



Further Exploration of the TWA 7 Planet-Disk System with JWST NIRCam

Katie Crofts || Postdoc || Space Telescope Science Institute

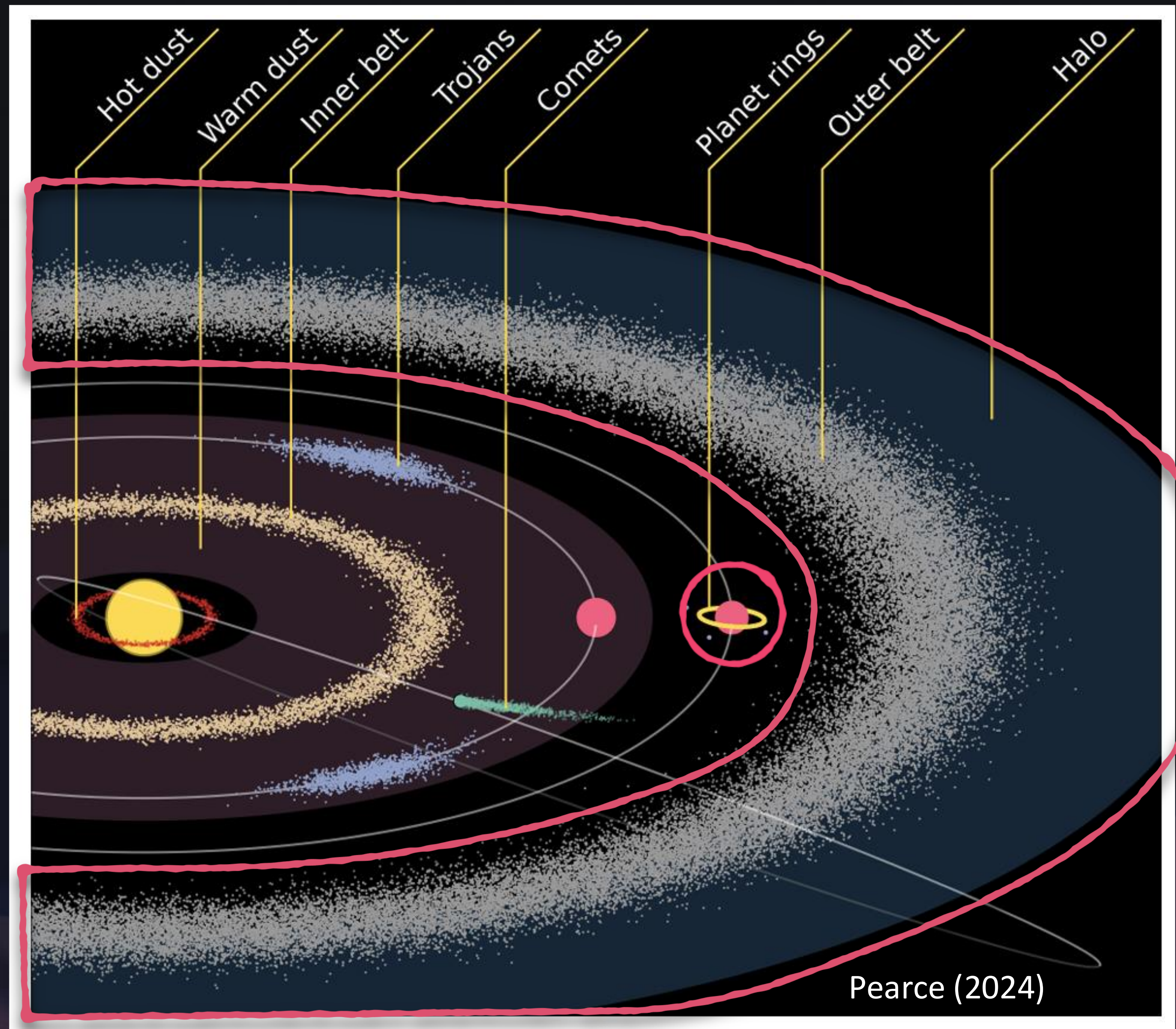
kcrofts@stsci.edu

51 Pegasi b | October 9th, 2025

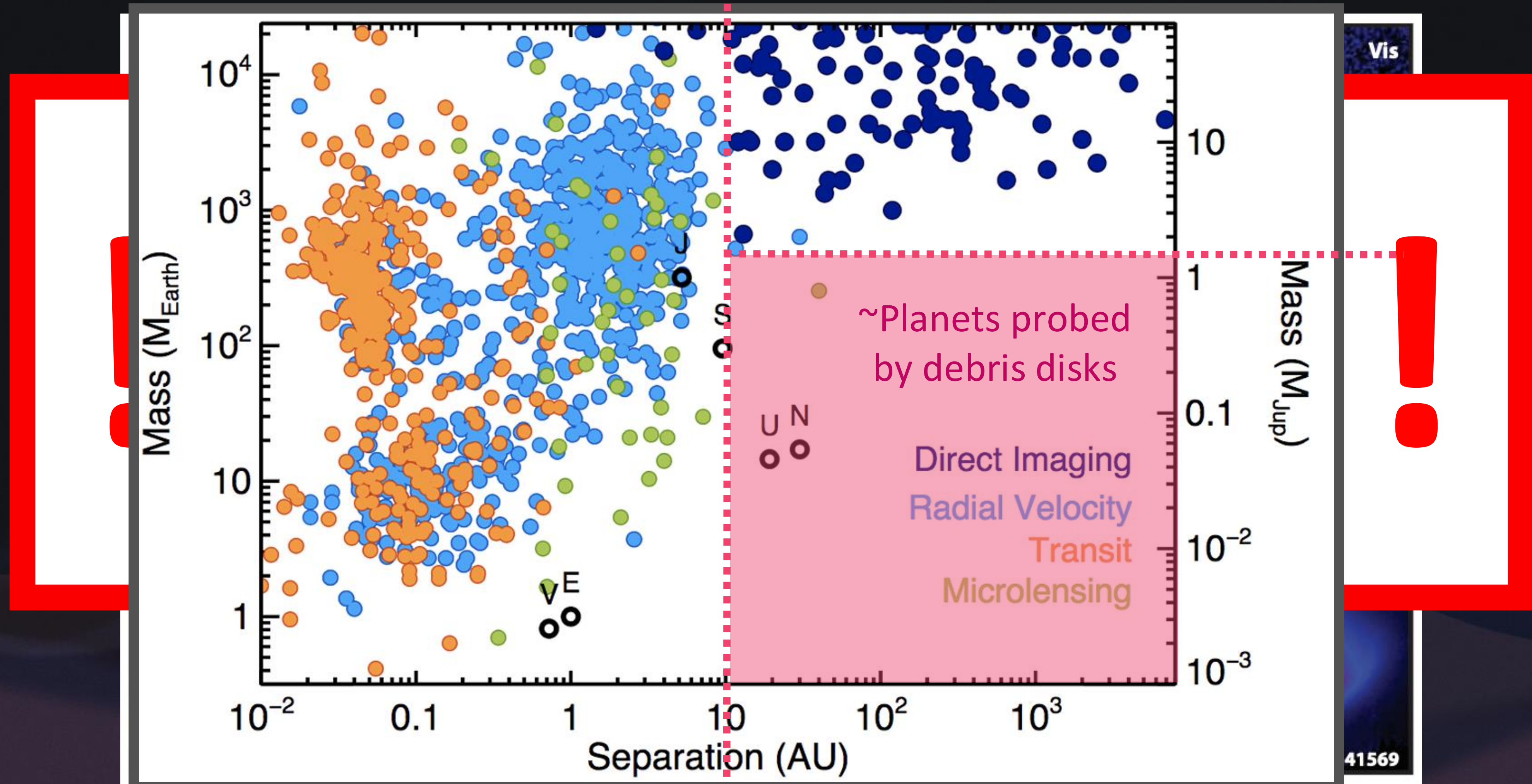
Aarynn L. Carter¹ , Kellen Lawson² , James Mang^{3,29} , Beth Biller^{4,5} , Mark Booth⁶ , Rodrigo Ferrer-Chavez⁷ , Julien H. Girard¹ , Anne-Marie Lagrange^{8,9} , Michael C. Liu¹⁰ , Sebastian Marino¹¹ , Maxwell A. Millar-Blanchaer¹² , Andy Skemer¹³ , Giovanni M. Strampelli¹ , Jason Wang⁷ , Olivier Absil¹⁴ , William O. Balmer^{1,15} , Raphaël Bendahan-West¹¹ , Ellis Bogat¹⁶ , Rachel Bowens-Rubin^{17,18} , Gaël Chauvin^{19,20} , Clémence Fontanive²¹ , Kyle Franson^{3,29} , Jens Kammerer²² , Jarron Leisenring²³ , Caroline V. Morley³ , Isabel Rebollido²⁴ , Nour Skaf¹³ , Ben J. Sutcliffe^{4,5} , Evelyn L. Bruinsma¹⁵ , Sasha Hinkley¹¹ , Kielan Hoch¹ , Andrew D. James¹¹ , Rohan Kane¹ , Dimitri Mawet^{25,26} , Michael R. Meyer¹⁷ , Skyler Palatnick¹² , Marshall D. Perrin¹ , Shrishmoy Ray²⁷ , Emily Rickman²⁸ , Aniket Sanghi^{25,29} , and Klaus Subbotina Stephenson¹³

Debris disks:

- Dusty disks found around main sequence stars.
- Post protoplanetary disk ($\gtrsim$ several million years).
- Created and sustained through collisional cascades.



Debris disks host a wide variety of morphologies!



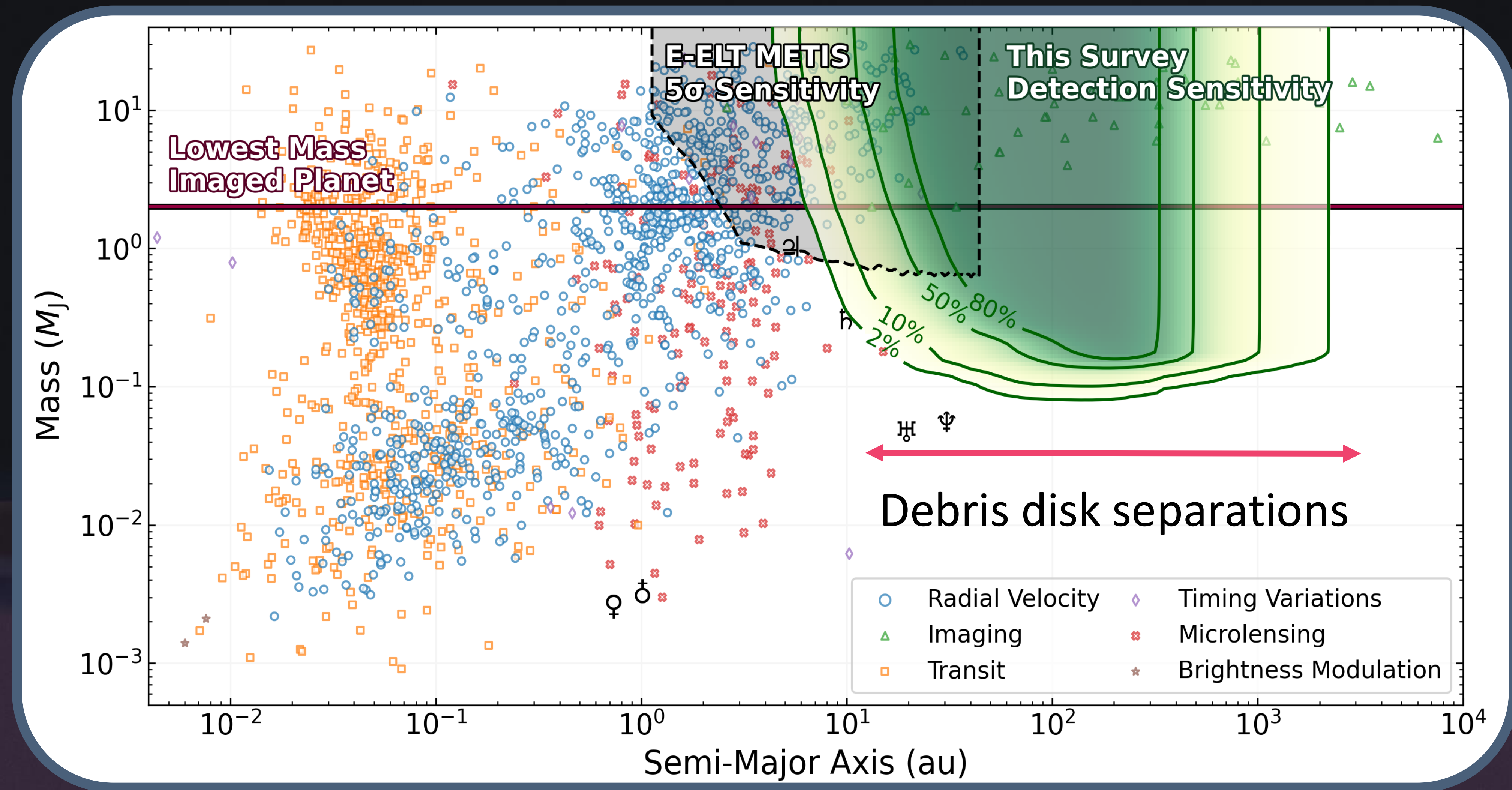
Hughes et al. (2018)



JWST to the
rescue!!

