

Precise and Novel Orbital Measurements for the Imaged Giant Planet Population using VLTI/GRAVITY

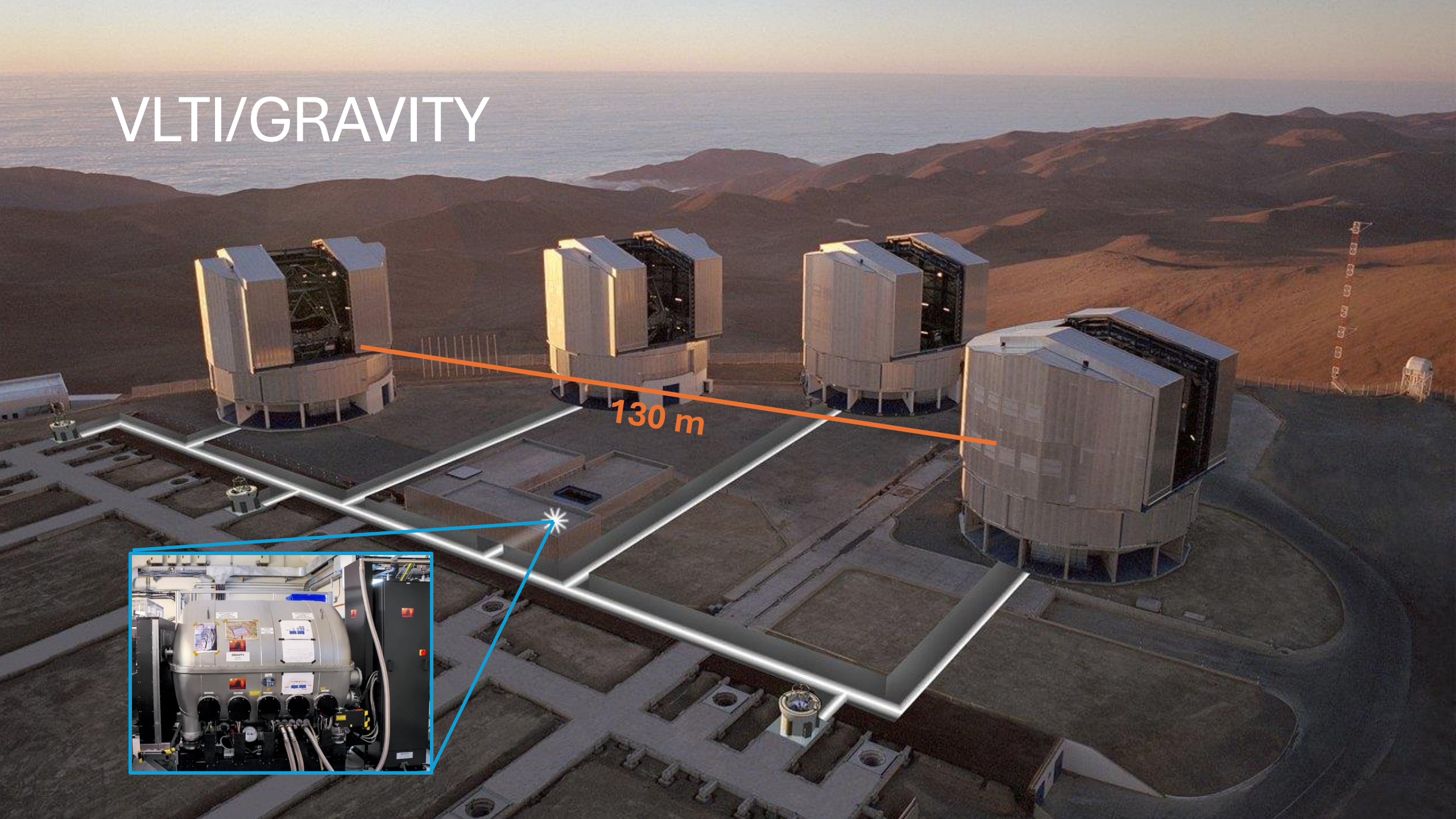
Jason Wang (Northwestern)

Amanda Chavez, Jonathan Roberts, Quentin
Kral, Sylvestre Lacour, the ExoGRAVITY team



