The First Direct Images of an Exoplanet with JWST

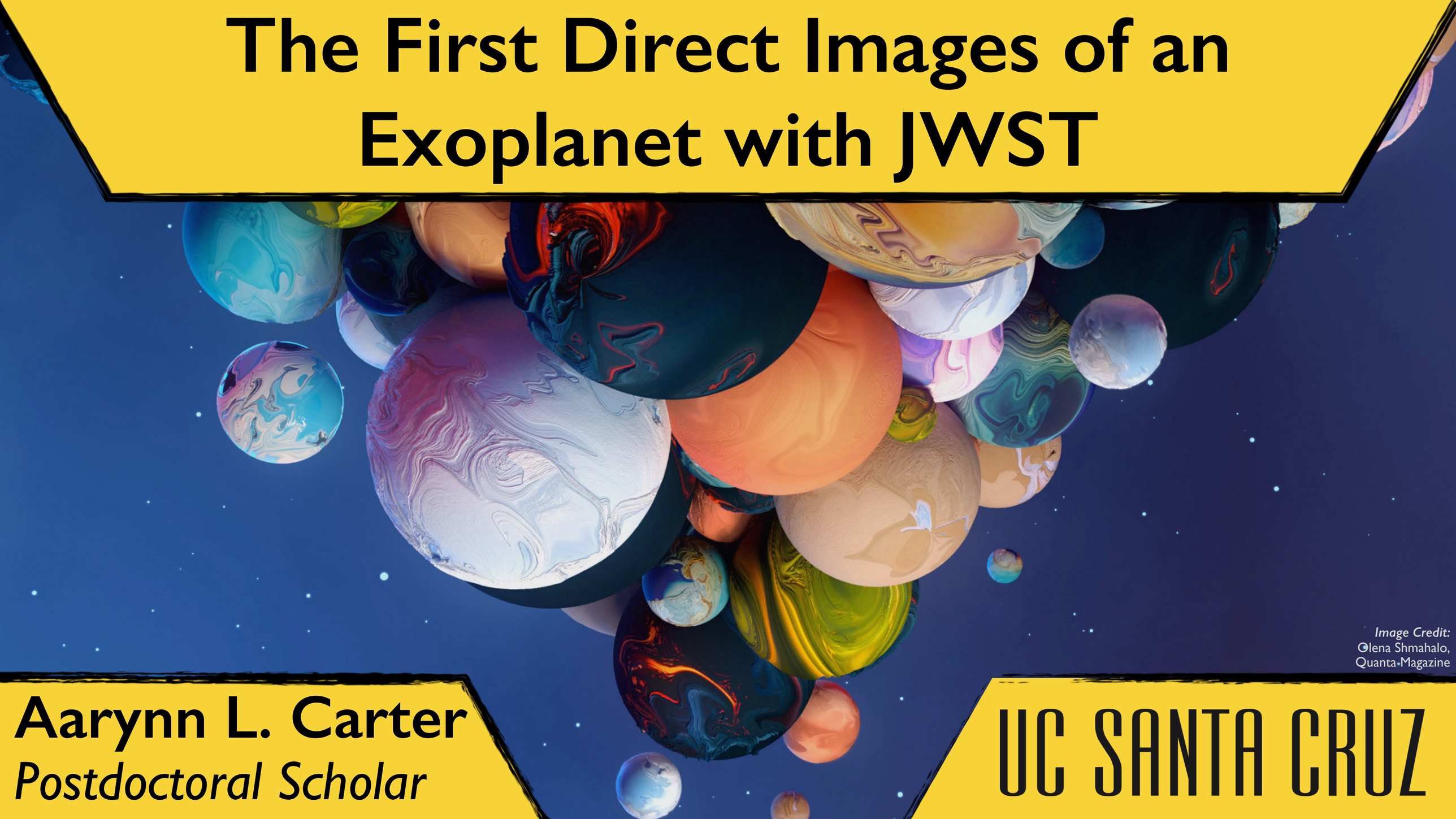

Image Credit:
Olena Shmahalo,
Quanta Magazine

Aarynn L. Carter
Postdoctoral Scholar

UC SANTA CRUZ

The Direct Imaging ERS Program

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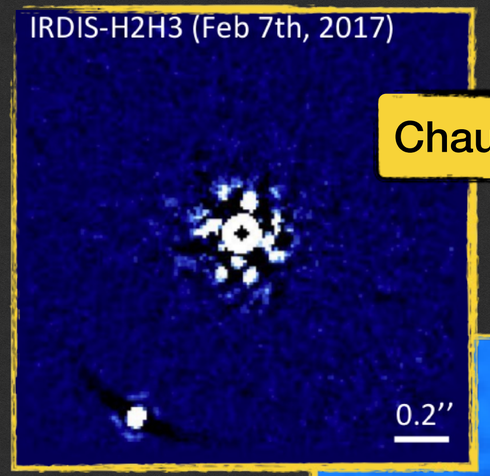
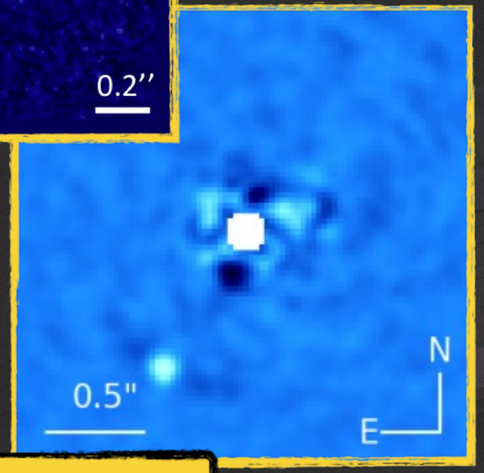
ExoPAG 27
January 7, 2023

HIP 65426 b

~7-9 M_{Jup}, 1300-1600 K



Chauvin et al. 2017

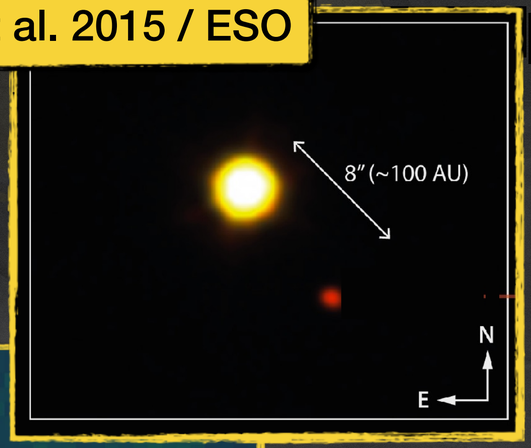


Cheetham et al. 2019

VHS 1256 b

~14-24 M_{Jup}, 1000-1200 K

Gauza et al. 2015 / ESO

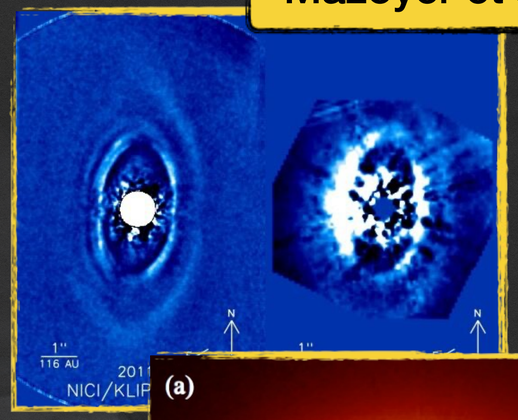


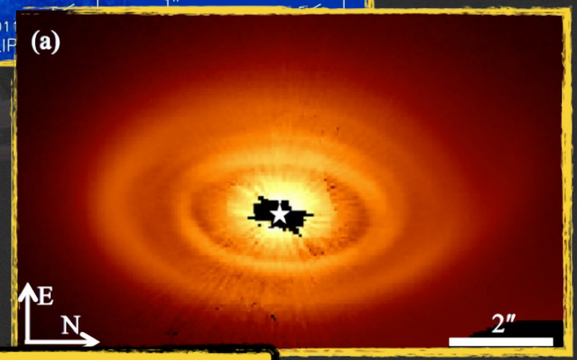
Zhou et al. 2020

HD 141569 A

Triple Ring Disk System

Mazoyer et al. 2016





Konishi et al. 2016

The Direct Imaging ERS Program

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HIP 65426 b

~7-9 M_{Jup}, 1300-1600 K

This Talk!
+
Carter et al.
In Review

Cheetham et al. 2019

VHS 1256 b

~14-24 M_{Jup}, 1000-1200 K

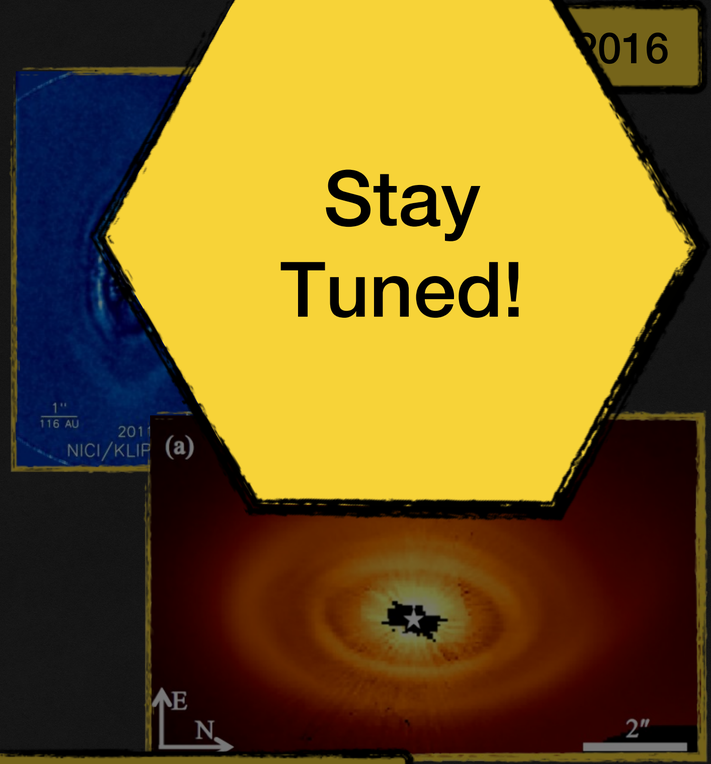
AAS-345.03
+
Miles et al.
2022

Zhou et al. 2020

HD 141569 A

Triple Ring Disk System

Stay
Tuned!