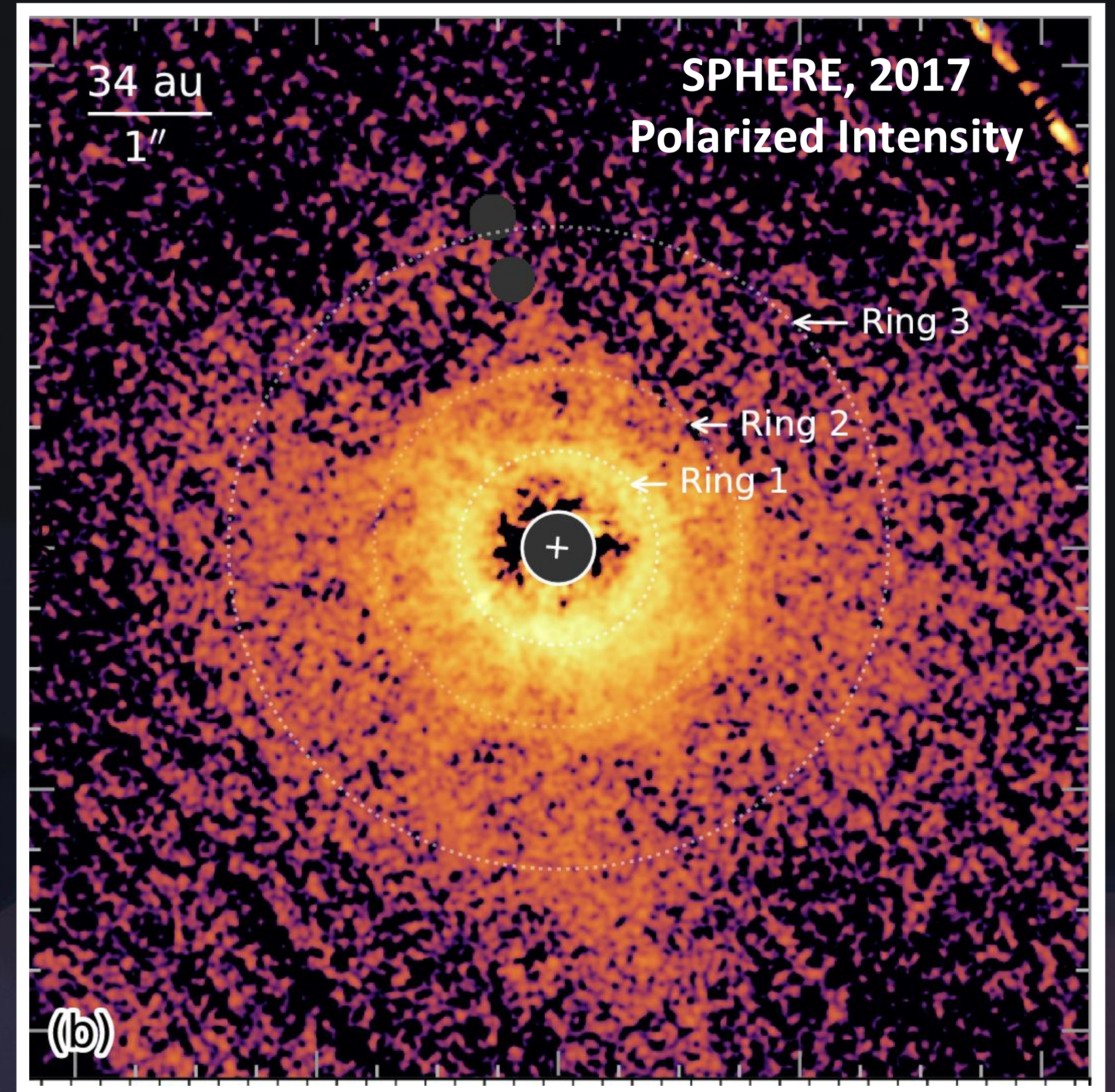
Sub-Jupiter Imaging Survey

PI: Aarynn Carter || GO 4050



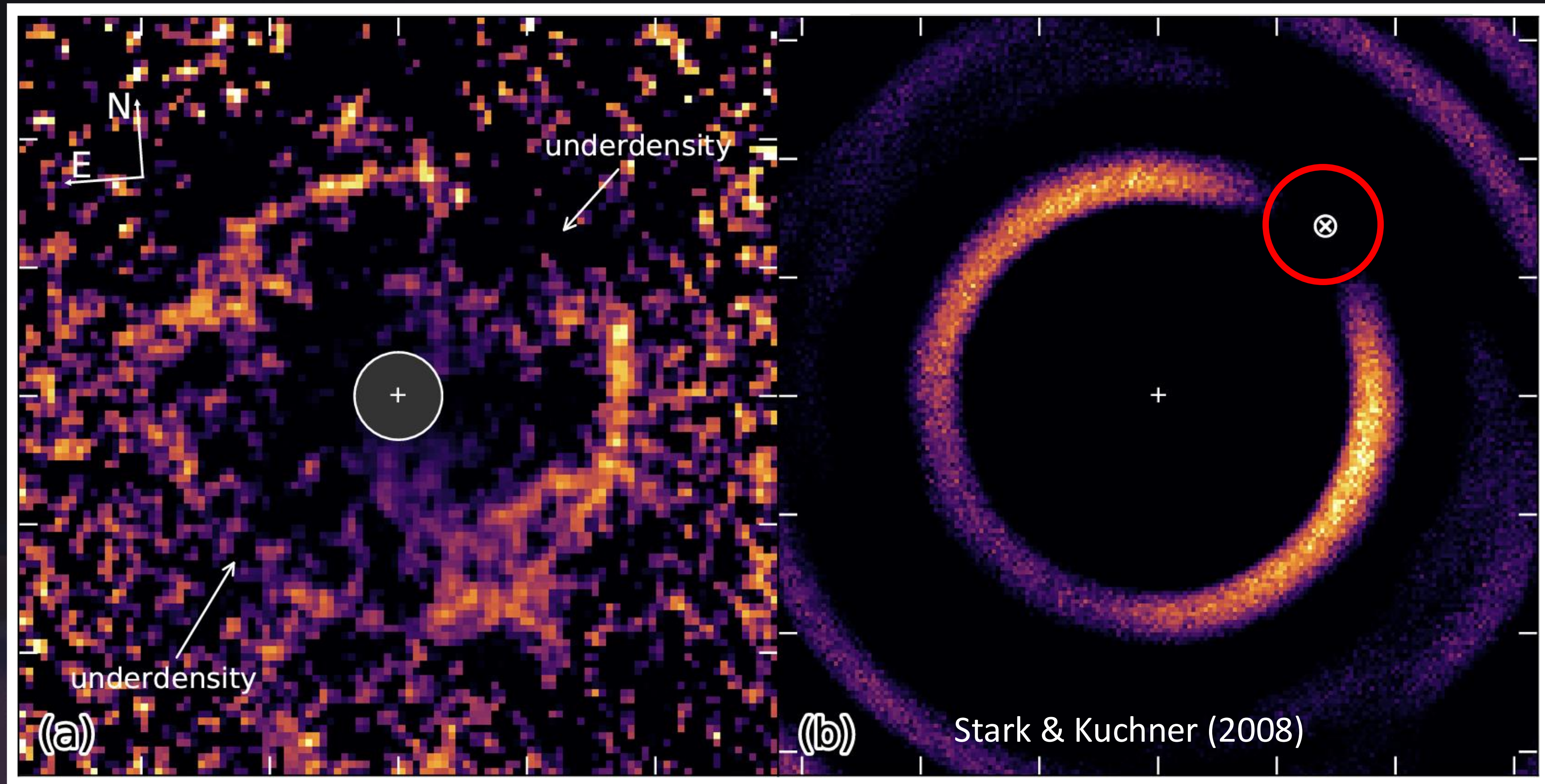
The case of TWA 7

- Young (~ 7 -13 Myr) M-dwarf.
- Harbors a complex, near face-on debris disk.
- Imaged from 1998-2019 with NICMOS, ALMA, SPHERE, GPI and STIS.
- Second narrow ring resembles a resonant-like structure.



Ren et al. (2021)

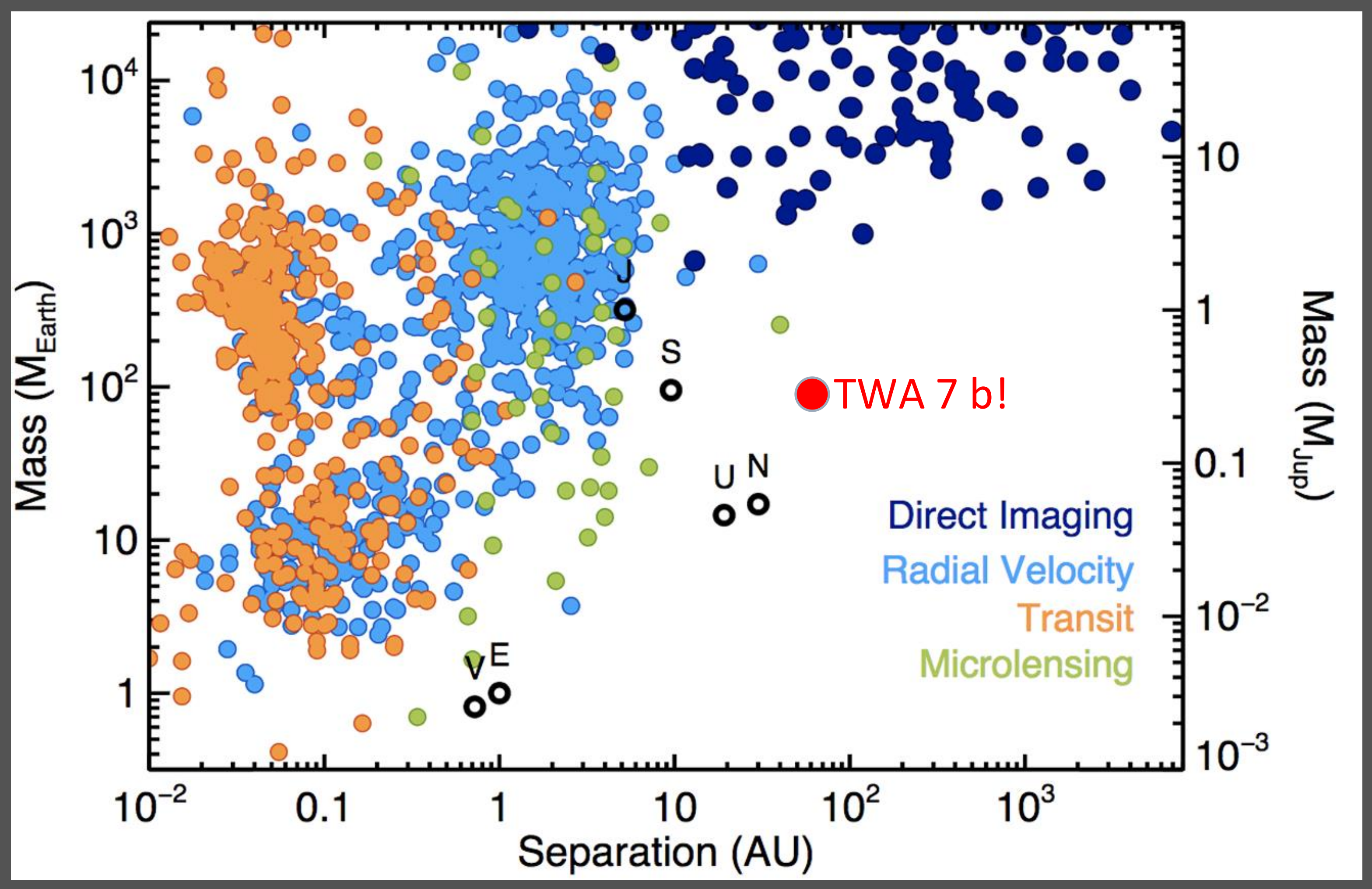
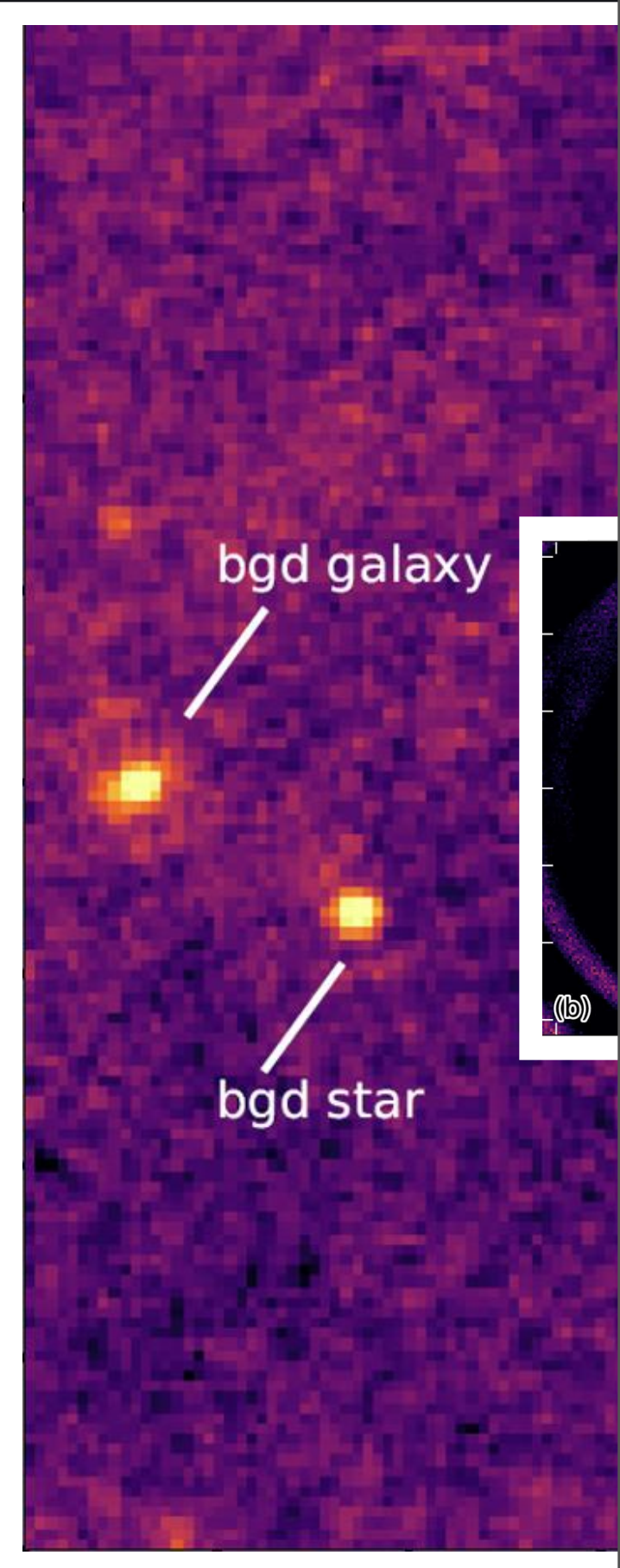
Planet-Disk Interactions?



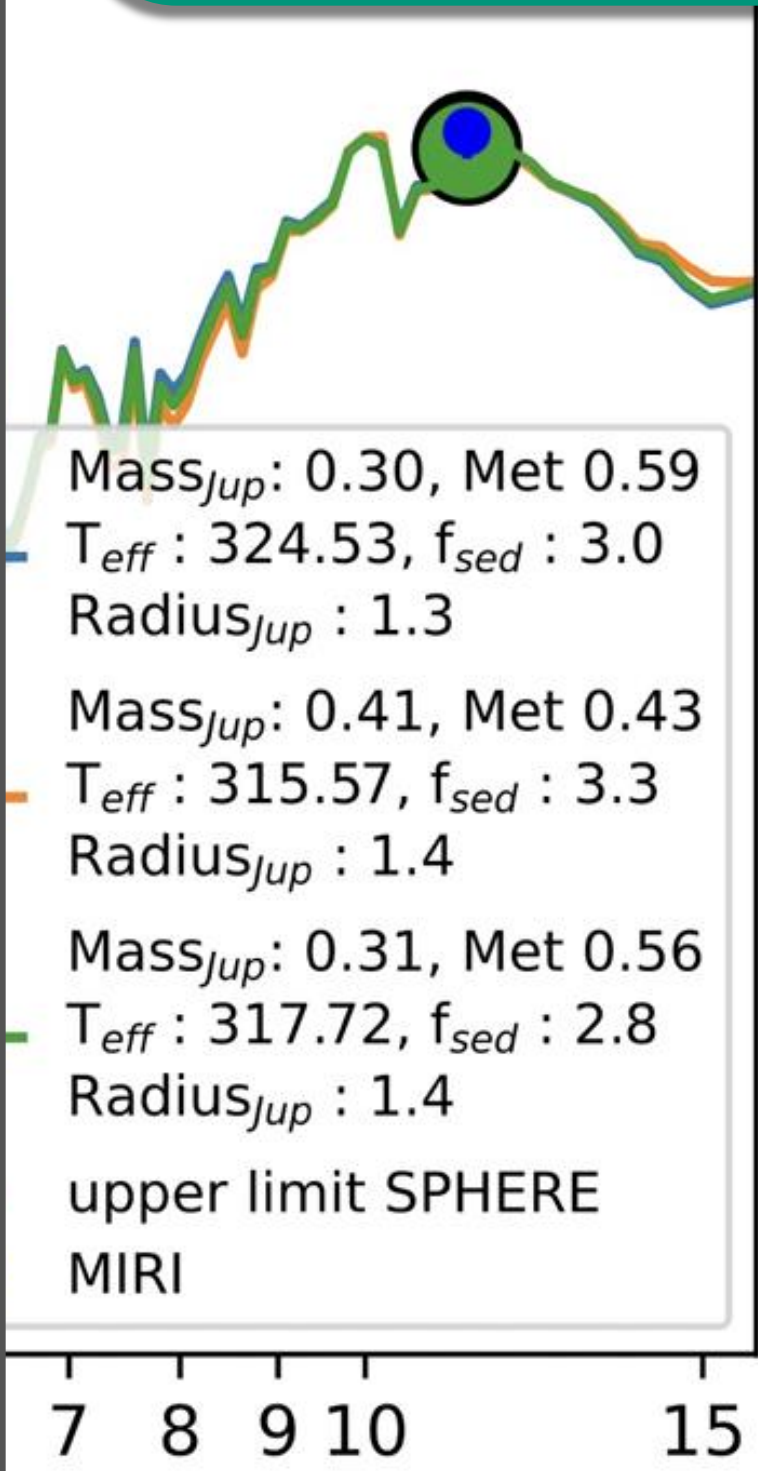
Ren et al. (2021)

MIRI Observations

Lagrange et al. (2025)

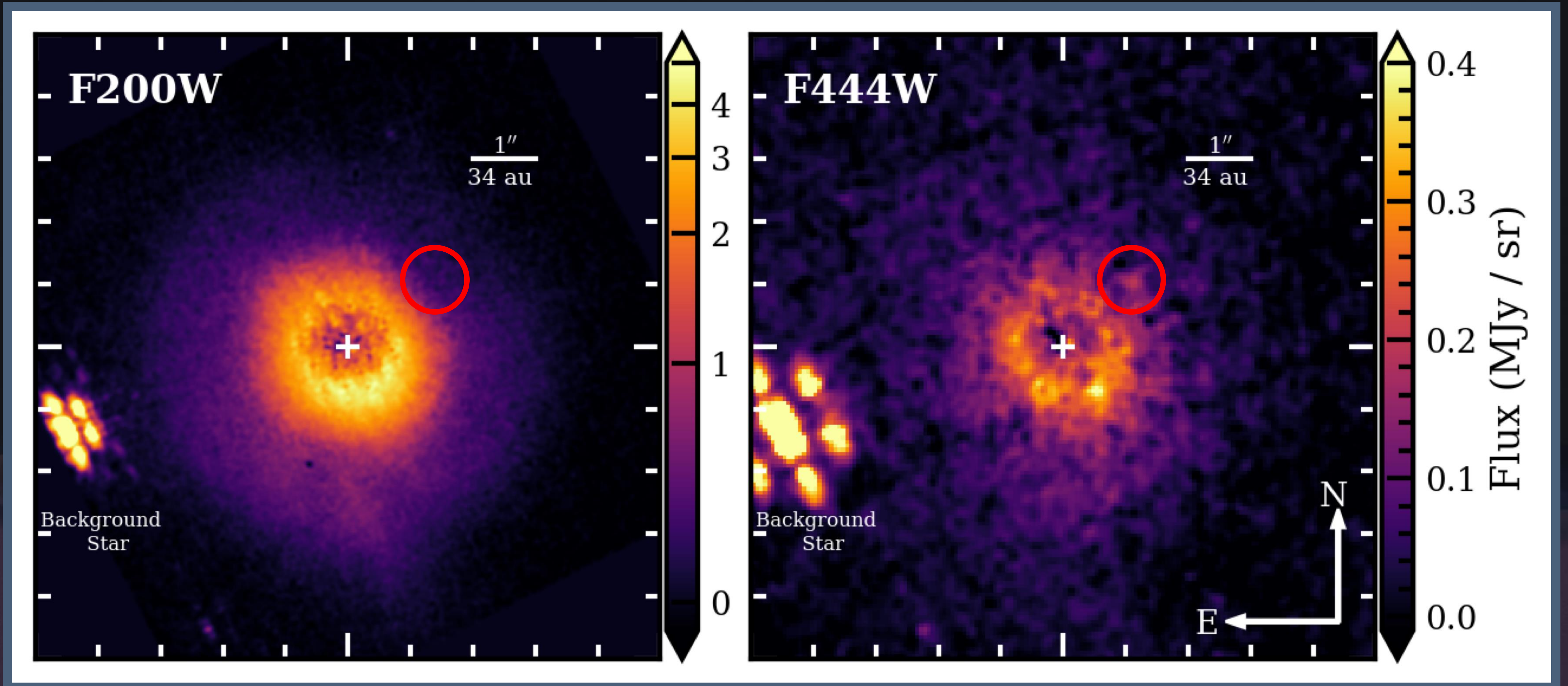


Consistent with
Saturn mass!!



