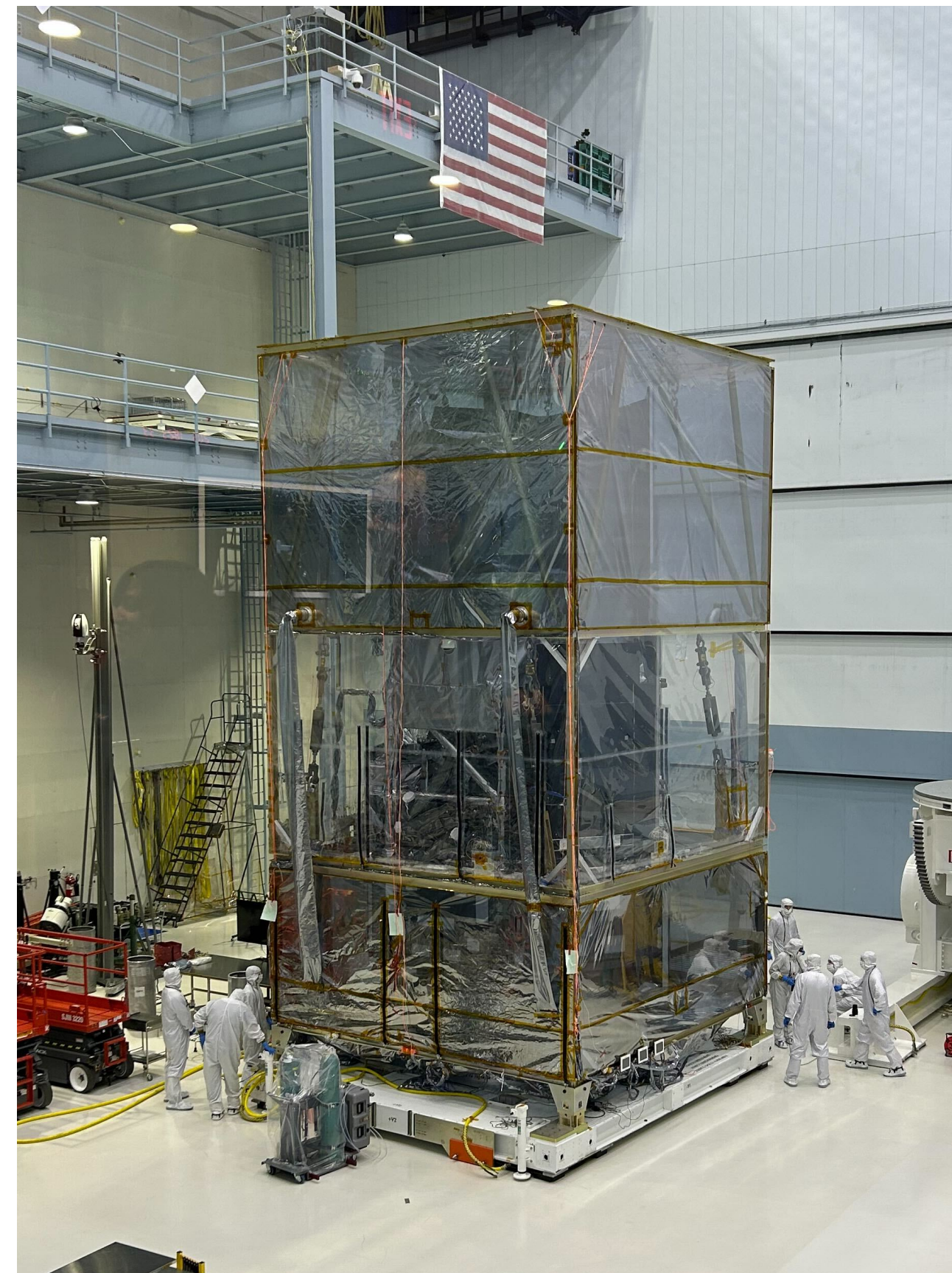
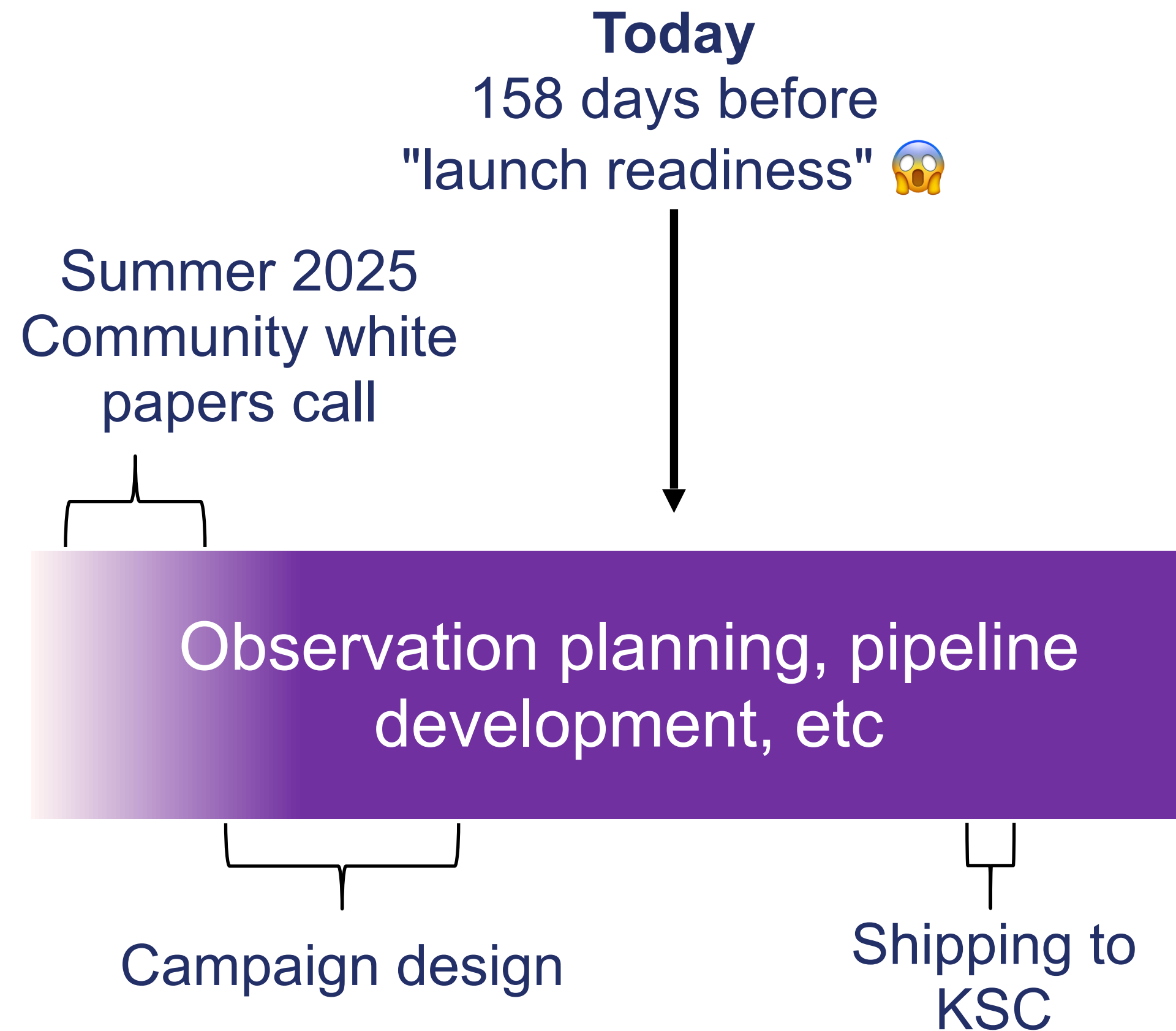
Methane absorption

