

The Nancy Grace Roman Space Telescope: Wide-Field Instrument

INSTRUMENT PARAMETERS

Field of View

0.8 x 0.4 deg, 0.281 deg² active area (excluding detector gaps)
Hubble: 1/100 the FOV

Spatial sampling

0.11 arcsec/pix; 288 Mpix focal plane

Image Stability

1.0 nm RMS wave front error variation in 180 sec

Detector Mosaic

6 x 3 array of Teledyne H4RG-10
*Hubble: one image sensor

Band pass

0.48 to 2.3 microns

Element Wheel positions

8 science filters, grism, prism, and blank for dark current and flat fields (using the internal calibration system)

Instrument + Telescope Focal Ratio

f/7.9
*Hubble: f/24

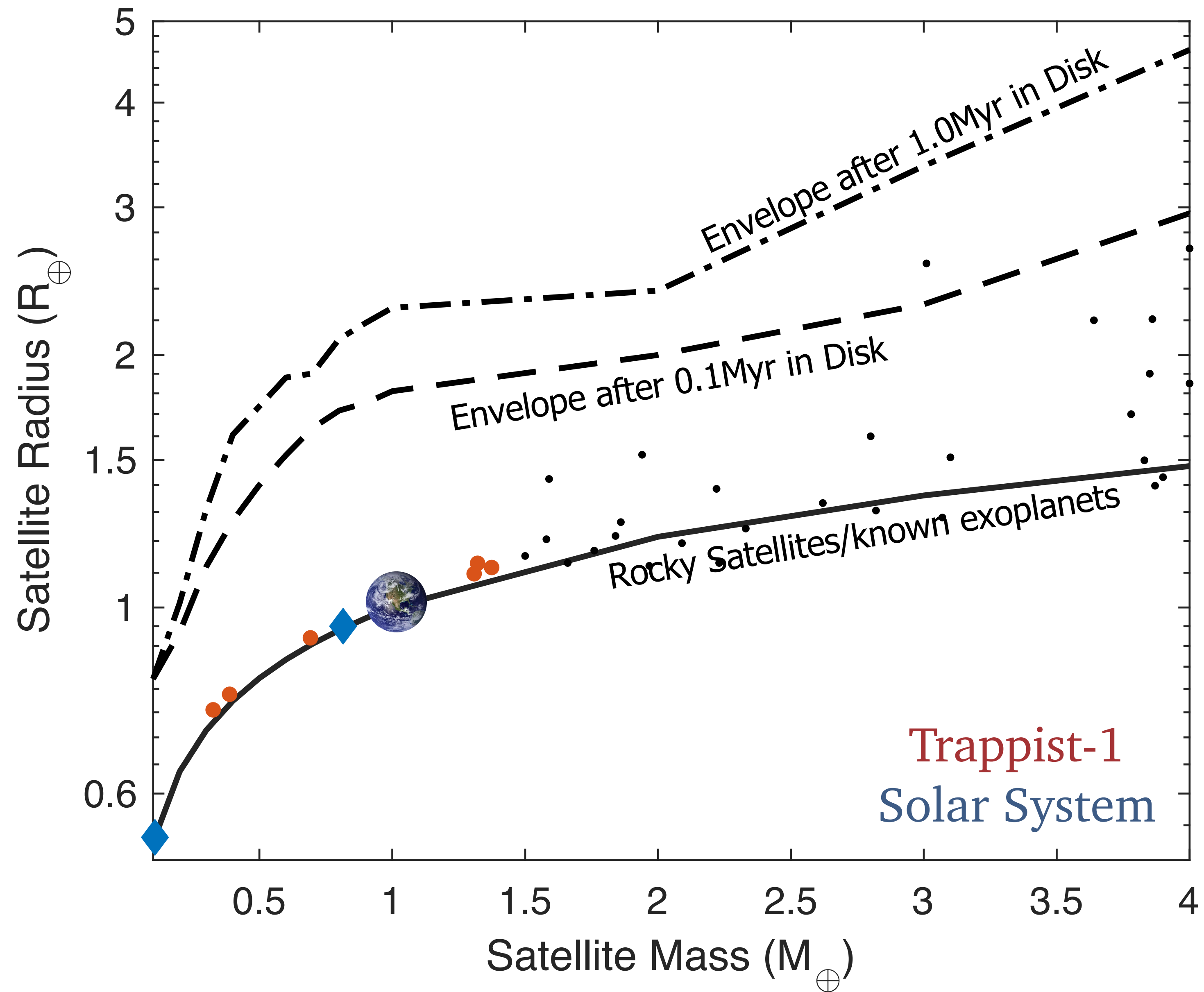


1.4 TB of data beamed back to Earth each day

Why survey young SFRs?

Anchor planetary evolution in time

- Probe planet occurrence rates as a function of age
- Capture the primordial radius distribution before atmospheric sculpting
- Constrain radius-valley emergence and mass-loss timescales
- Test in-situ formation vs. migration with close-in planets at a few Myr
- Probe multiplicity and dynamical stability of newly-formed systems
- Build census of young planets

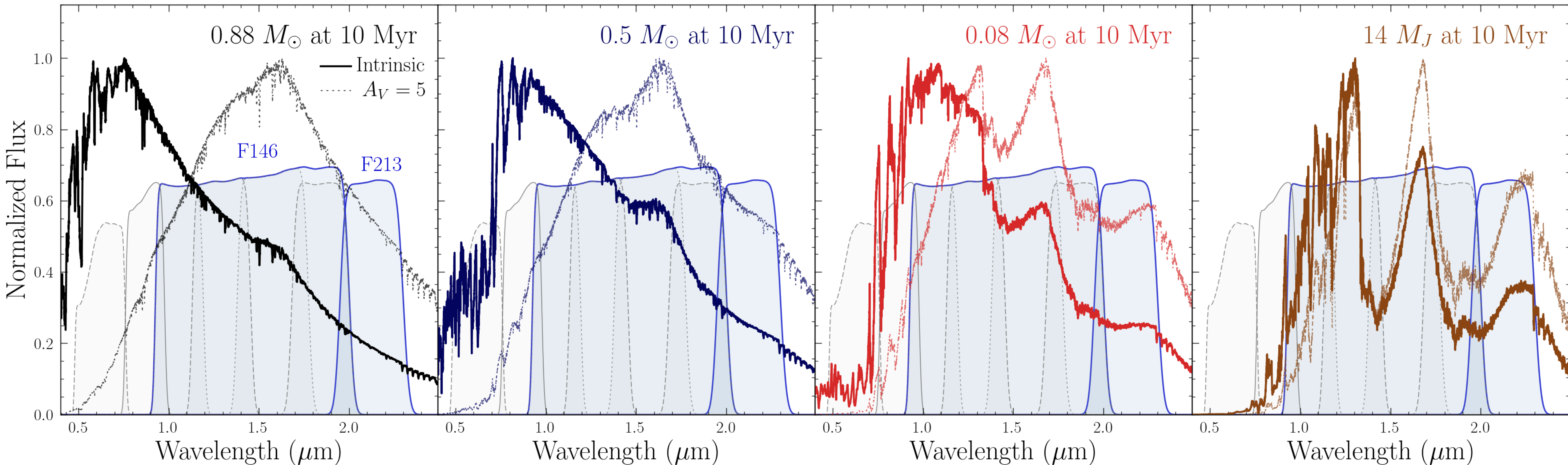


Why survey young SFRs with Roman?

Near-Infrared Reach

- Observe through dust that reddens young regions
- Reaches embedded stars optical surveys miss
- Sensitive to cool, low-mass hosts and brown dwarfs

Roman can monitor low-mass stars, brown dwarfs, and planets



Rosette Nebula (10 Myr, 1.5 kpc)

Why survey young SFRs with Roman?

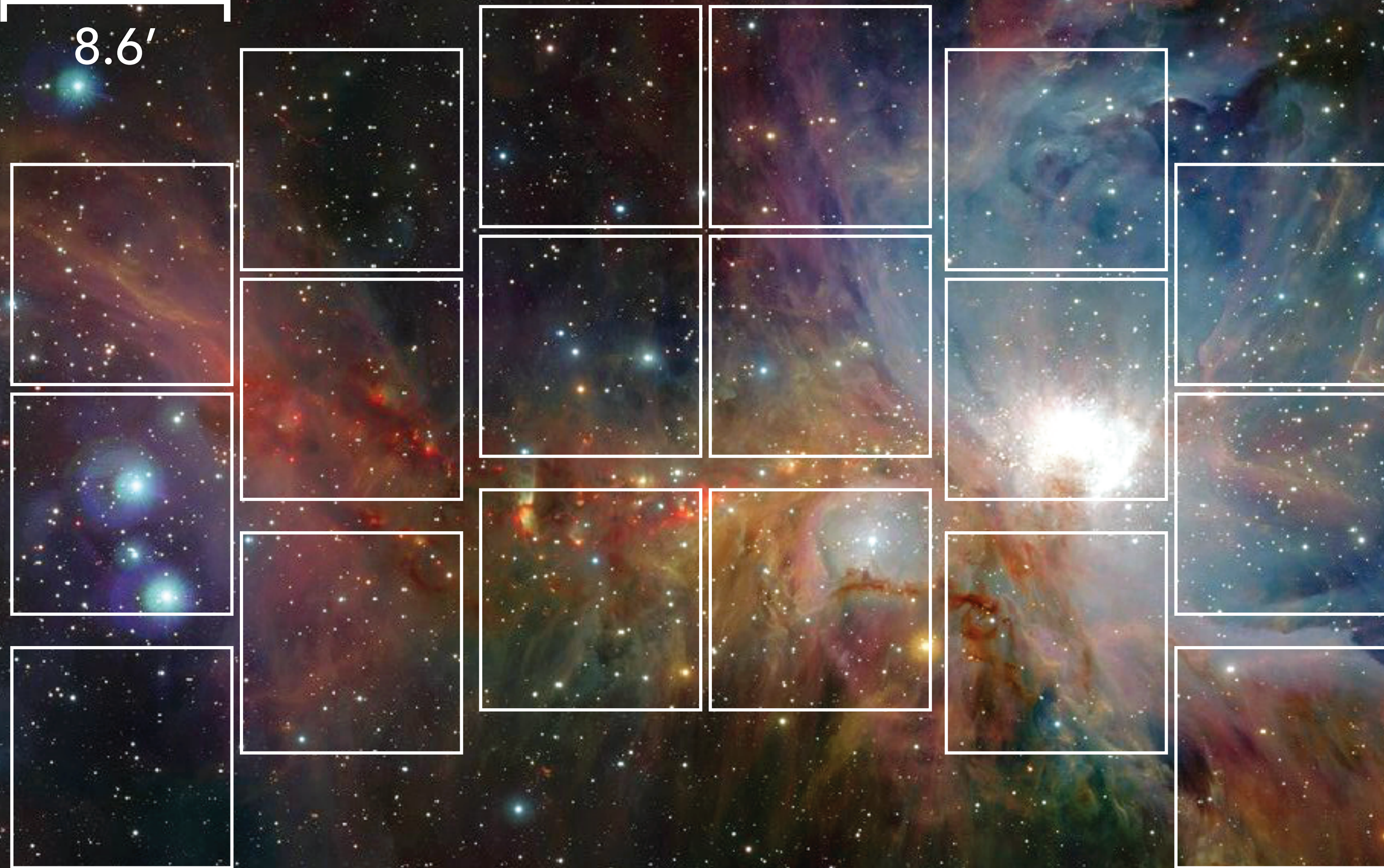
Large Field of View & High Spatial Resolution