Konishi et al. 2016

The Spectrum of HIP 65426 Before JWST

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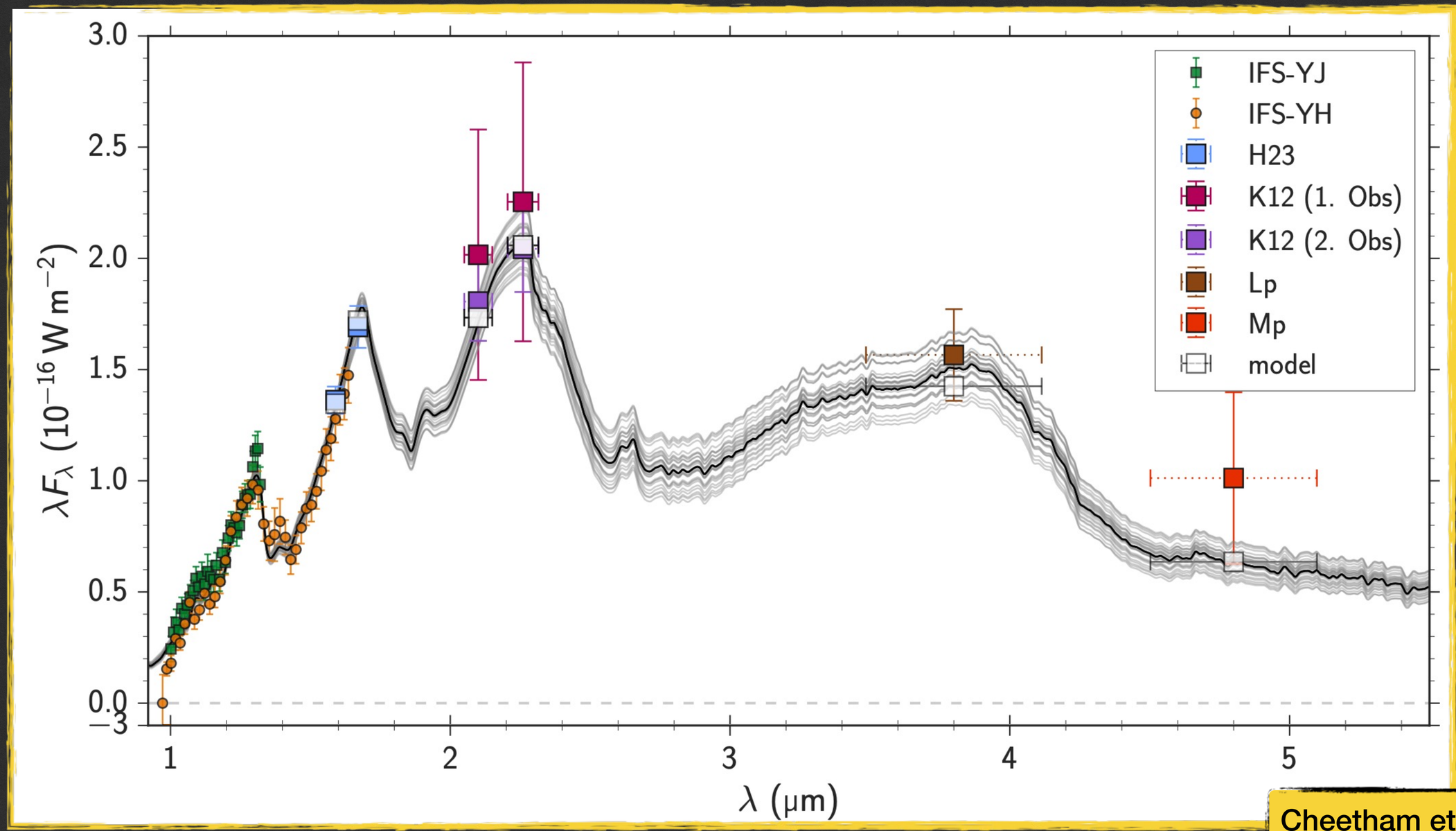

Cheetham et al. 2019

JWST Has Unprecedented Infrared Sensitivity

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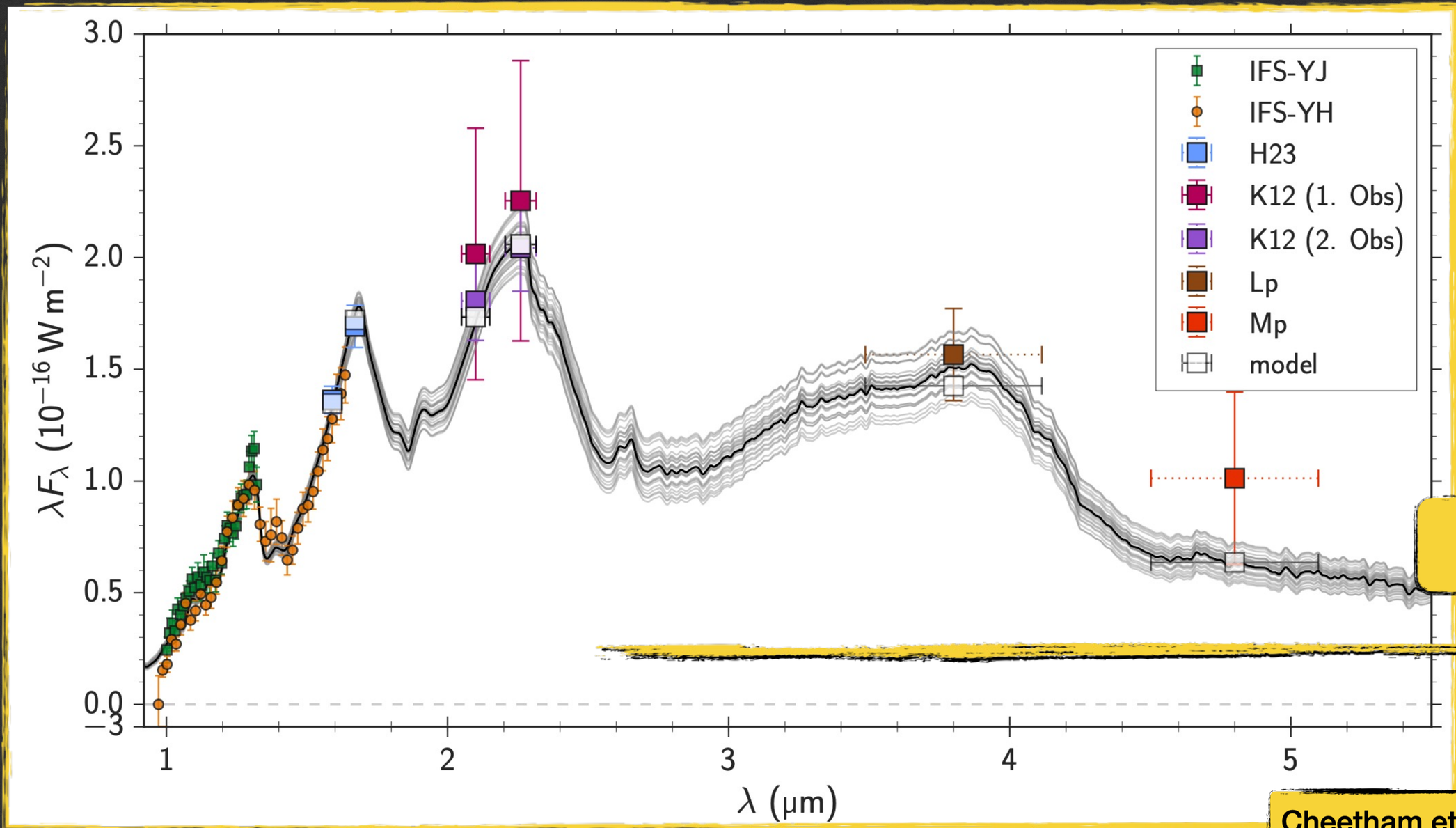

JWST

Cheetham et al. 2019

Coronagraphy is Used to Reveal Exoplanets

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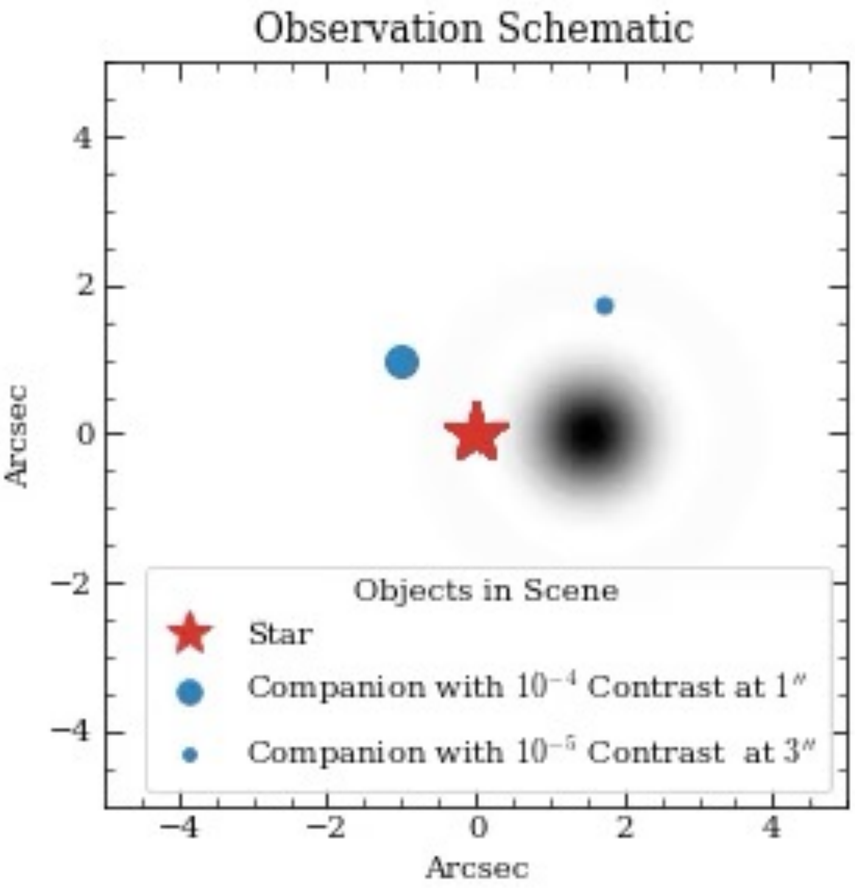