All goal modes are on
best effort basis !

Credit: Julien Girard



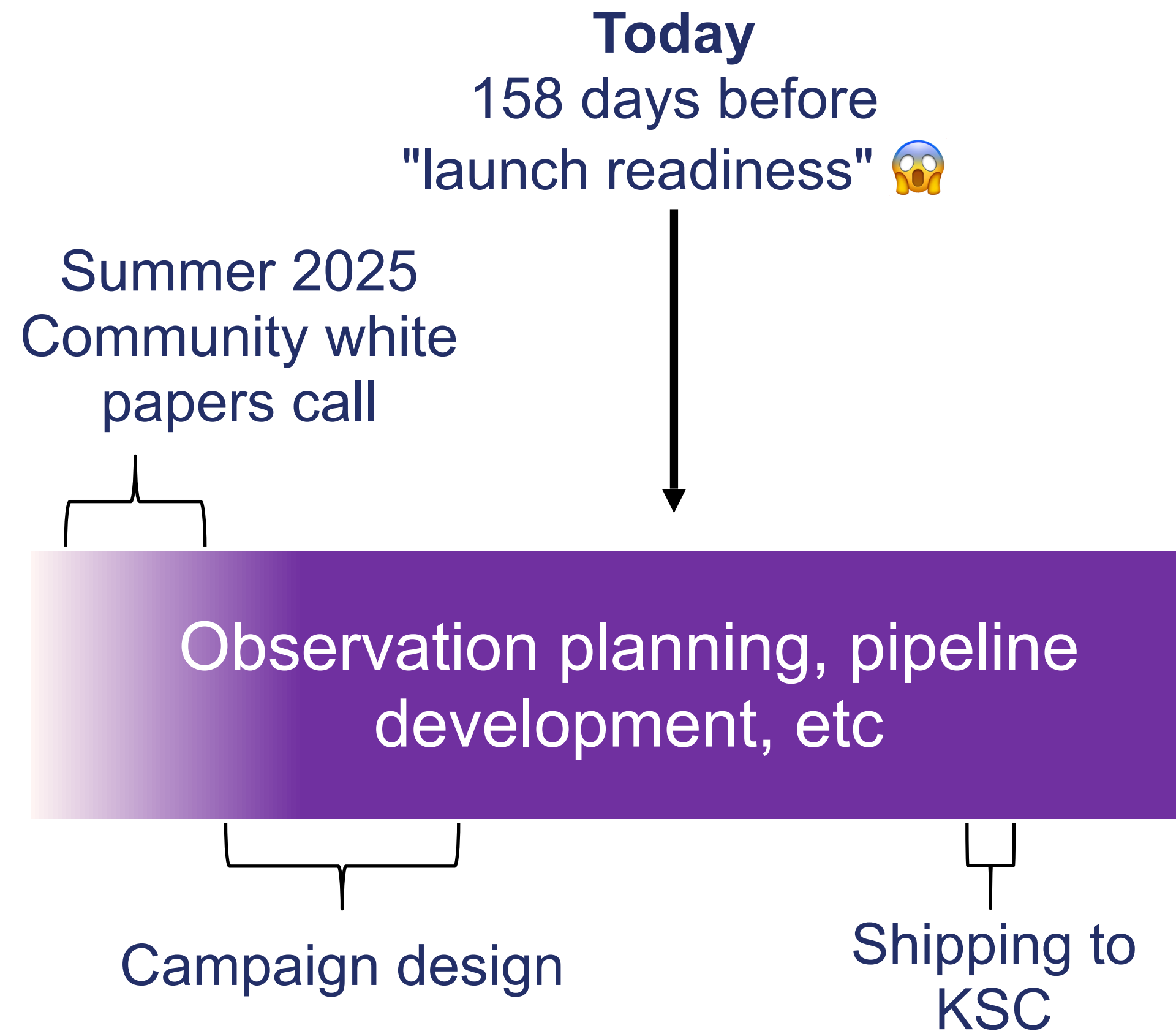
Timeline: Roman is coming. Fast.