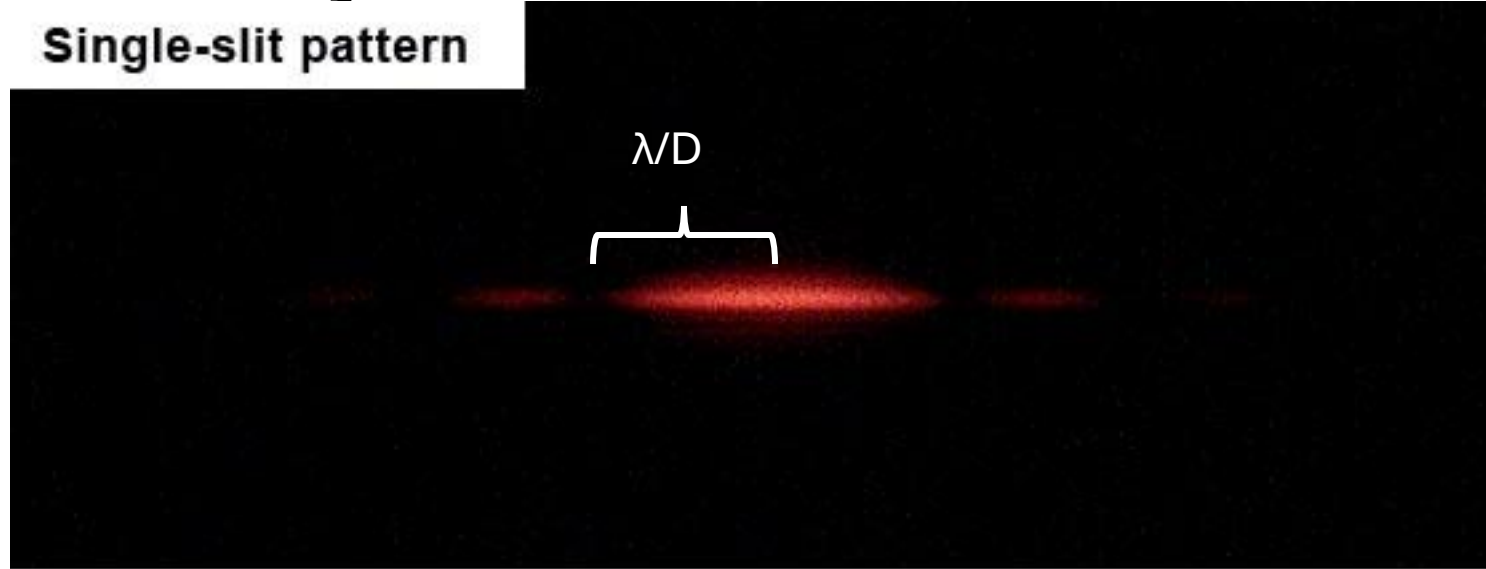
~1967

VLT/GRAVITY



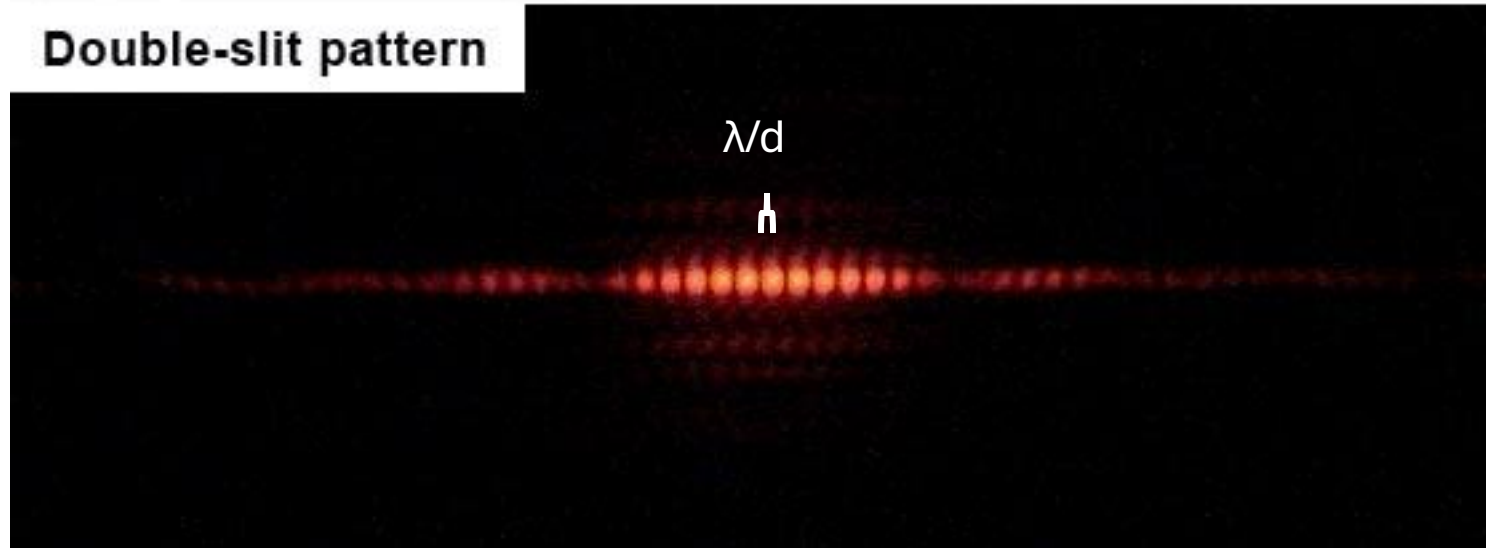
Interferometry Basics

Single-slit pattern



$D = 8 \text{ m}$

Double-slit pattern

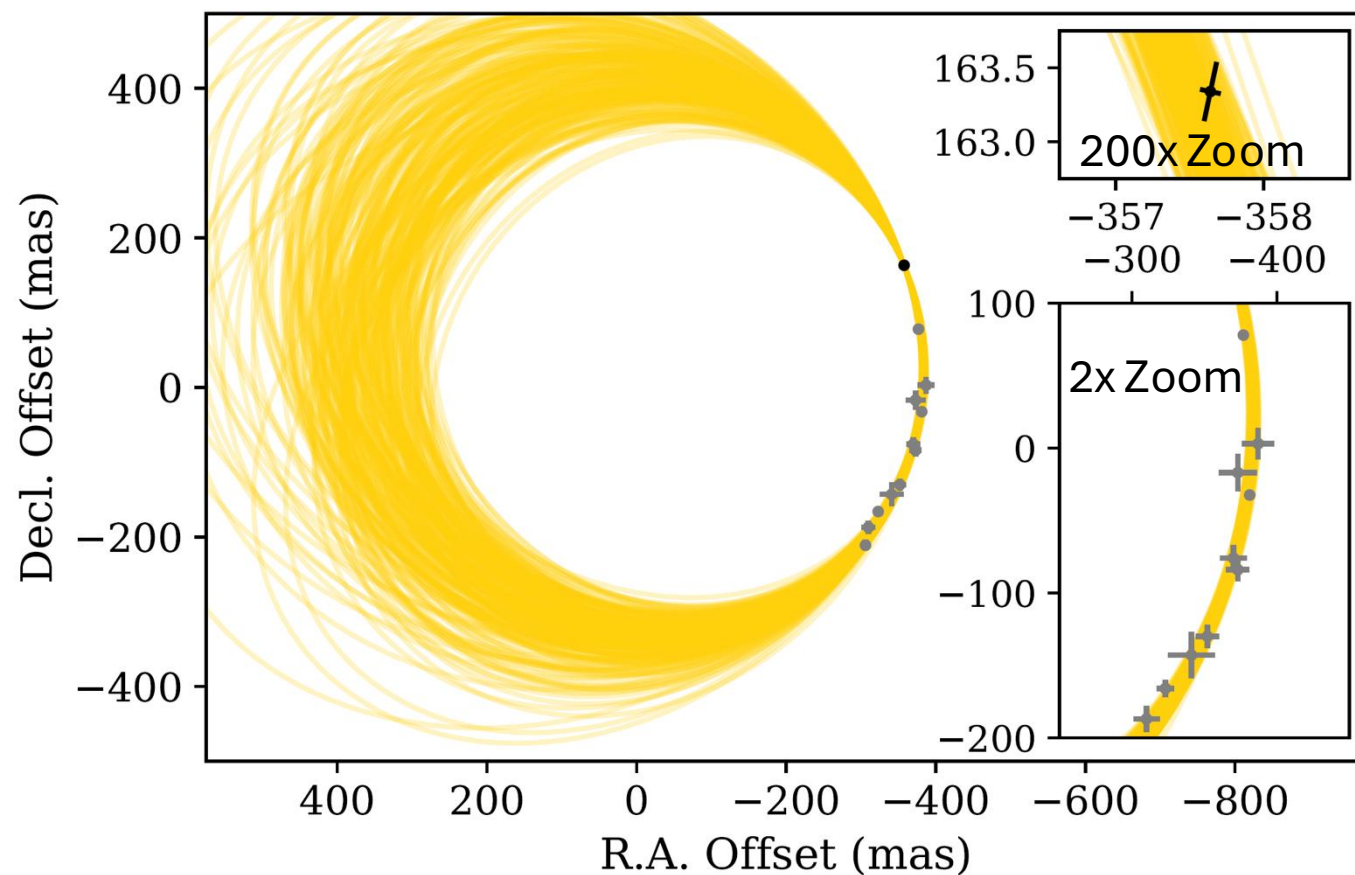
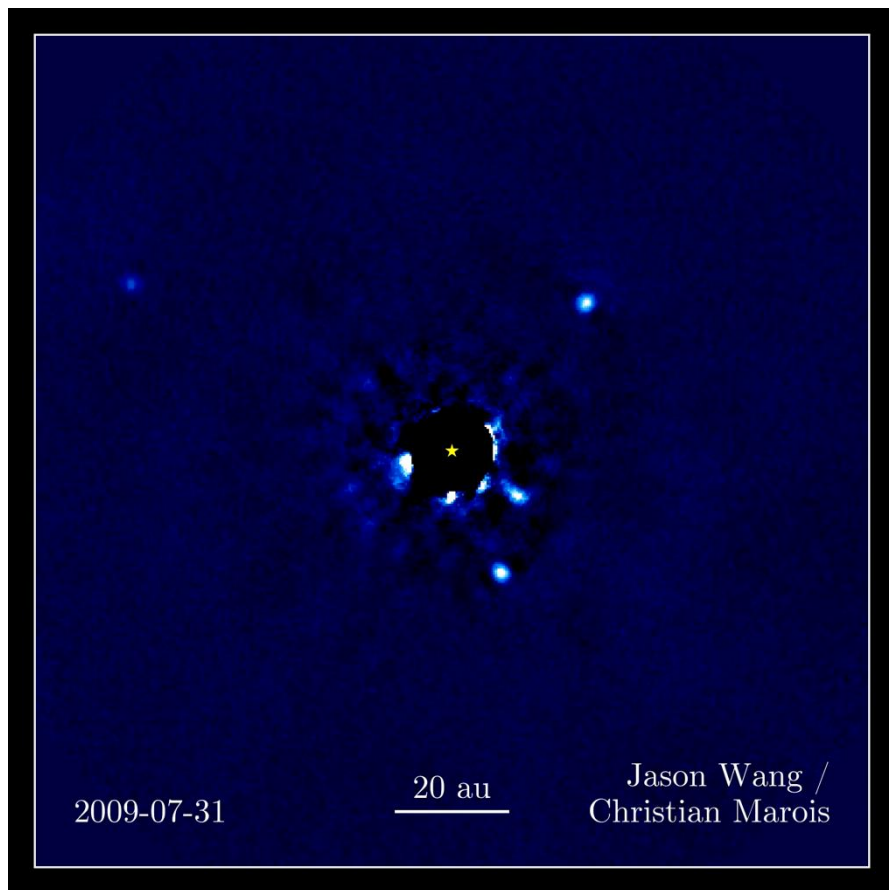