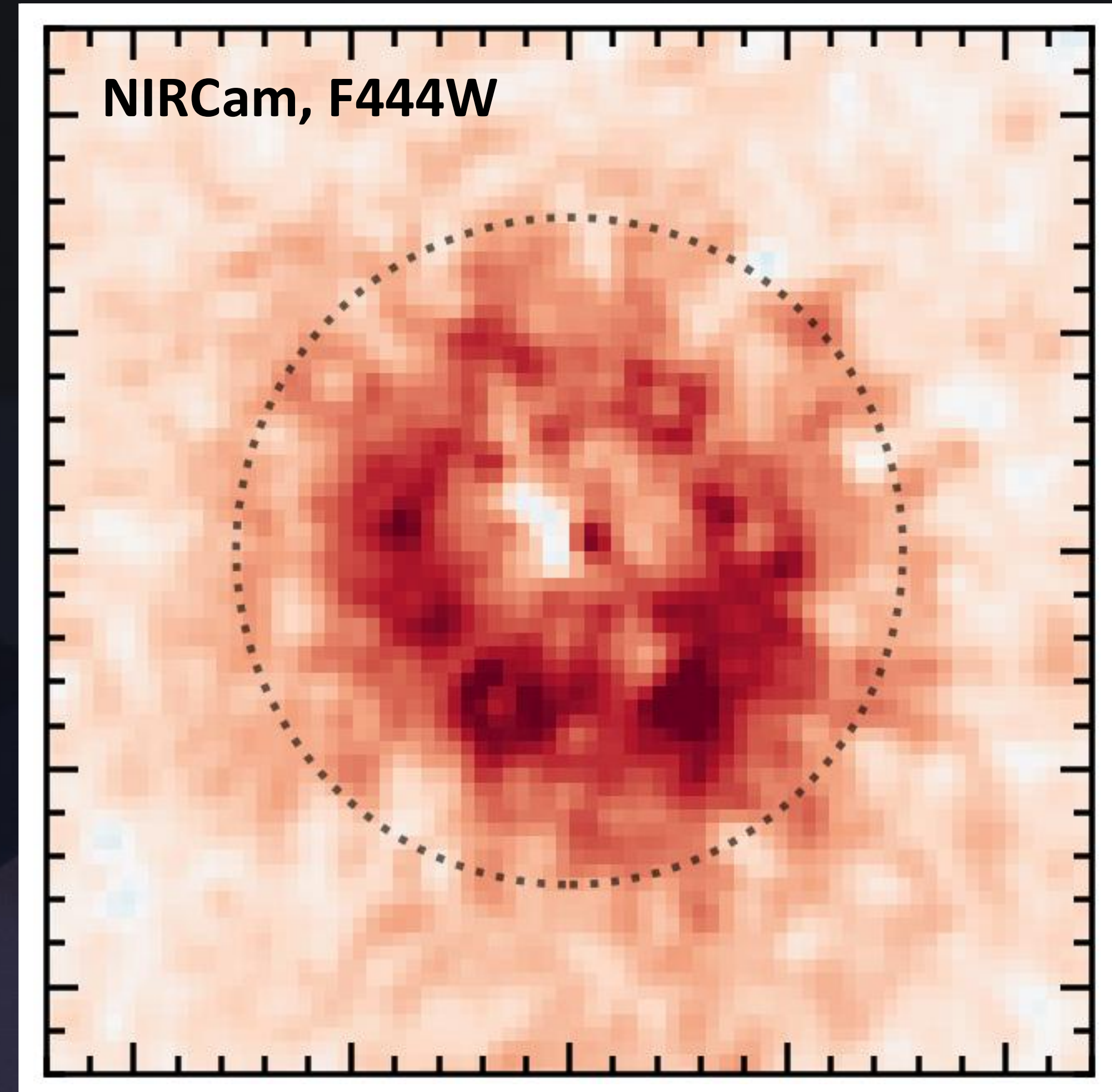
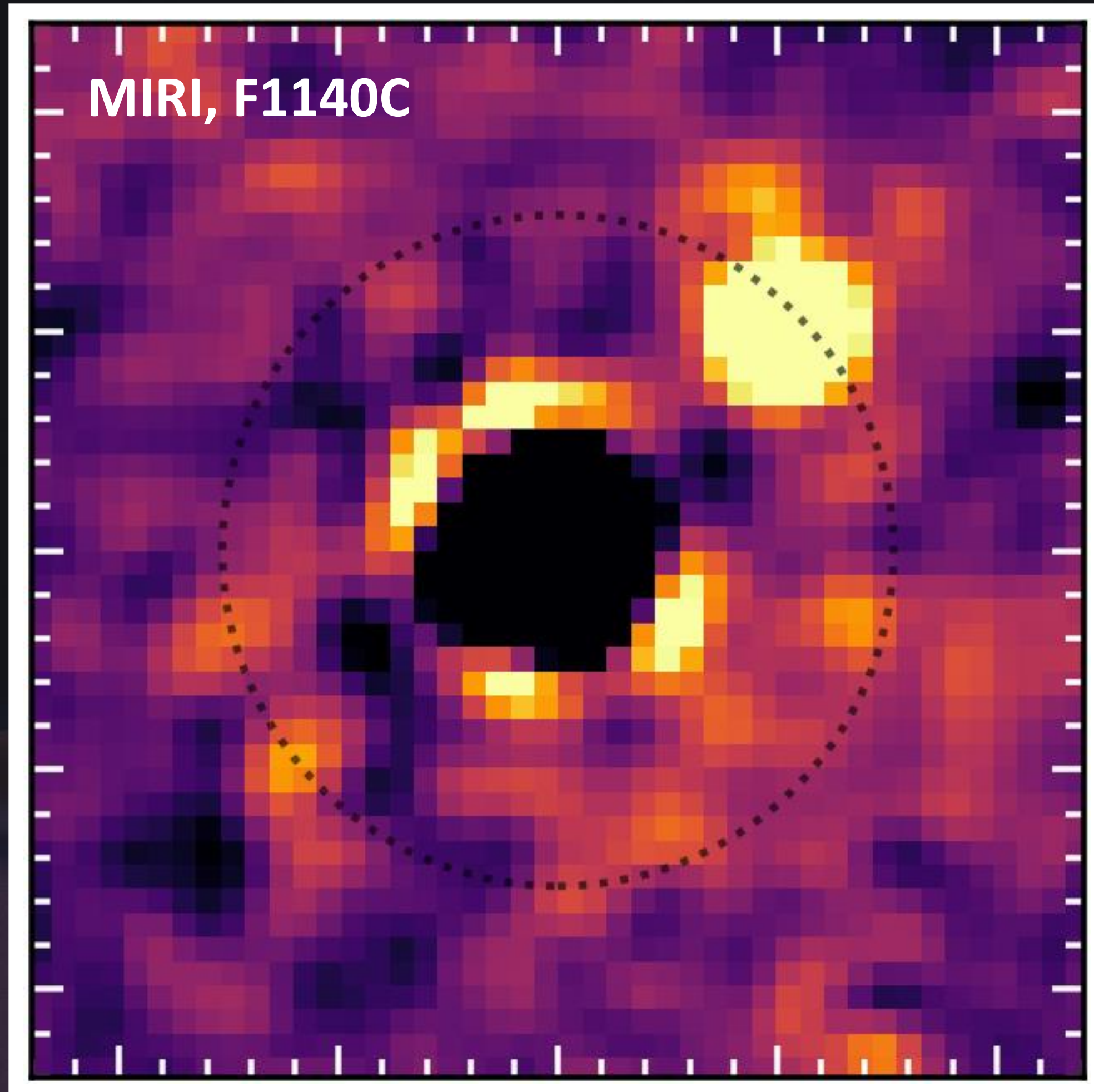
NIRCam Observations

Crotts et al. (2025)



NIRCam Observations

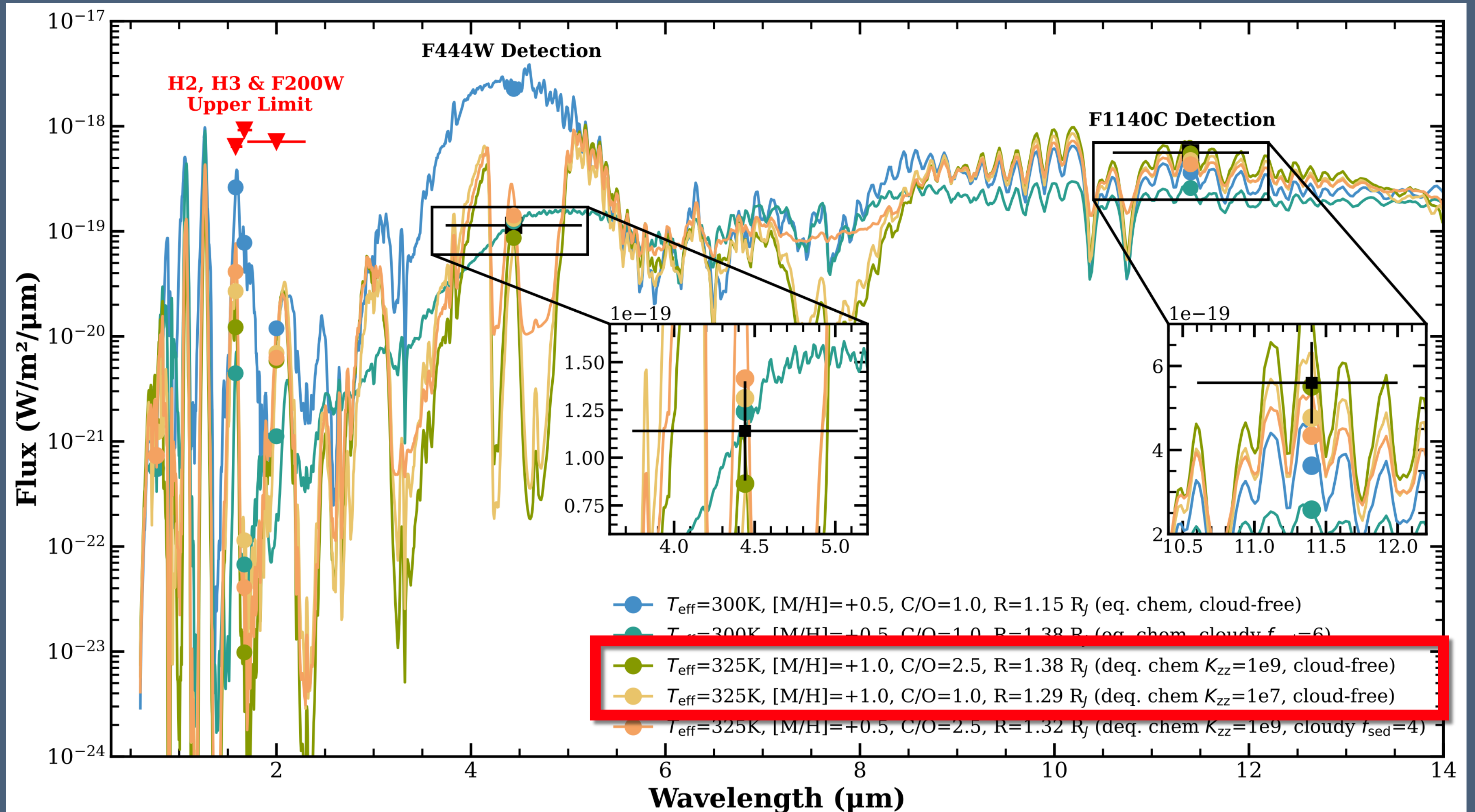
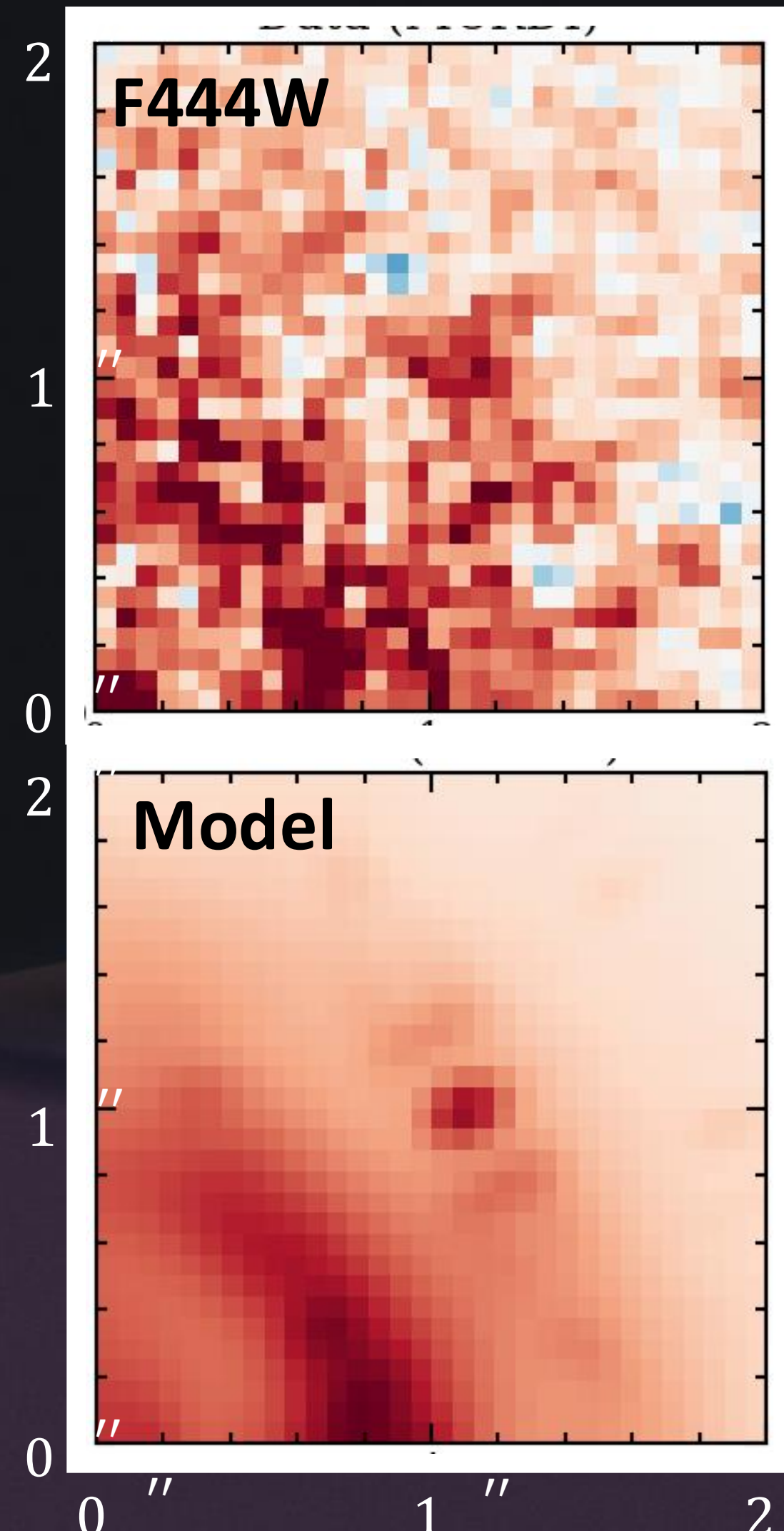
Crotts et al. (2025)