3 March 2026
Observatory out of the final
vibration and acoustics testing
Ready for packing! 📦



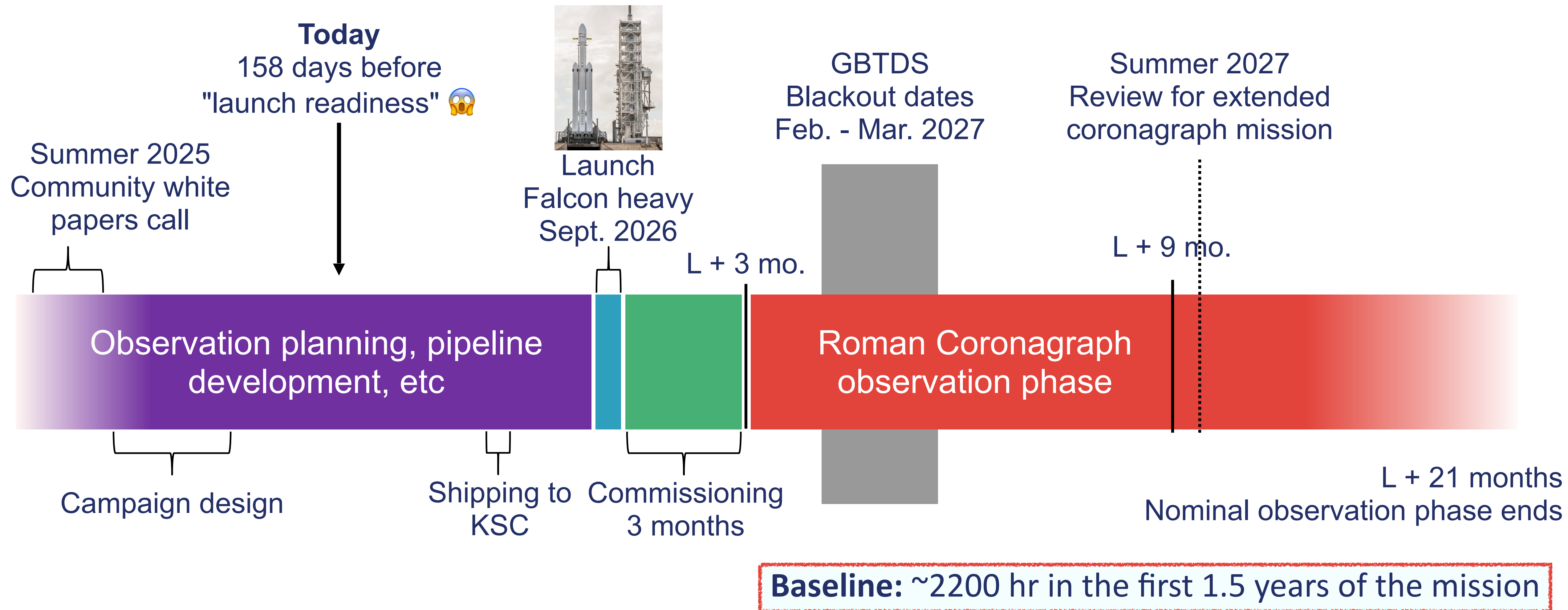
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