- Wide field monitors large populations
- High spatial resolution enables transit survey of dense fields

The TEMPO Survey



1 pc
8.6'



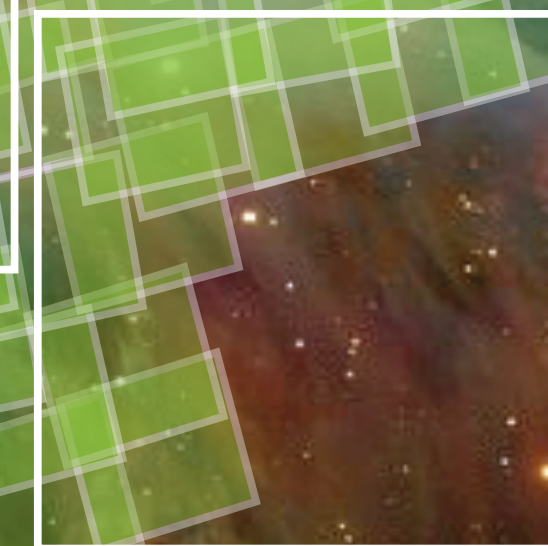
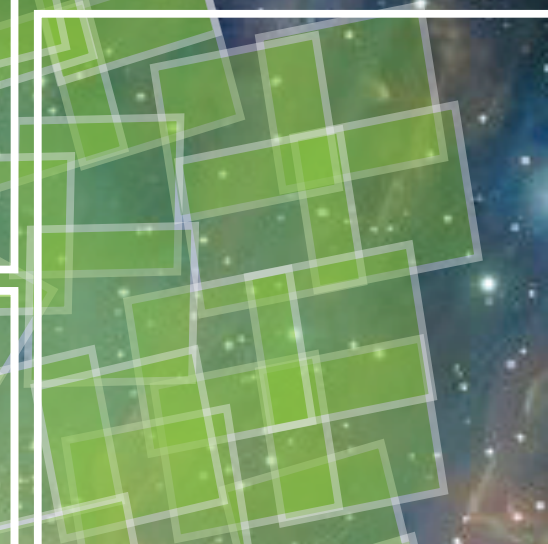
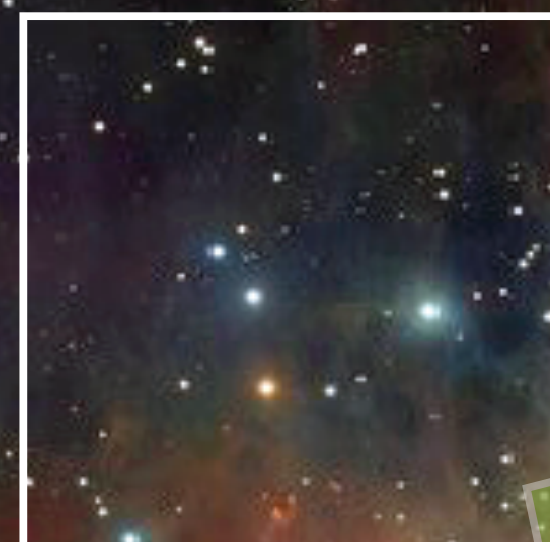
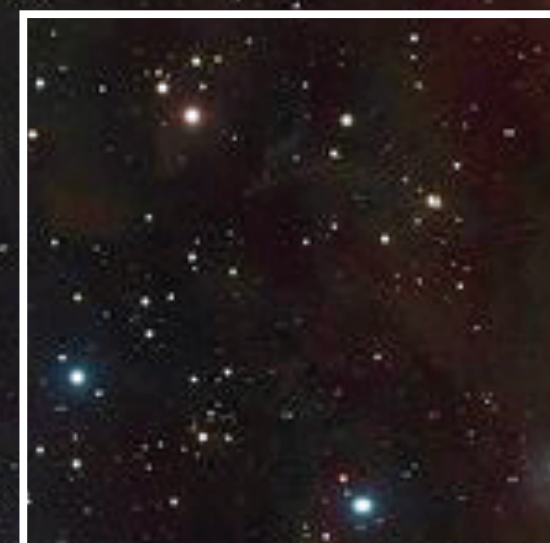
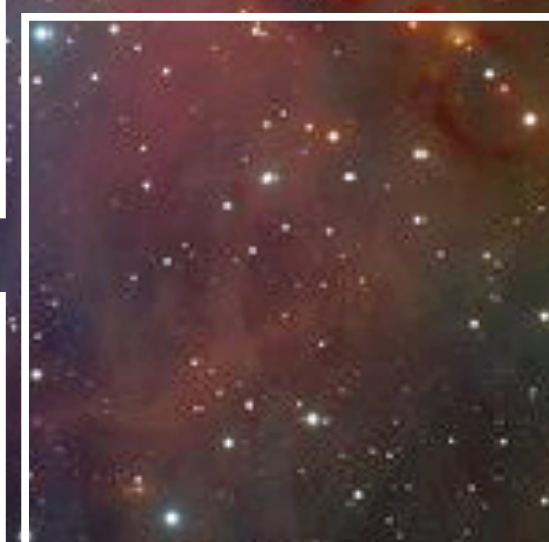
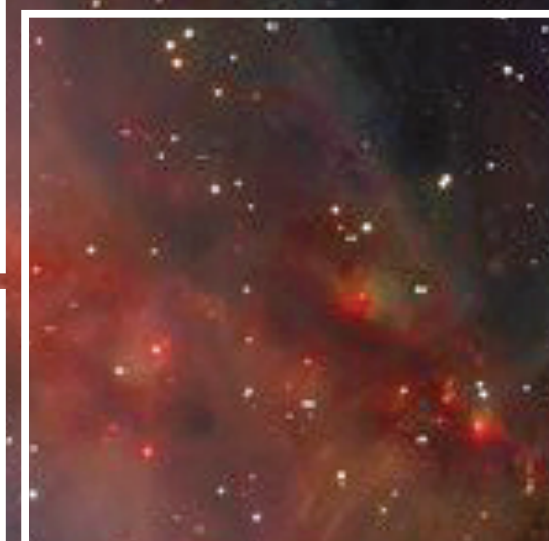
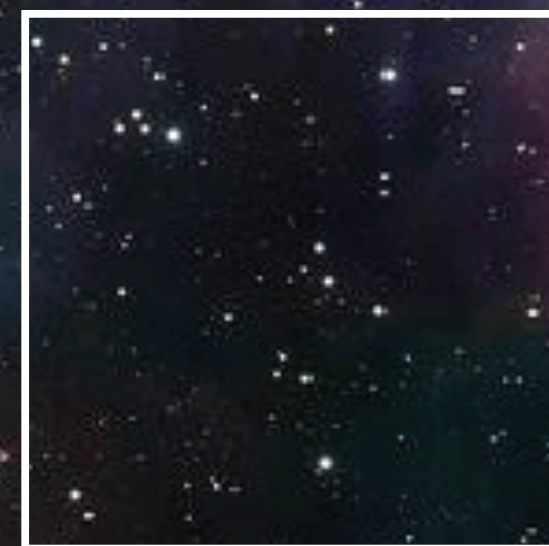
0.28 square degrees

Credit: ESO, H. Dress

The TEMPO Survey



1 pc
8.6'



Cycle 22 HST Treasury Program,
Robberto+2020

Credit: ESO, H. Dress

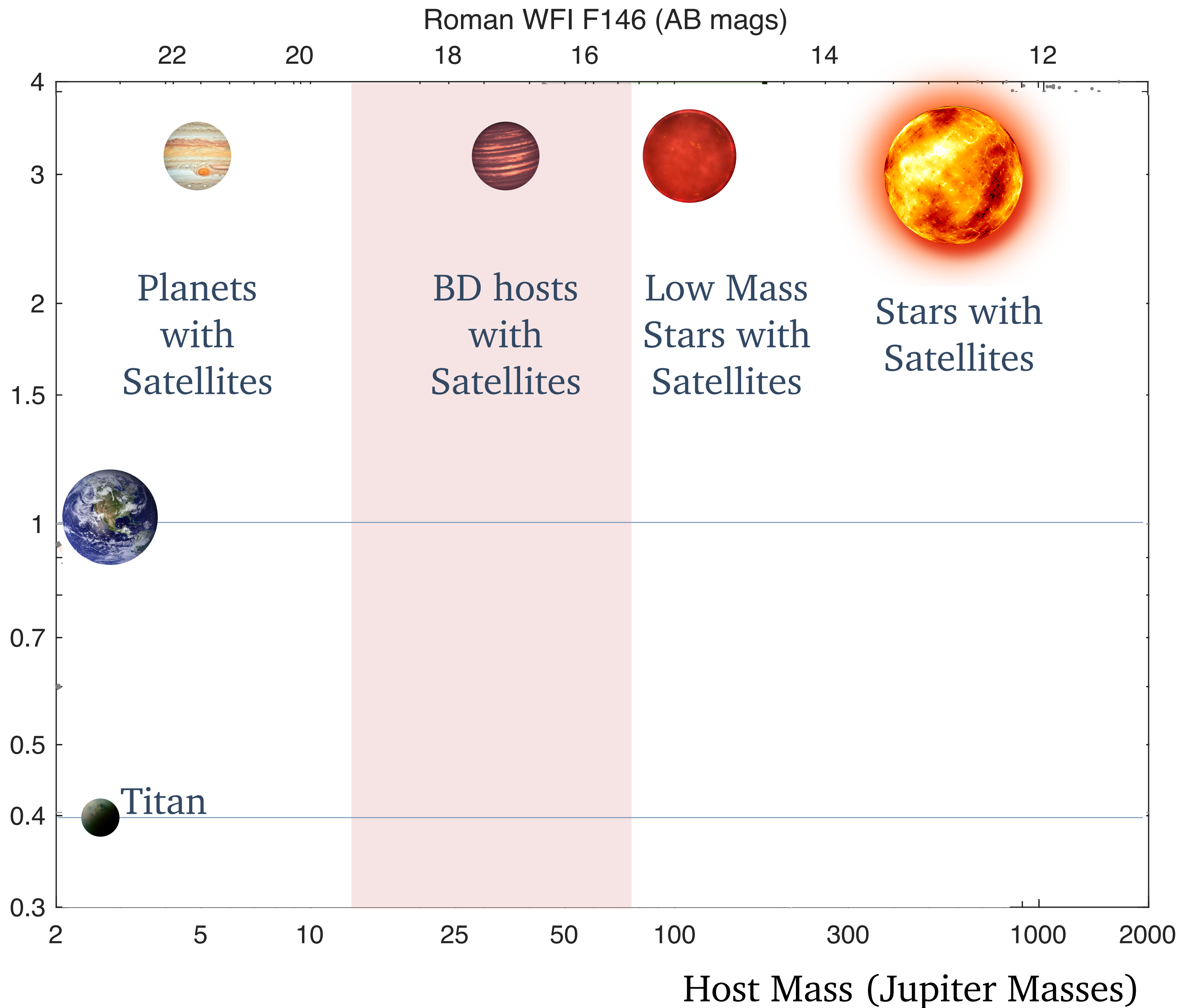
Why survey young SFRs with Roman?