Atmospheric Modeling

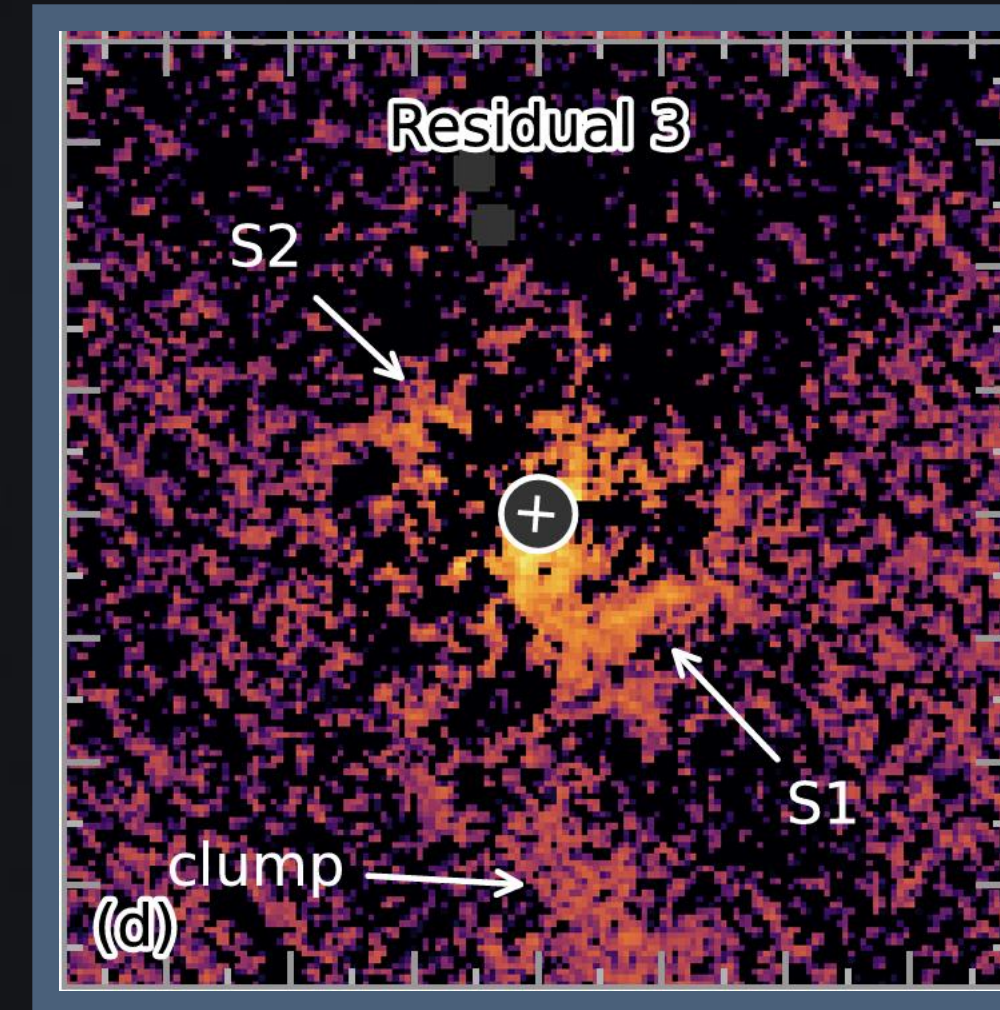
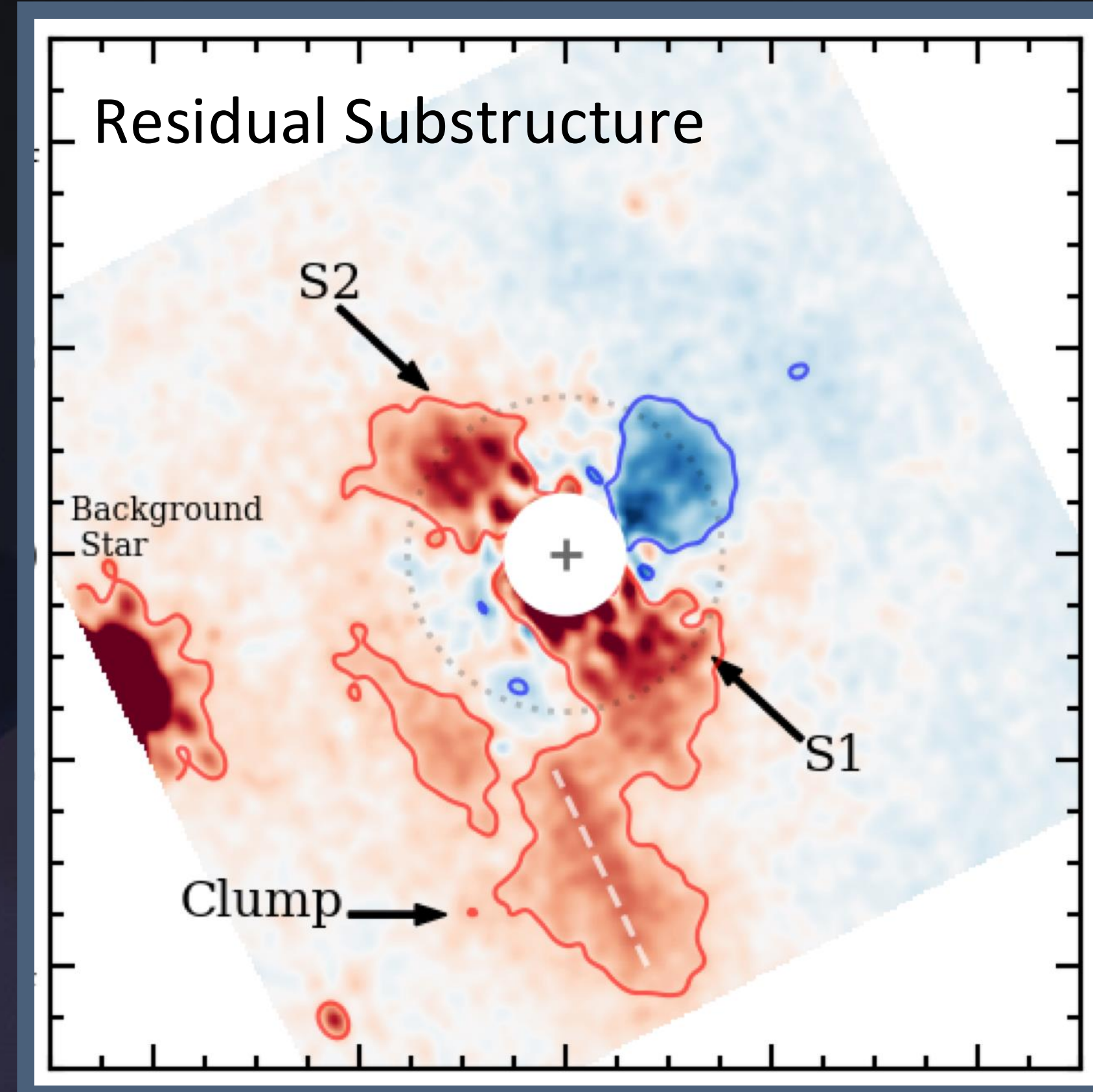
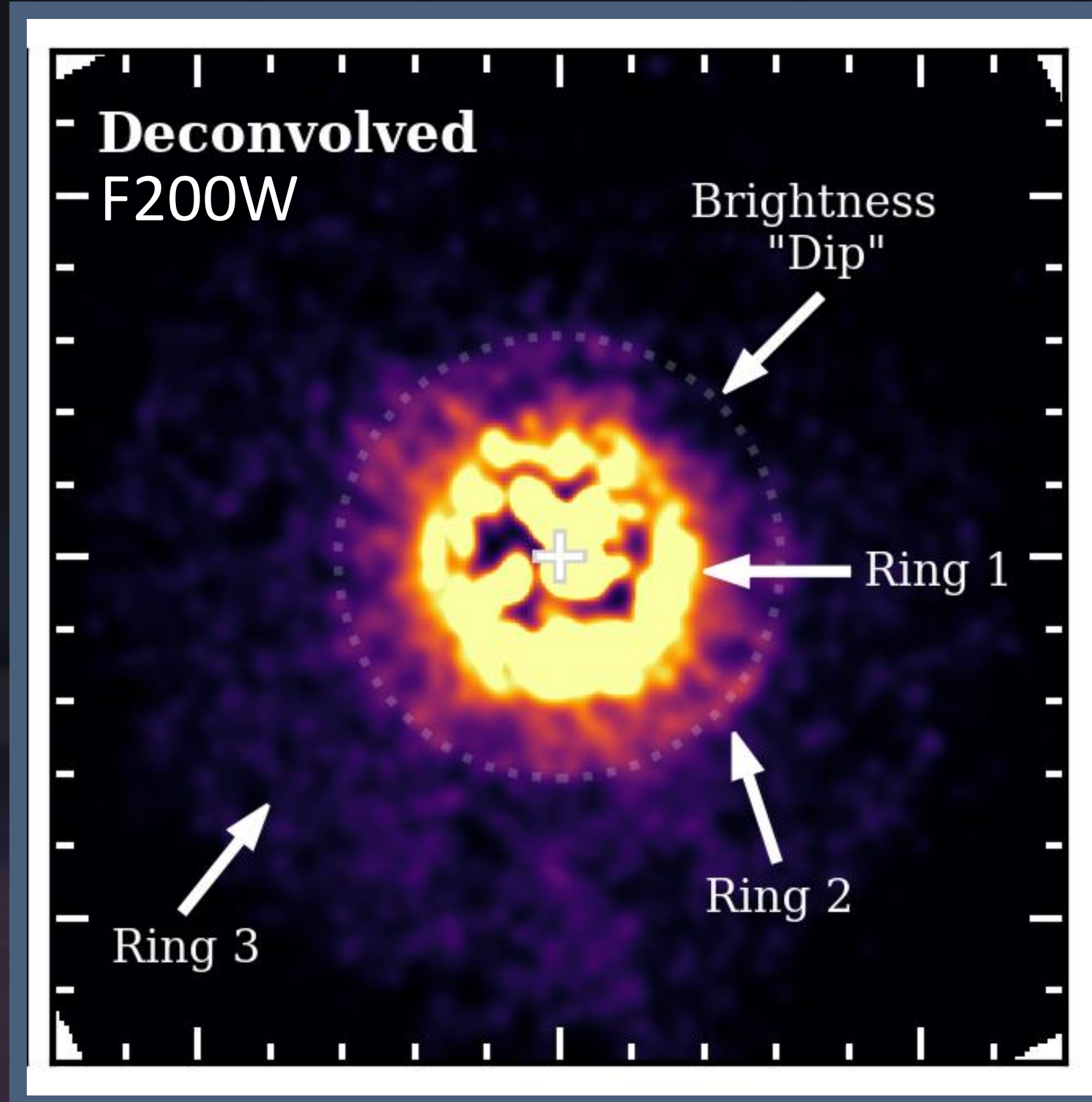
Crotts et al. (2025)

Warm Saturn mass planet w/above Solar
metallicity and chemical disequilibrium
required



Disk Substructures

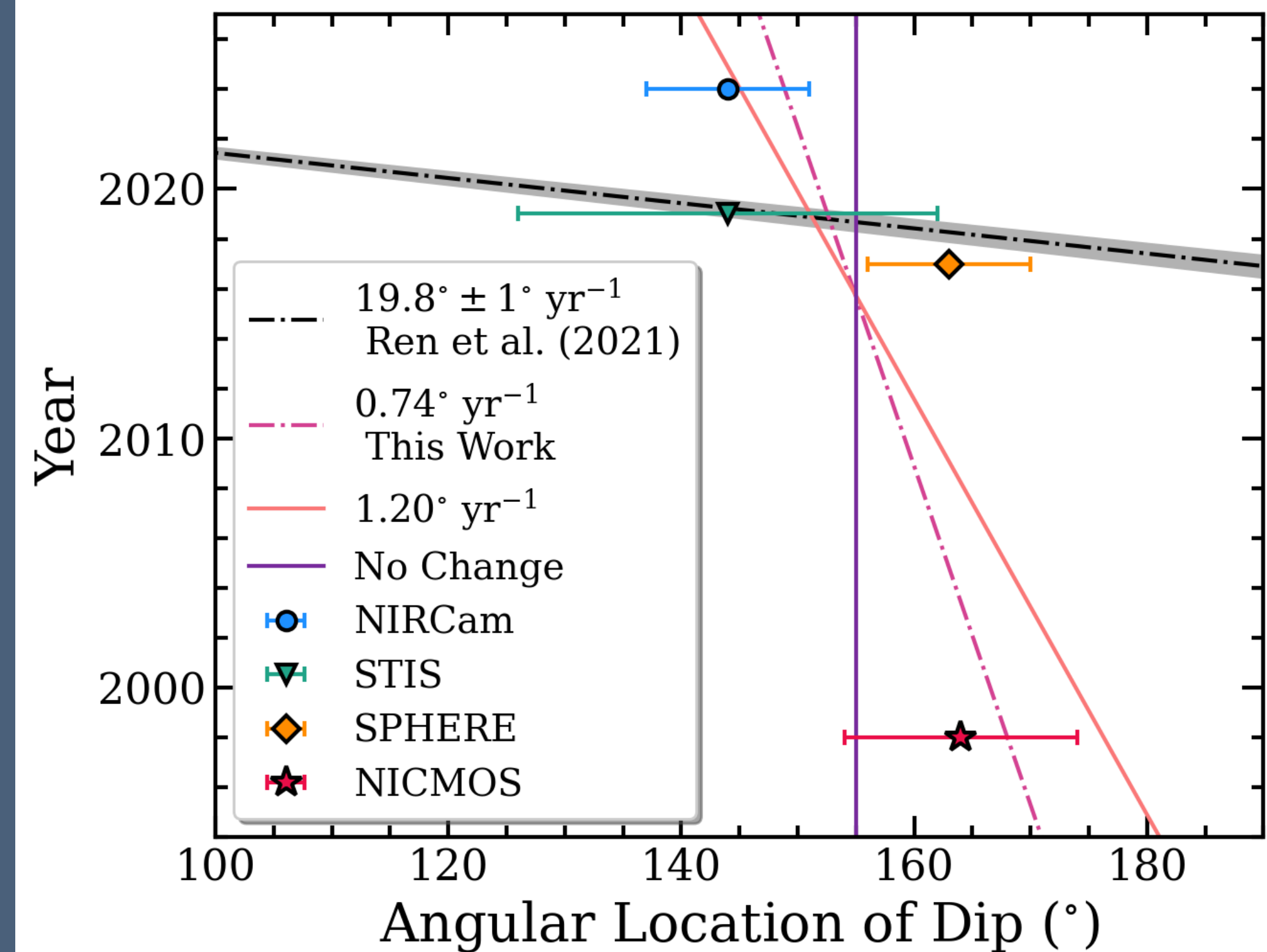
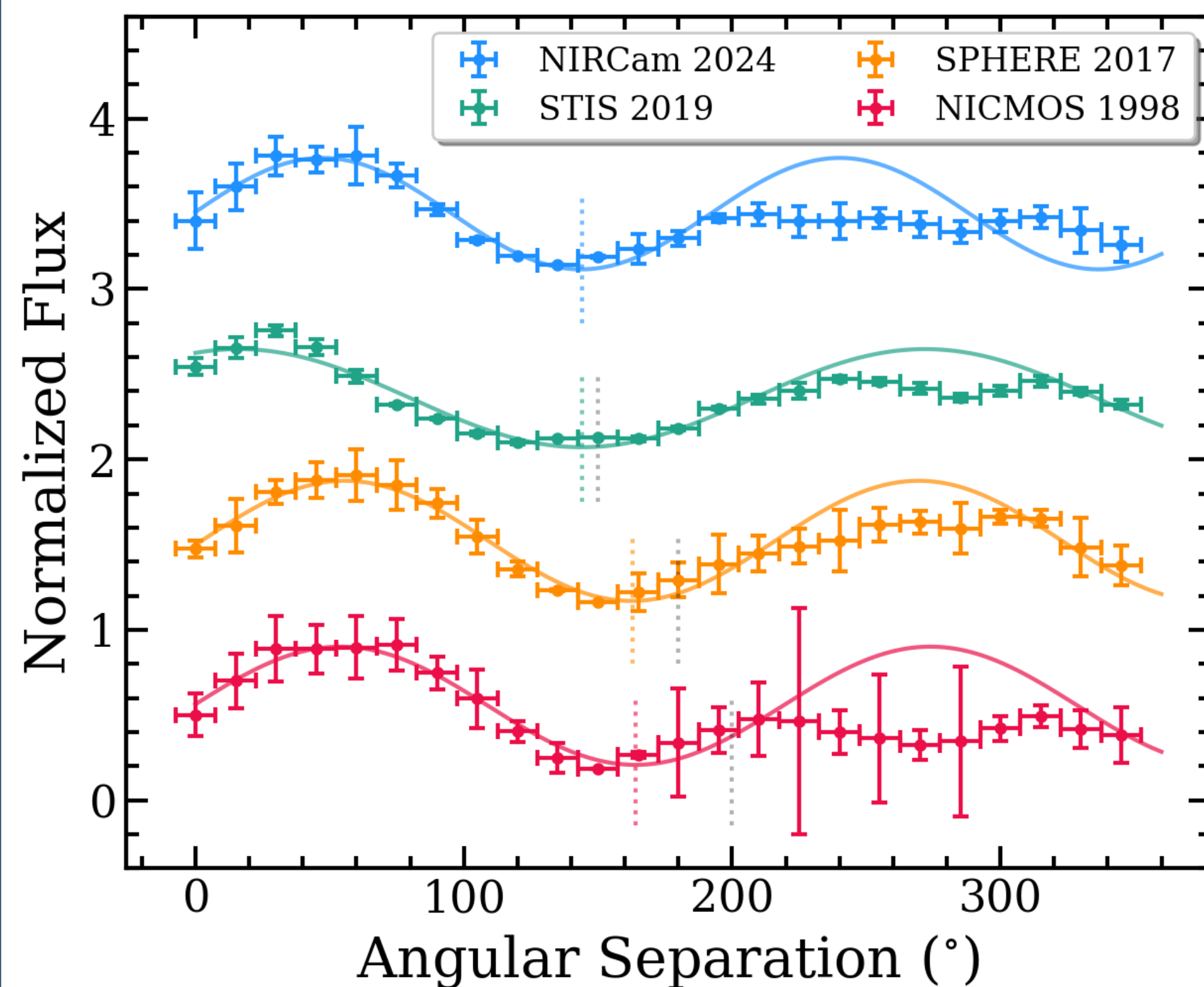
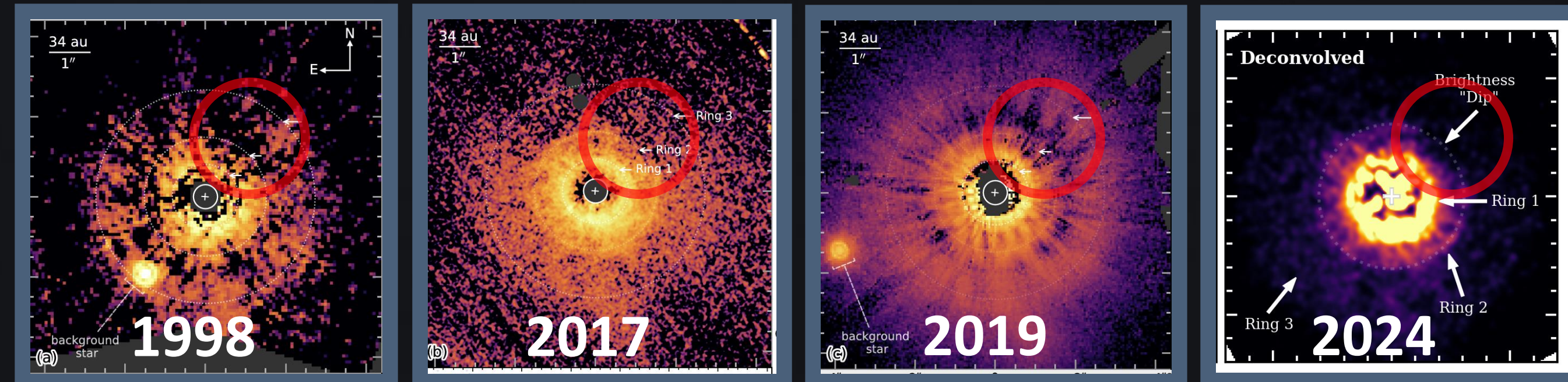
Crotts et al. (2025)