$d = 130 \text{ m}$

Credit: Wikipedia

First interferometric detection of an exoplanet

HR 8799 e



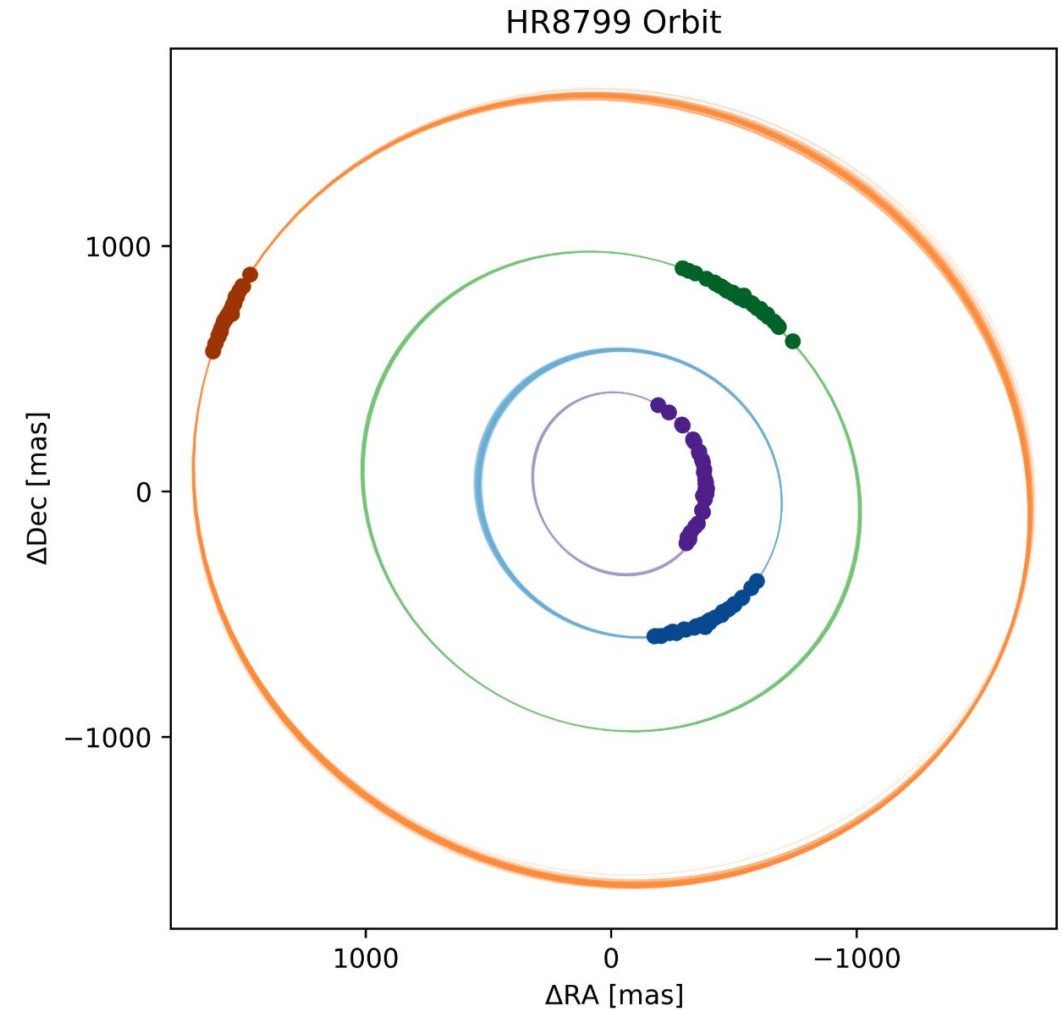
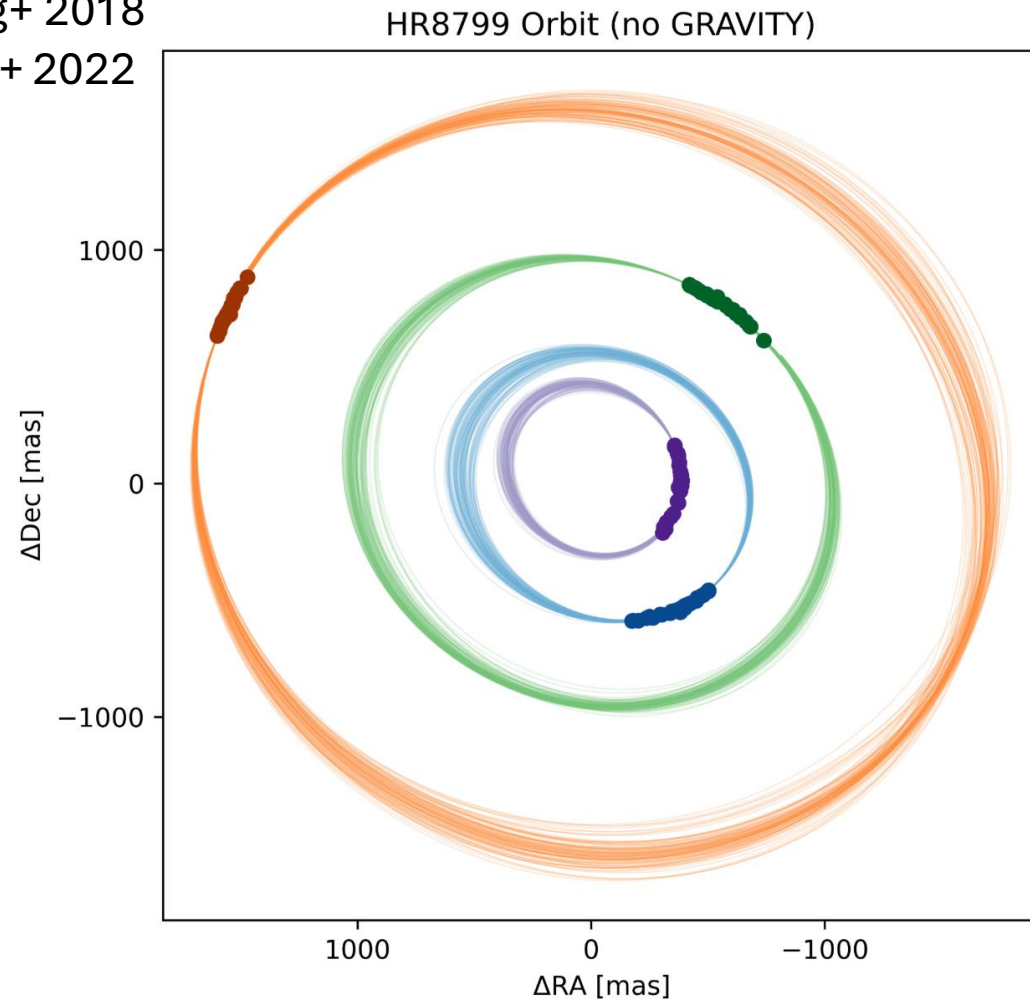
HR 8799 Orbital Monitoring