Opens New Discovery Space

- Transiting satellites and moons orbiting self-luminous free-floating / rogue planets

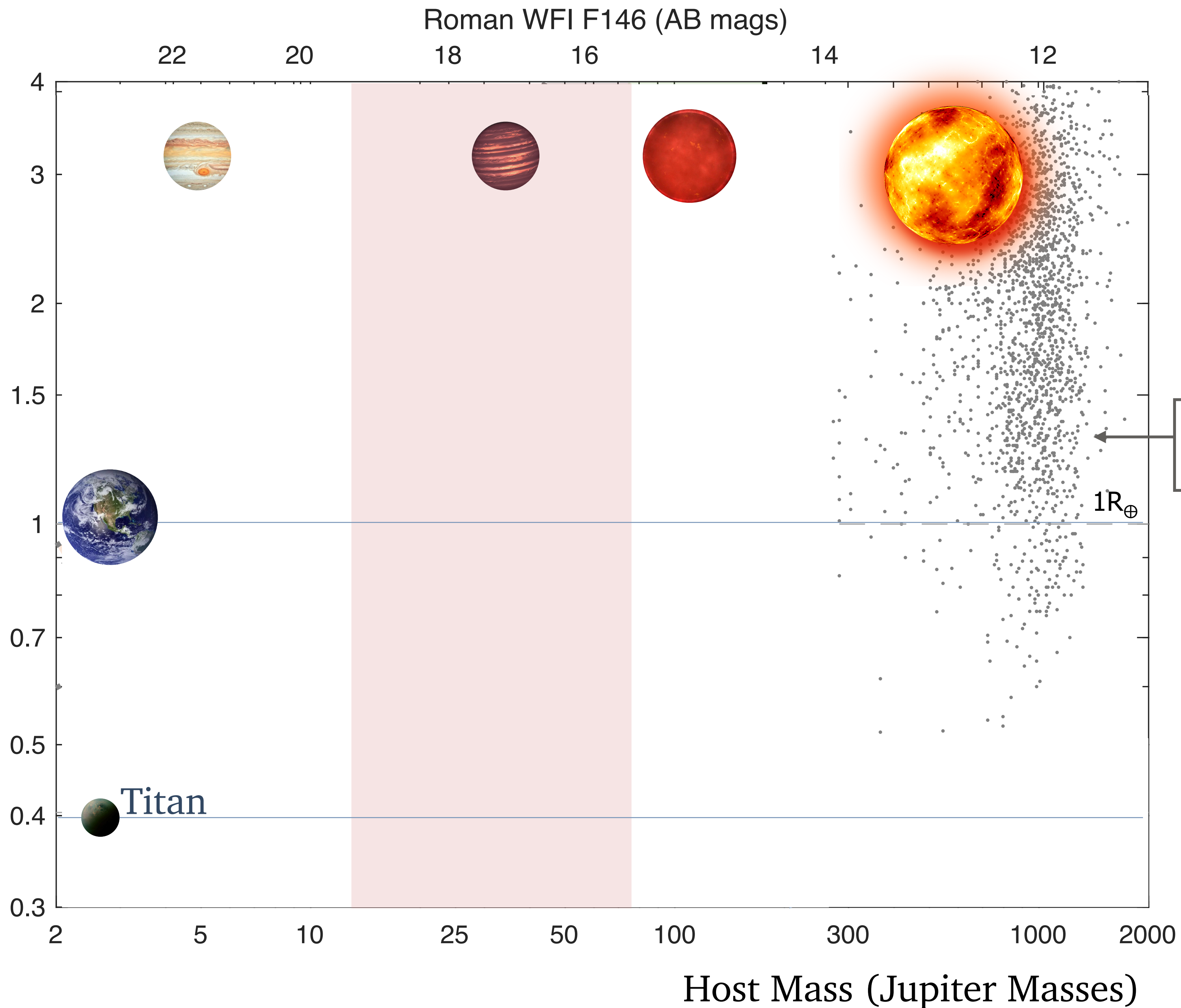
ONC
1-3 Myr
400 pc

Detectable Satellite Radius (7-sigma)