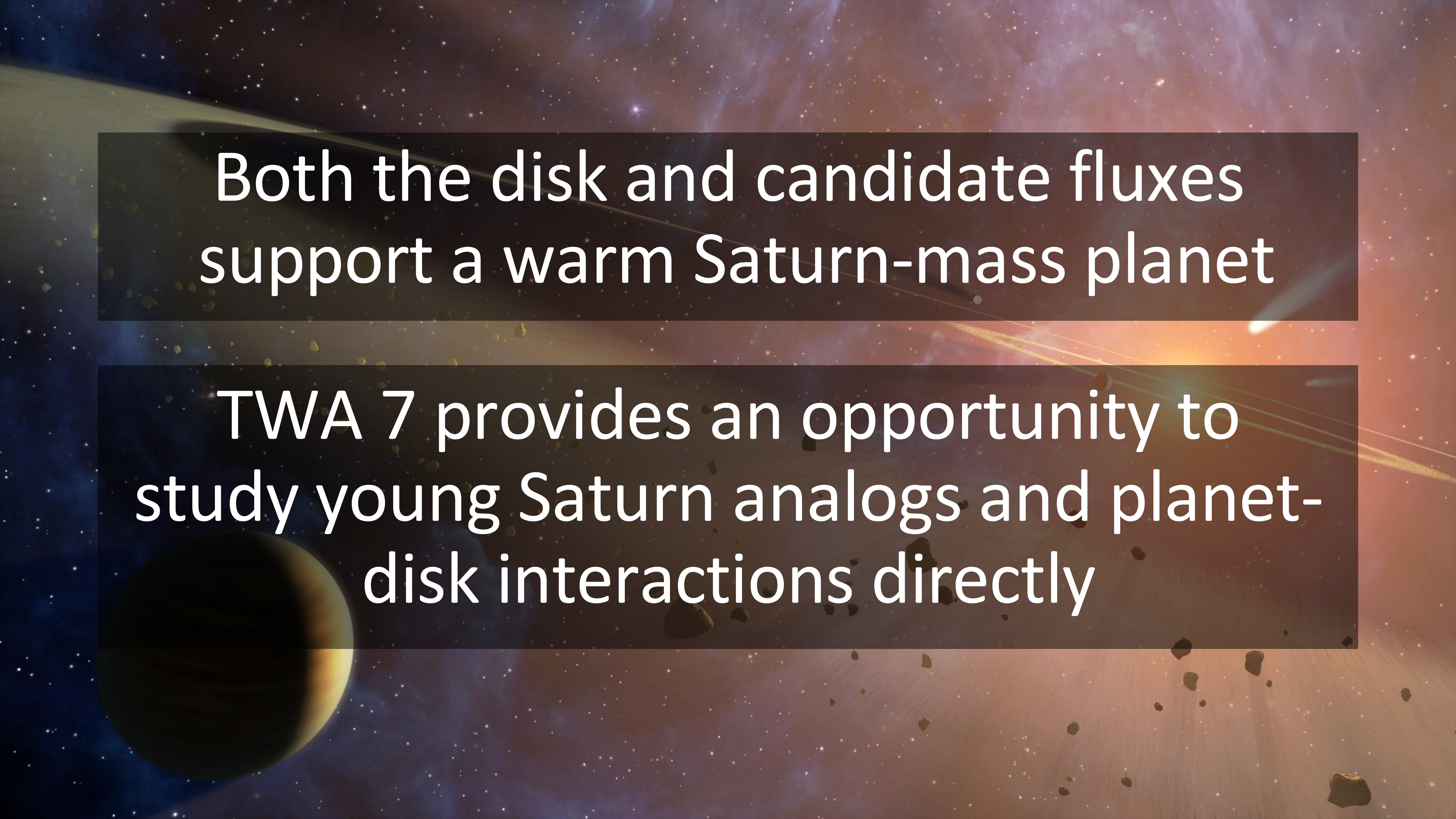


SPHERE
Ren et al. (2021)

Location of Ring 2 Underdensity

Crotts et al. (2025)



The background of the slide is a composite image of space. It features a vibrant nebula with purple and blue hues at the top, transitioning into a reddish-orange glow towards the bottom. A bright, glowing ring of light, possibly representing a protoplanetary disk, is visible in the center. In the bottom left corner, a portion of a planet with a yellowish-brown surface is visible. The entire scene is filled with numerous small, distant stars.

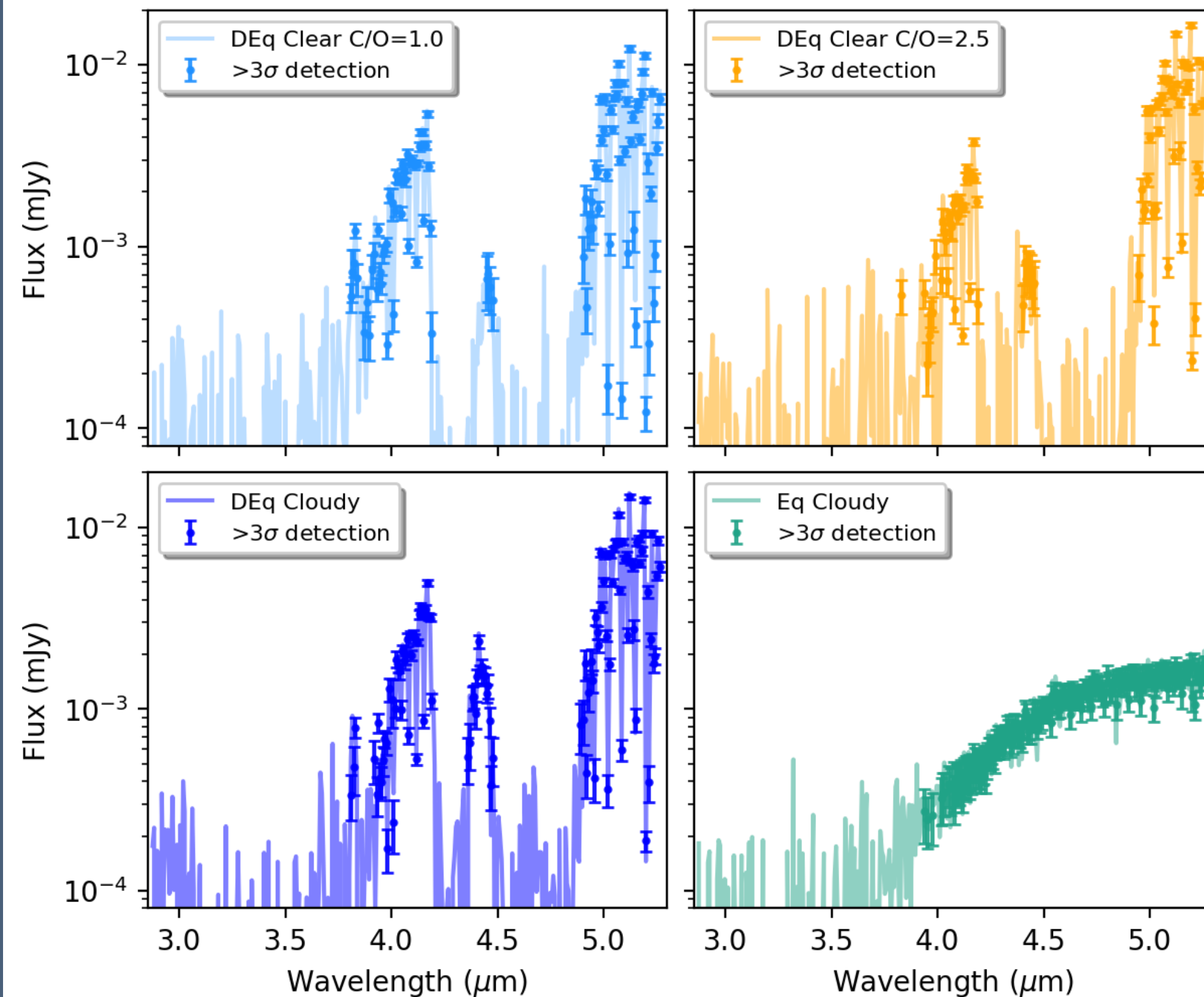
Both the disk and candidate fluxes
support a warm Saturn-mass planet

TWA 7 provides an opportunity to
study young Saturn analogs and planet-
disk interactions directly