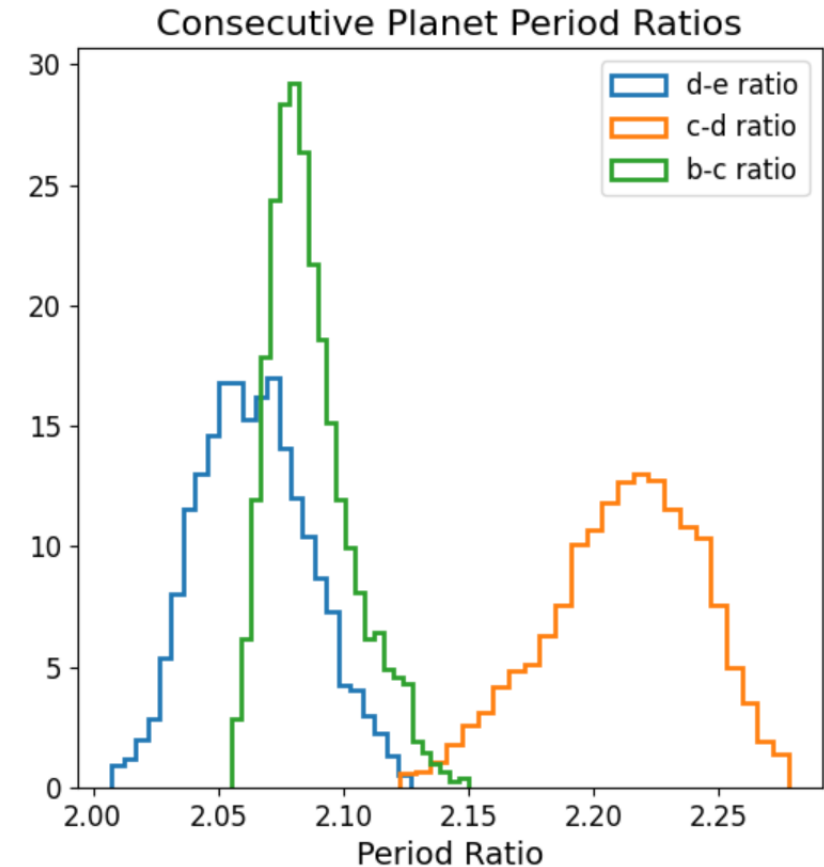
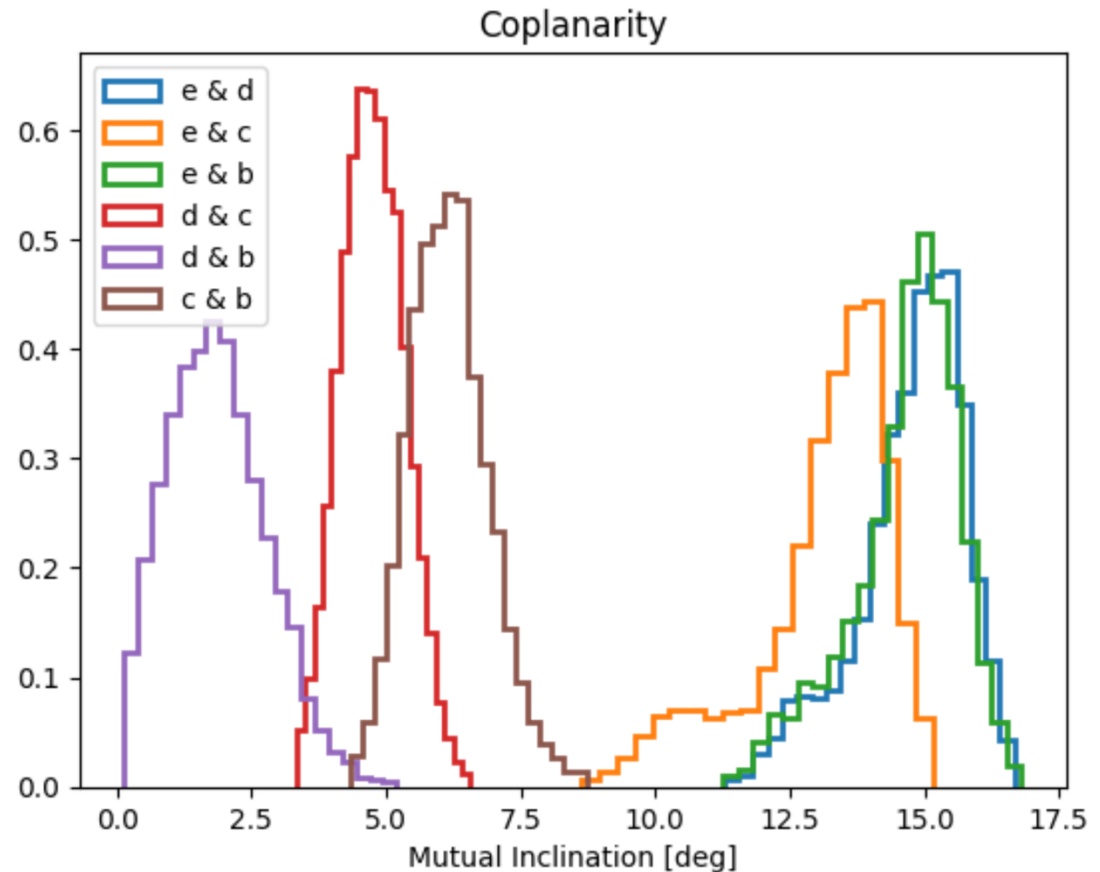
Amanda Chavez+ in prep.