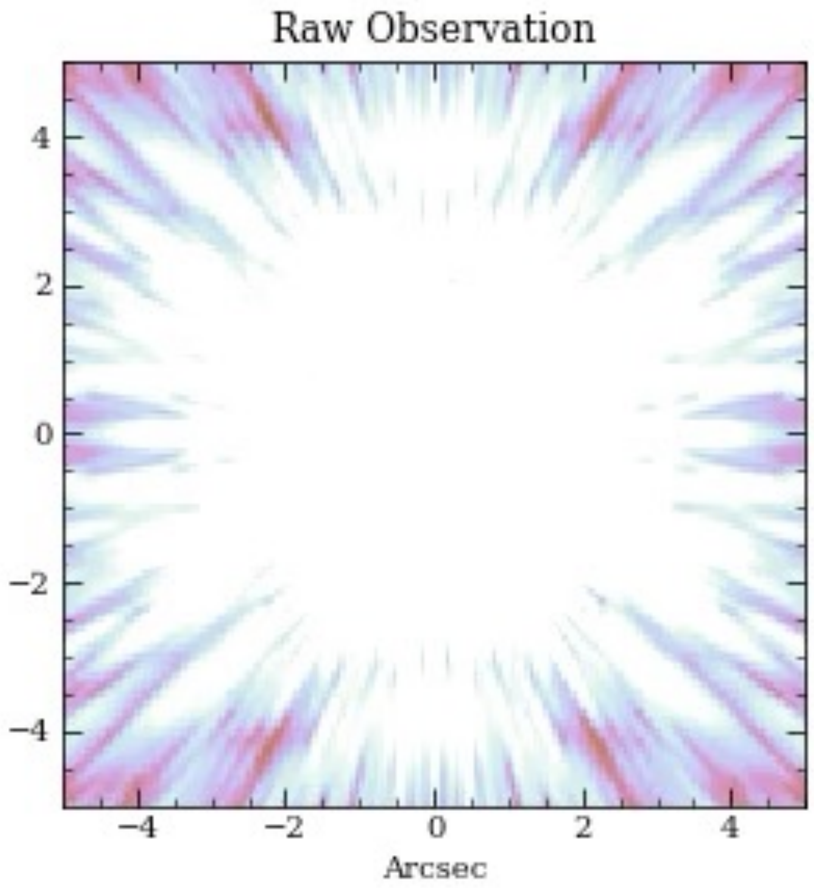

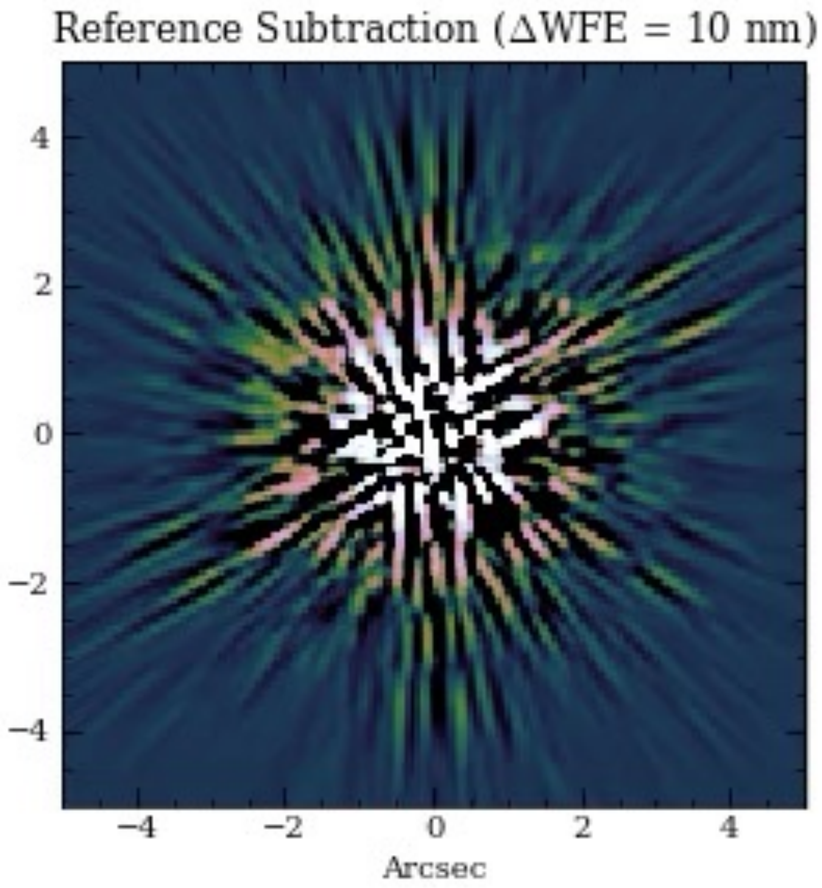

Jarron Leisenring

Coronagraphy is Used to Reveal Exoplanets

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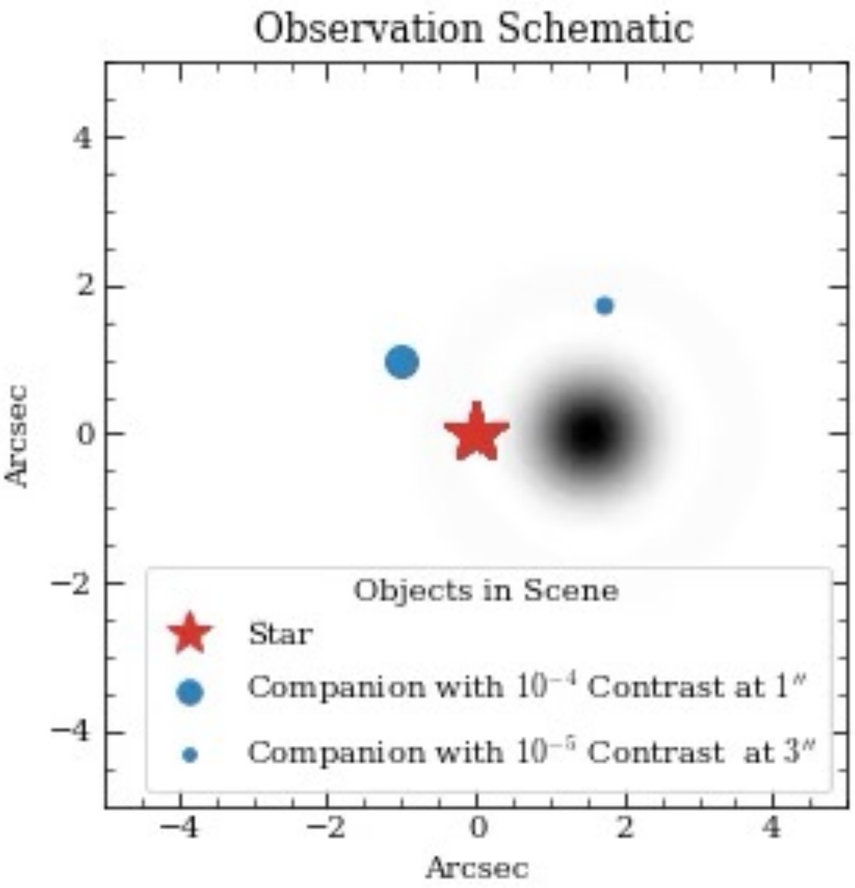

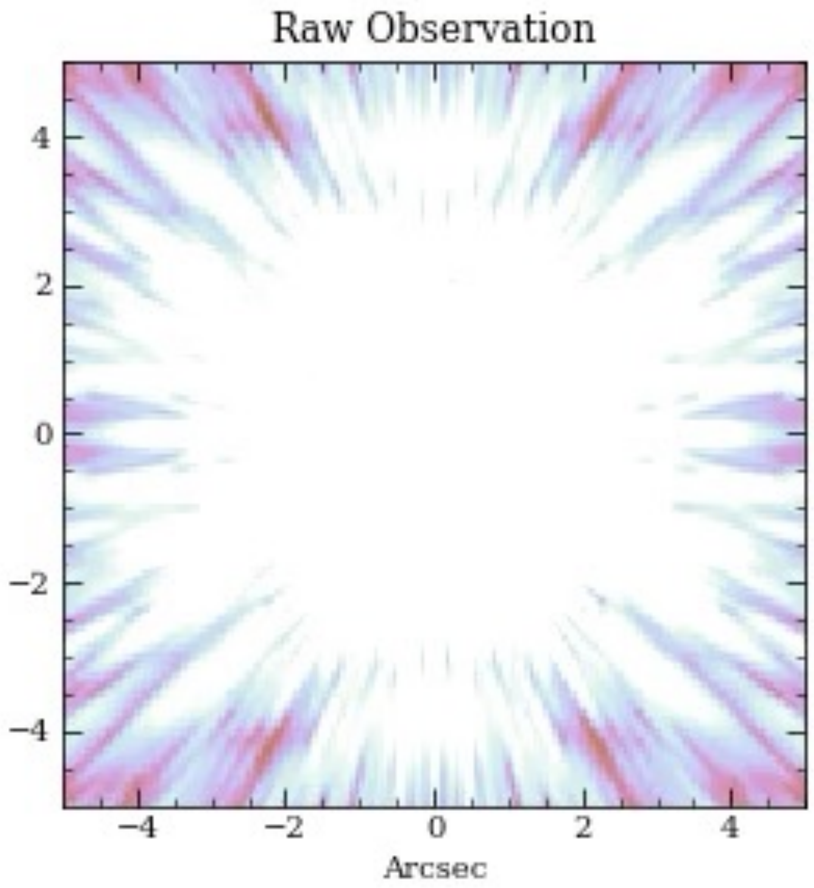

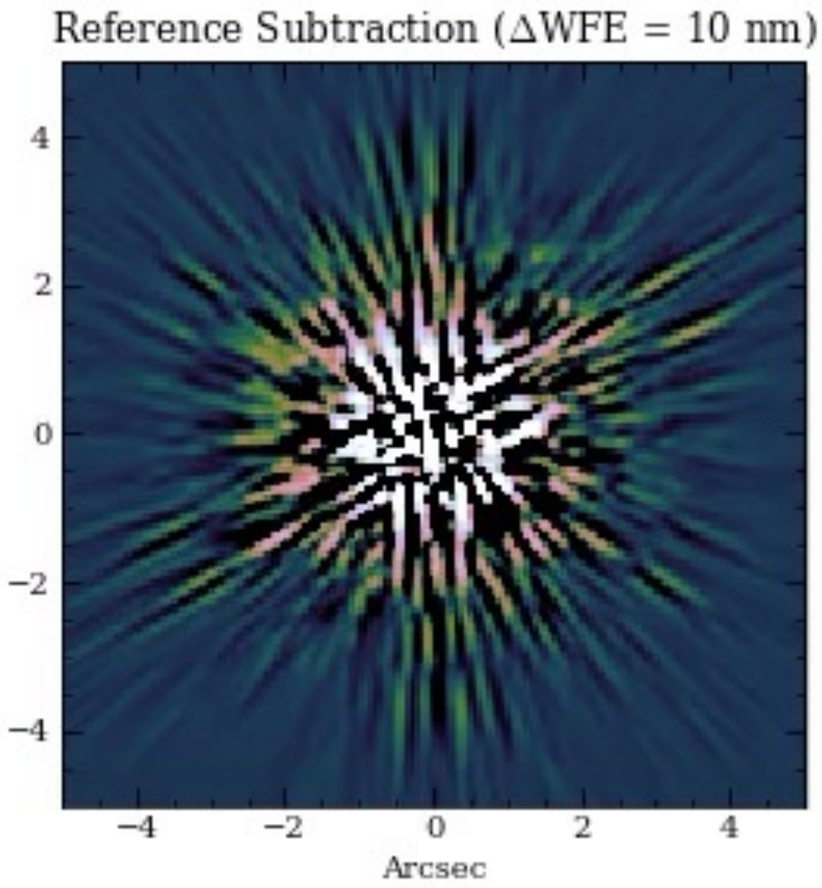

Jarron Leisenring

Coronagraphy is Used to Reveal Exoplanets

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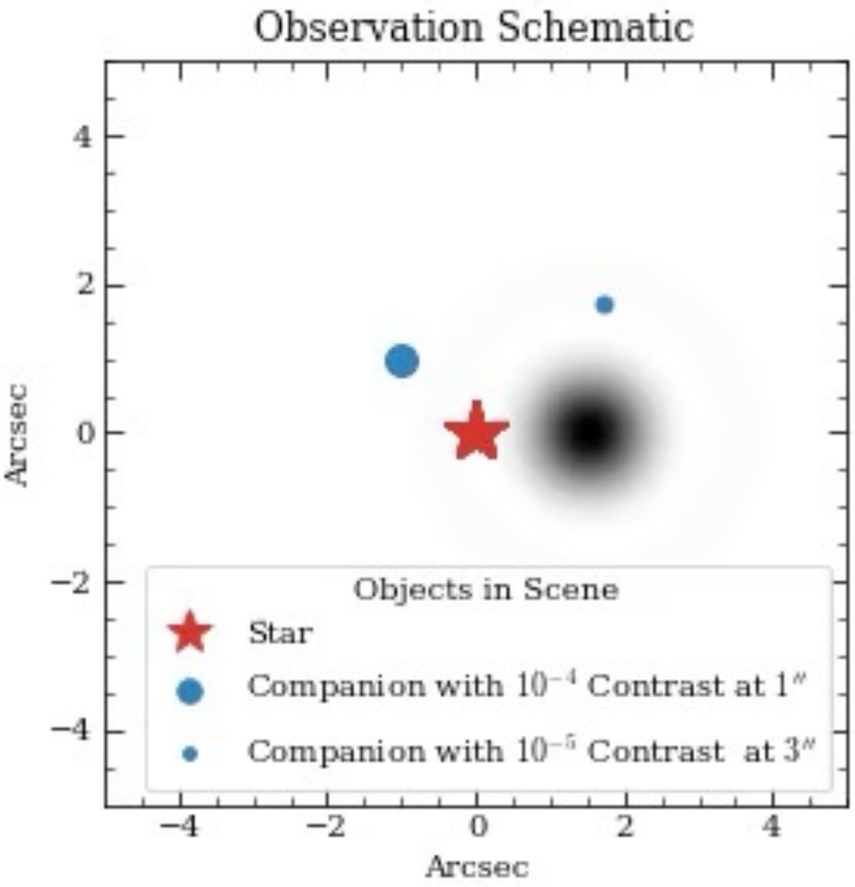