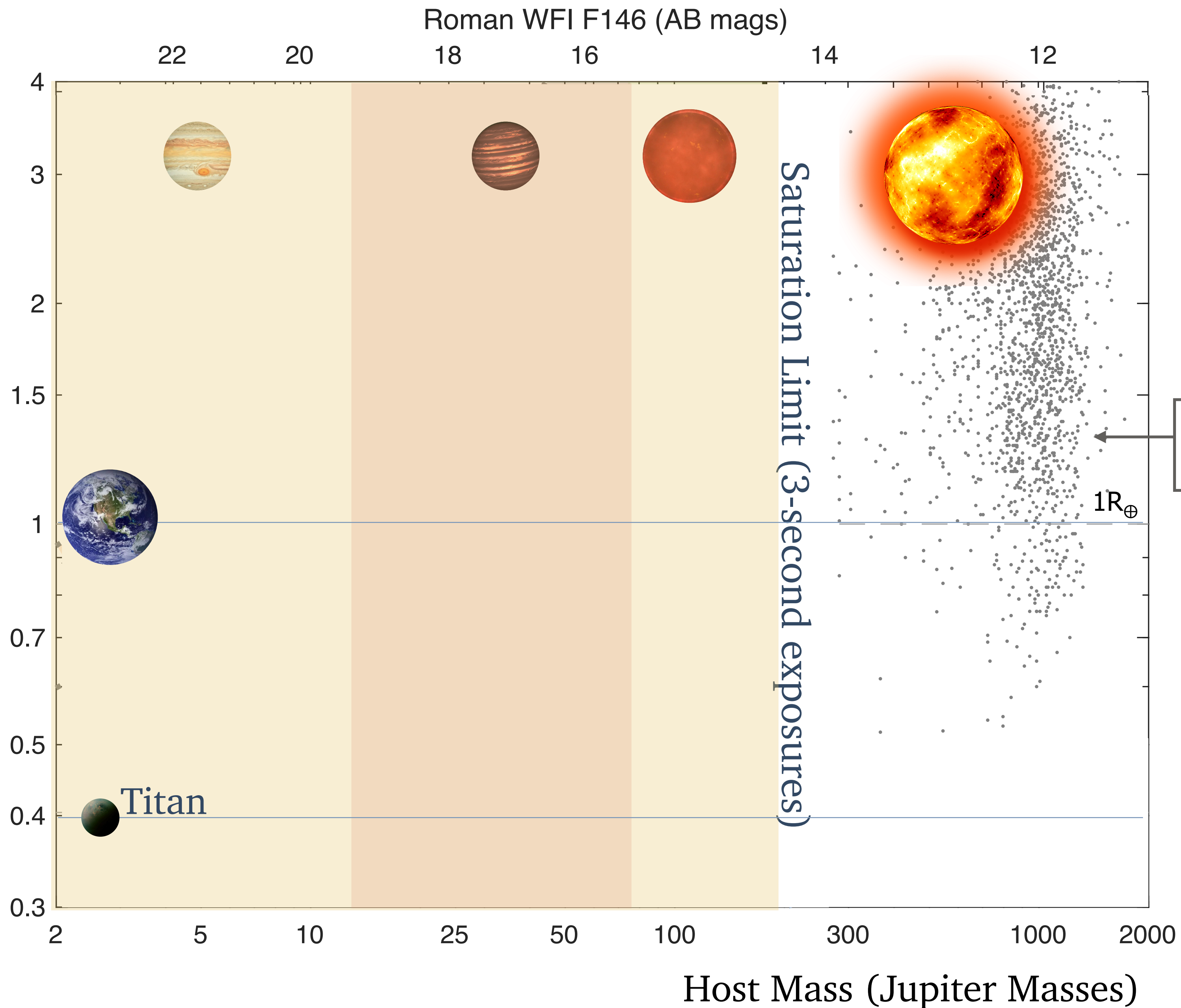
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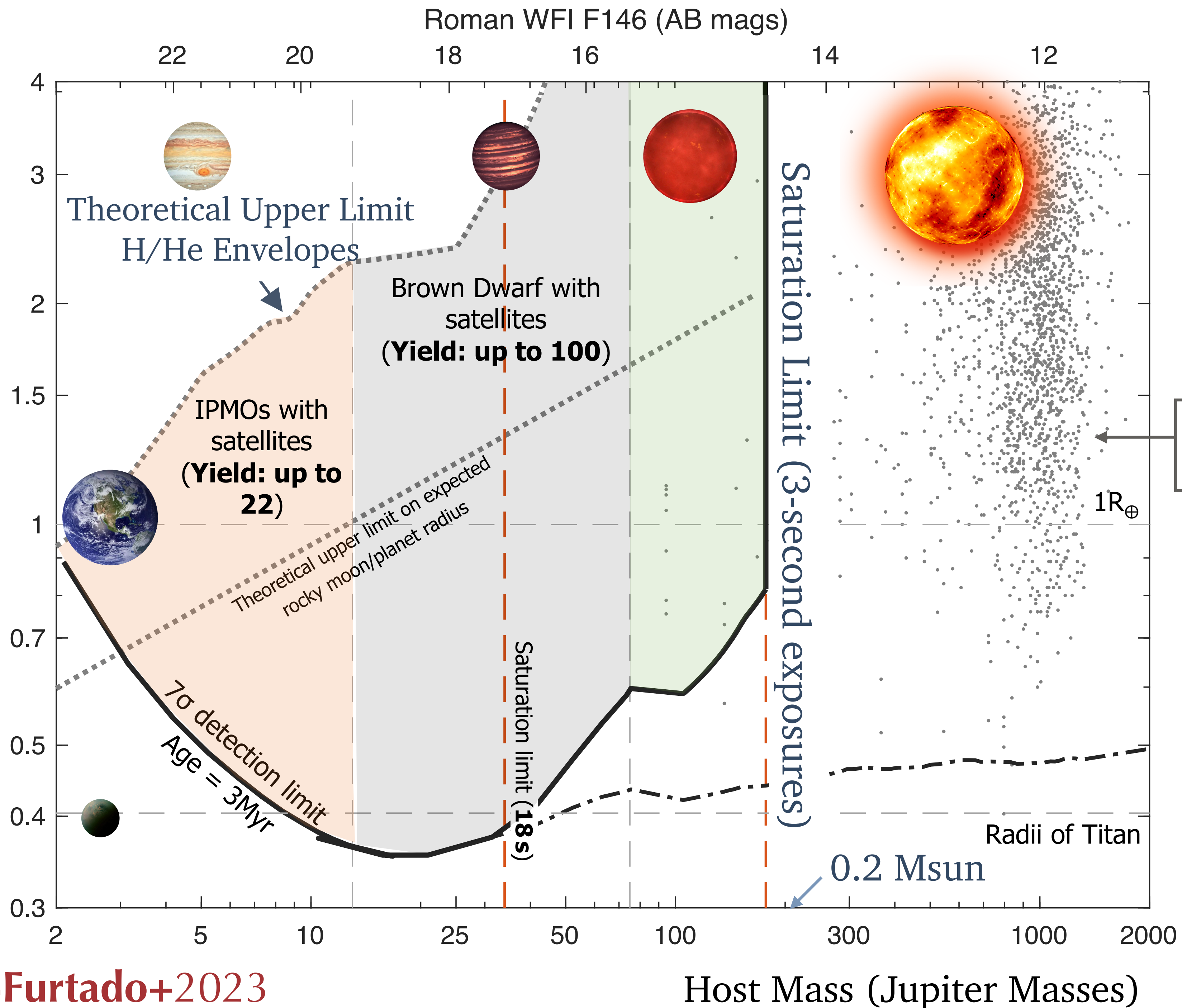
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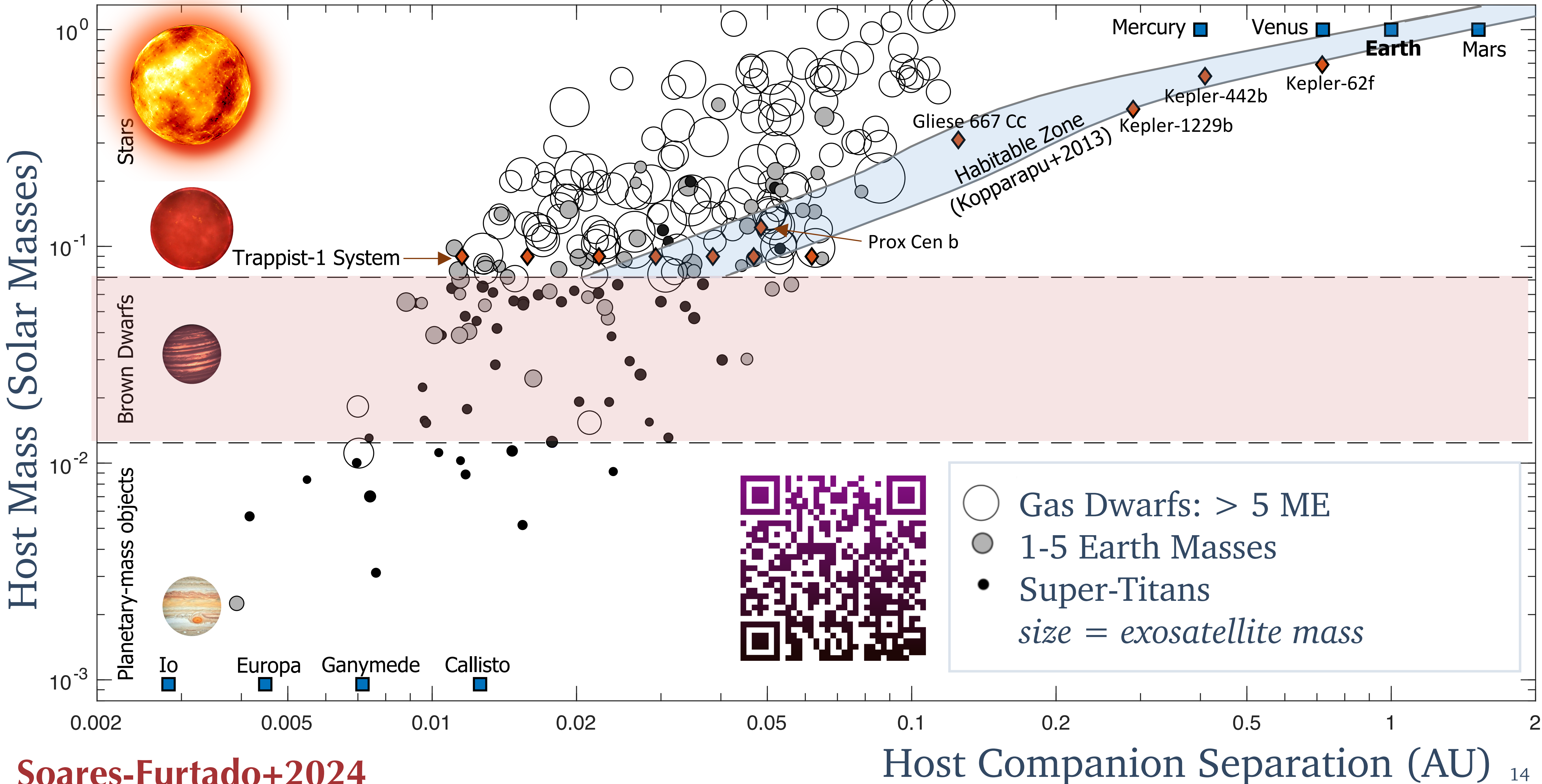
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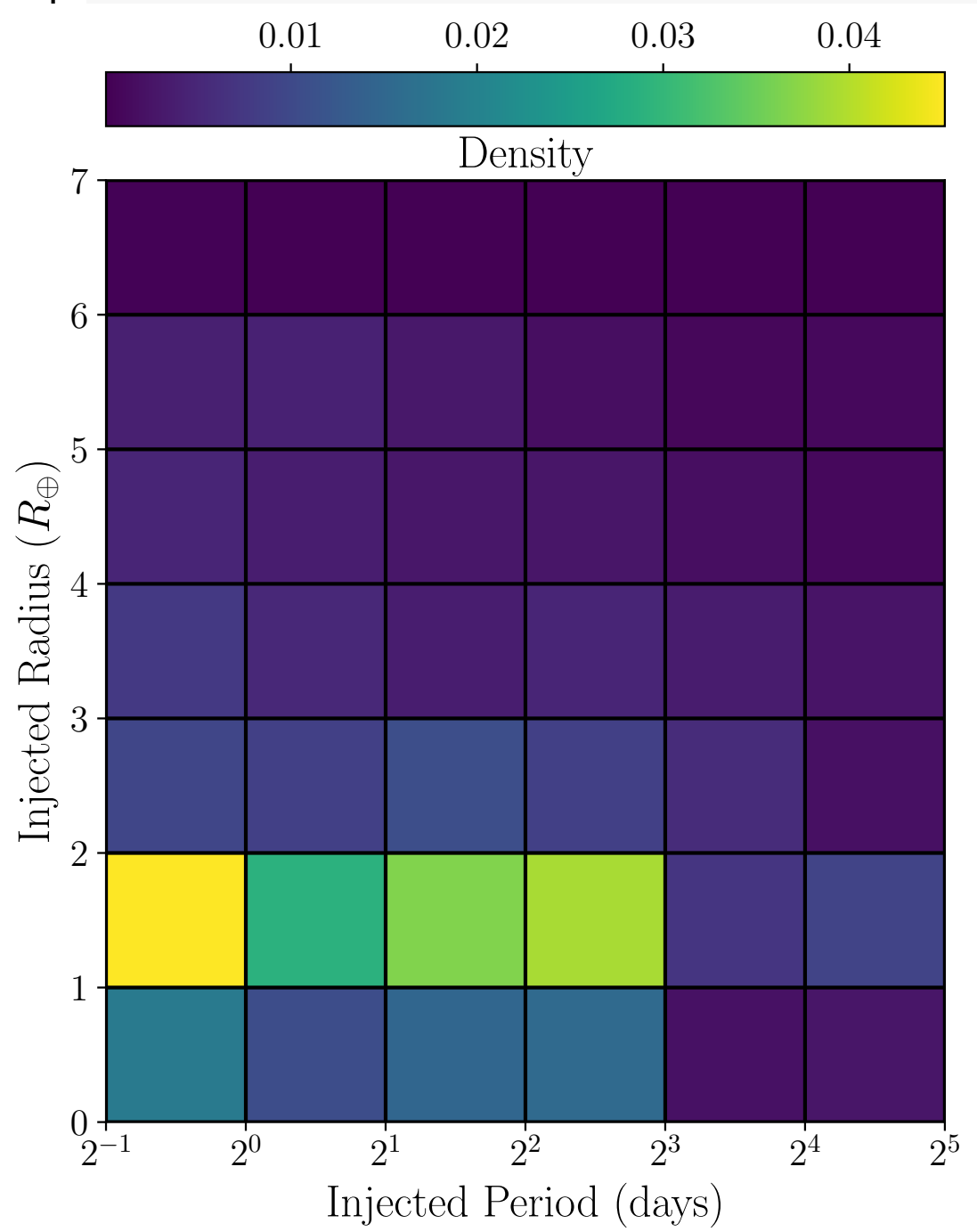
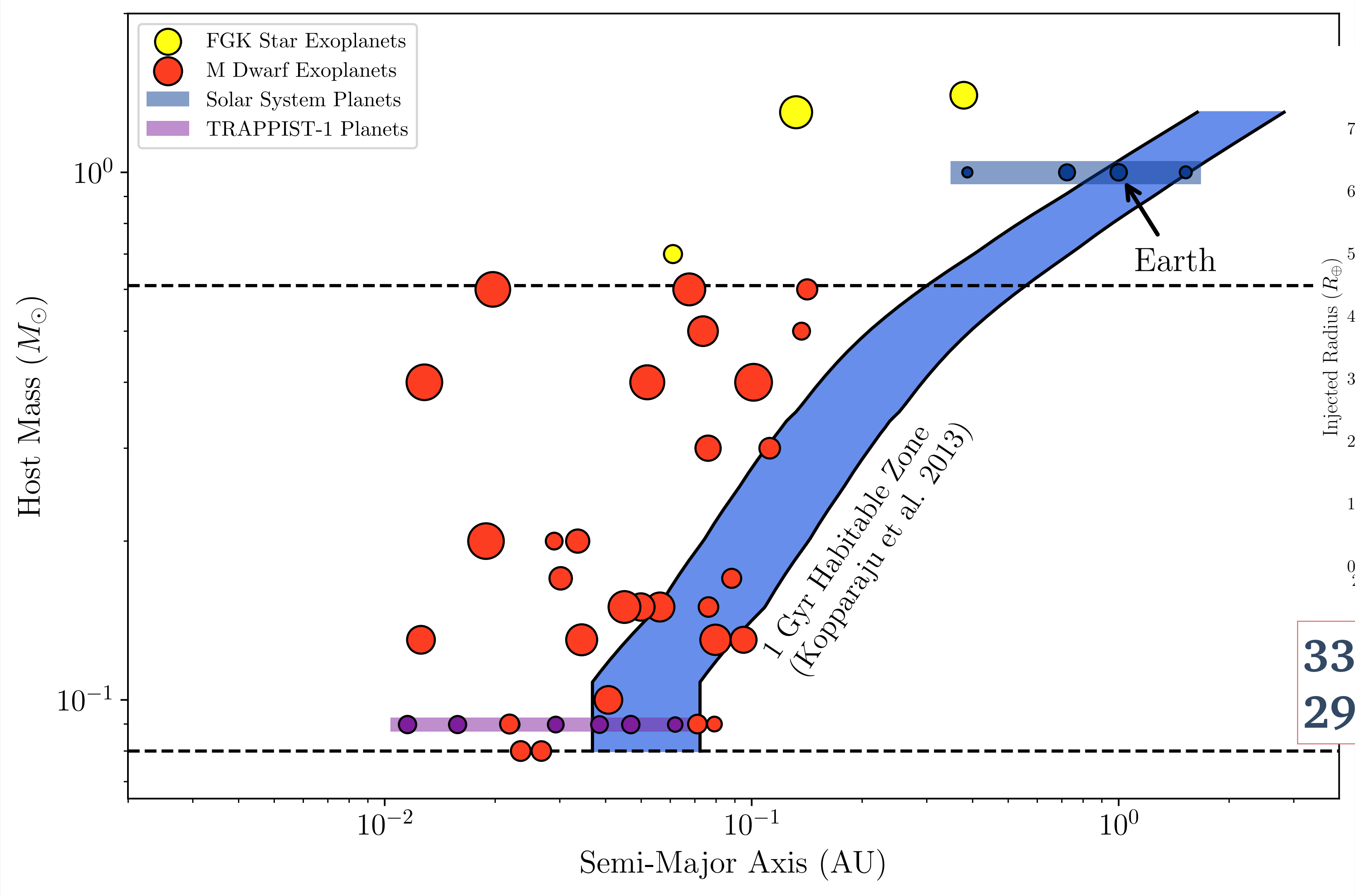