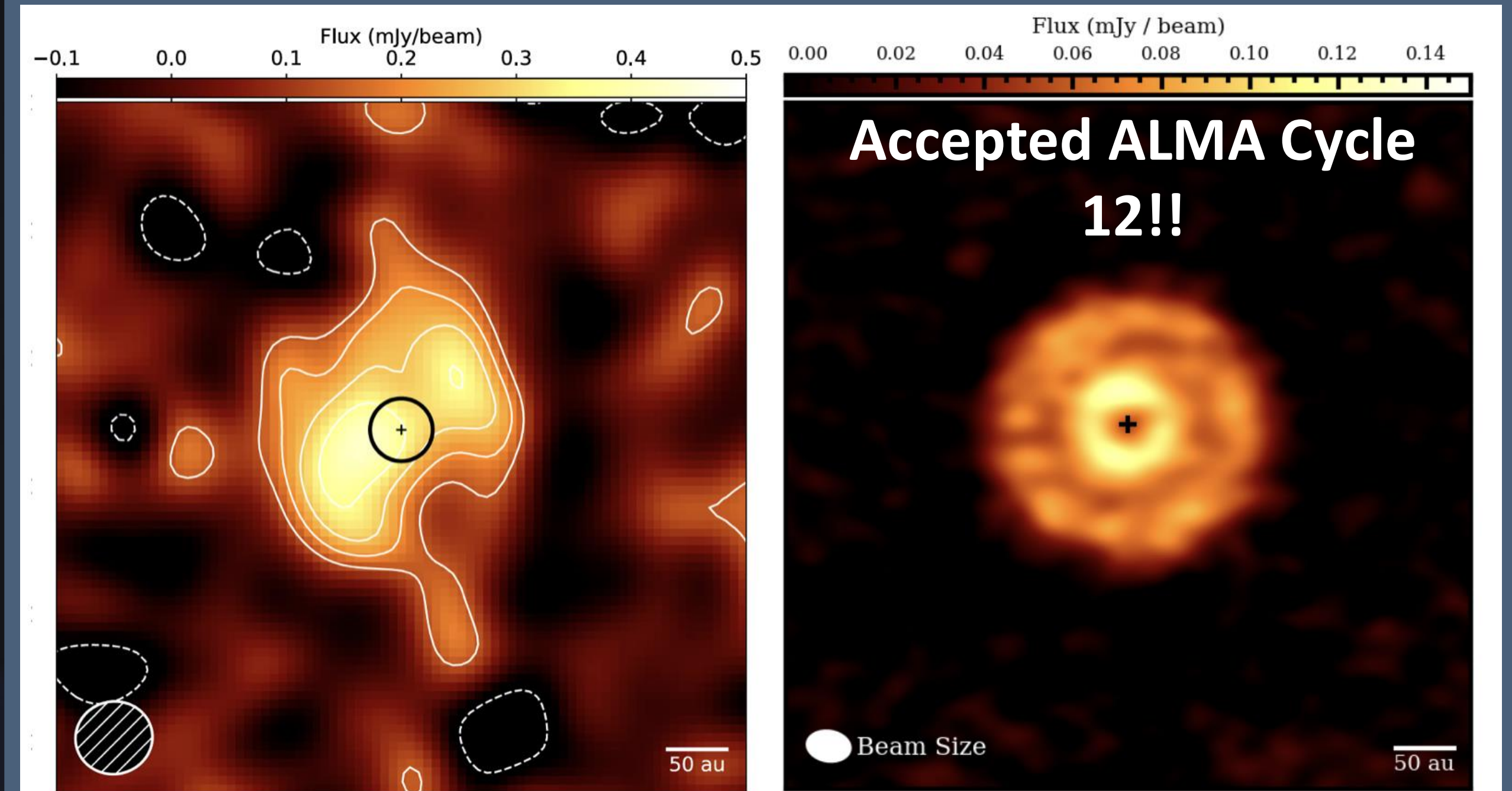
Future Work

TWA 7 Observations

Spectroscopy



Millimeter Disk Observations



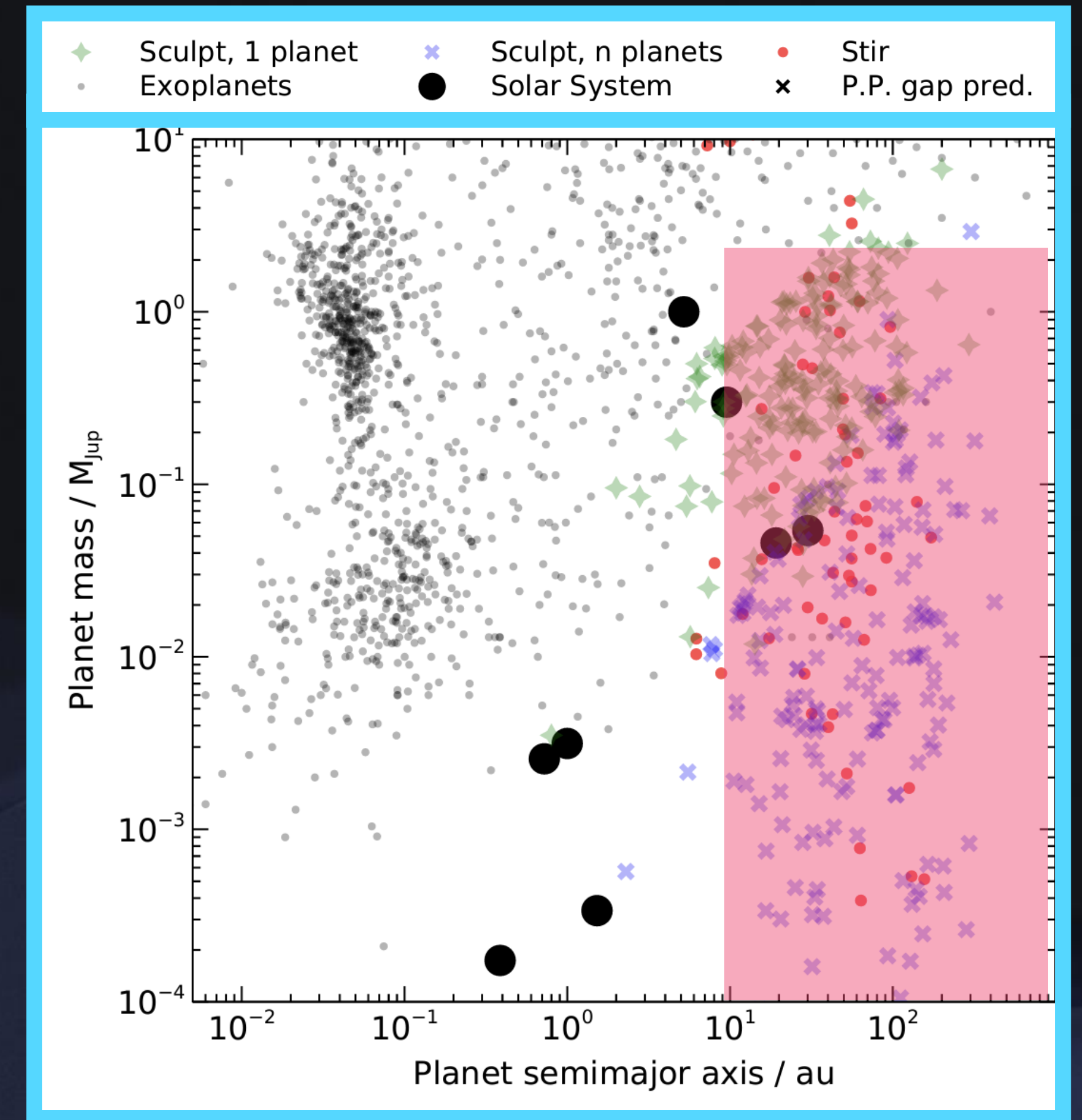
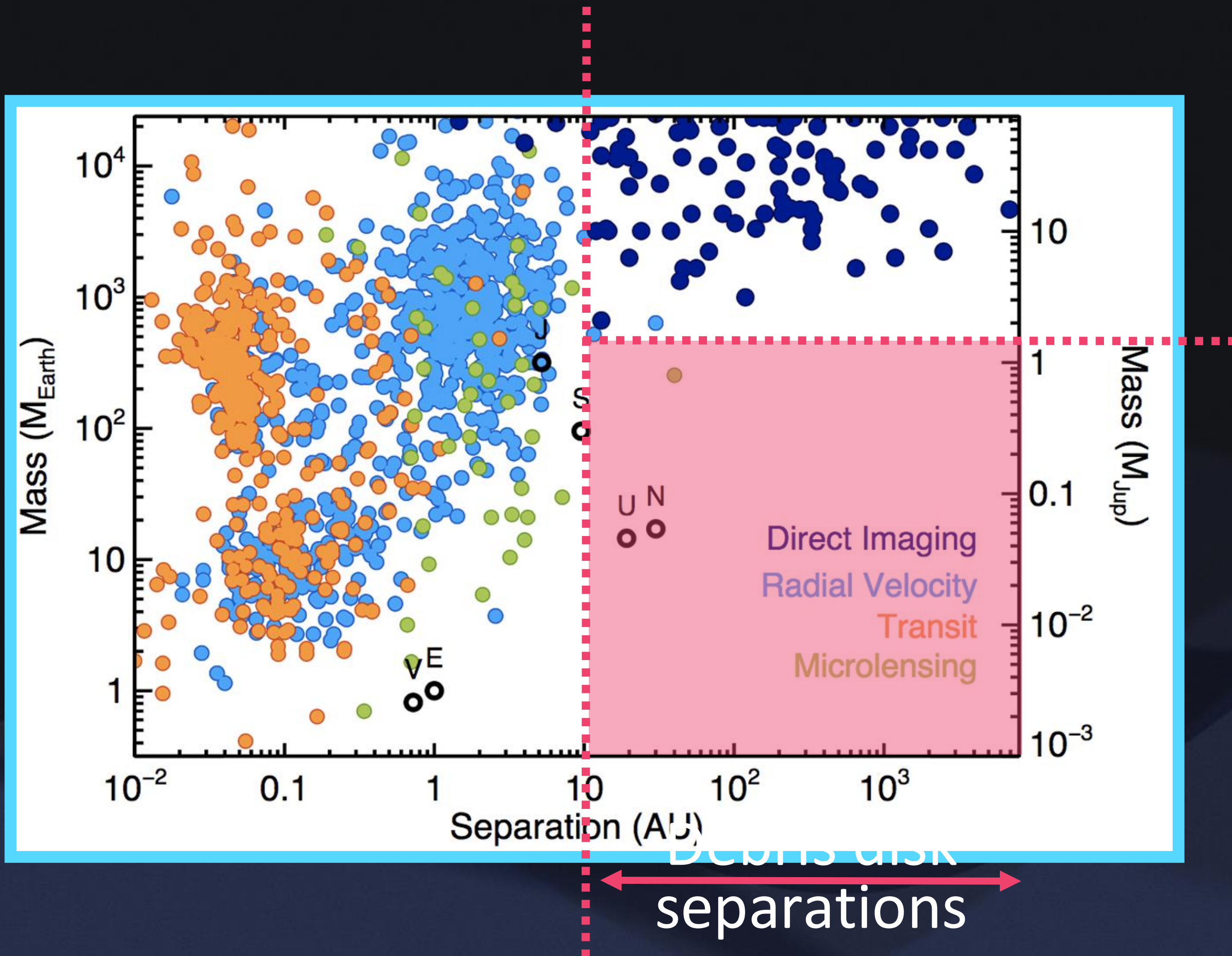
- What is the chemical composition of TWA 7b?
- How does the disk morphology vary with wavelength?
- What is the spatial location of the disk's CO?
- What can we learn about the planet's formation and evolution?

Summary

- We have imaged the near-IR counterpart of a planet candidate imaged with MIRI in the TWA 7 debris disk system.
- The companion presides in the exact location predicted in 2021 to help explain the disk's substructures.
- The NIRCам observations are consistent with the MIRI candidate being a warm Saturn-mass planet companion, making it the smallest planet to be directly imaged to date.
- The TWA 7 system is further confirmation that we can reliably predict planets from debris disk morphologies

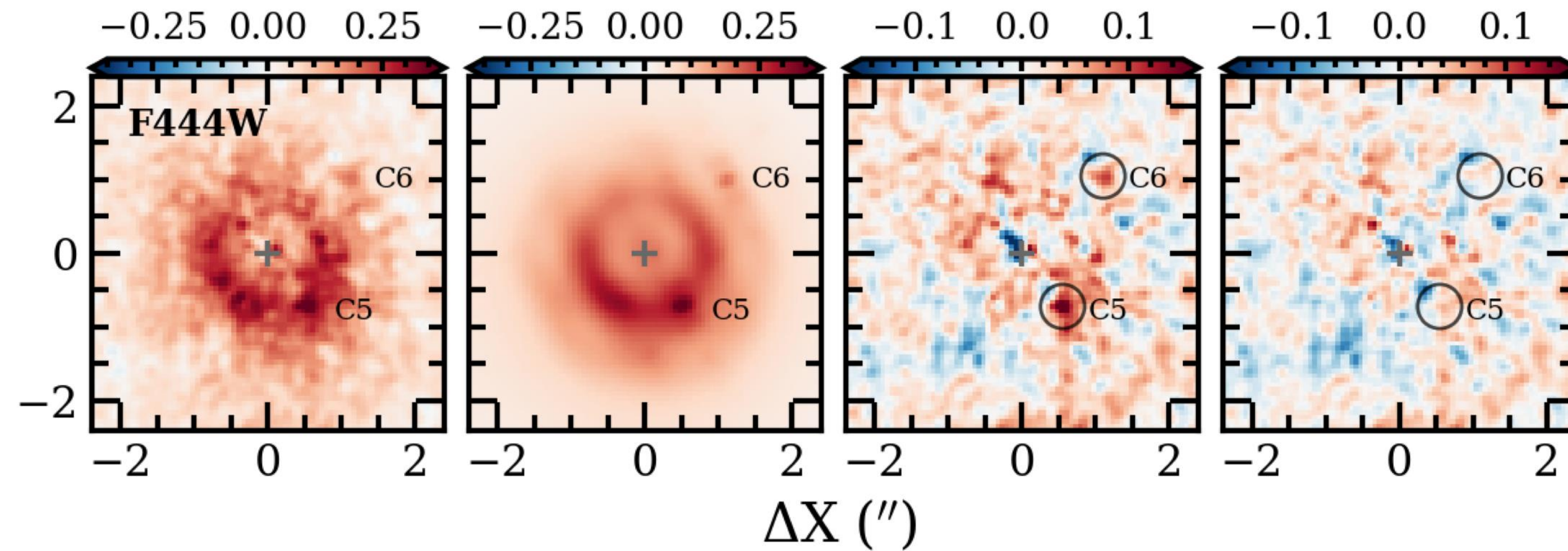
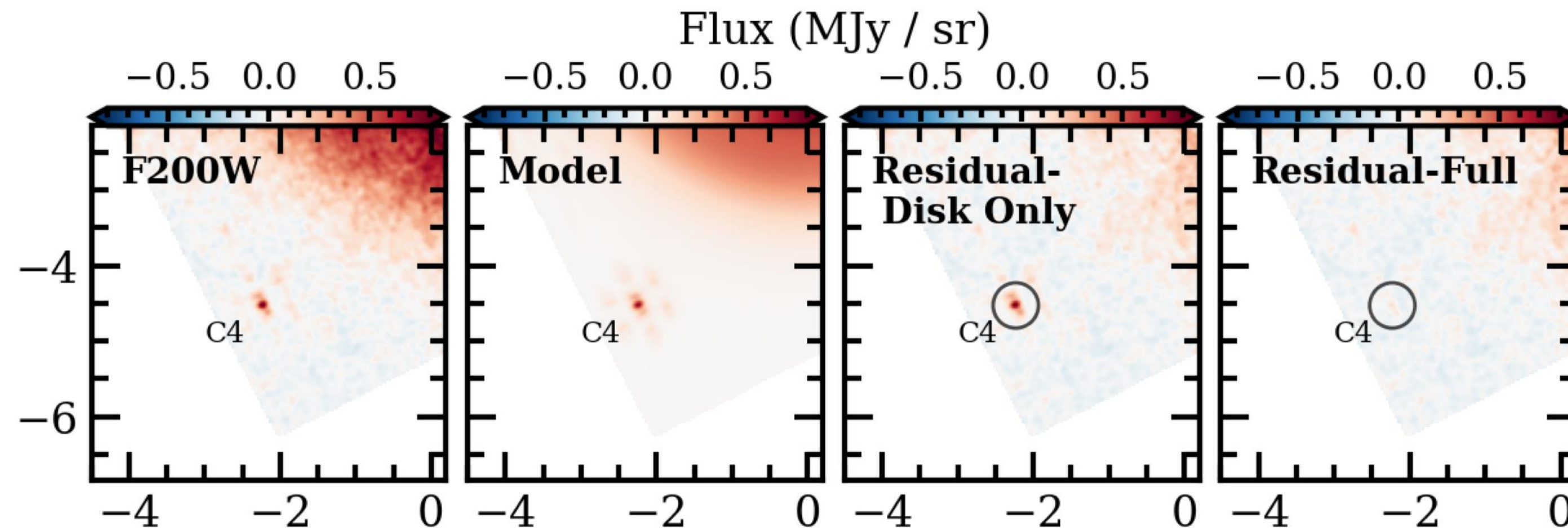
Backup Slides

Where are the planets?

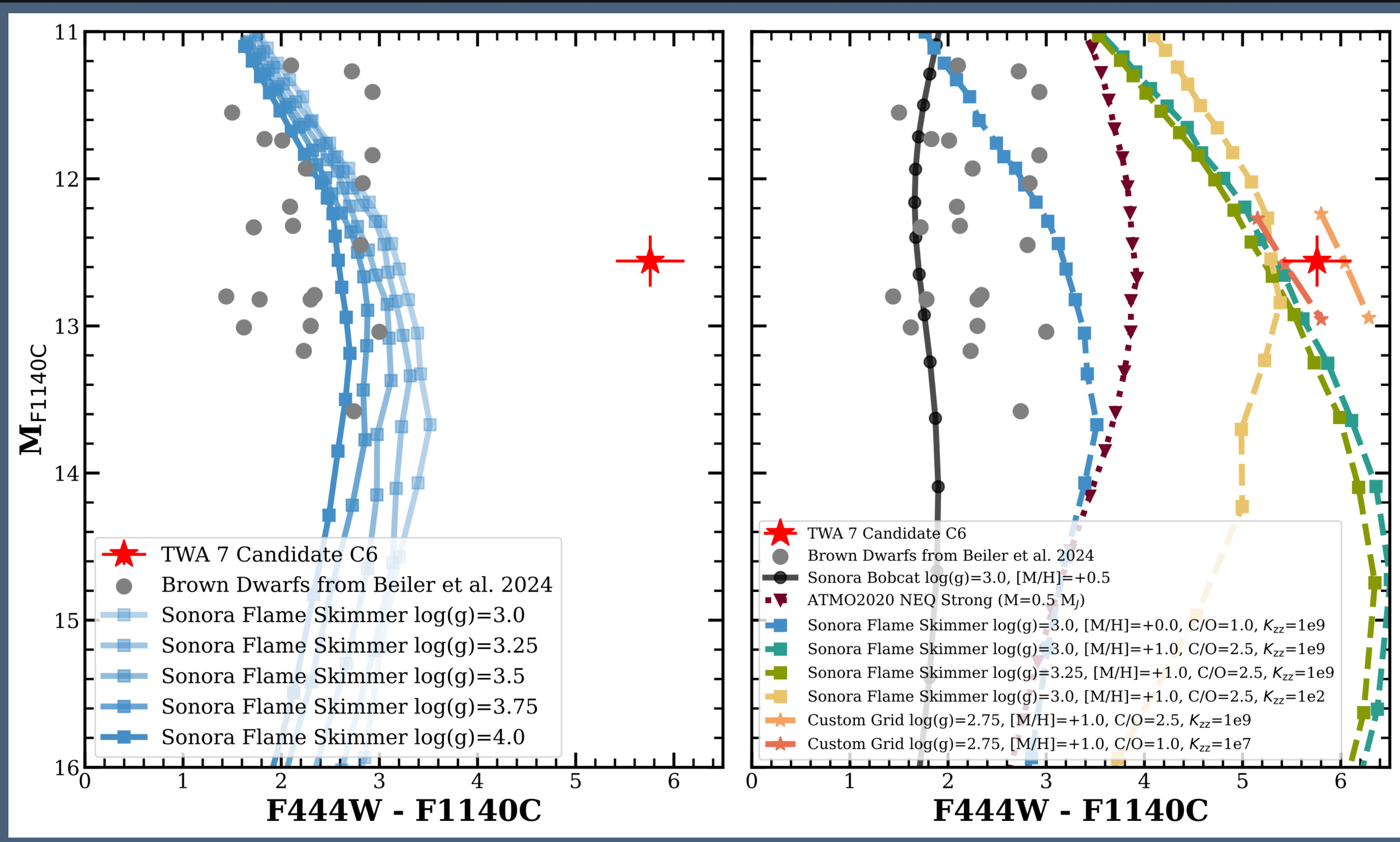


Pearce et al. (2022)