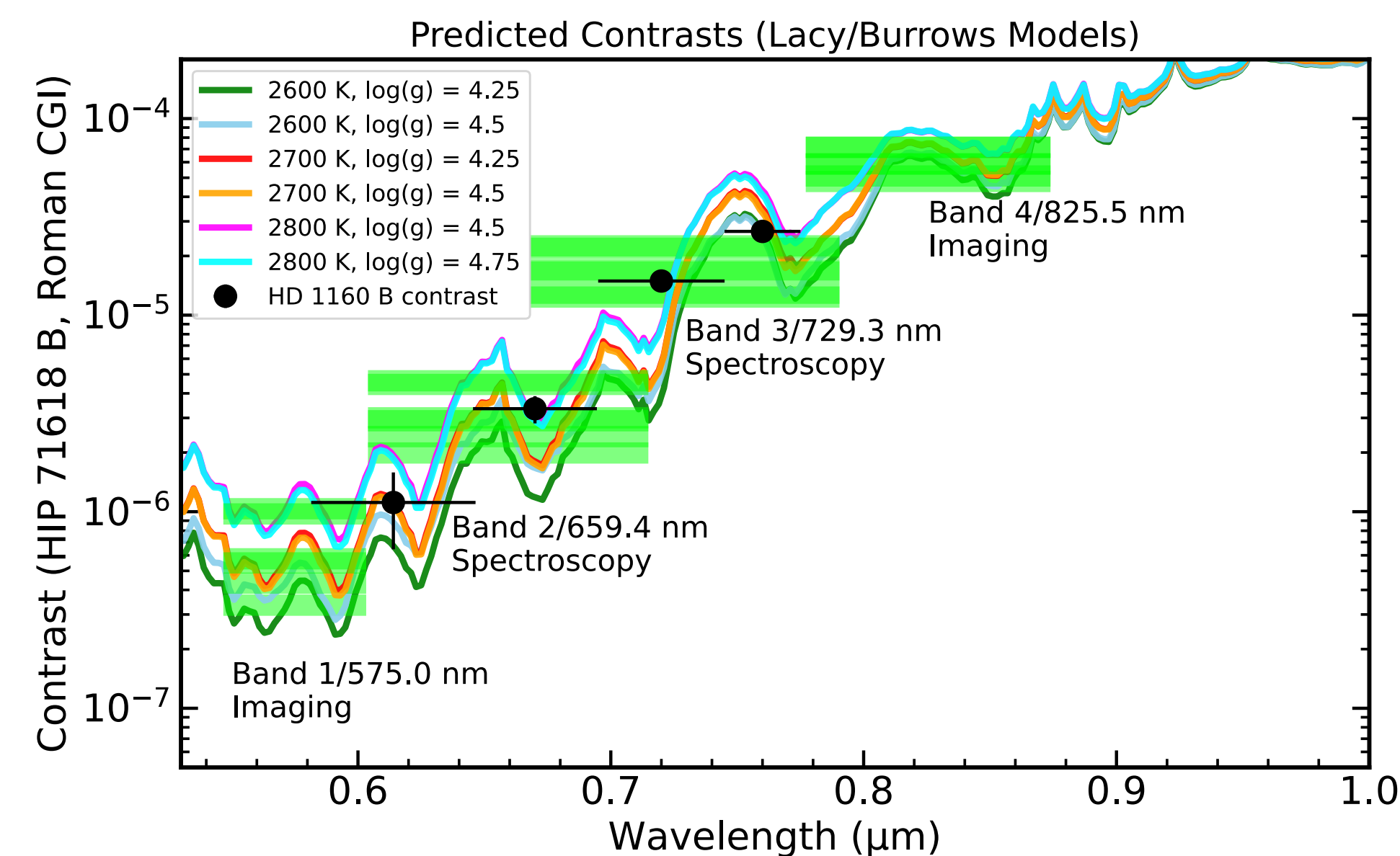
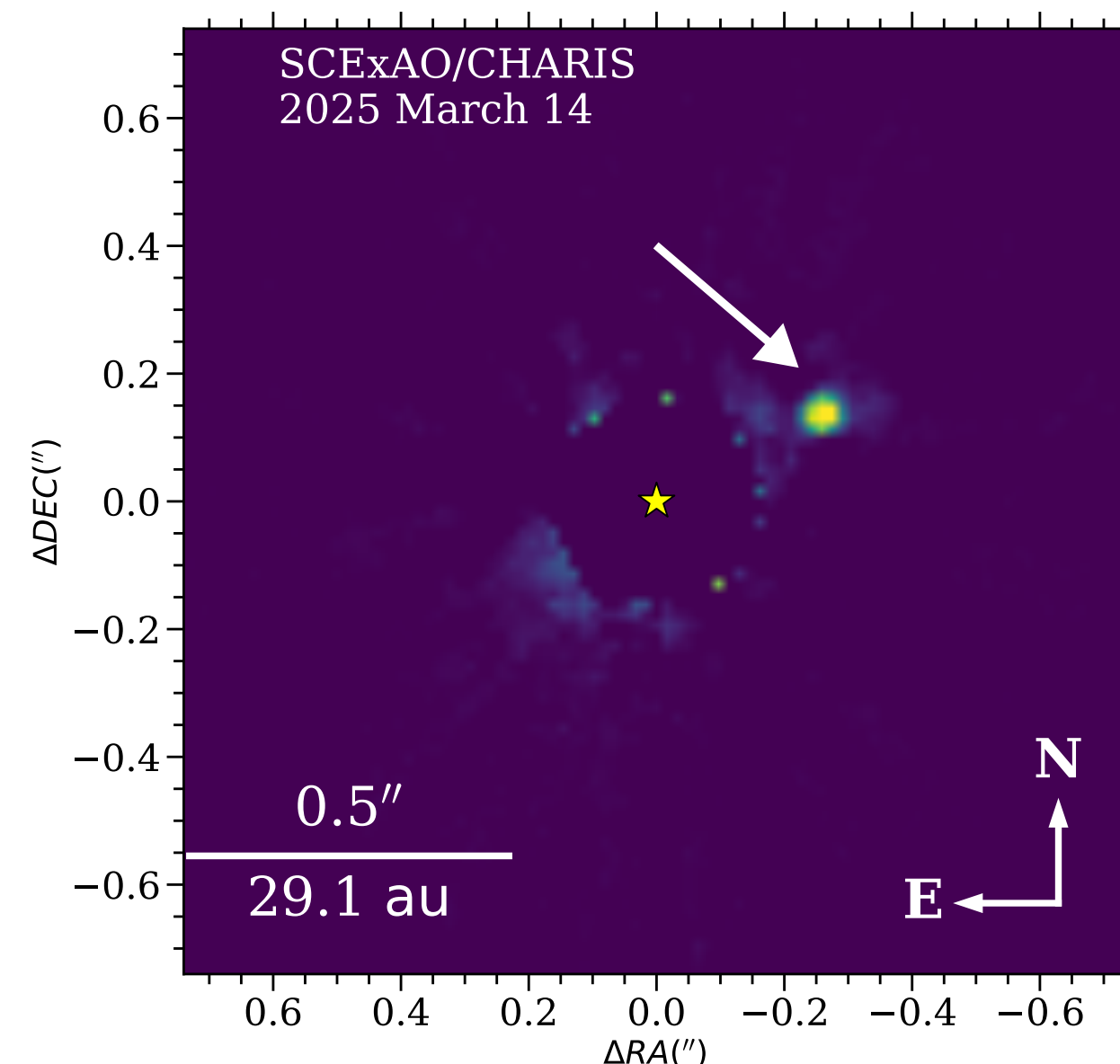
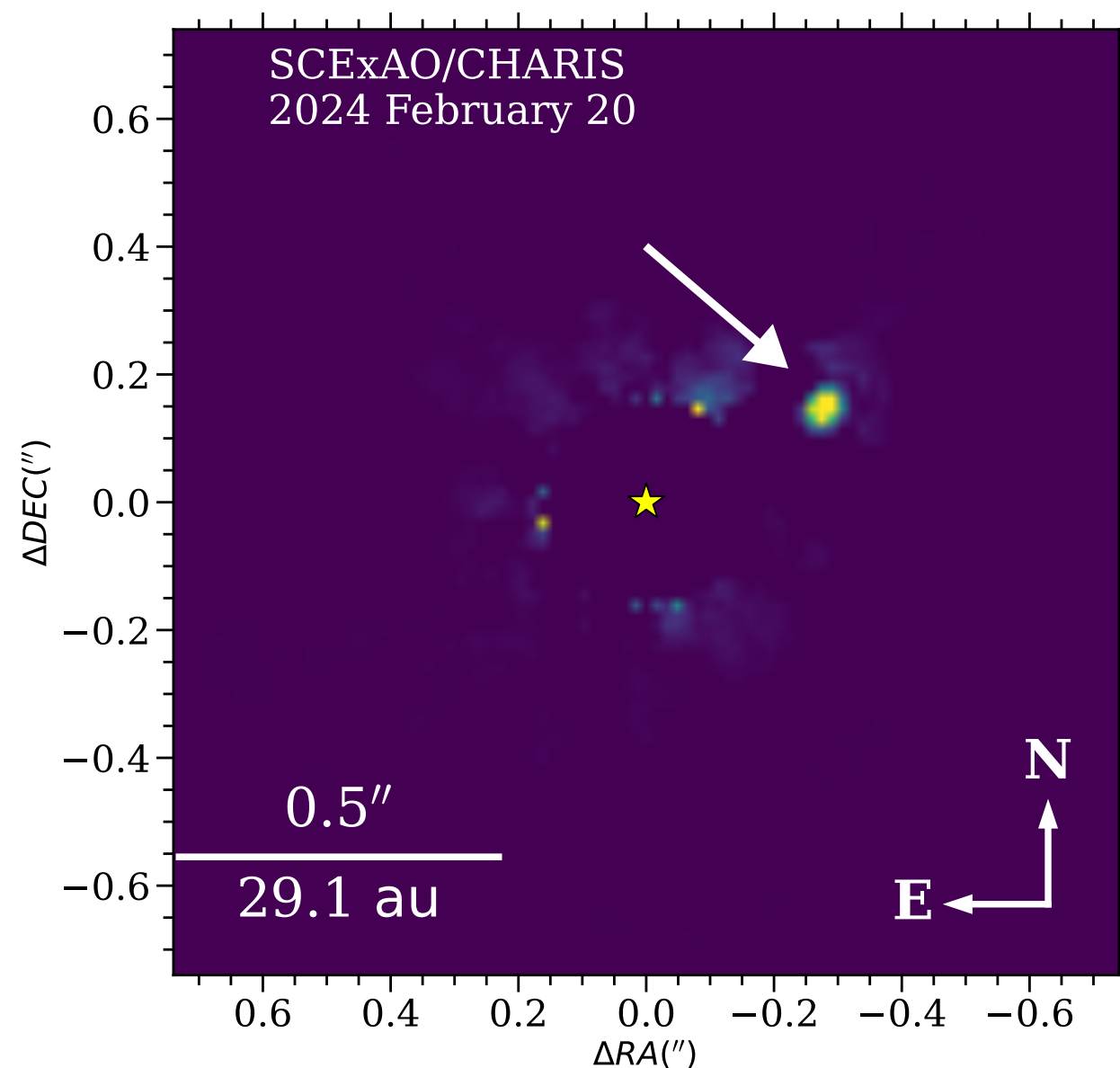
Timeline: Roman is coming. Fast.