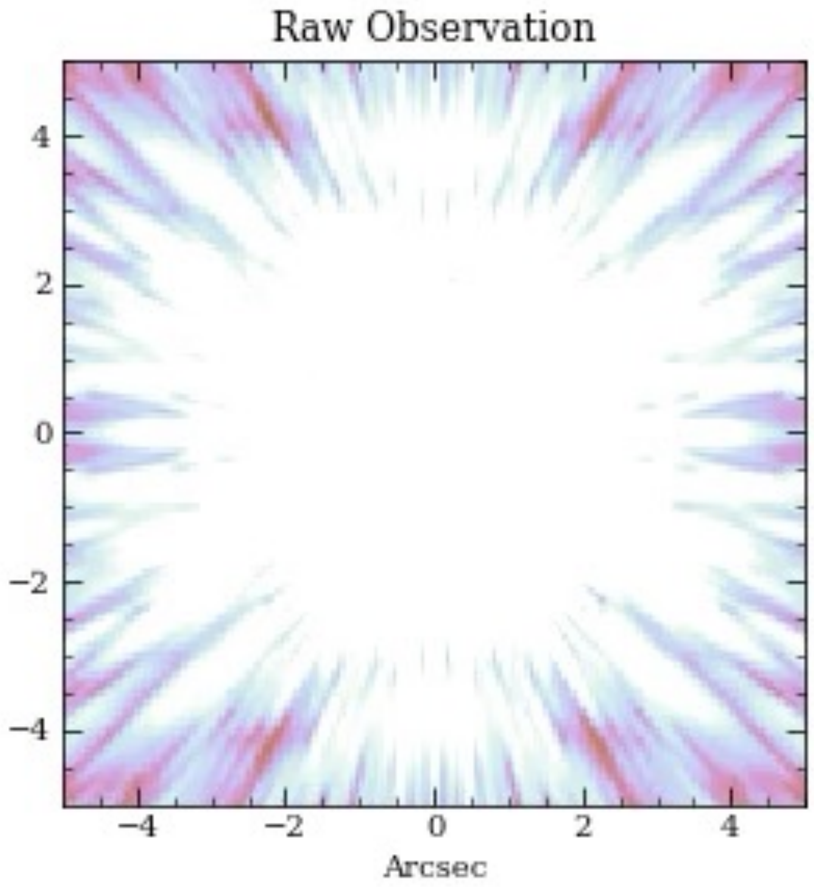

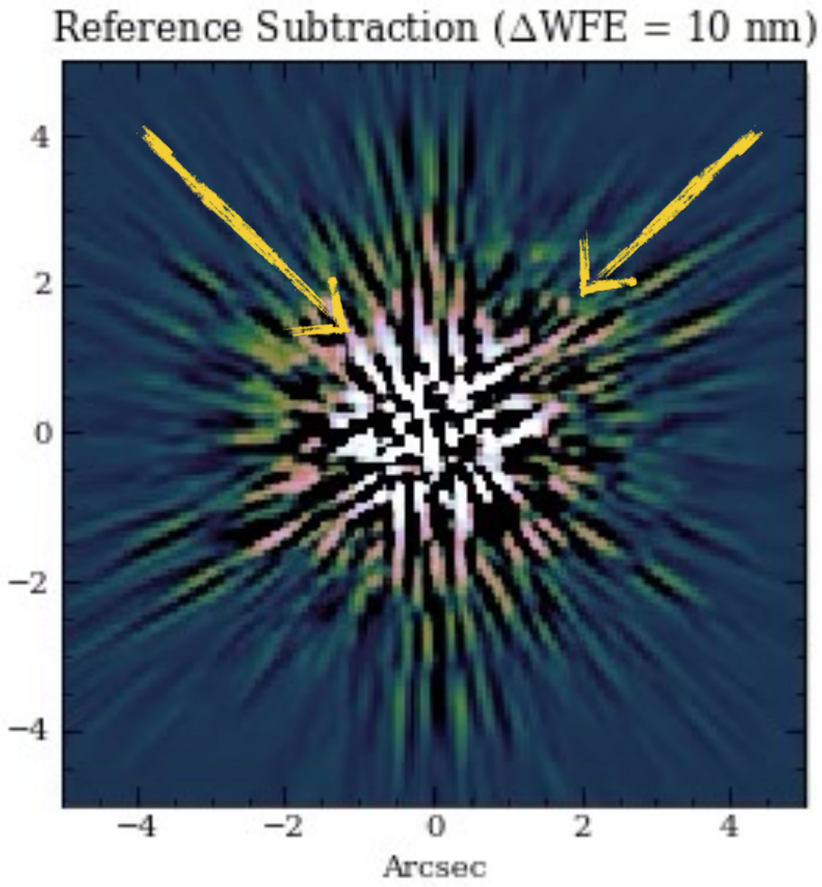

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Residual Stellar Light Needs to be Subtracted

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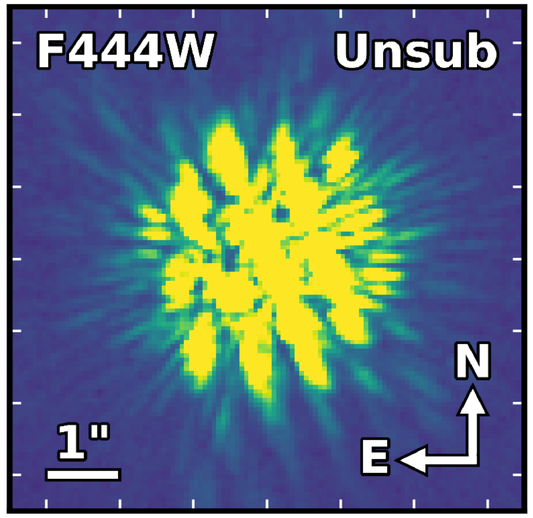

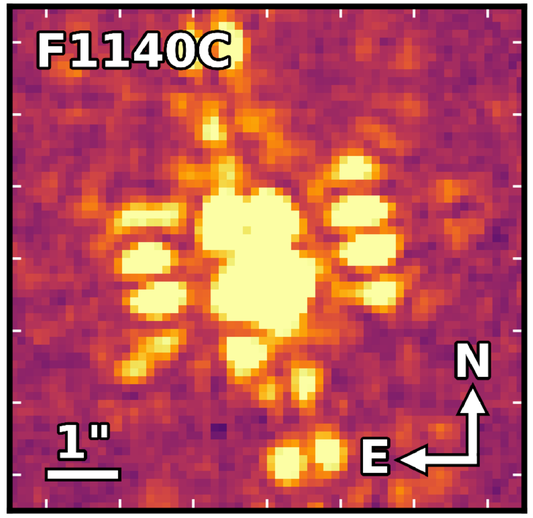

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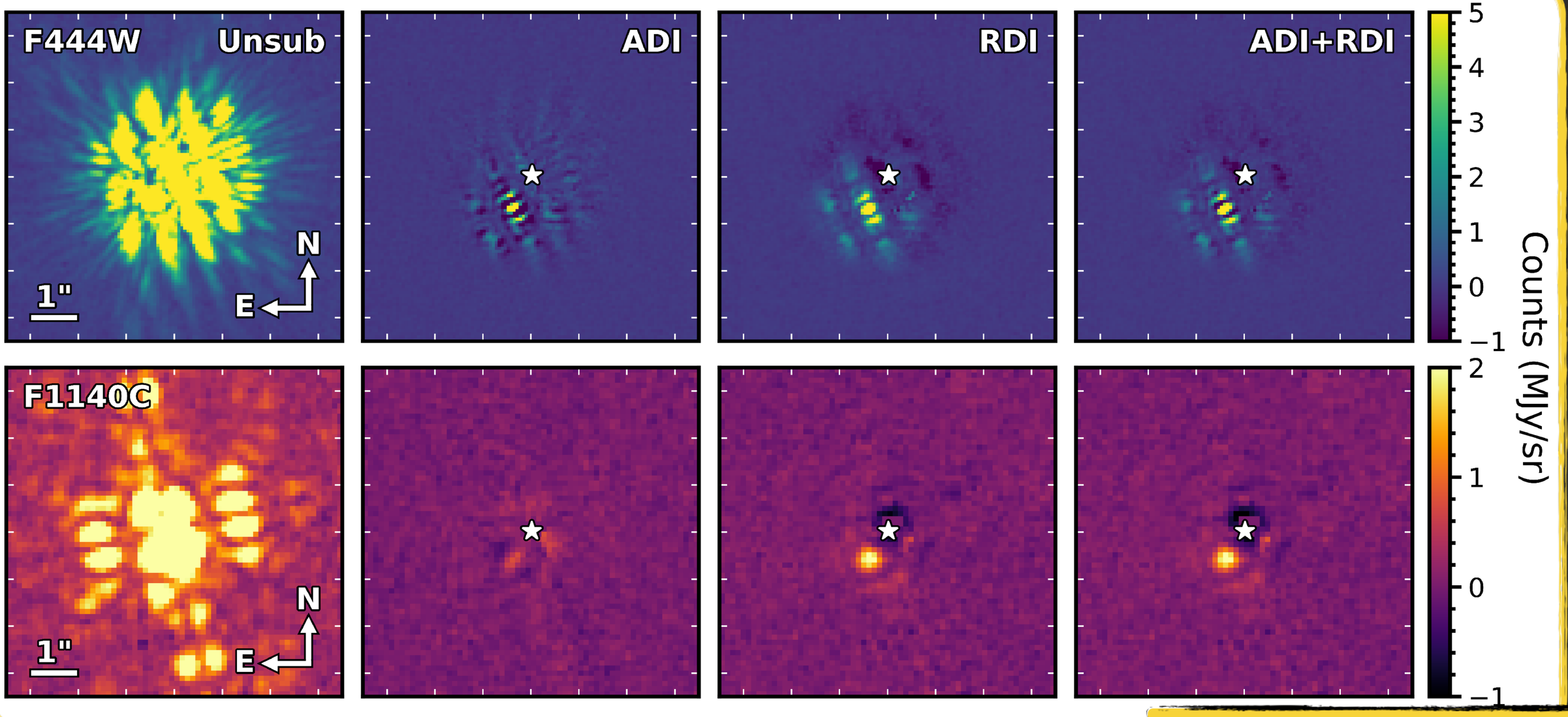

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Spatial Structure is NOT Astrophysical

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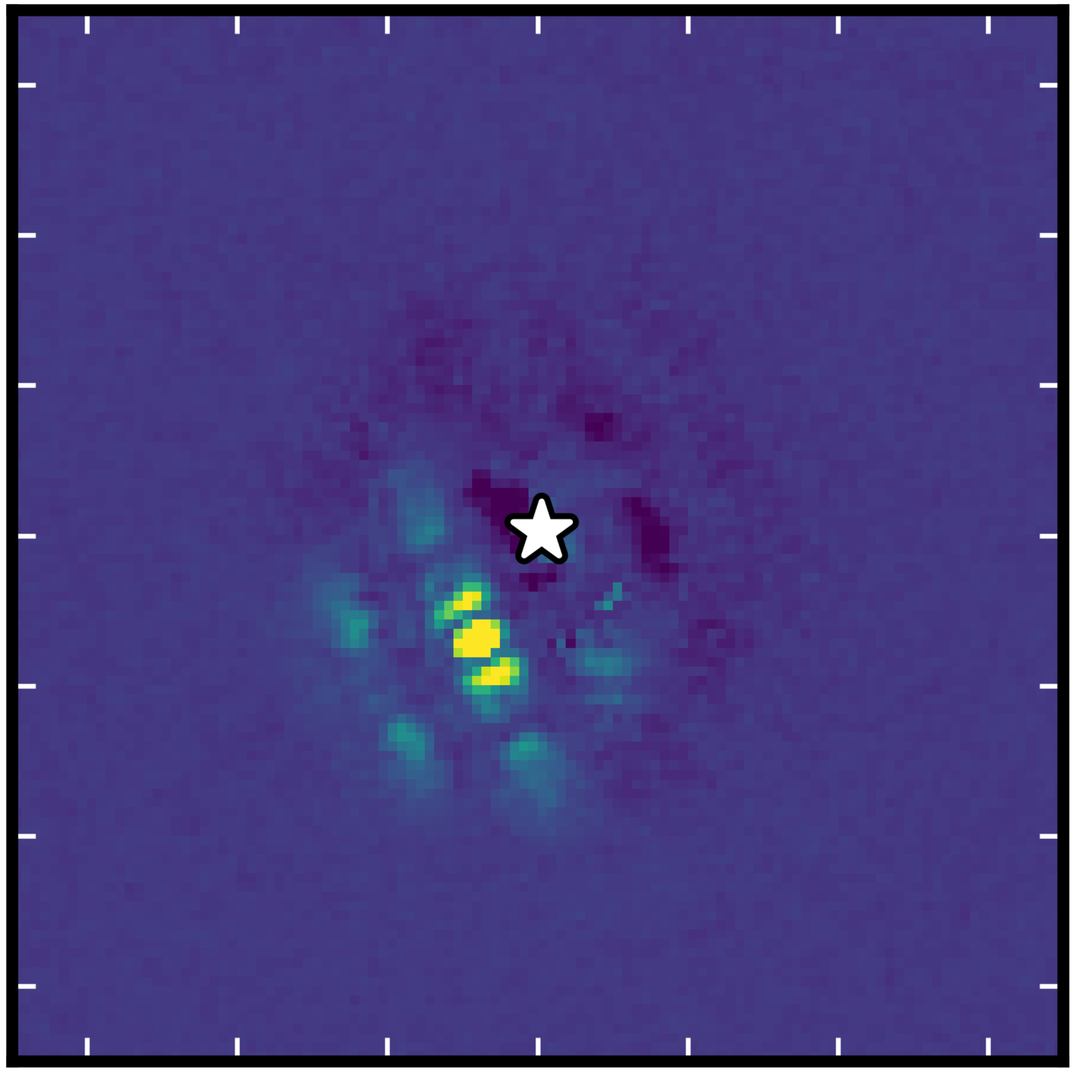