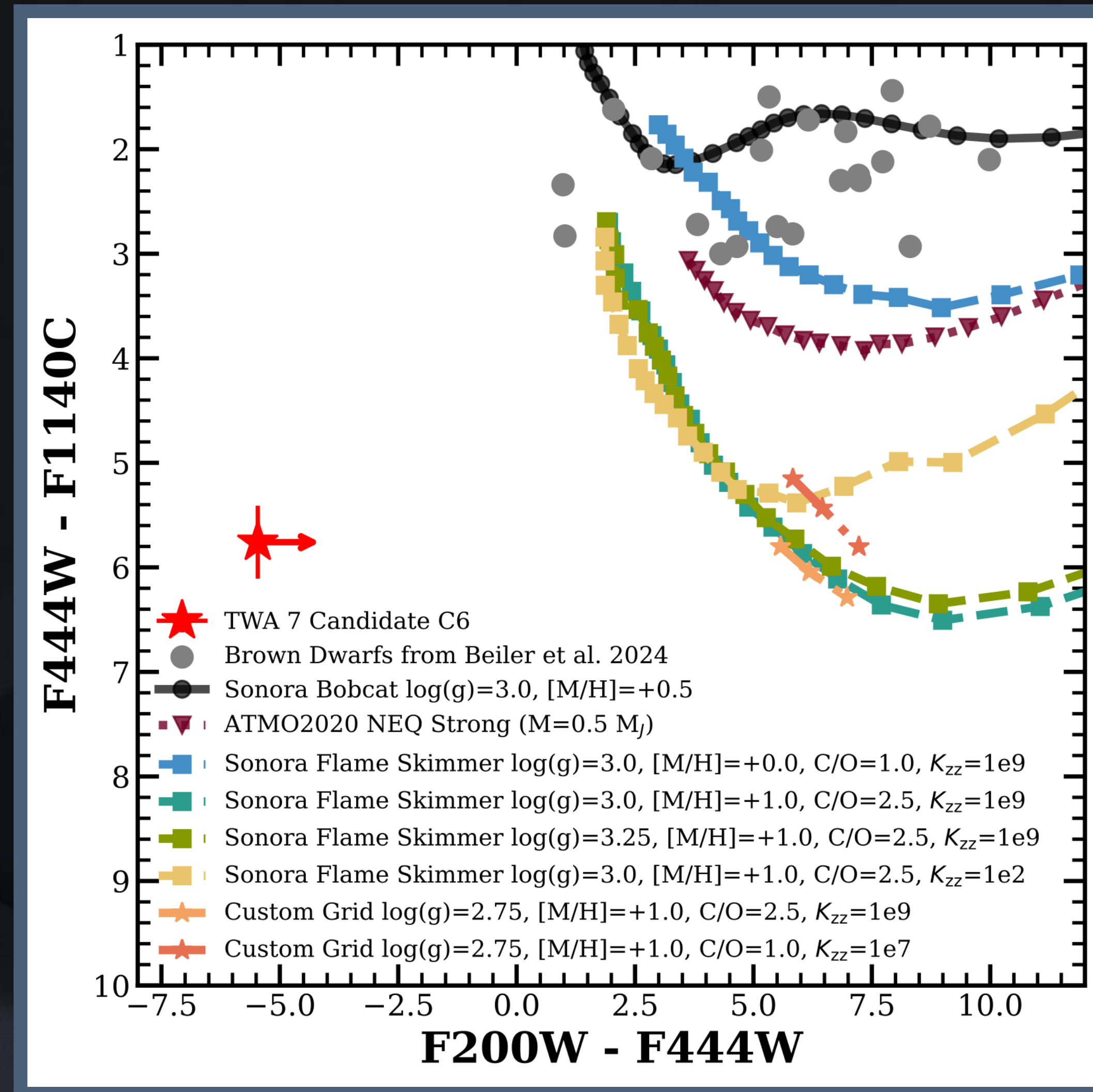
Disk+Planet Models



TWA 7b Color

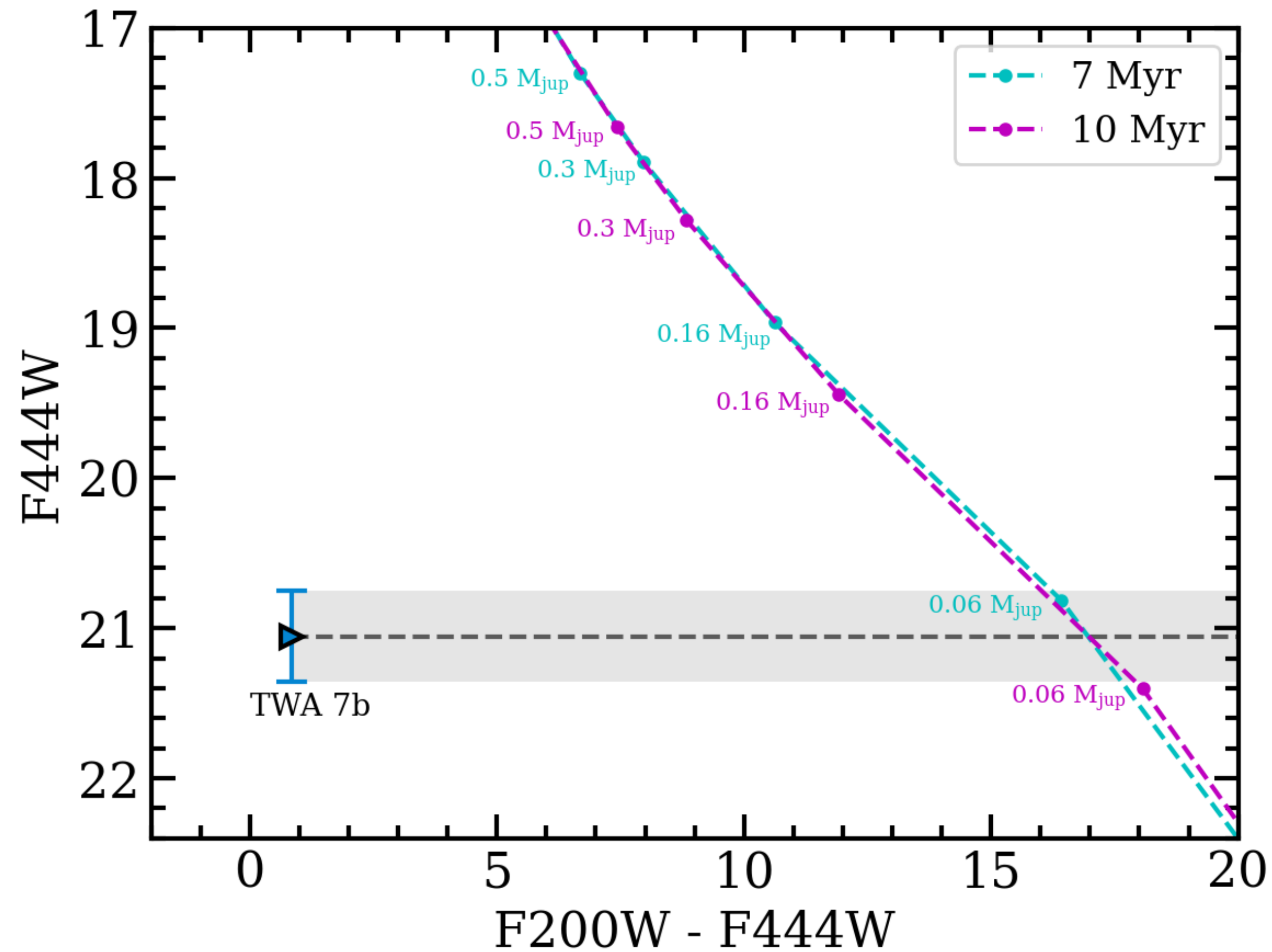


TWA 7b Color

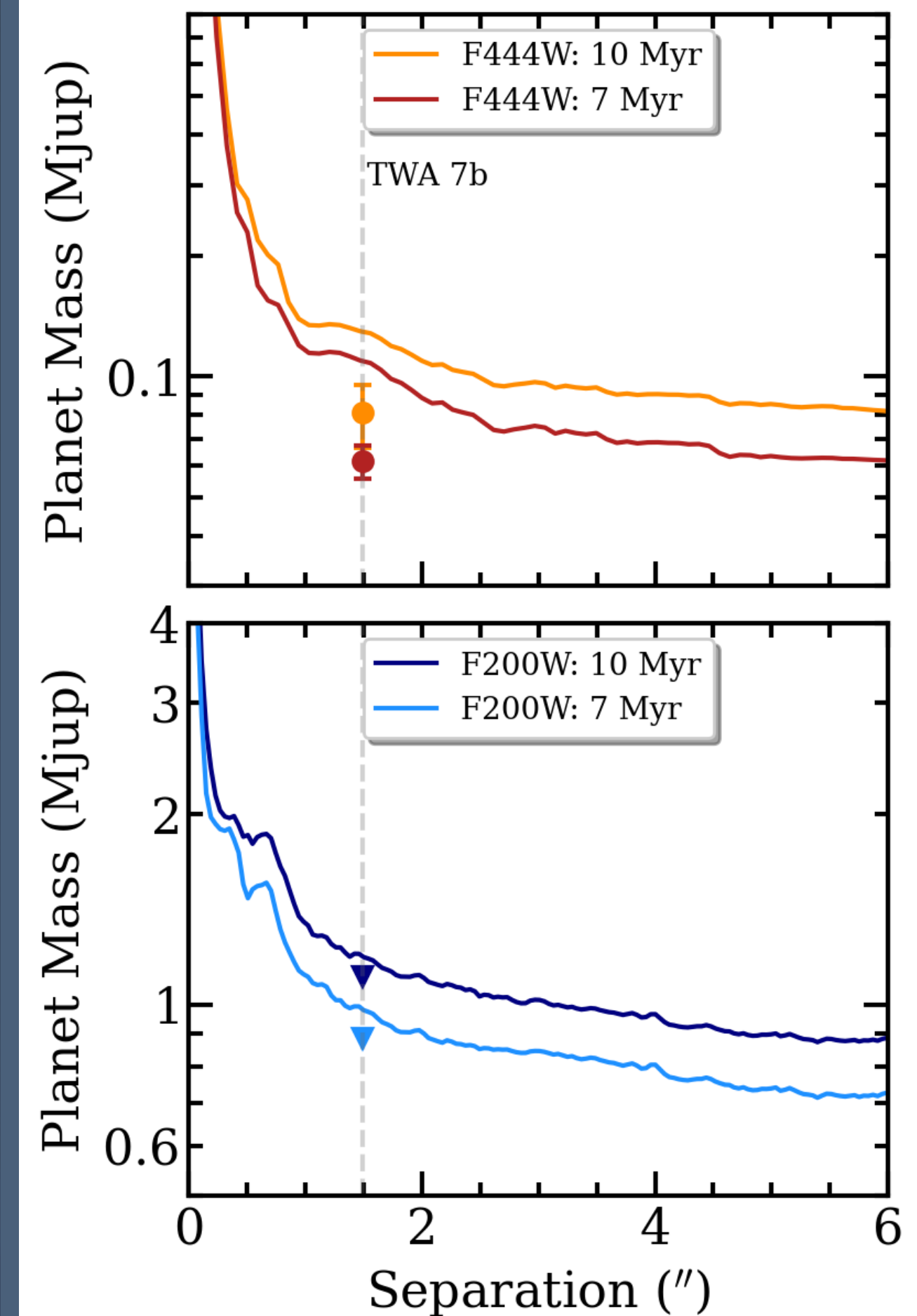


Estimated Planet Mass

Crotts et al. (2025)

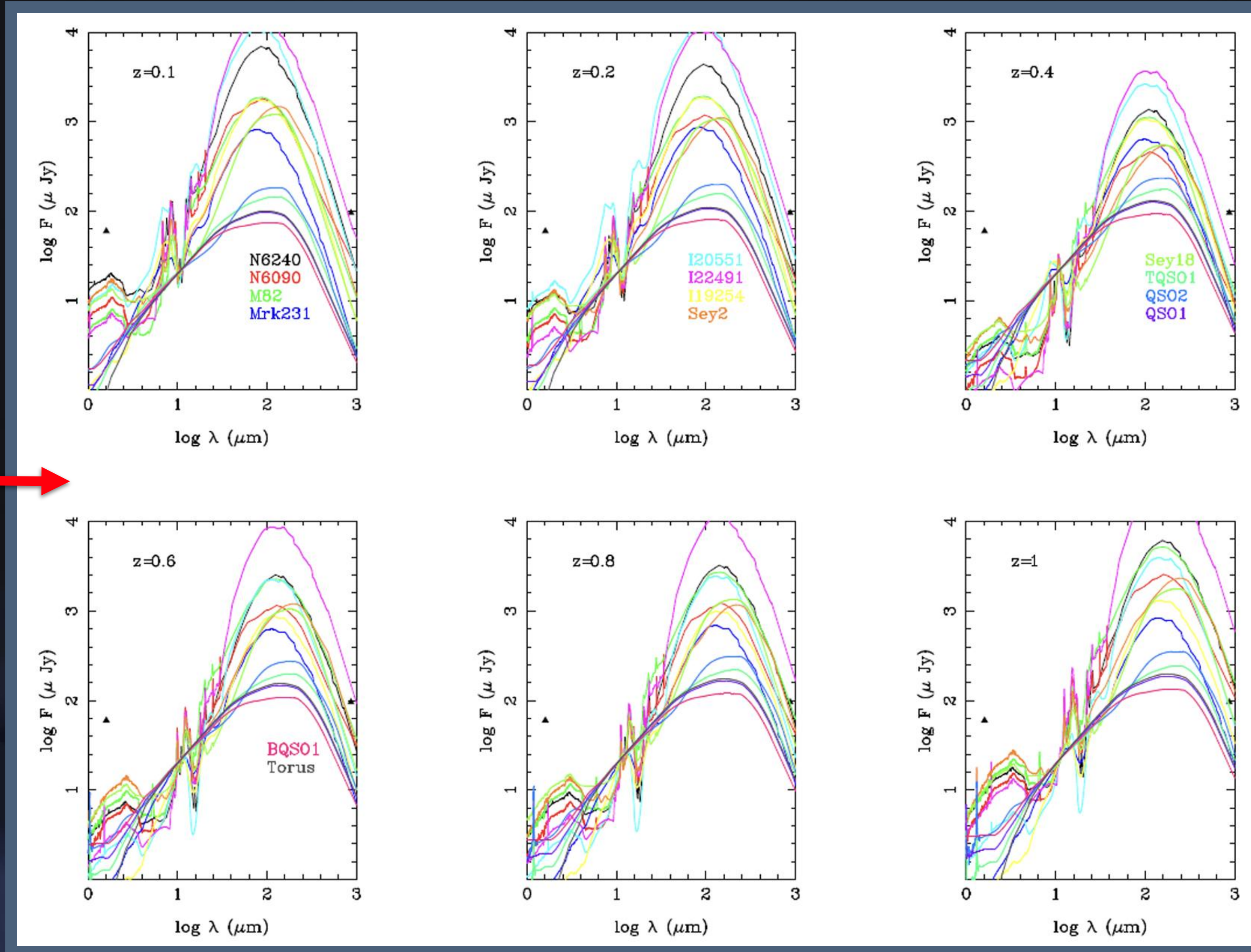


Linder et al. (2019) planet evolutionary models



Planet or Background Galaxy?