Ambitious goals for early operations (first 6 months)

- Begin with TTR5 (if not already demonstrated in Commissioning)
- Early moderate contrast test system: likely HIP 71618 B (El Morsy et al. 2025)



Ambitious goals for early operations (first 6 months)

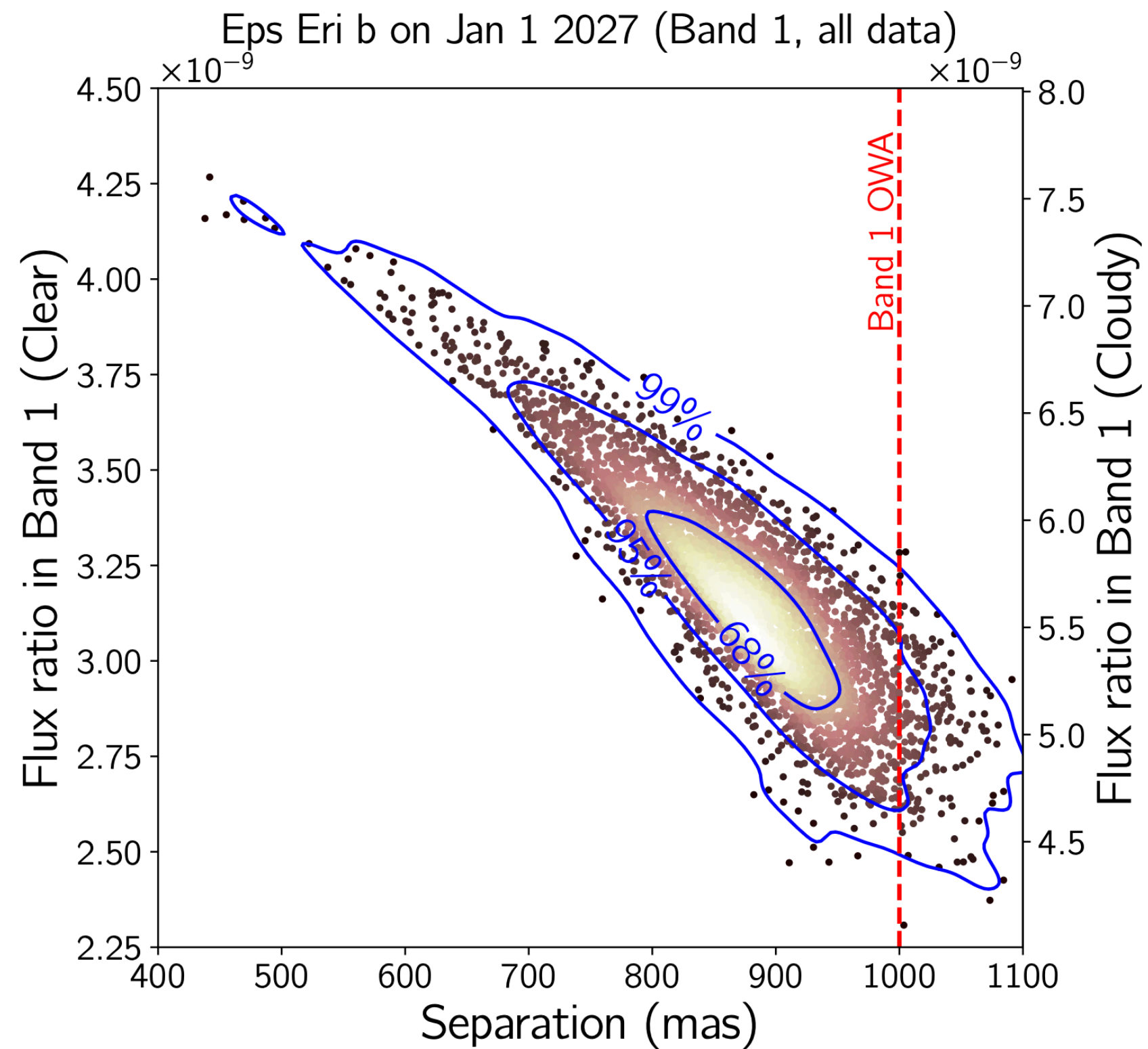


- High-impact science goals:
 - Reflected light planets: ν And d, ϵ Eri b
 - Debris disks and exozodi observations: ϵ Eri, η Crv, HR 4796