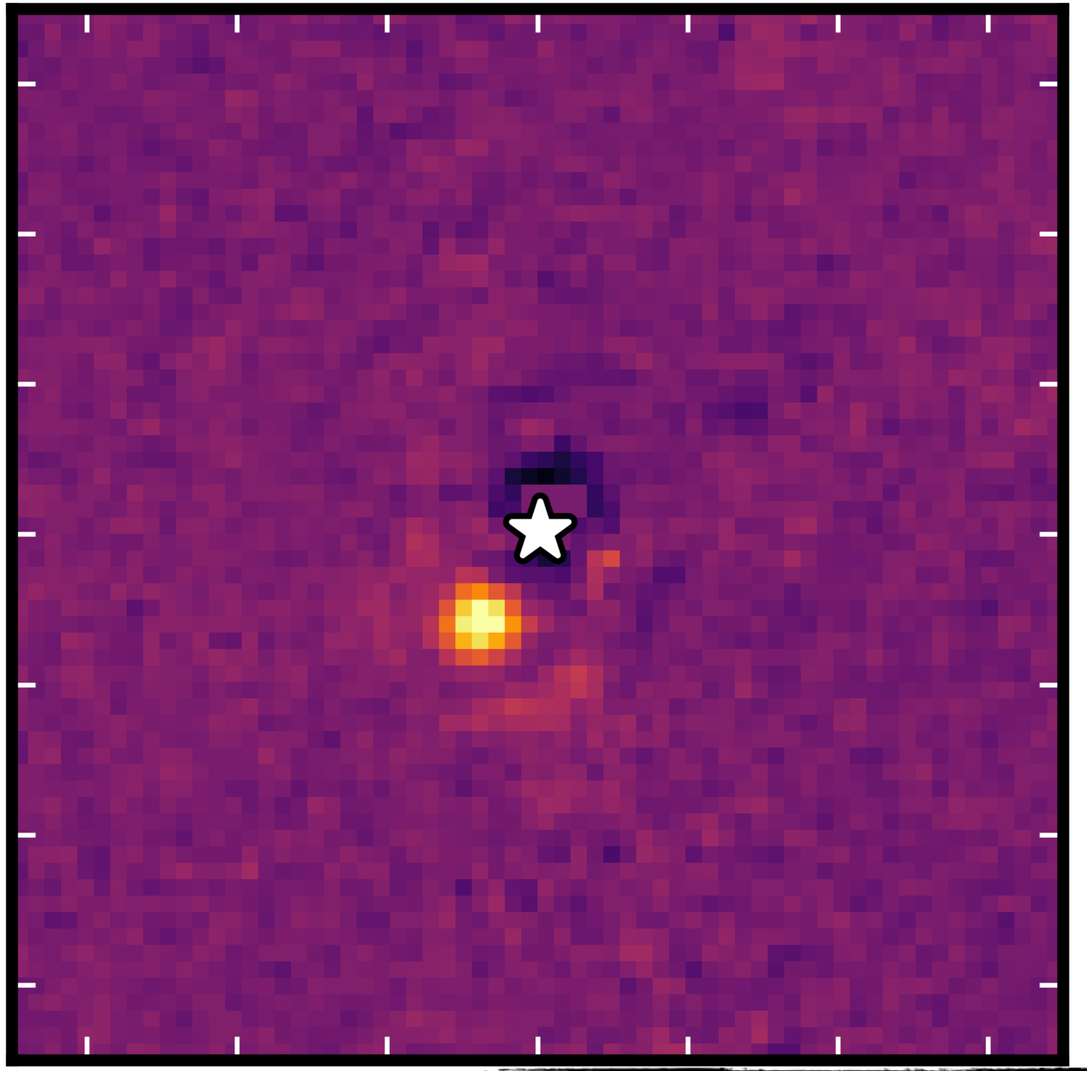

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Contrast Curves Describe Sensitivity with Separation

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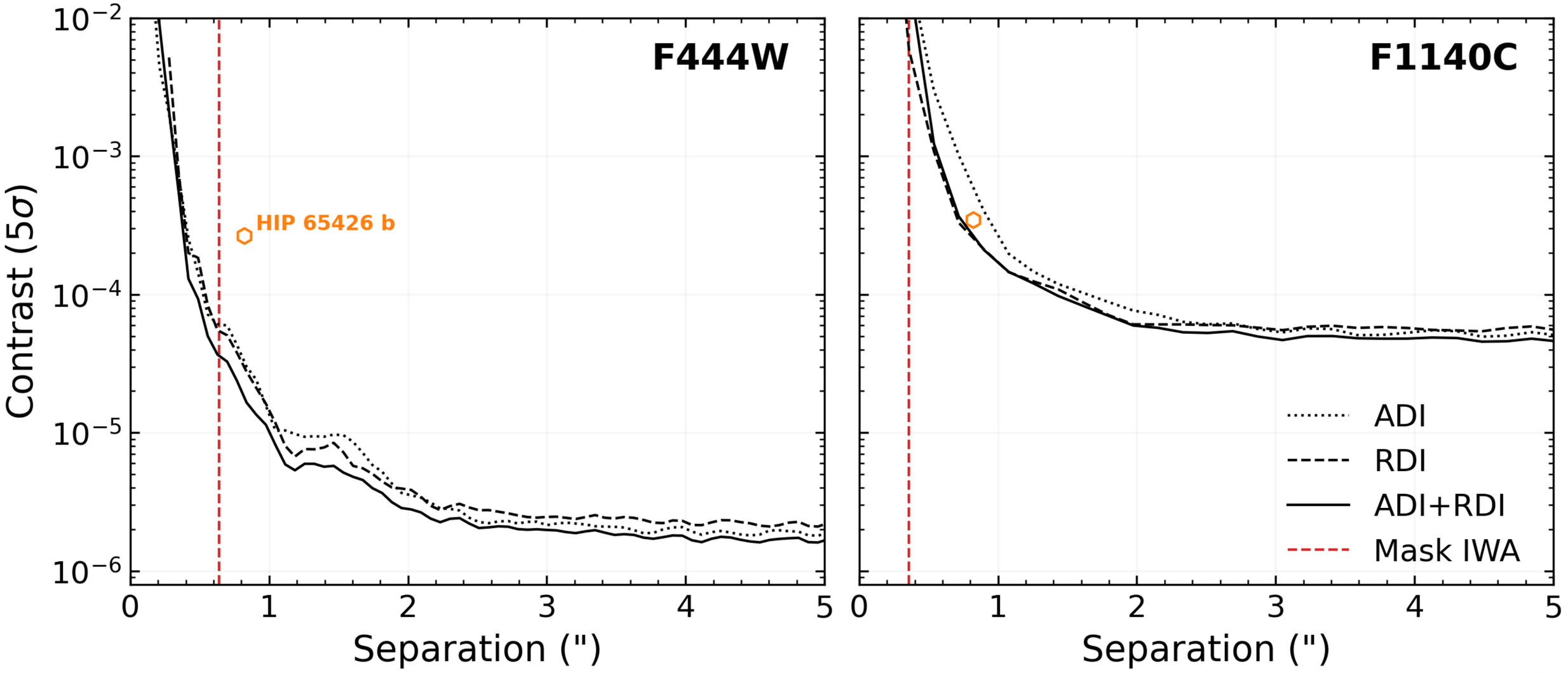

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JWST Coronagraphy is Exceeding Expectations

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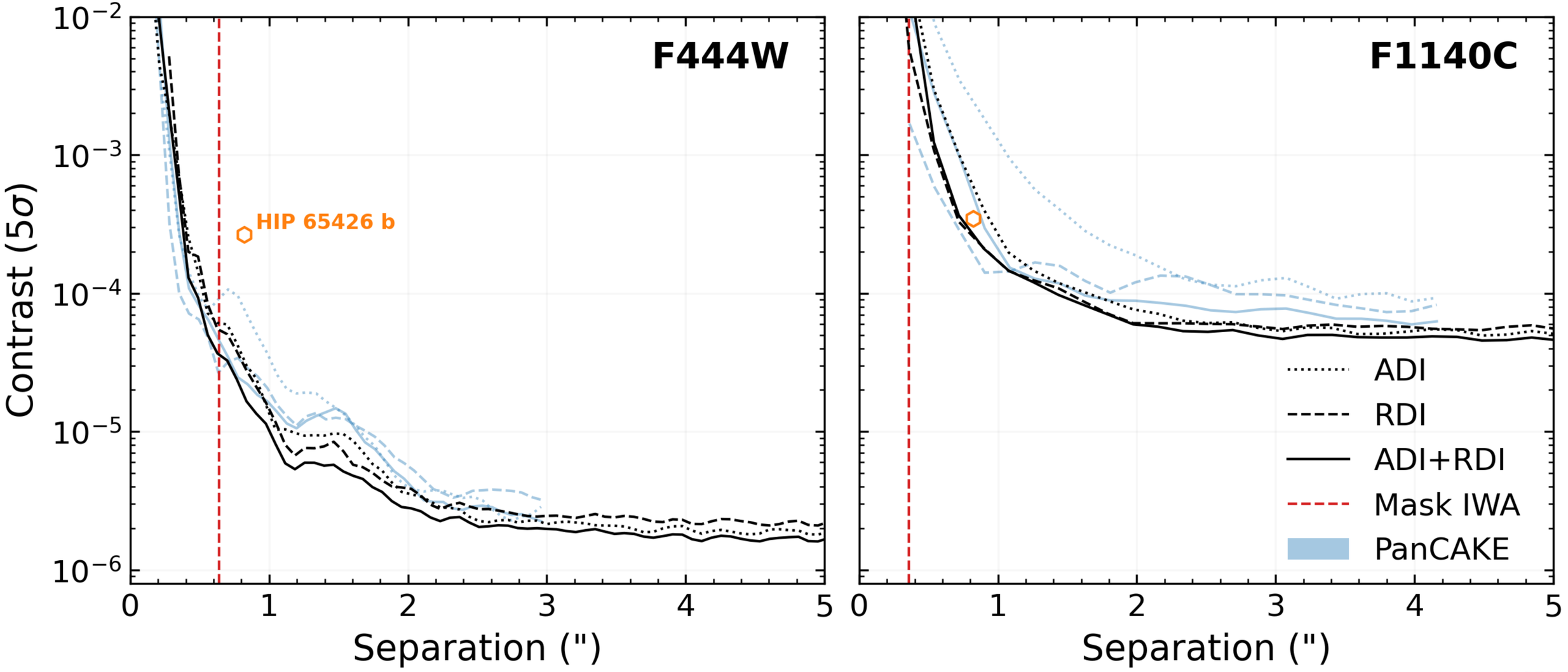