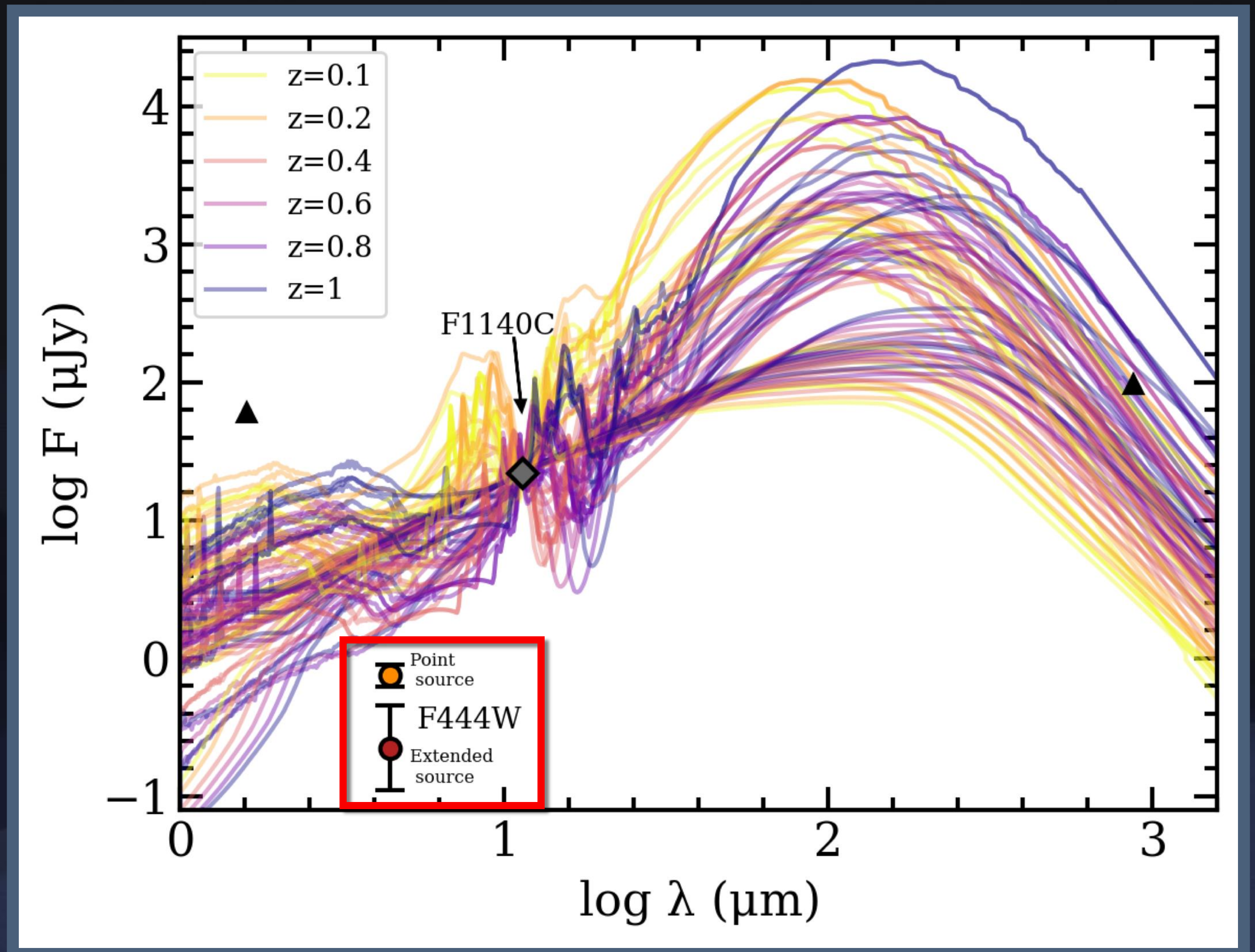
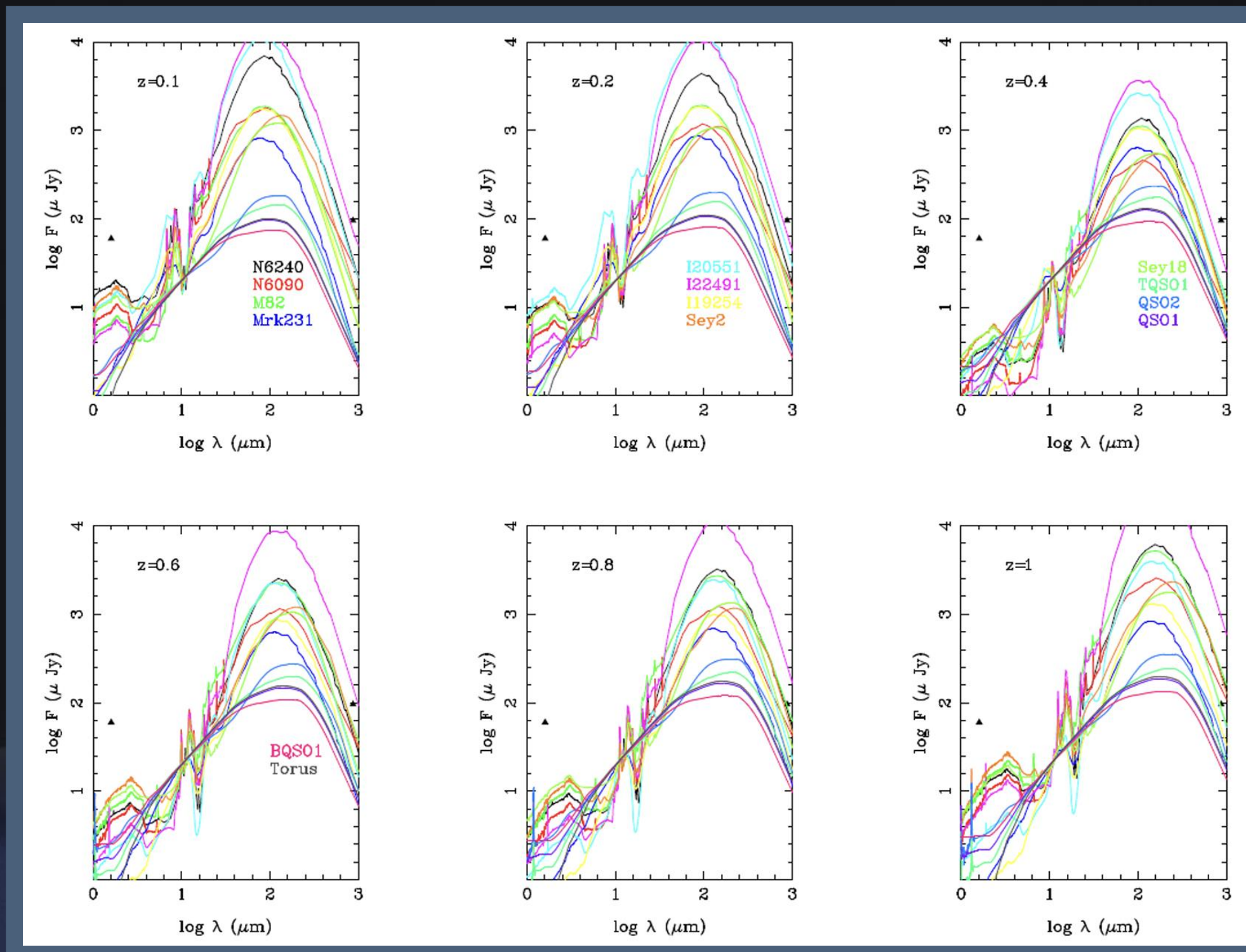
14 Starburst + AGN
Galaxy SEDs of
various low-
intermediate
redshifts



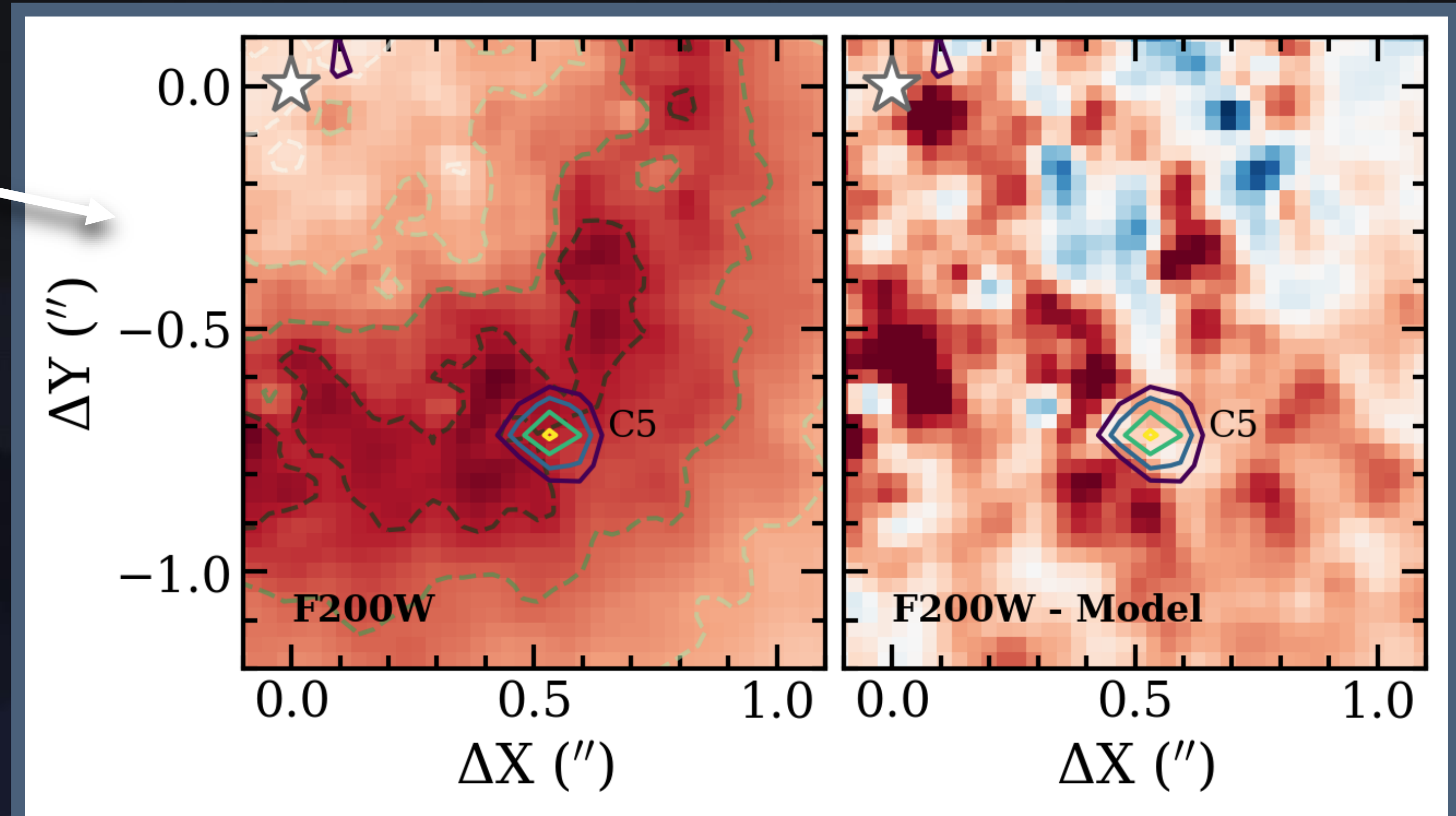
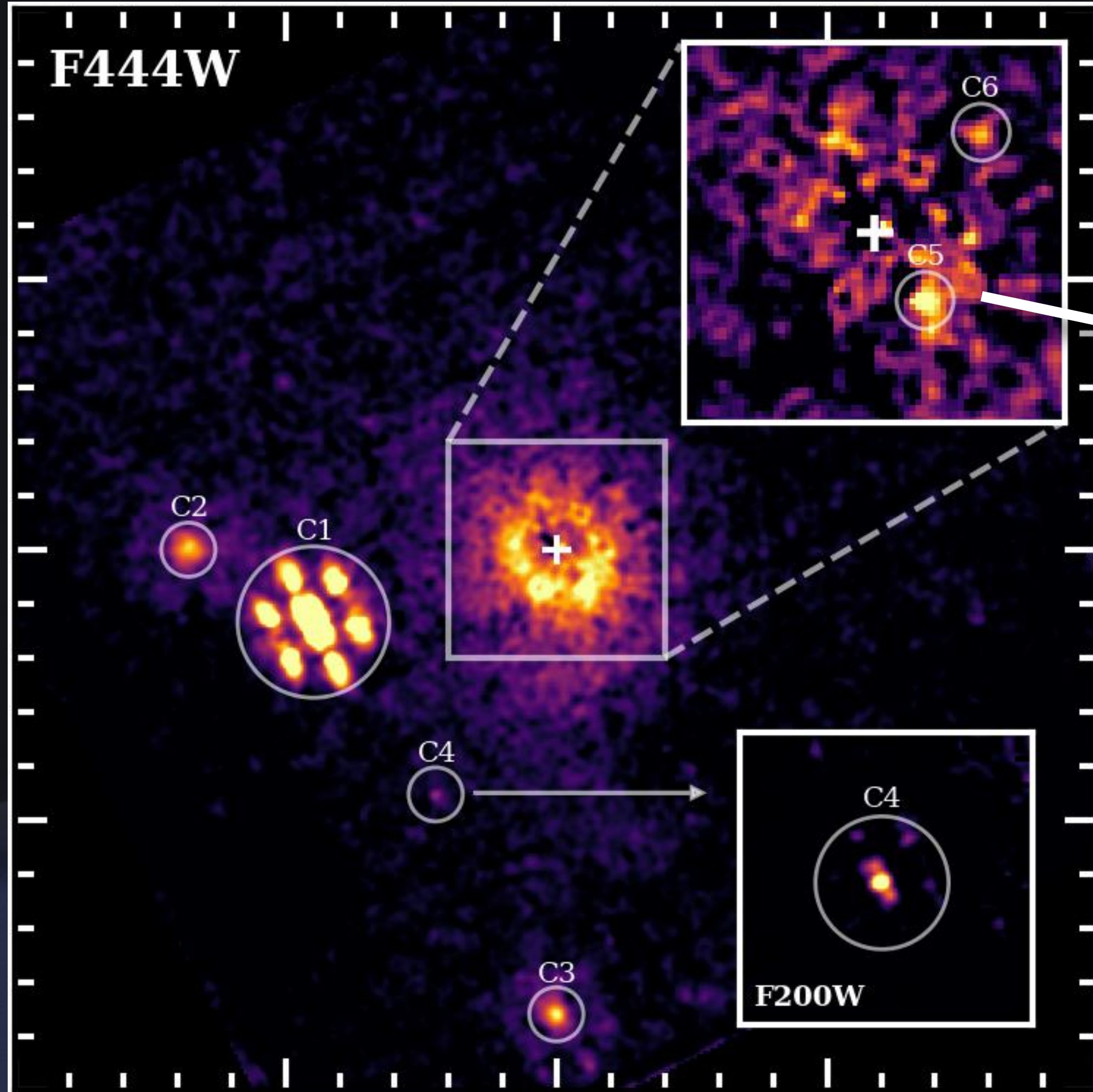
~0.3% chance of being a
background galaxy

Planet or Background Galaxy?

Crotts et al. (2025, submitted)

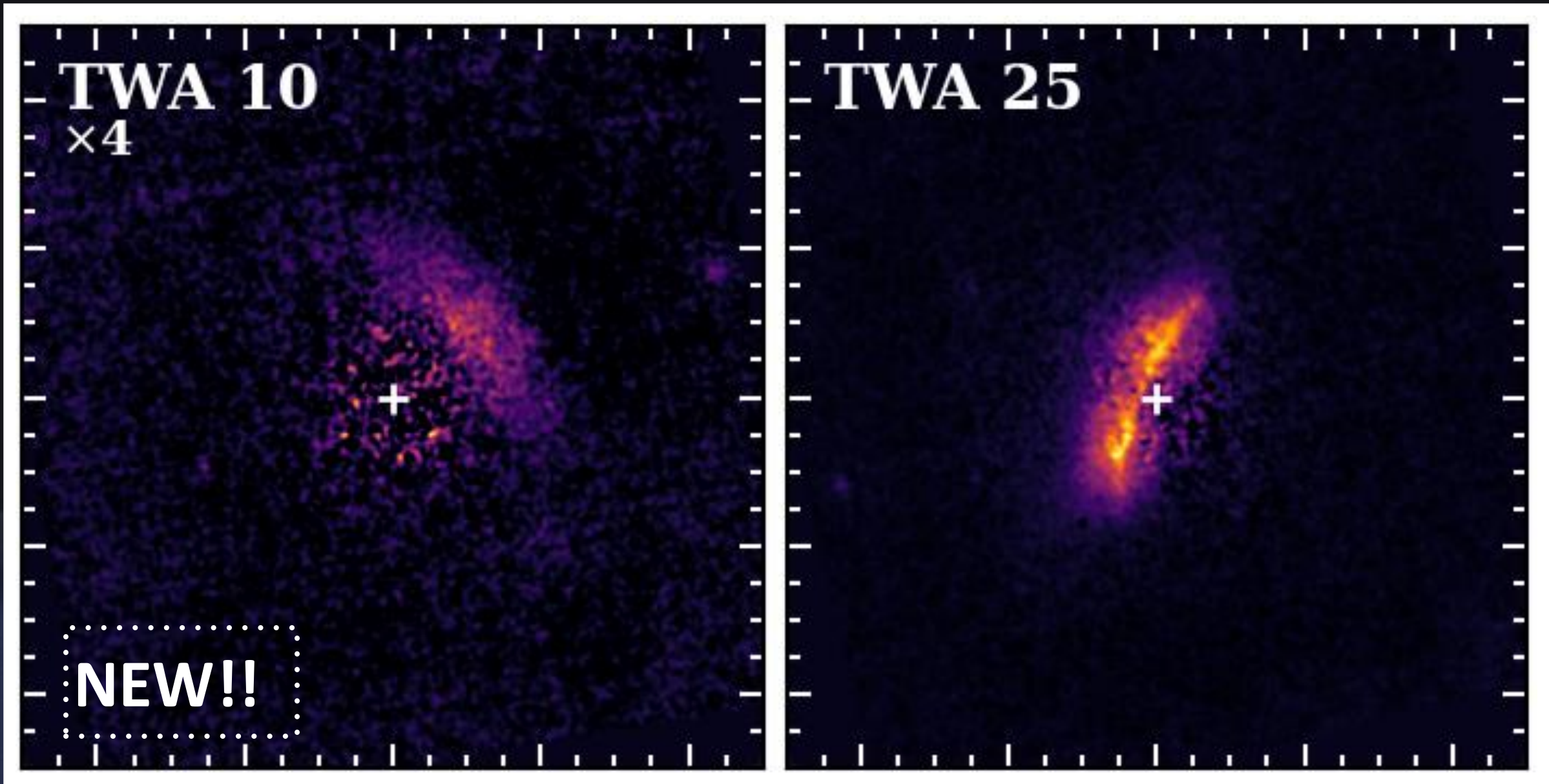


TWA 7c?



What does the future hold for planet-disk science?

More JWST observations!



Upcoming Instruments/Upgrades