Reflected light planets



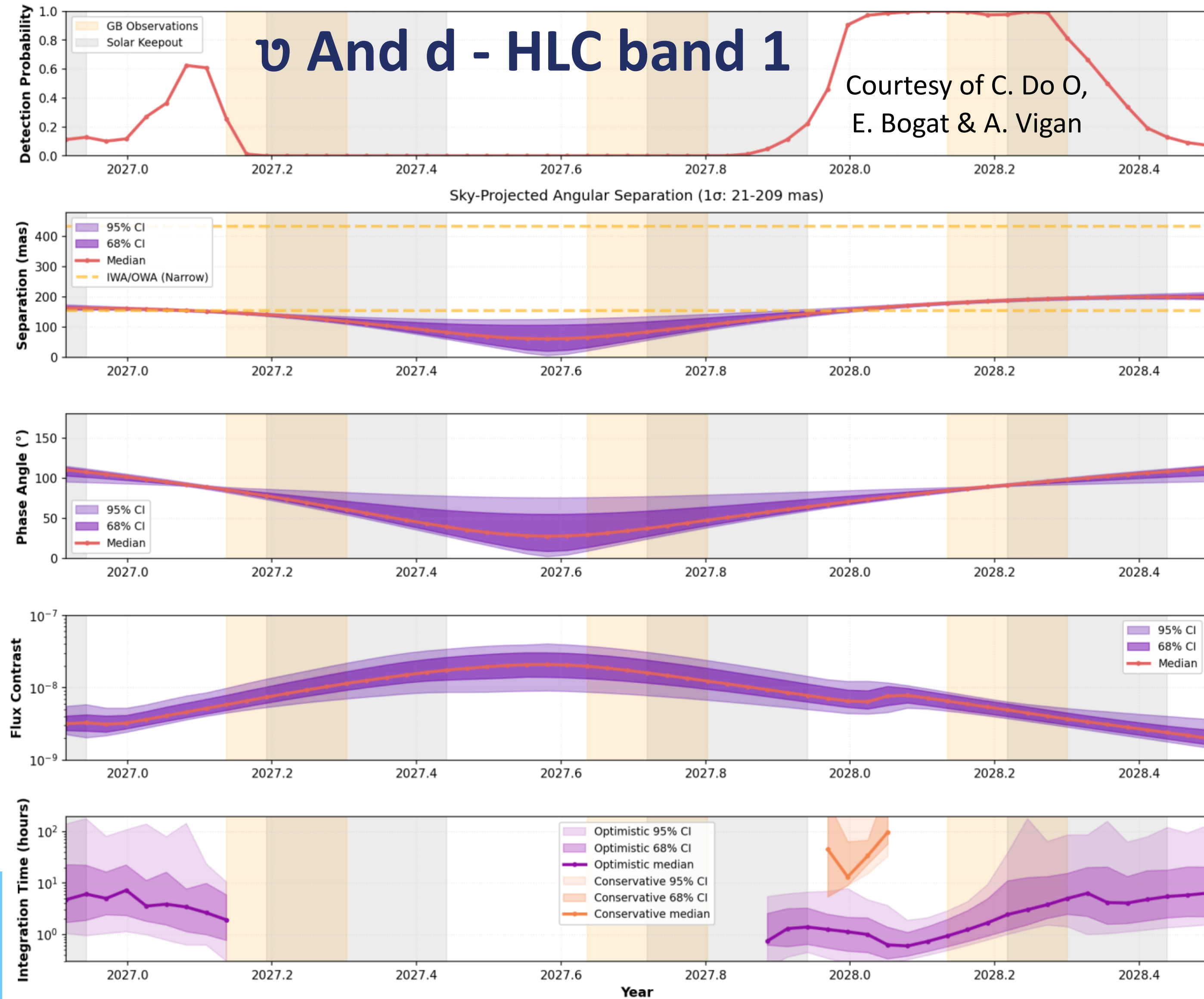
ϵ Eri b - SPC band 1



Courtesy of J. Llop-Sayson,
W. Balmer, W. Thomson

Arthur Vigan
ExoSystemes V

υ And d - HLC band 1

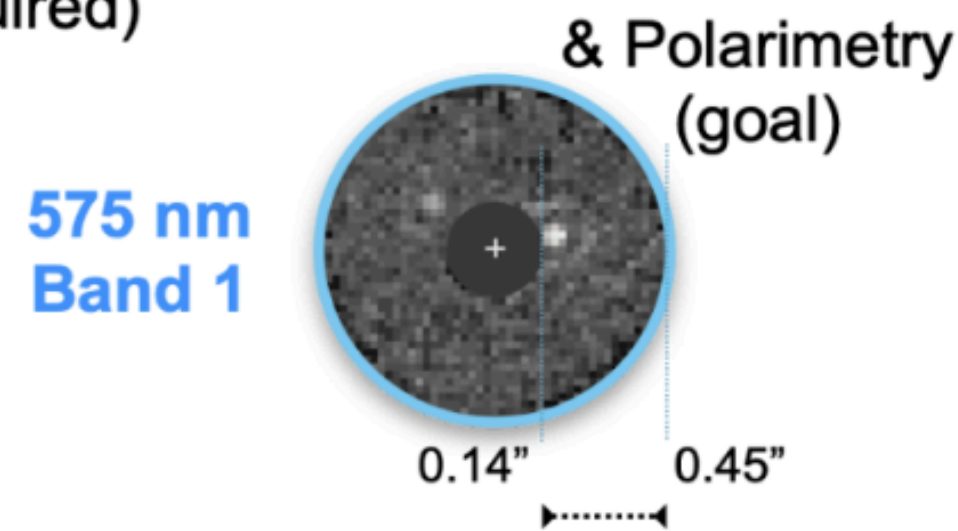




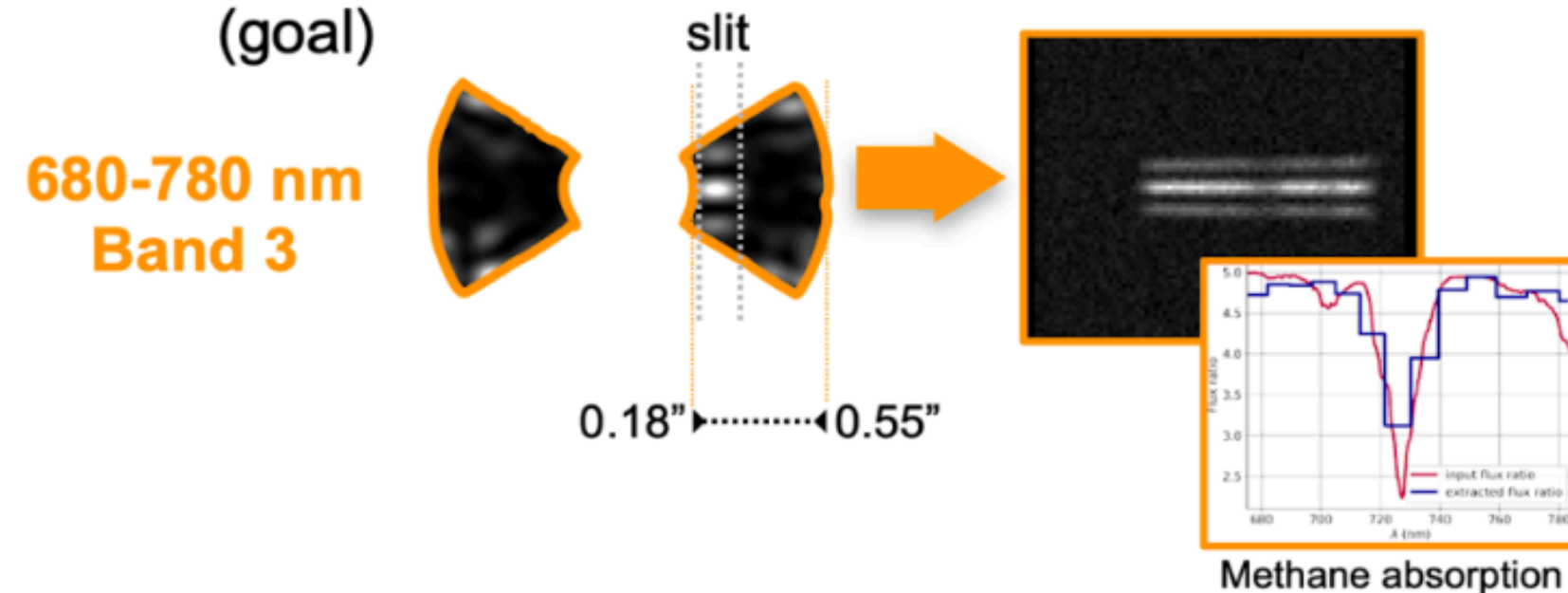
Exercise all “best effort” modes

- Spectroscopy on moderate brightness BDs
 - Ex. one easily in FOV (HIP 71618) and one at IWA (HIP 54515)