Known Exoplanet Population

ONC (1-3 Myr; 400 pc)



Rosette Nebula (10 Myr; 1.5 kpc)



33 +/- 9 planets in a 1-month survey
29 +/- 8 planets in a 2-week survey

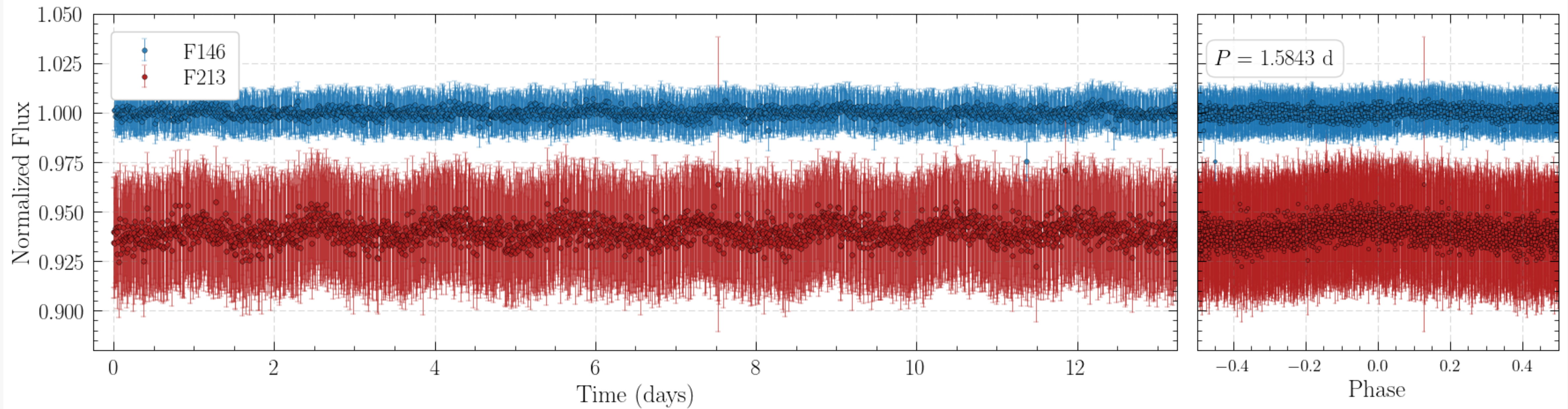


Ritvik Narayan

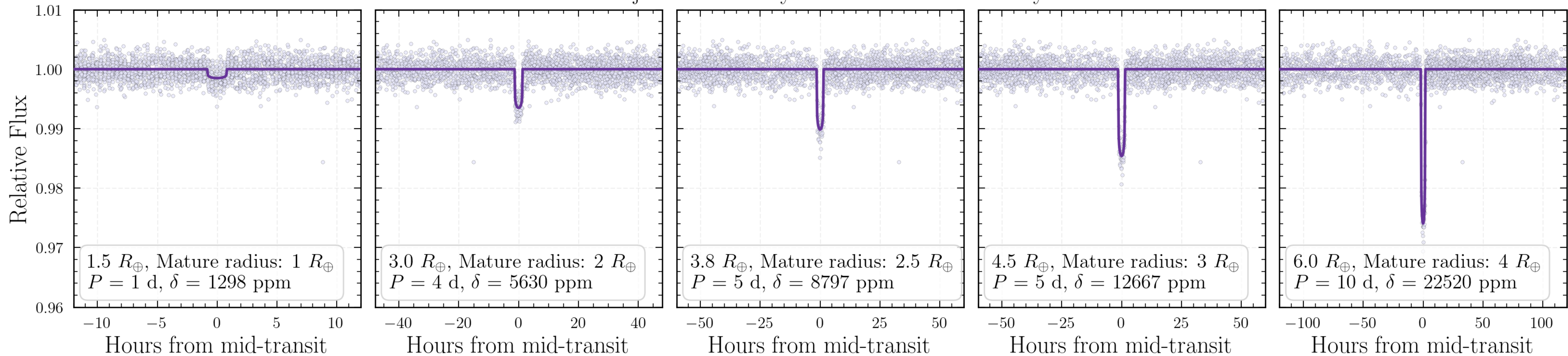


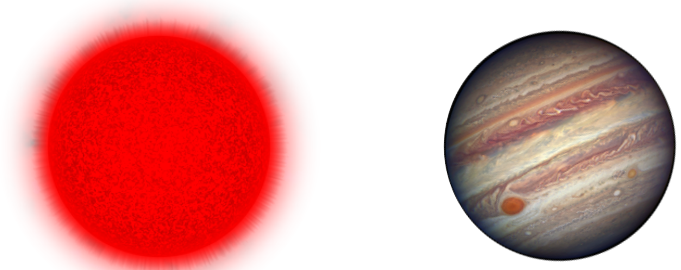
The Orion Nebula Extrasolar Moon and Planet Transit Survey	
Observational Parameters	
Field of view	0.28 deg ²
Duration	2 × 15 days
Spectral band	F146 (0.93 - 2.00 μm)
Exposure time	6 reads, 18 s
Limiting magnitude (1-month)	F146 = 29.7 AB mag
Photometric precision (1-hr)	850 ppm at F146 = 21 mag _{AB}
Photometric precision (1-hr)	125 ppm at F146 = 17mag _{AB}
Estimated Number of Monitored Sources	
Field stars	5000
Young stars (ONC)	2000
Brown dwarfs (ONC)	560
IPMOs (ONC)	400
Detections	
Field star exoplanets	≈20
Young star (ONC) exoplanets	143 (100 – 200)
Exoplanets (orbiting brown dwarfs)	54 (8 – 100)
IPMO exomoons/satellites	14 (3 – 22)

Light curve reveals host rotation and companion transits

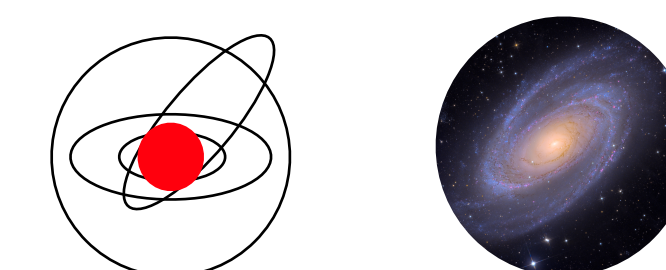


Transit Injection Recovery for M9.5V Host at 10 Myr





Prof. Sam Grunblatt, University of Alabama



planet hunter/asteroseismologist/galactic archaeologist/fan of mountains at all temperatures