Wang+ 2018

Zurlo+ 2022



No dynamical constraints added

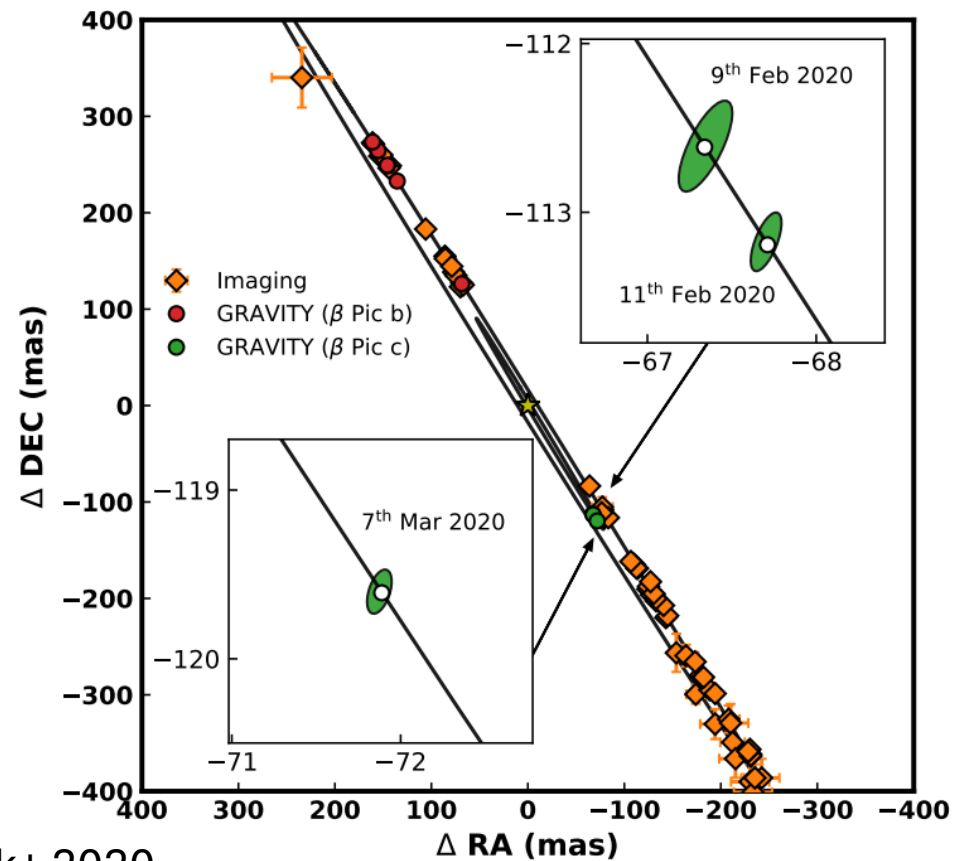


- First time resolving that planet e is misaligned with the outer 3 planets
- First direct evidence that not all four planets in resonance lock?

GRAVITY Multi-planet Systems

β Pic c at 2.7 au, $8.2 \pm 0.8 M_{\text{Jup}}$

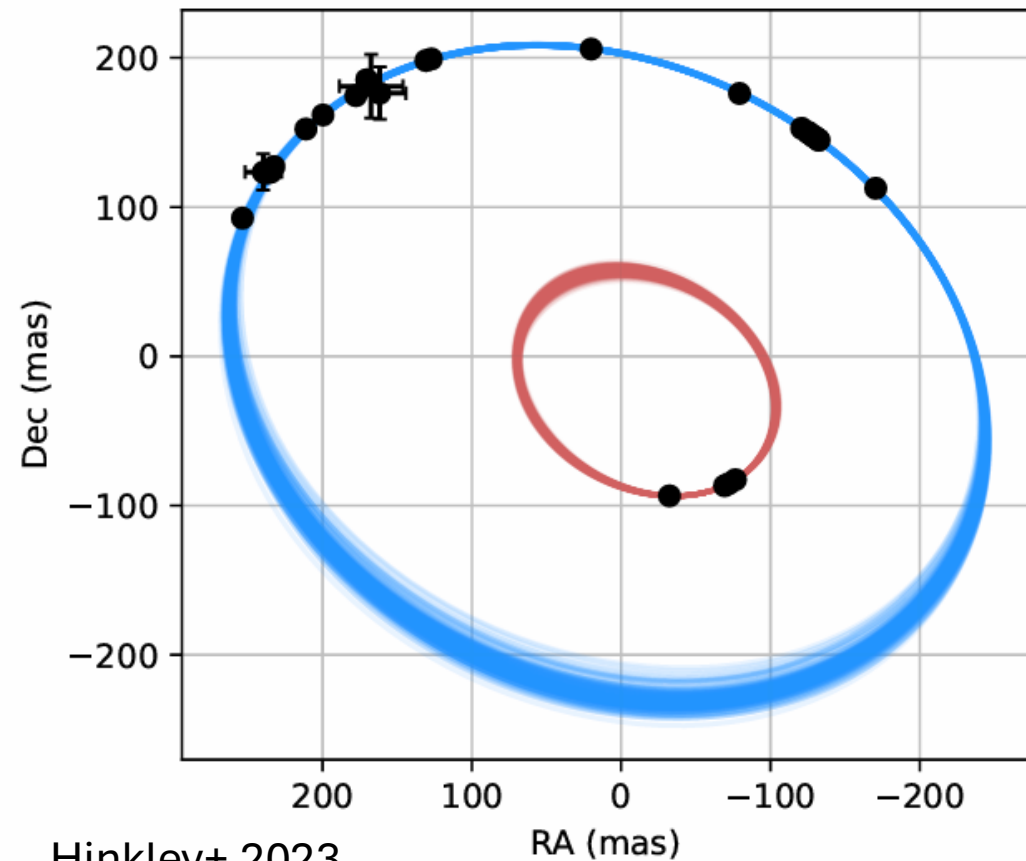
β Pic b at 10 au, $9.0 \pm 1.6 M_{\text{Jup}}$



Nowak+ 2020
Lagrange+ 2020

HD 206893 B: 10 au, $27 \pm 2 M_{\text{Jup}}$

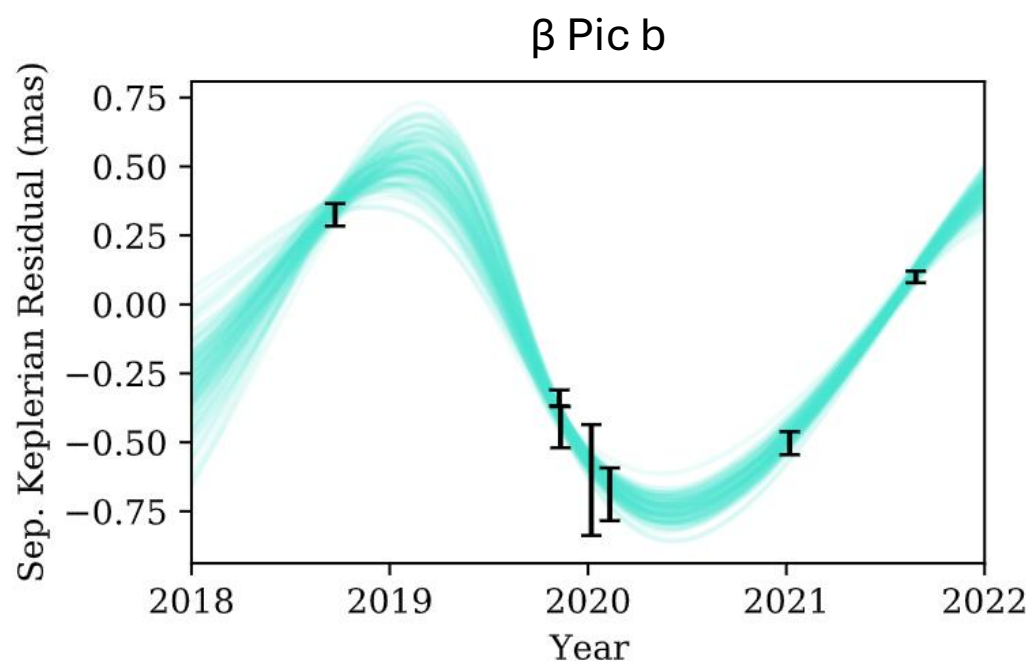
HD 206893 c: 3.5 au, $12 \pm 1 M_{\text{Jup}}$



Hinkley+ 2023
Kral, Wang+ subm.