- Interleave observations of self-luminous planets/BD (HR 8799, κ And, HR 2562) with imaging+polarimetry of reflected light debris disks to probe dust transport and planet interactions
- USco ‘star hopping’ disk search w/ polarimetry
- Spectroscopy of HR8799e
- Additional objects from exozodi campaign
- May try for SPF of bright disks (HD 191089, HD 163296), but chance of deferral b/c of very tight schedule

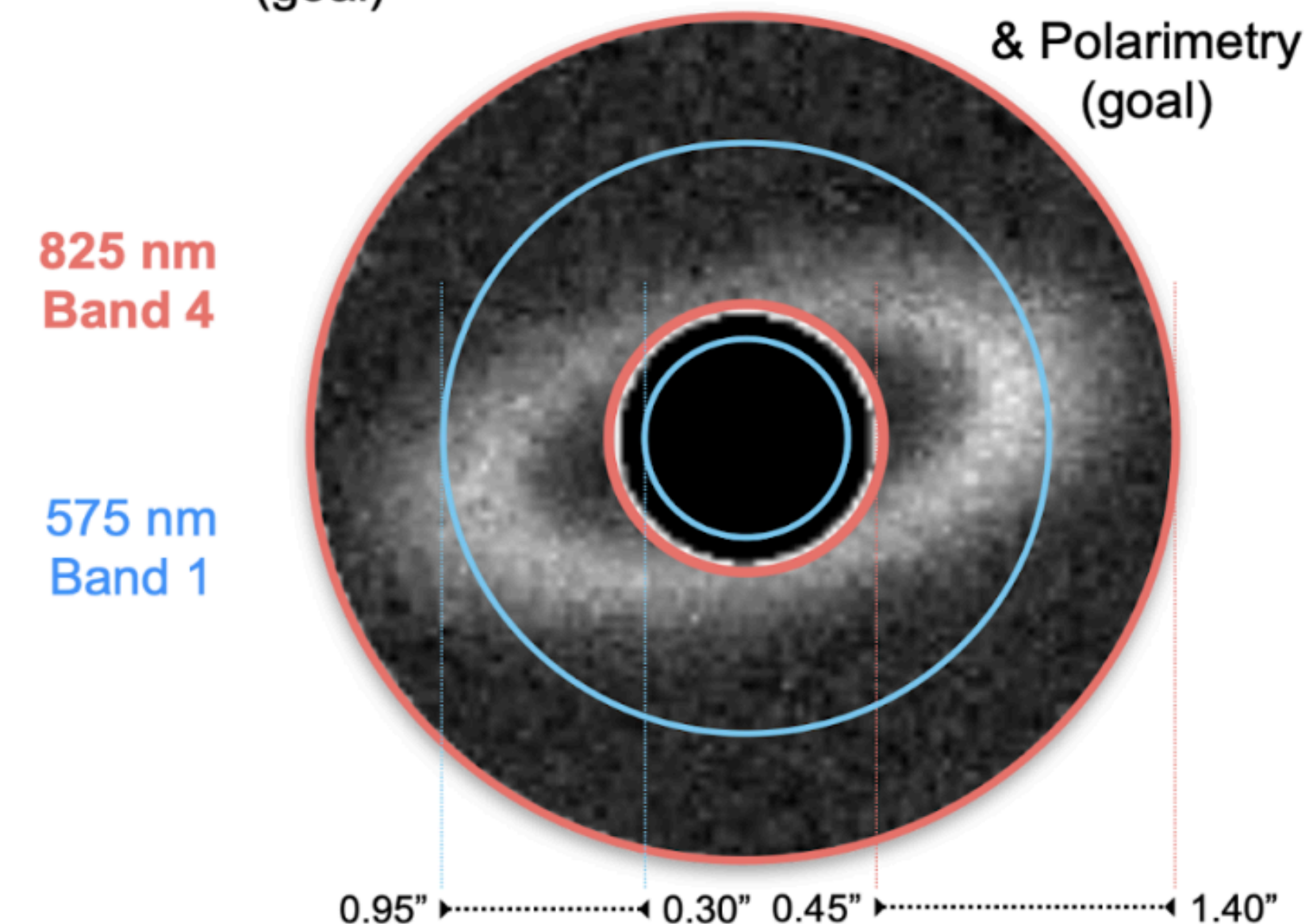
Narrow Field Imaging
(required)