temperate mountains

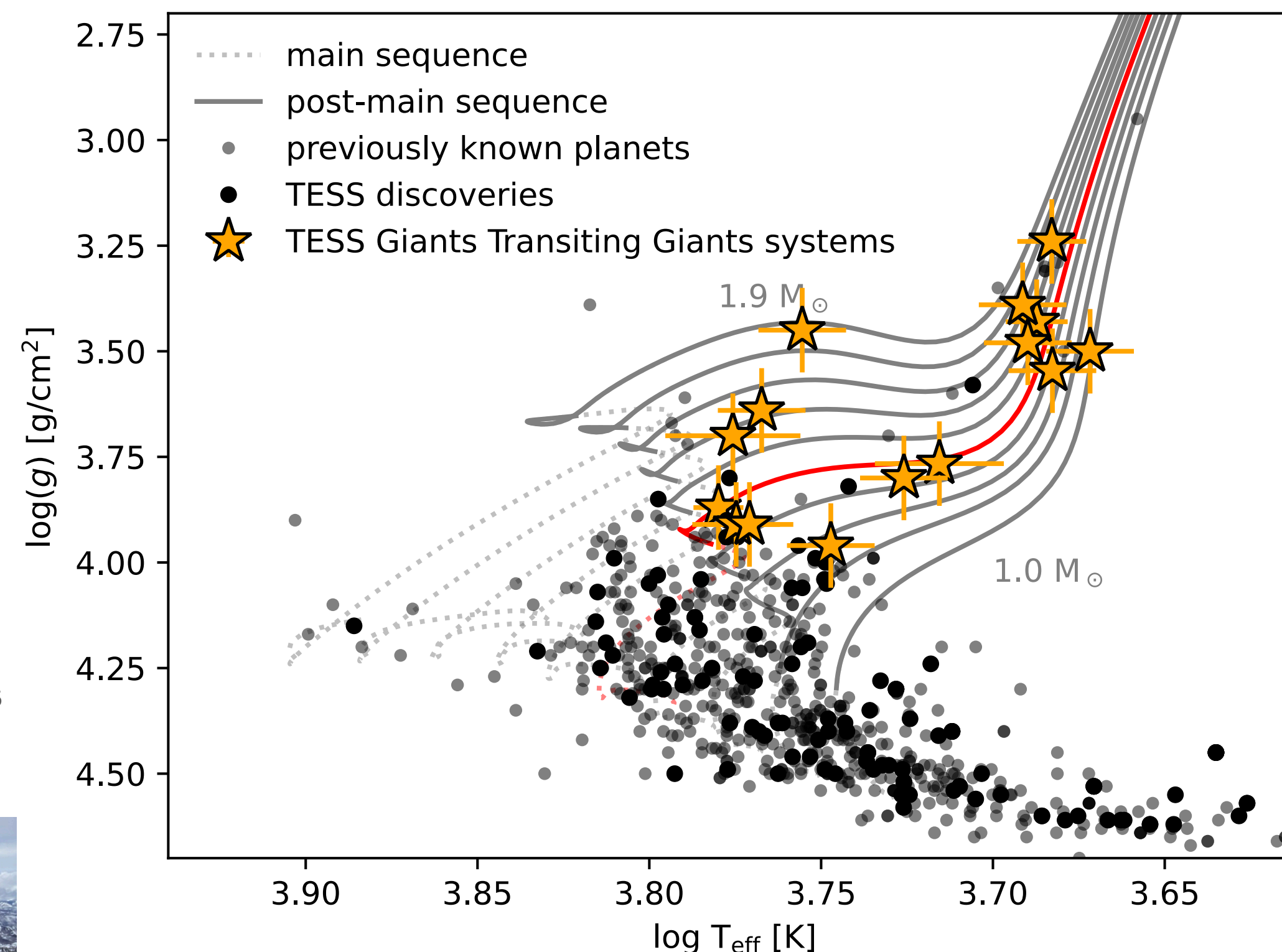


warm mountains



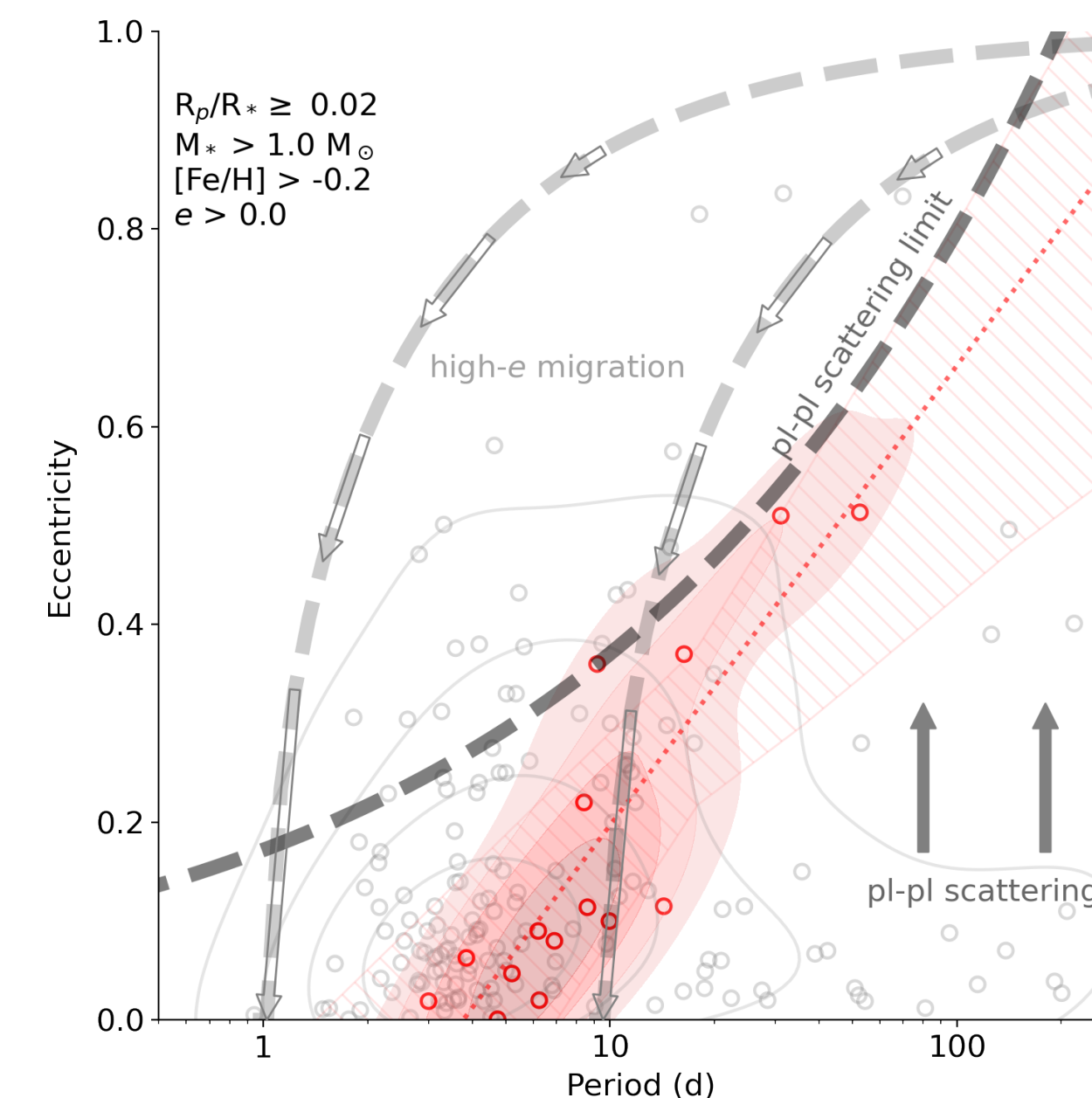
cold mountains

sgrunblatt@ua.edu
skgrunblatt.github.io

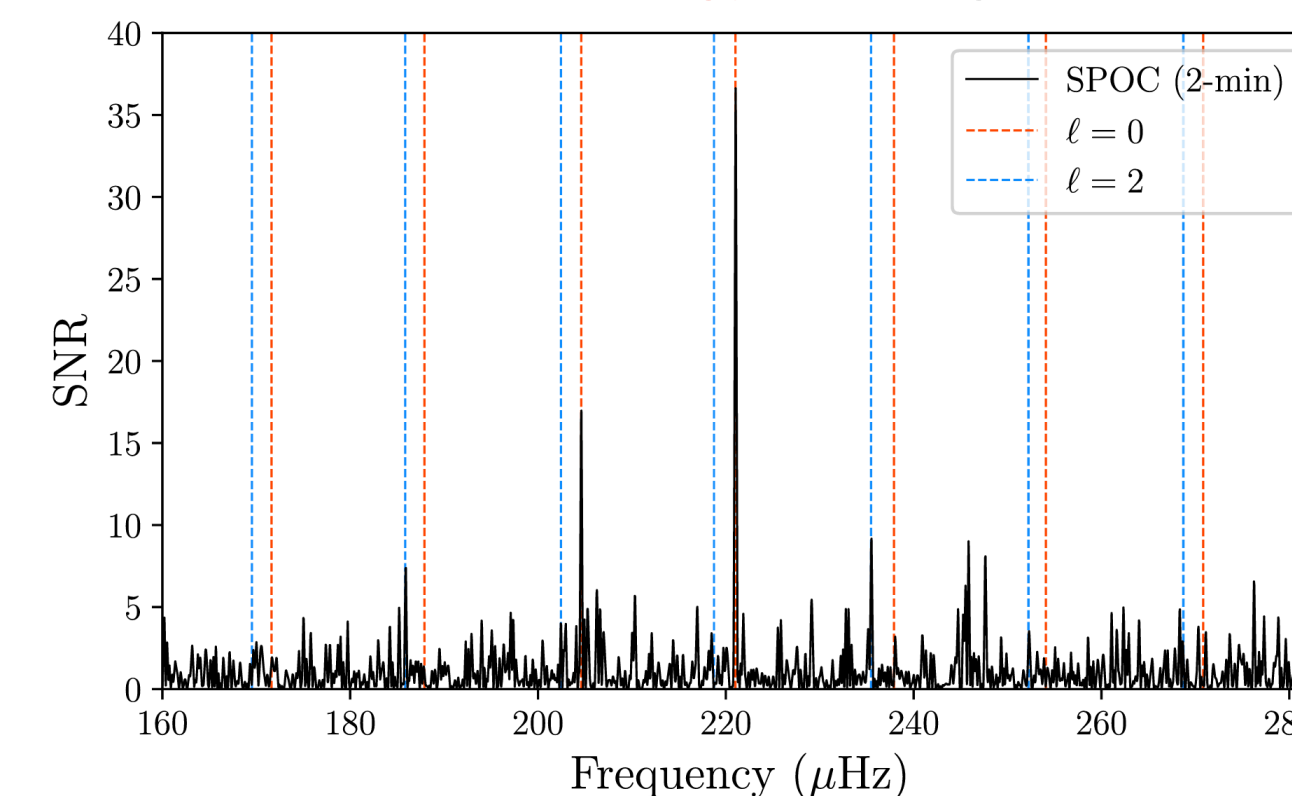


detection of transiting exoplanet systems
around **post-main sequence** stars

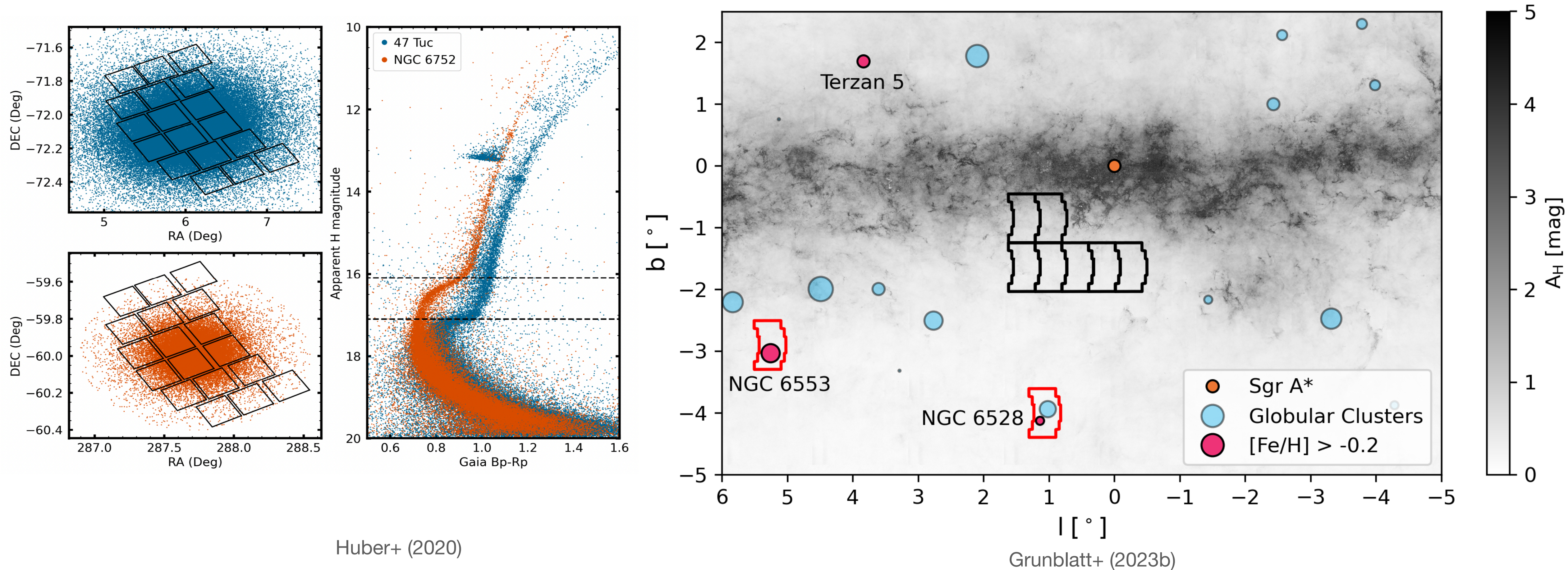
comparing population demographics to understand
late-stage **planetary system evolution**