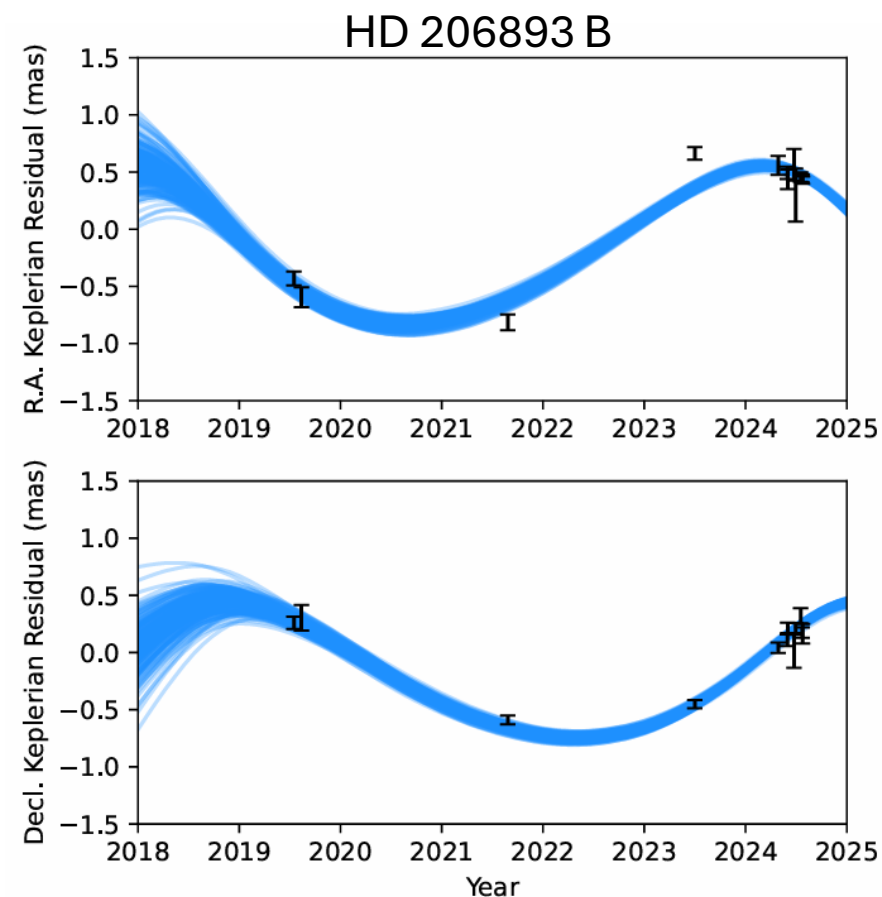
Dynamical Masses with Only Relative Astrometry

Subtracting a Keplerian Orbit of the outer planet
reveals the reflex motion of the inner planet



Infers a mass of $c = 9 \pm 1 M_{\text{Jup}}$

Lacour, Wang+ 2021

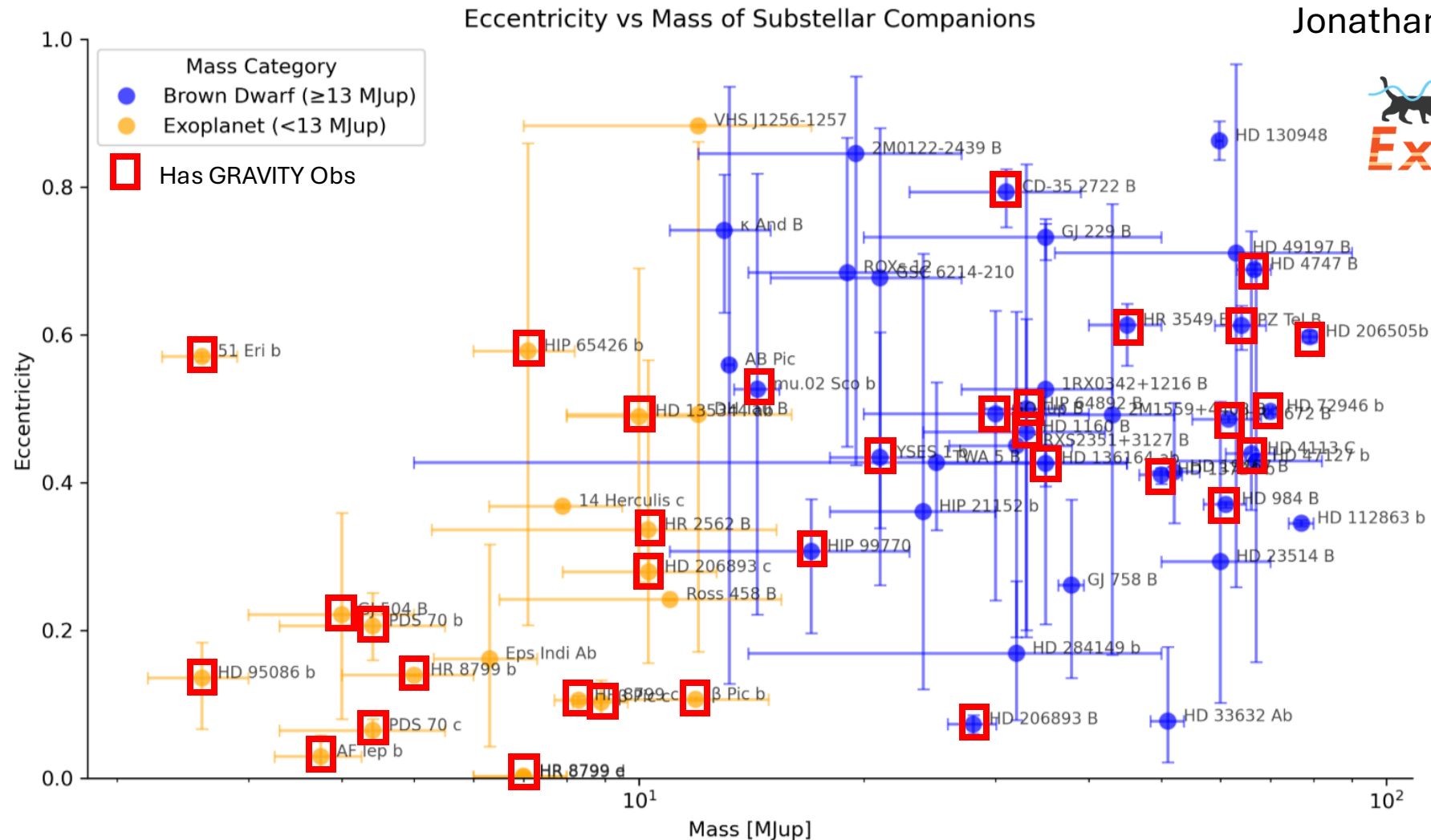


Kral, Wang+ subm.