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Sensitivity to sub-Jupiter Mass Companions

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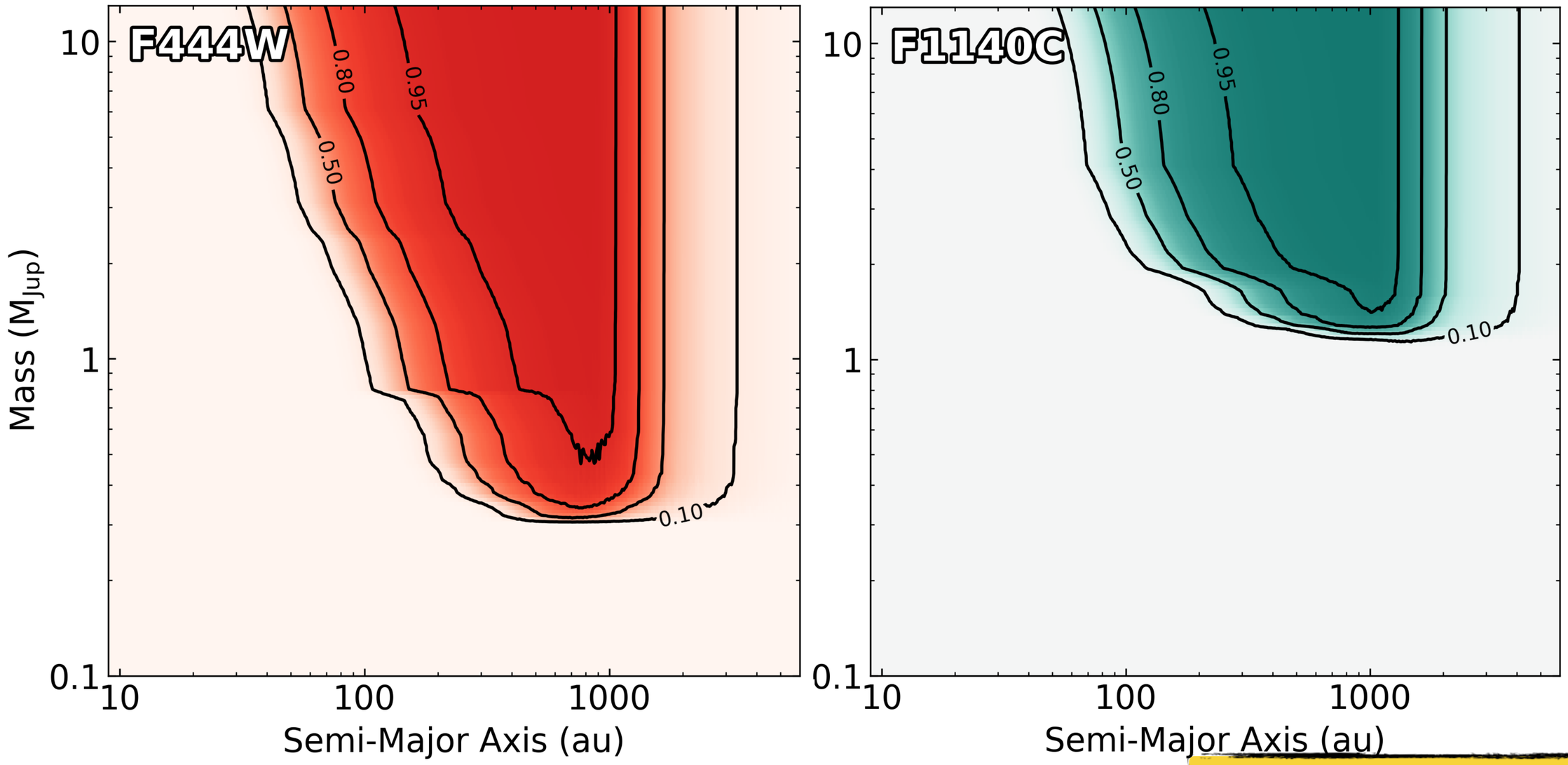

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HIP 65426b Detected from 2-16 µm

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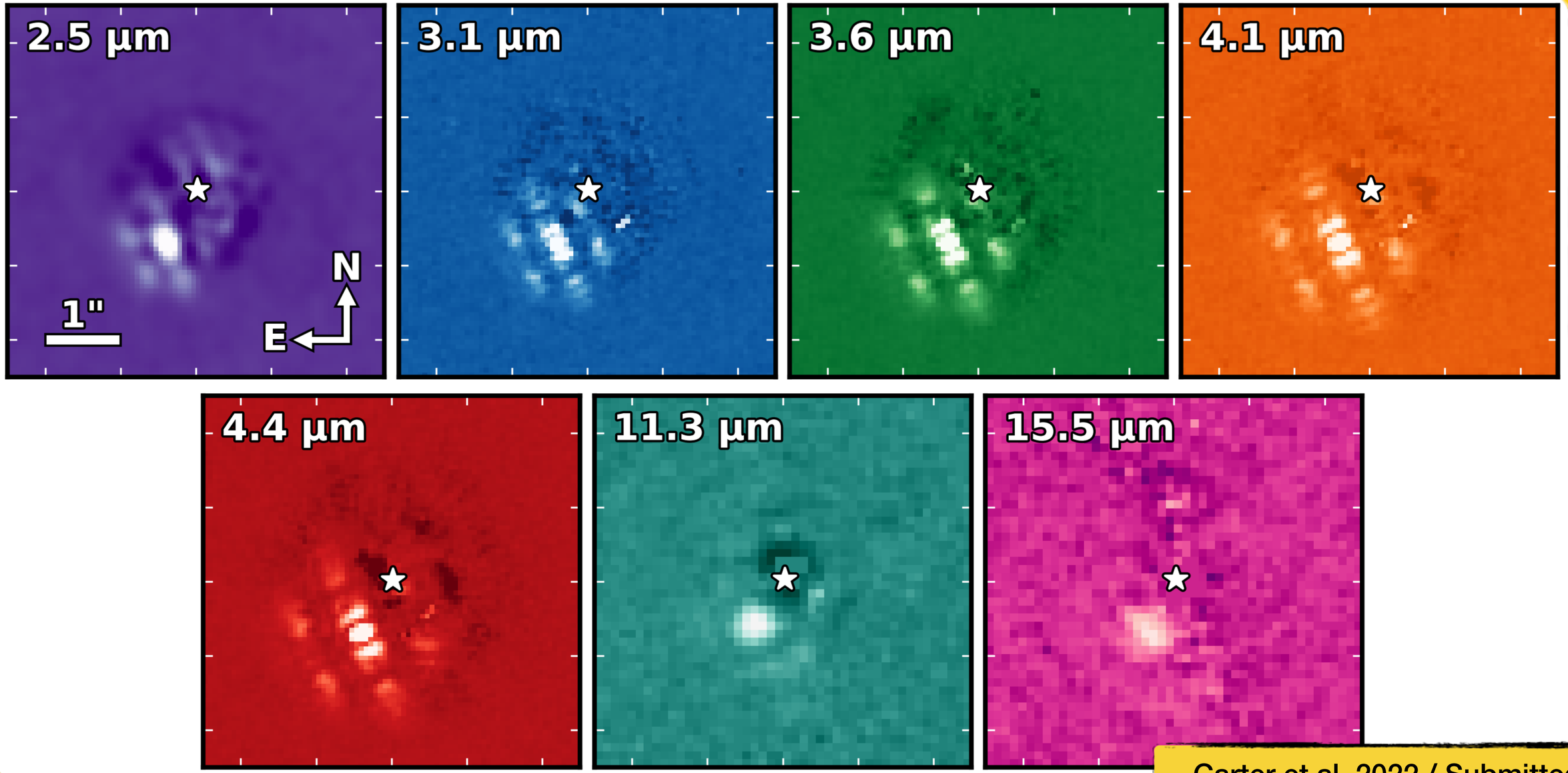

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Precise Measurements Across Full Spectrum

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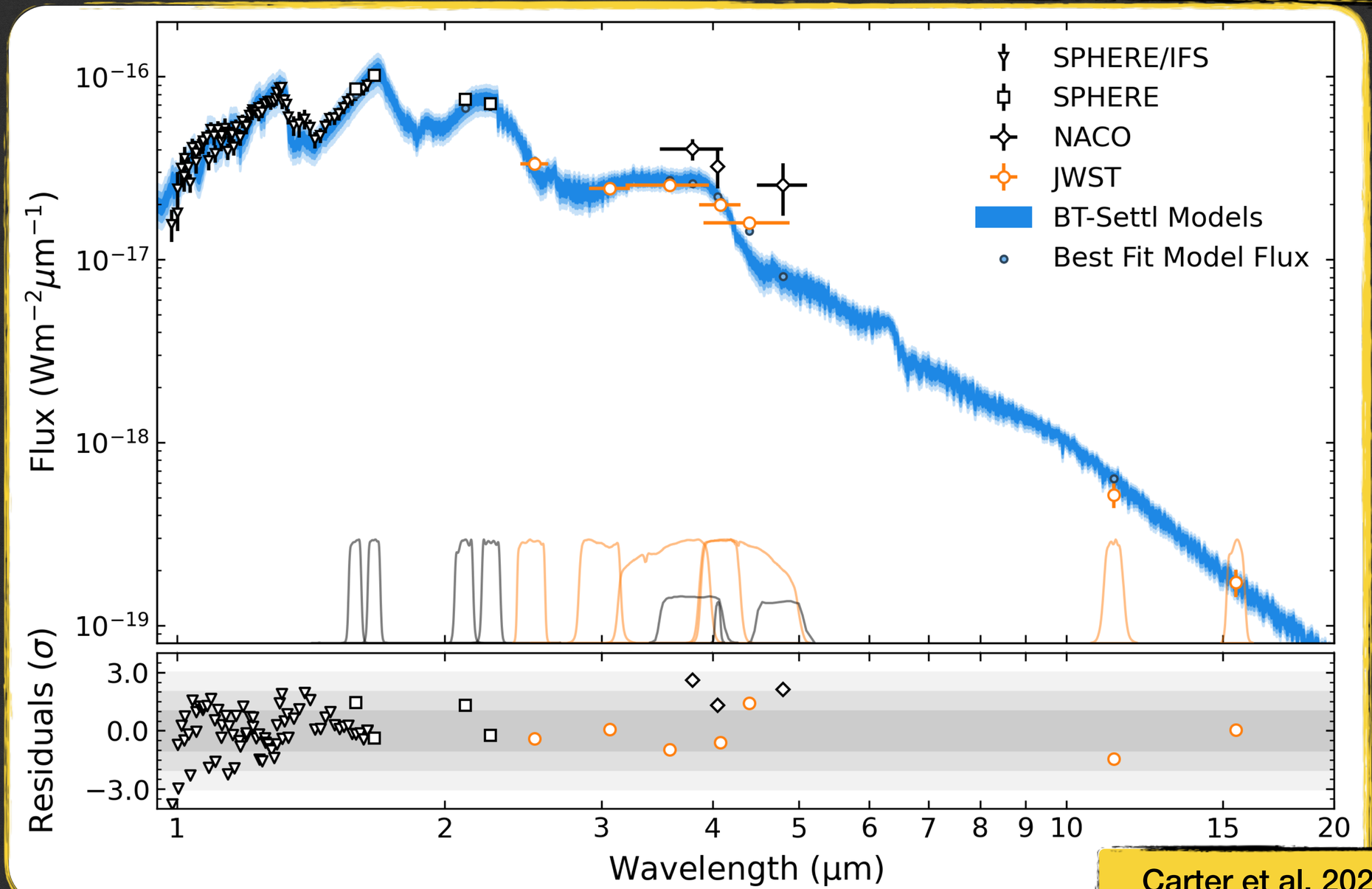