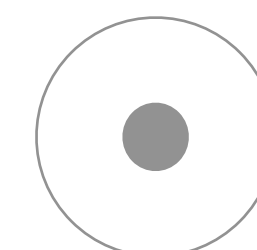


asteroseismology of red giant stars

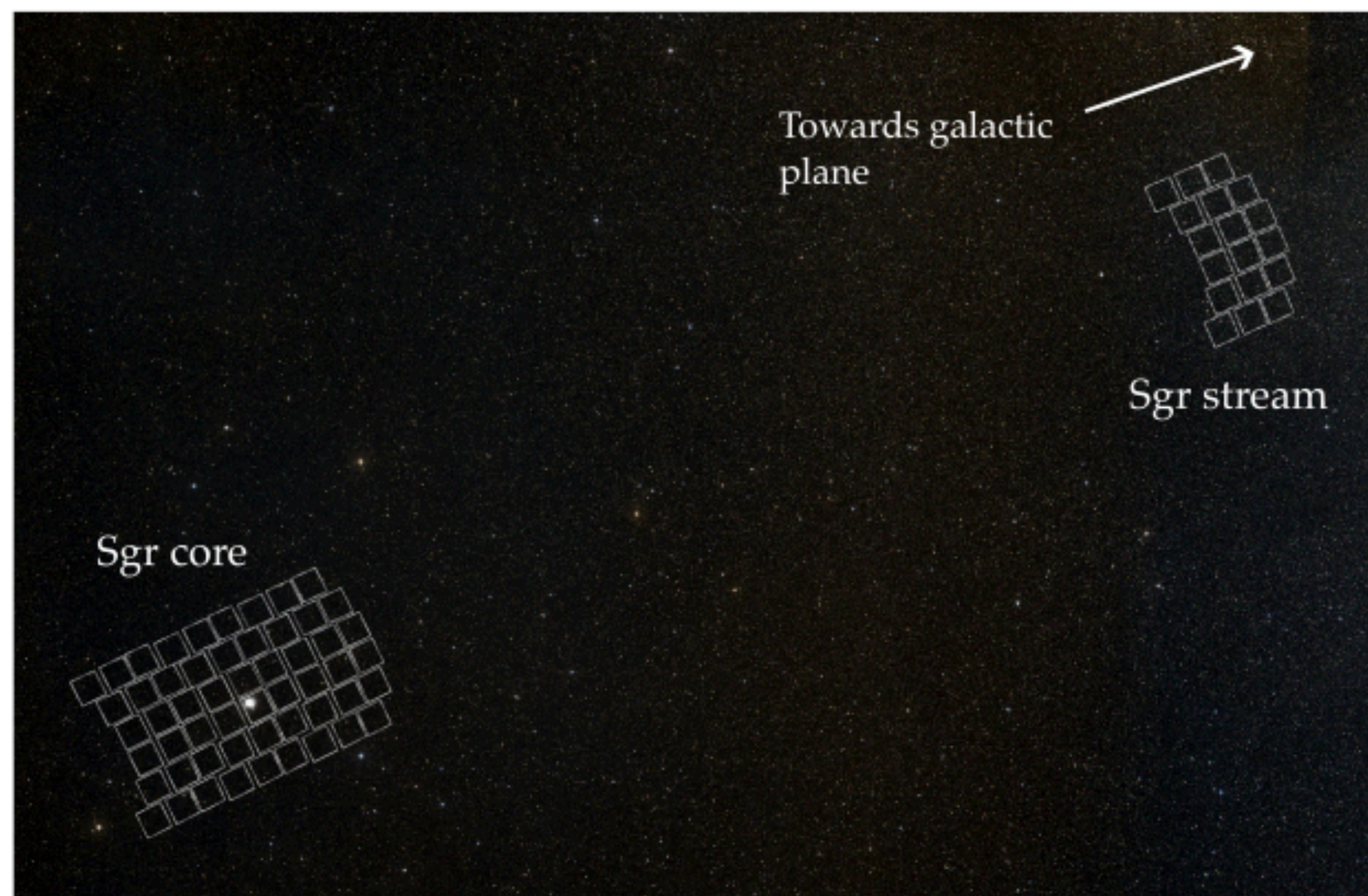
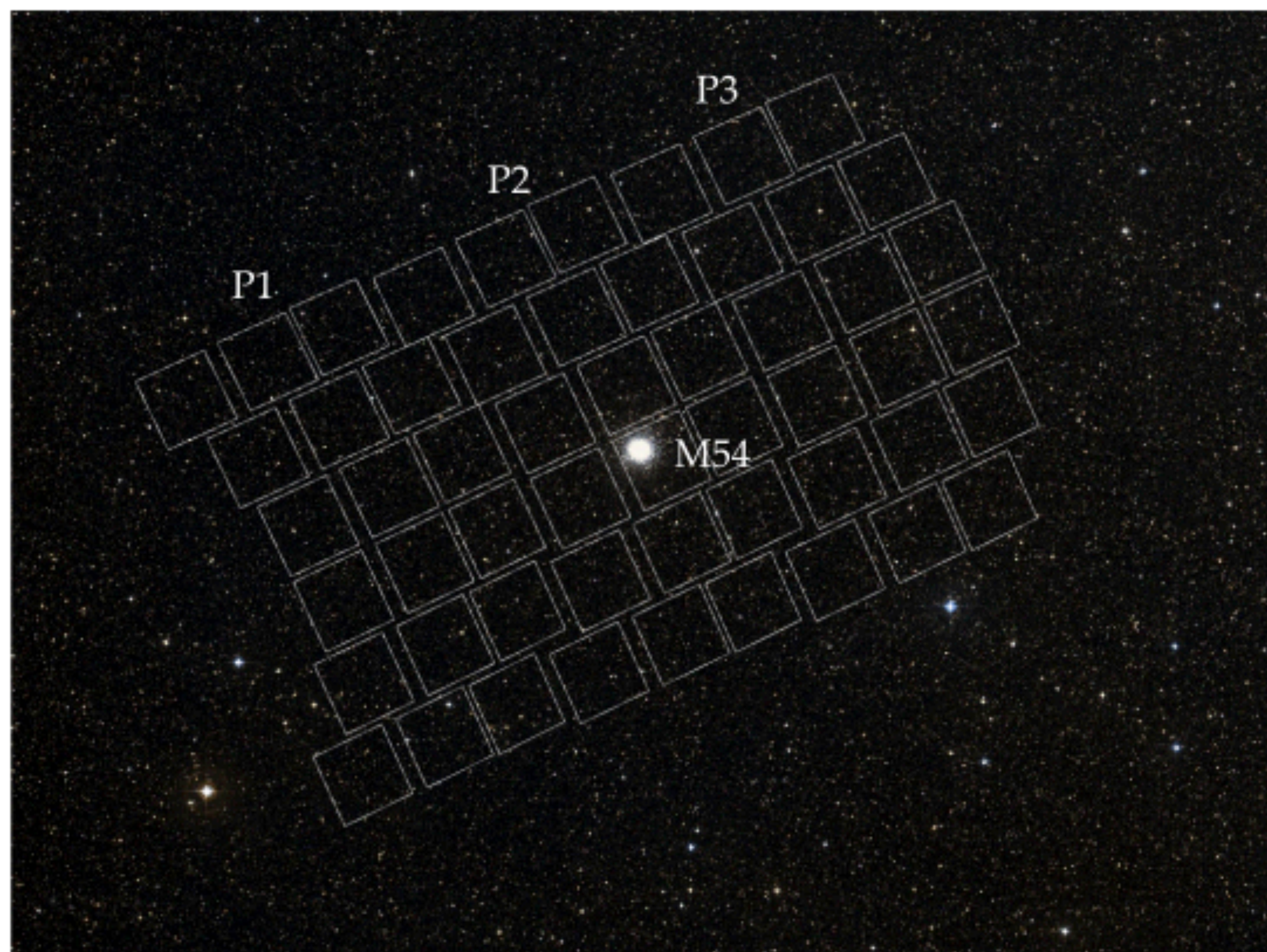


Extending planet demographics to large star clusters will let us search for planet populations with unique origins.