The Population of Companion Orbits Measured by ExoGRAVITY

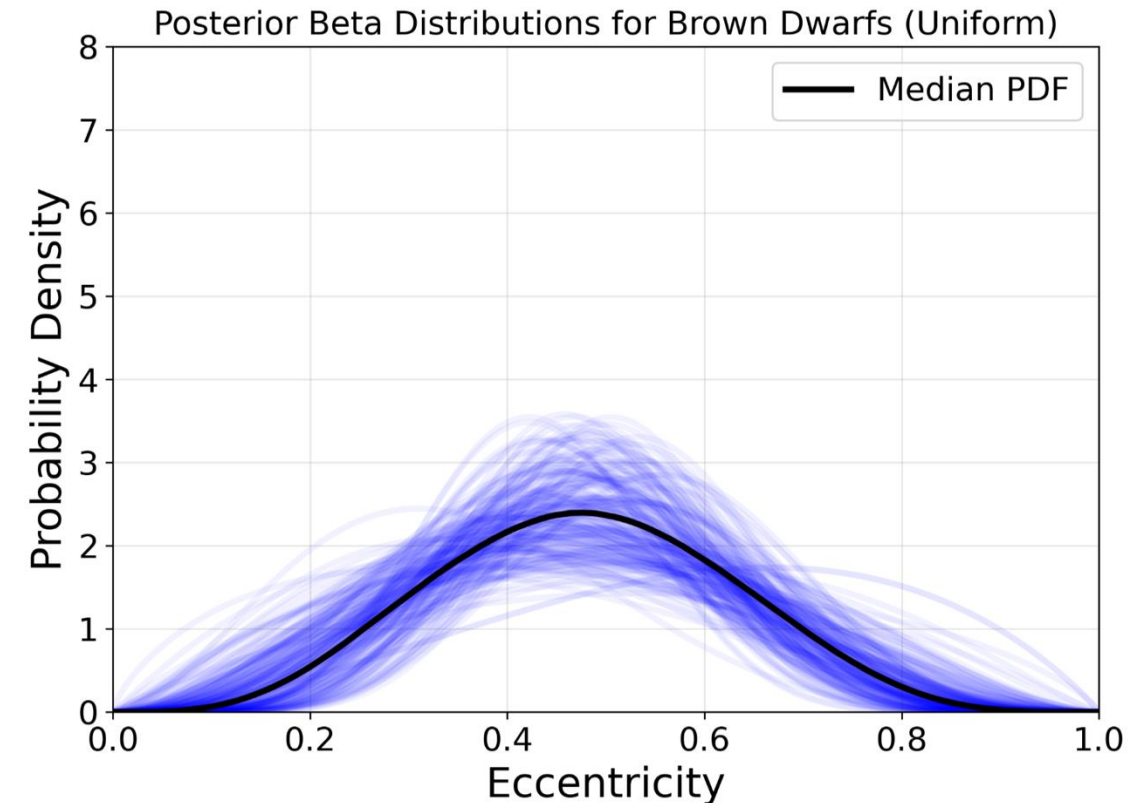
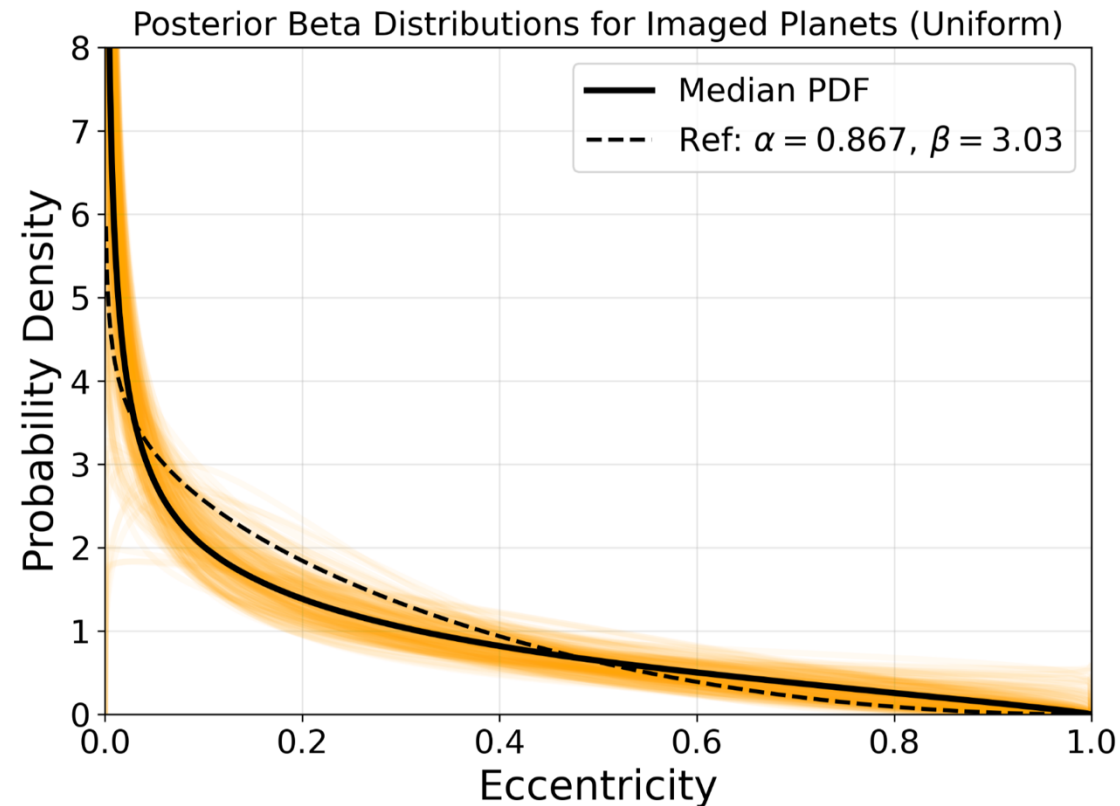


Jonathan Roberts+ in prep.



Confirm that Giant Planets and Brown Dwarfs have Different Eccentricity Distributions

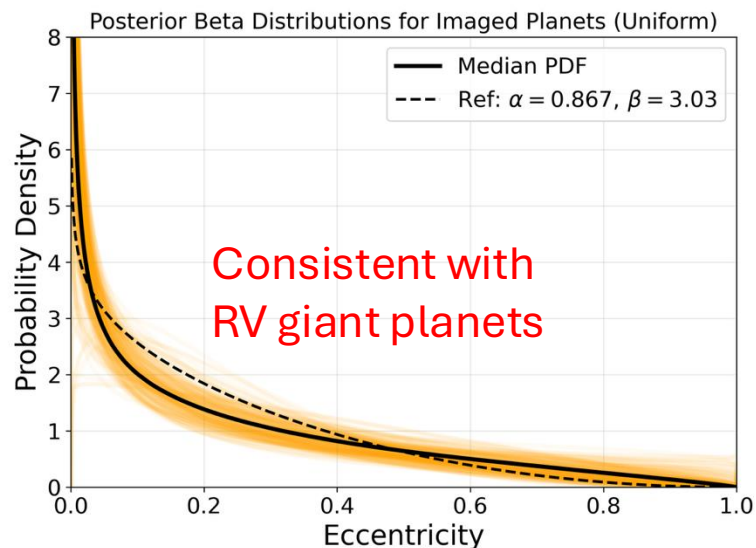
Confirms the results in Bowler et al. (2020)