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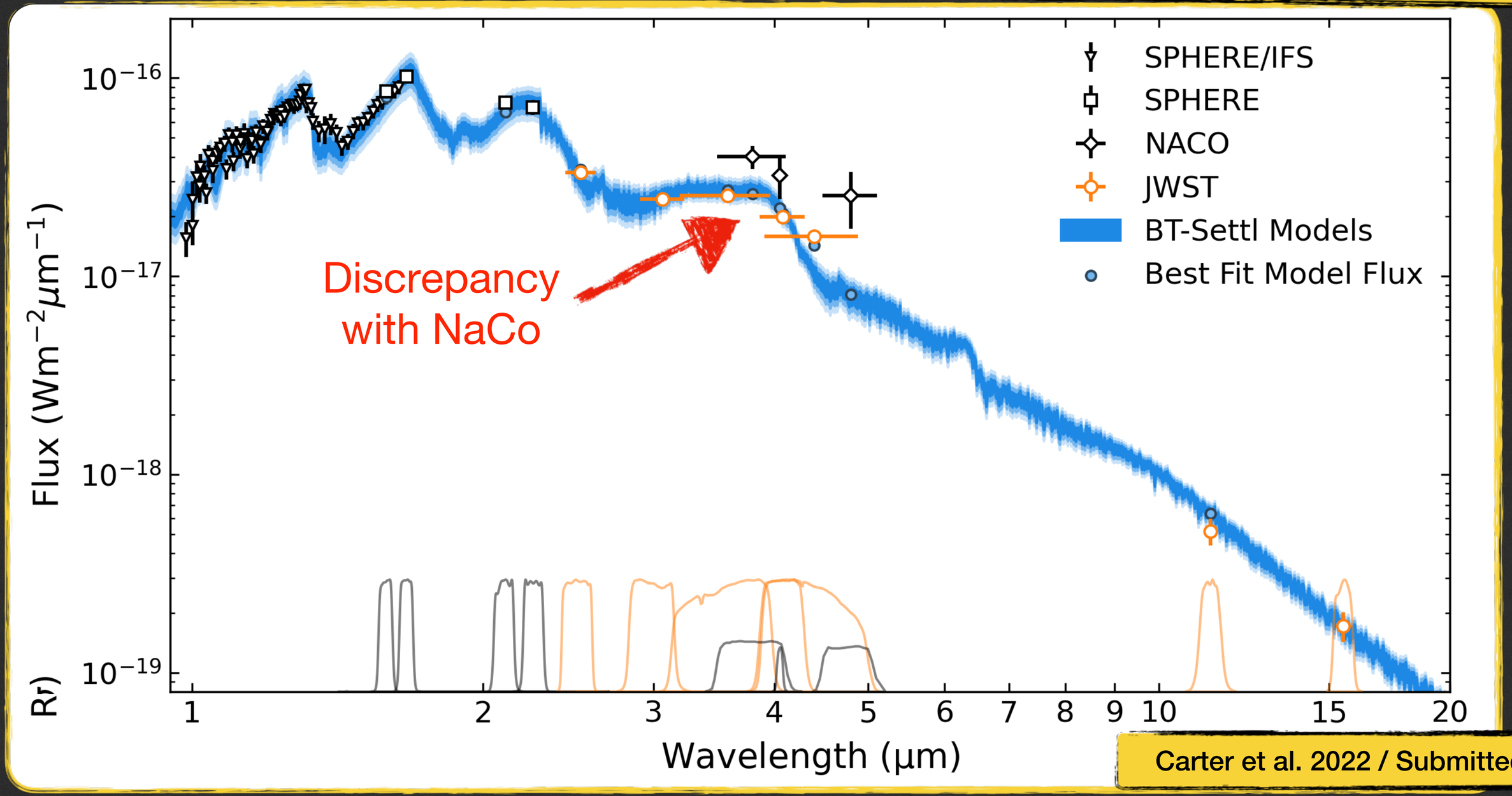

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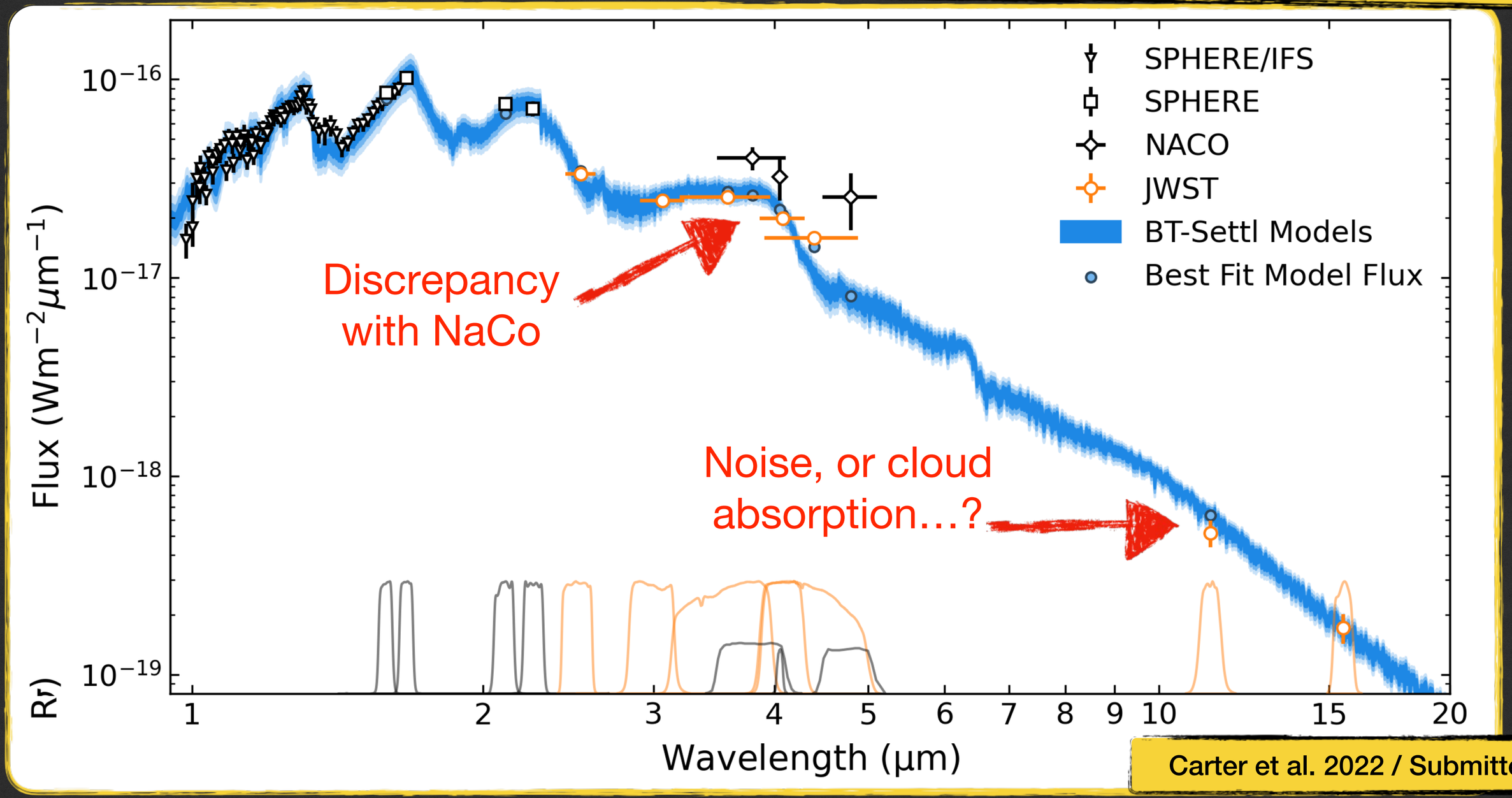

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Evolutionary Models Inform Bulk Planetary Properties

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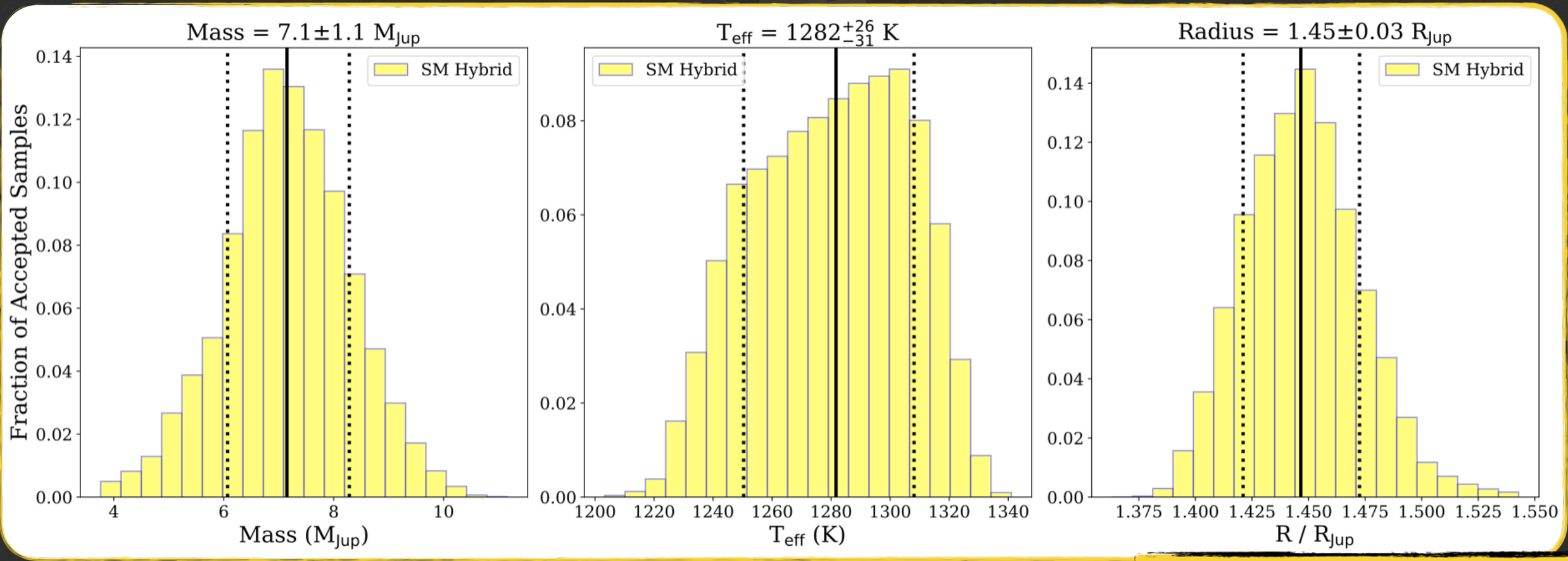

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Atmospheric Model Properties Don’t Match!