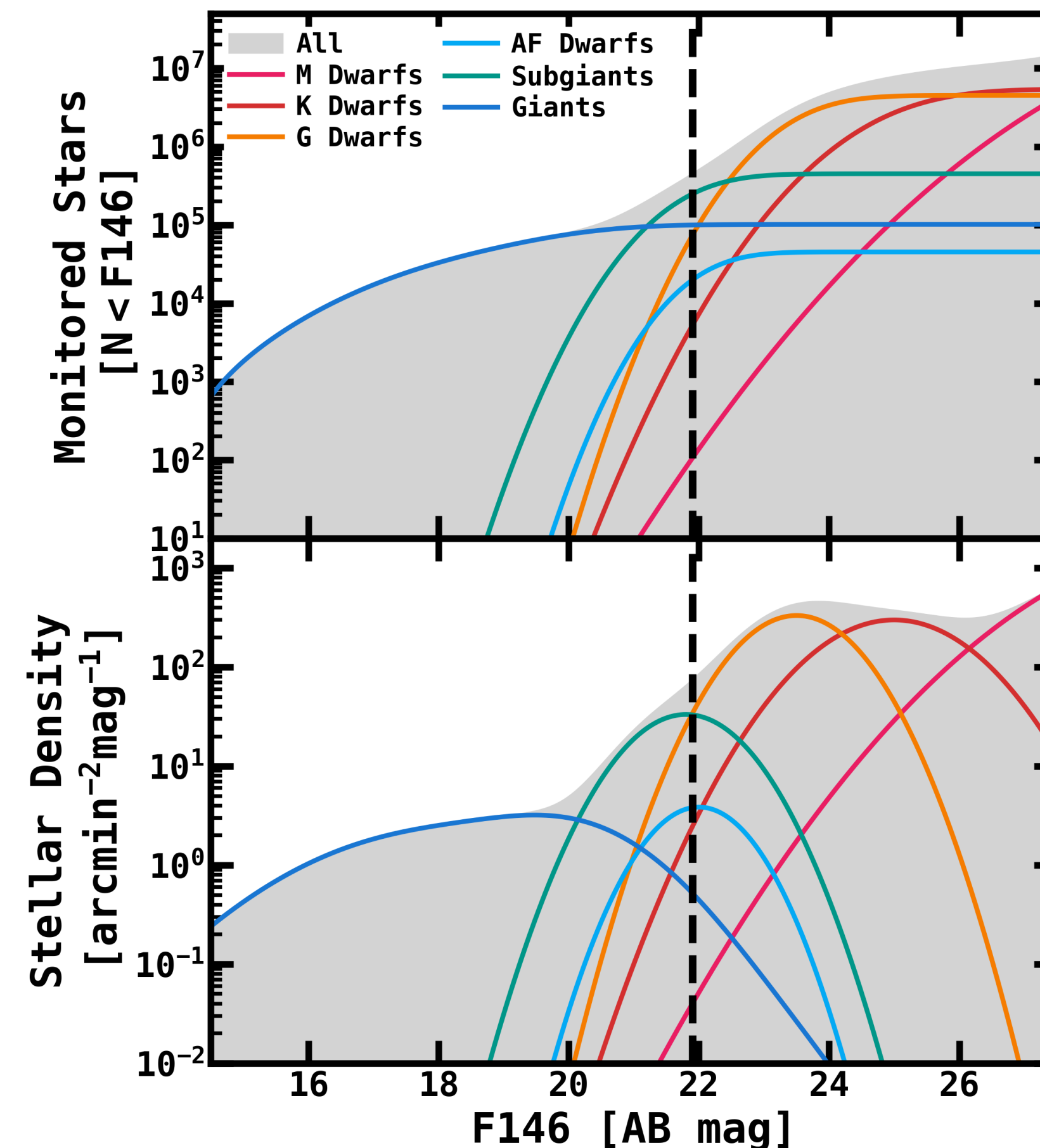
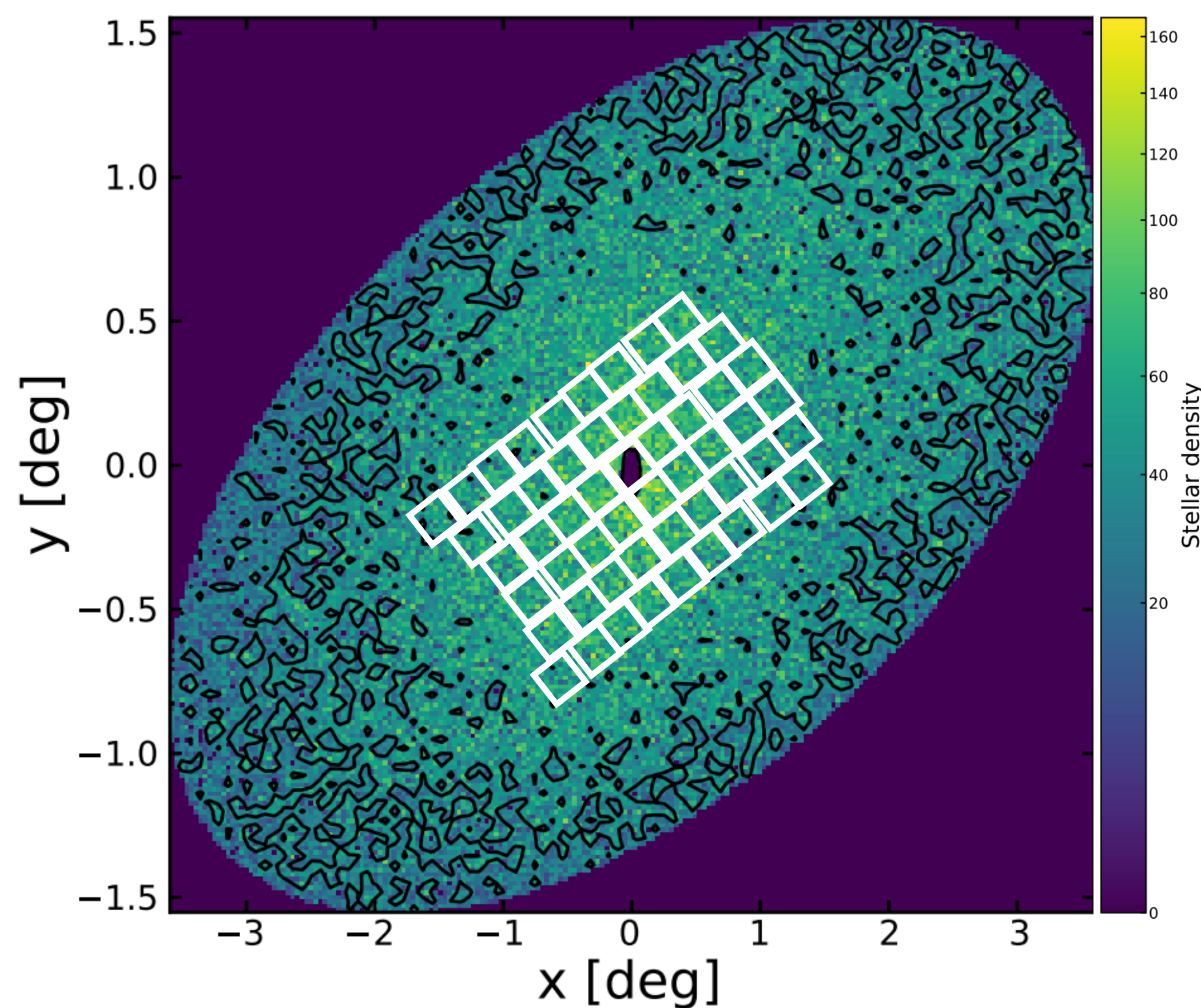




We can even consider searching for planets that formed in other galaxies—such as the metal-rich component of the Sagittarius core/stream.



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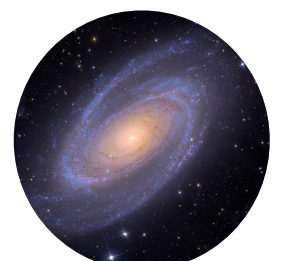


Figure 10 is a stacked area chart showing the expected number of Sgr HJ detections as a function of exposure time per tile visit (t_{exp}) in seconds. The y-axis represents the 'Expected Sgr HJ detections' from 0 to 25, and the x-axis represents 'Exposure time per tile visit t_{exp} (s)' from 0 to 2500. The chart is divided into eight categories: RGB 8R (dark blue), RGB 5R (medium blue), RGB 3R (light blue), SGB 2.2R (dark green), SGB 1.8R (medium green), SGB 1.5R (light green), MSTO 1.3R (yellow), and a Total (black line). The total number of detections peaks at approximately 26 around 960 seconds. Vertical dashed lines indicate the GBTDS limit at 54 s, the proposed limit at 600 s, and the optimal limit at 960 s.

Exoplanet Demographics Opportunities with Roman General Astrophysics Surveys Time

Scott Gaudi (OSU)

2026 Sagan Summer Workshop

Exoplanets with Roman Surveys: Microlensing and Transits

7/24/2026

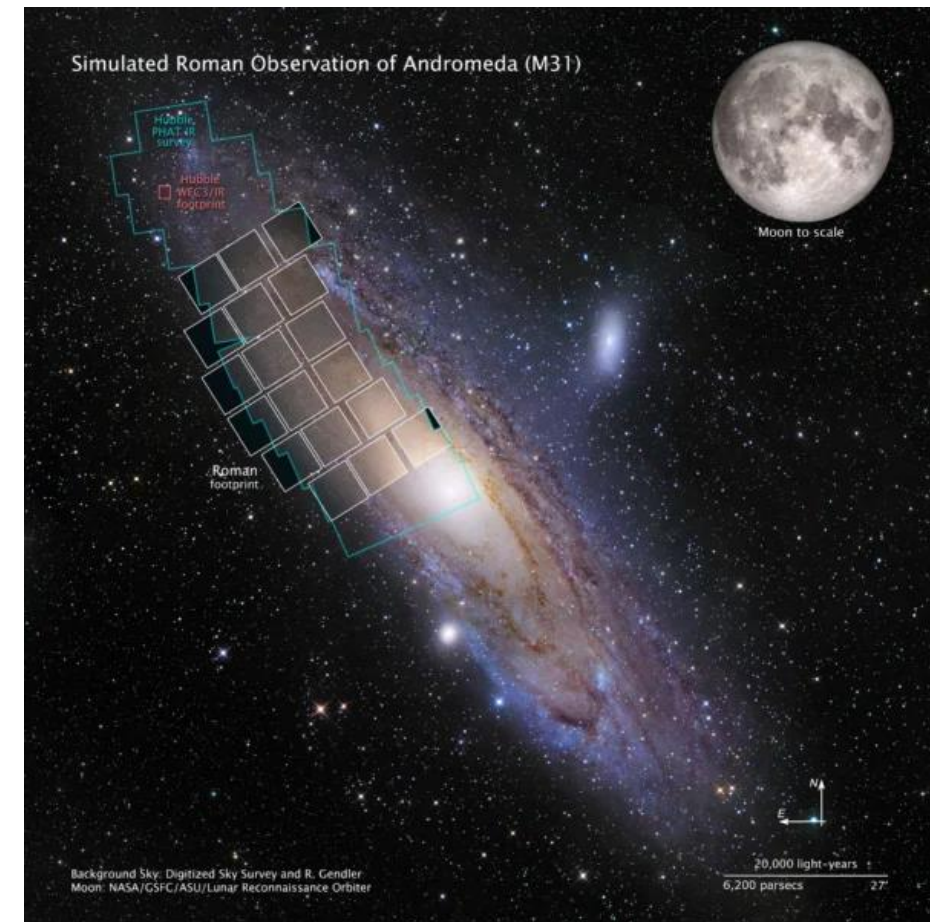
Coronagraph GAS?

- It is not possible to apply for GAS time on the coronagraph (at the moment)
- CGI is a tech demo instrument – not a science instrument
- There is no infrastructure for a CGI GI program (user support, documentation, general planning tools, etc.)
- One can submit white papers to the Coronagraph Community Participation Program (CPP) with observing suggestions.
- Likely will be call for white papers after commissioning after the capabilities are better understood.

Extragalactic Planets

Probing Extragalactic planets with Roman

- **Survey:** High-cadence imaging of one field in M31 (Ingrosso+2009) for ~2 months
- **Microlensing yields:** ~50 events/month for resolved stars
- **Planet yields:** ~few per campaign for giant planets
- **Science:** Bound and free-floating planets, stellar variability



Covone et al. 2000, Baltz & Gondolo 2001, Chung et al. 2006, Ingrosso et al. 2009

Other bulge surveys

- Very high cadence bulge survey (single field, ~minute cadence)
 - Microlensing: low-mass bound planets, free-floating planets, moons
 - Other variability: flares, ultra short period binaries, small transiting planets
 - https://asd.gsfc.nasa.gov/roman/white_papers/2023/044_Kupfer_GBTDs.pdf
 - https://asd.gsfc.nasa.gov/roman/white_papers/2025/003_Kupfer_GPS_WP.pdf
 - <https://arxiv.org/abs/2212.14887>
- Wide survey for microlensing parallax?
 - Cover ground-based survey fields or Earth 2.0 fields
 - Would require a very high overhead

Very high cadence?

- Maximum data rate is set by downlink constraints (visibility windows from the White Sands ground station).
- The GBTDS data rate (2 minutes x 6 downlinked frames per exposure) is close to this maximum
- May be able to increase this using ESA + JAXA ground stations
- But will need to assess data compression quality