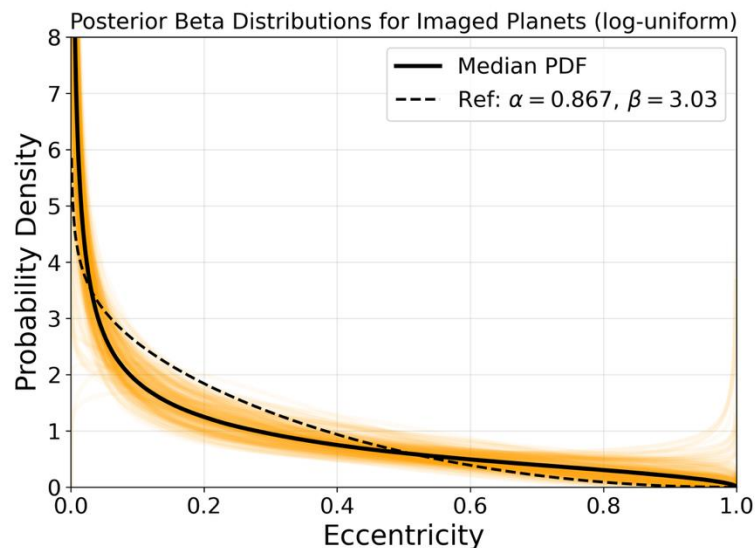
The shape of our distributions are robust to prior choice

See Nagpal+
2023

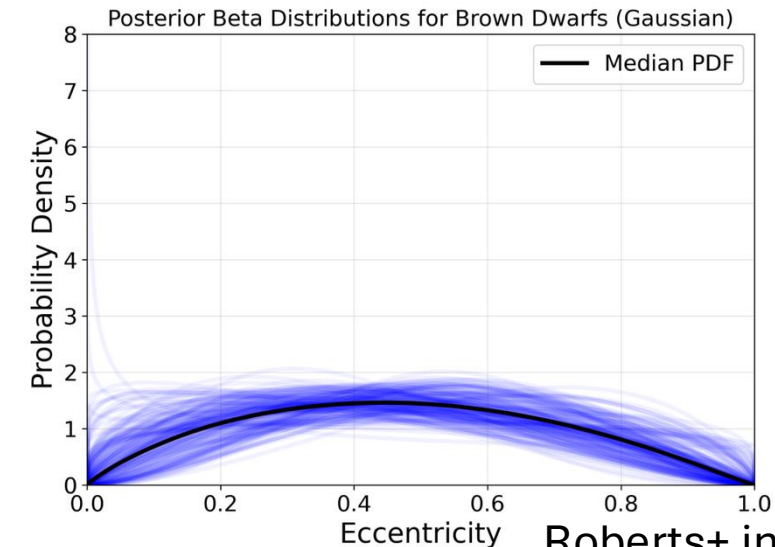
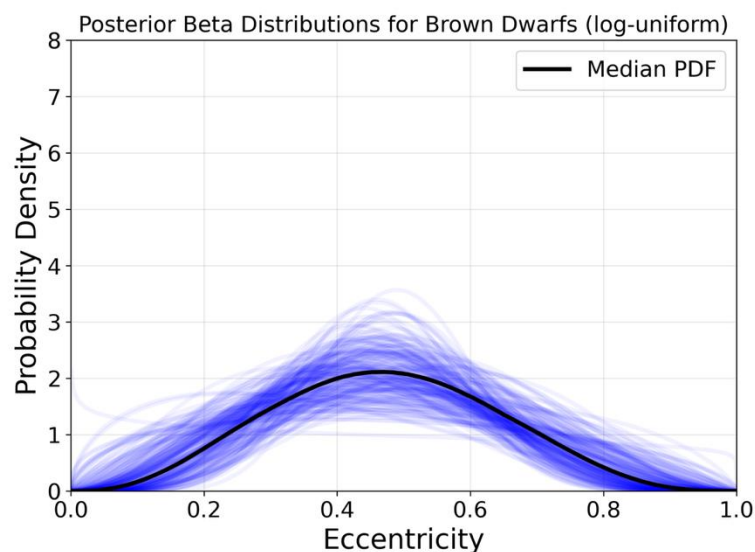
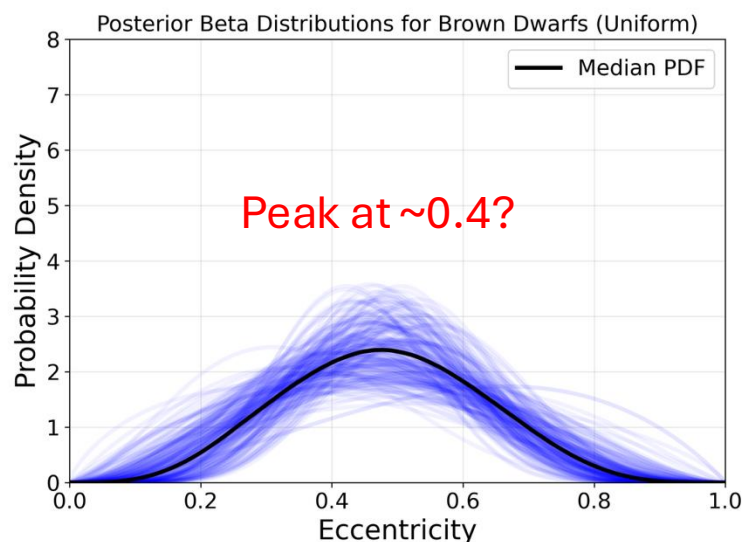
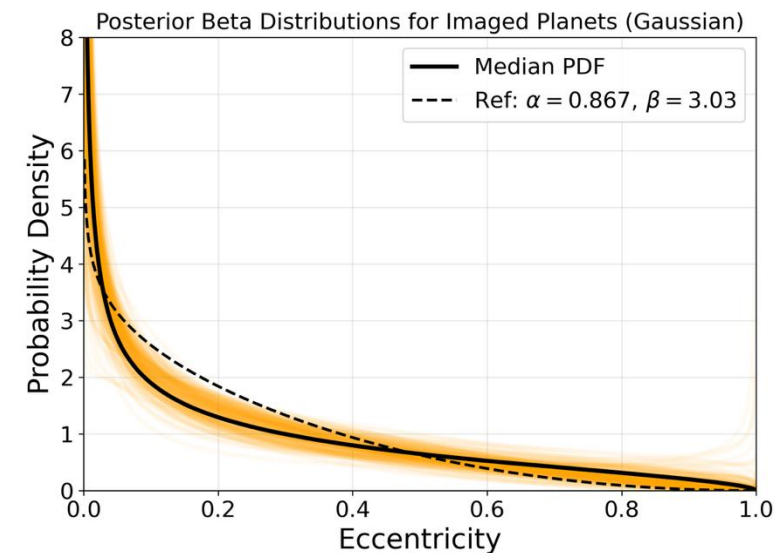
Uniform



Log-Uniform



Gaussian



Roberts+ in prep.

GRAVITY astrometry enables new-levels of orbital characterization and even direct mass measurements



Prior-independent view on the eccentricity distributions of wide-separation giant planets