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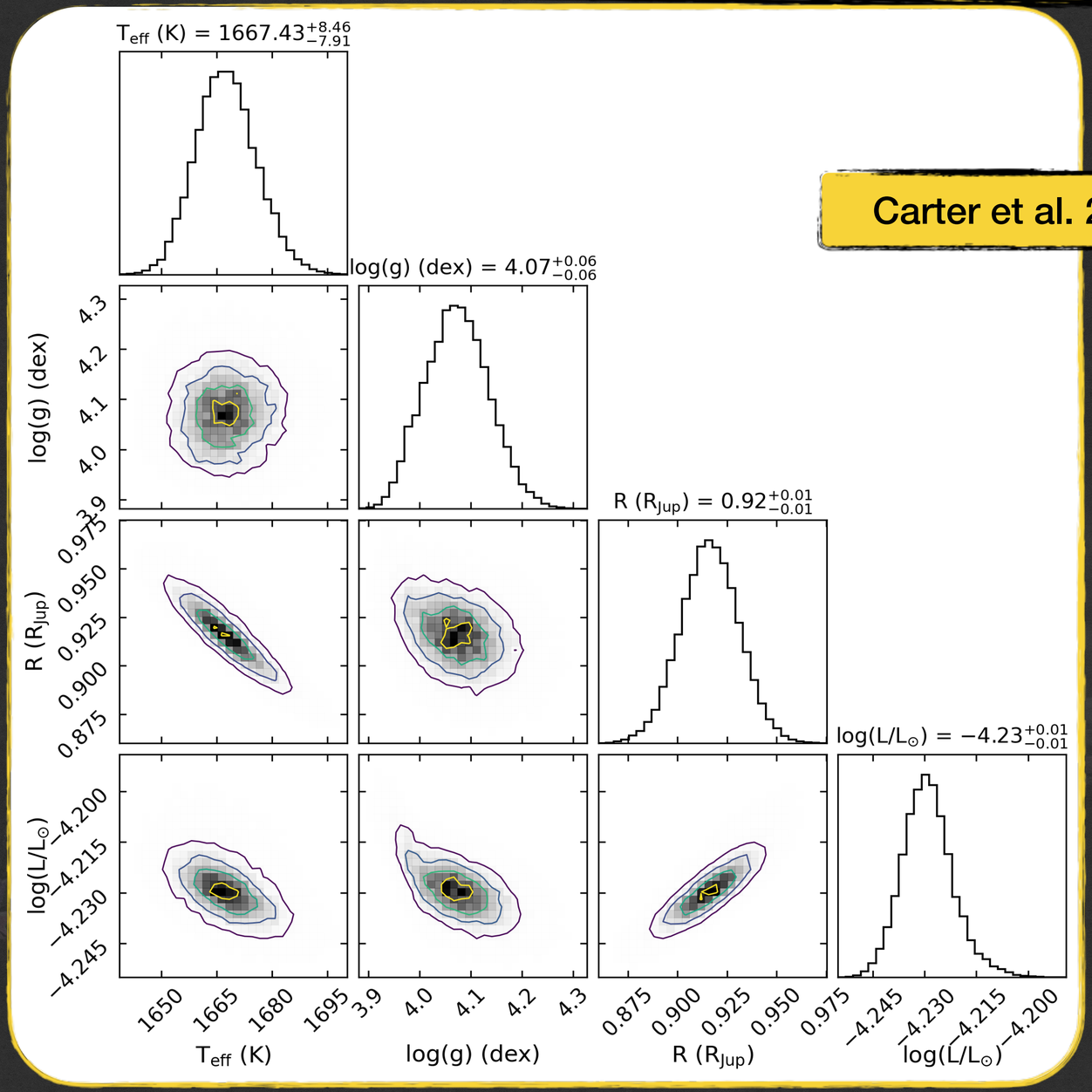

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Conclusions

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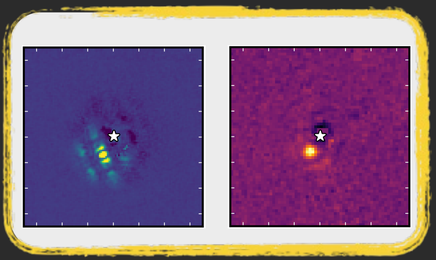
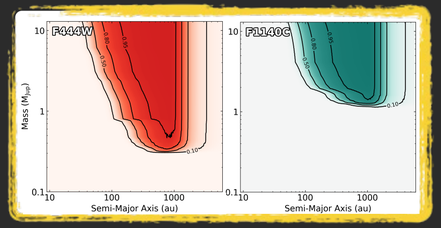
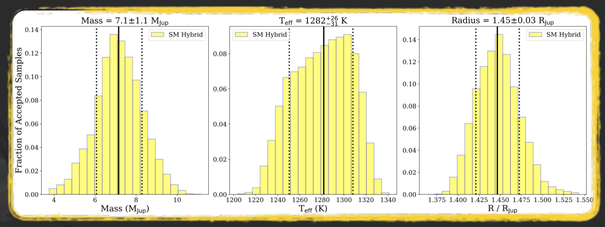
JWST coronagraphic imaging is exceeding its nominal predicted performance, and **opens the door to observations beyond 5 micron for the first time.**





With JWST high contrast observations, **we will be able to directly image sub-Jupiter / sub-Saturn mass objects at young ages**, in addition to mature planets at ~200K.

Precision and wavelength coverage provided by **JWST allows for tight constraints on bolometric luminosity and in turn other bulk properties.**

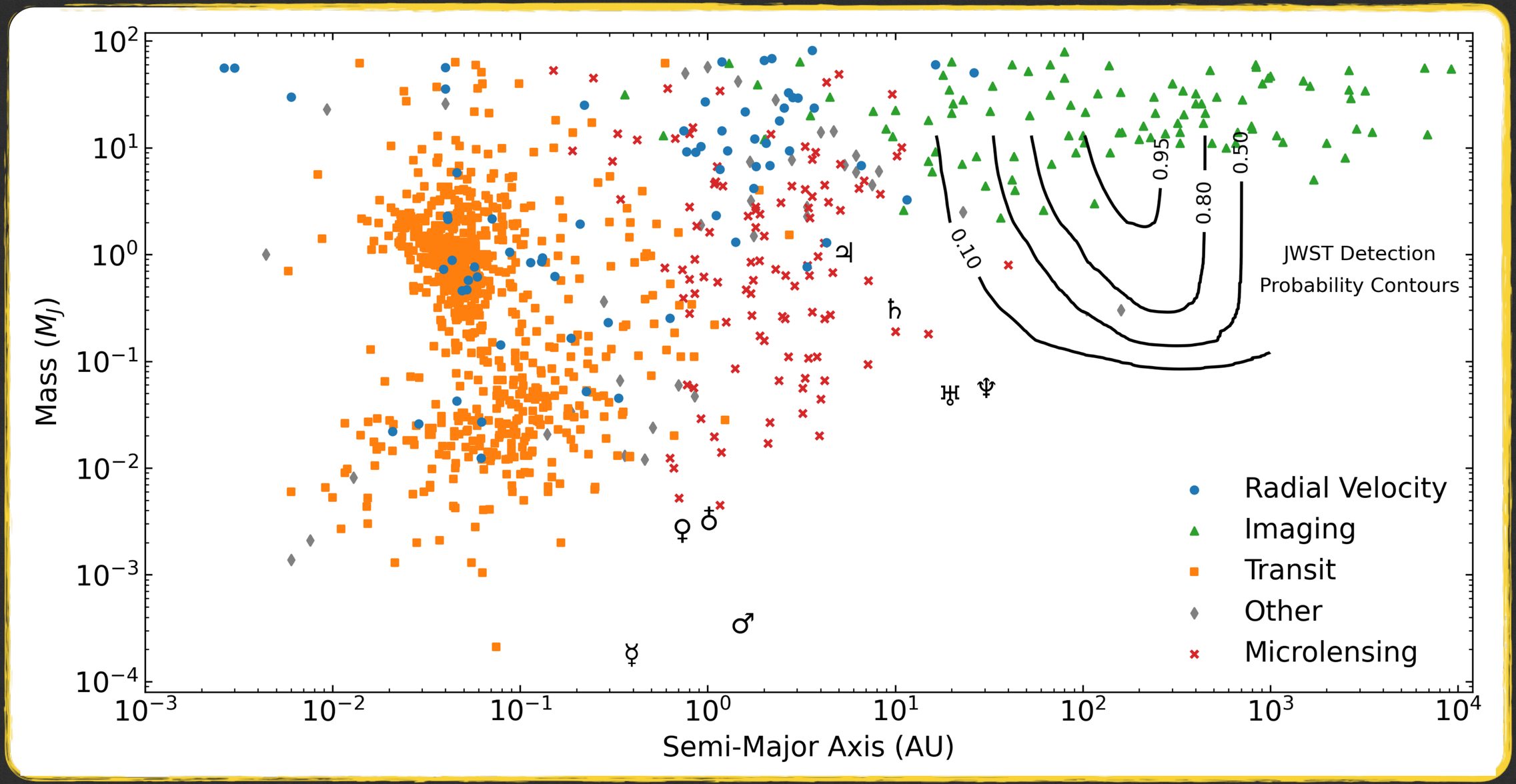


Mismatches between bulk properties as determined by atmospheric vs evolutionary models are still evident. But **more complex model fitting and analysis still needs to be done.**

Additional Slides

Promising for Future Observations

Aarynn L. Carter
UT Austin Colloquium
November 1, 2022



NIRCam PSF Modelling

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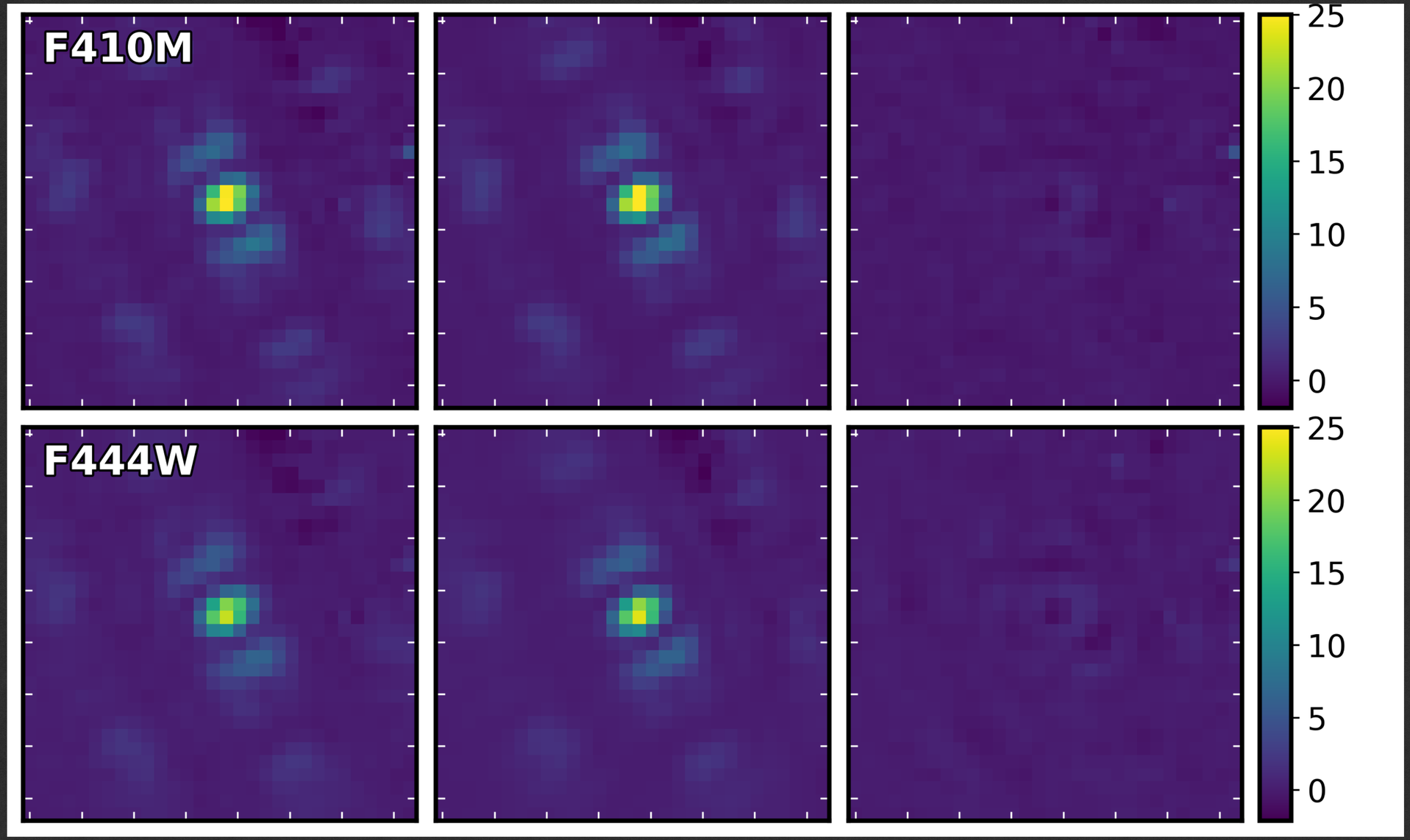

MIRI PSF Modelling

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