Grism Spectroscopy
(goal)

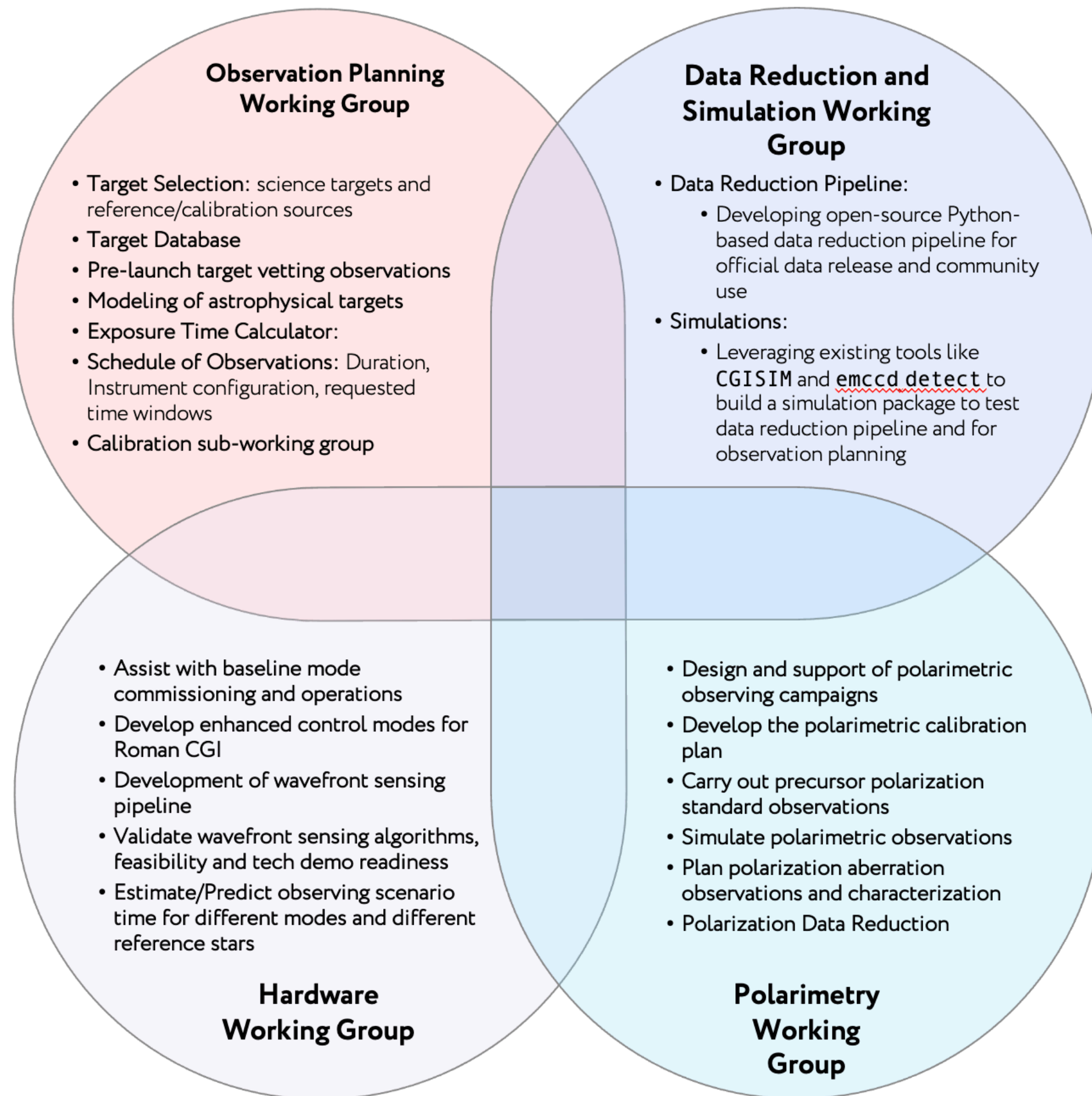


Wide Field Imaging
(goal)





Roman Community Participation Program (CPP)



- CPP constitution: Instrument team (JPL) + 10 US selected teams + 4 international partners (incl. CNES)
- In charge of numerous activities
 - Target selection
 - Campaign planning
 - Tools and pipeline development
 - Community engagement
 - ...

Roman Community Participation Program (CPP)





French involvement in the CPP

- Coordination: Arthur Vigan (LAM/CNRS) & Johan Mazoyer (deputy, LIRA/CNRS)
- 9 full CPP members in France (LAM, LIRA, Lagrange)

<i>Obs Planning, TPC</i>	<i>DRP</i>	<i>Simulations</i>	<i>Hardware</i>	<i>Polarimetry</i>
A. Vigan	L. Altinier E. Choquet S. Noiret	I. Laginja A. Lau S. Noiret	A. Potier I. Laginja P. Baudoz A. Vigan J. Mazoyer A. Lau	

- Note: **ERC ESCAPE** (PI Choquet) funding dedicated to Roman

Opportunity for our community



- All Roman Coronagraph data is public immediately!
- Want to be ready? Join CPP France :-)
- Unique scientific opportunity:
 - New exoplanet science in reflected light
 - Broad science: instrumentation, observation, modelling, ...
 - Preparation for HWO, PCS

