

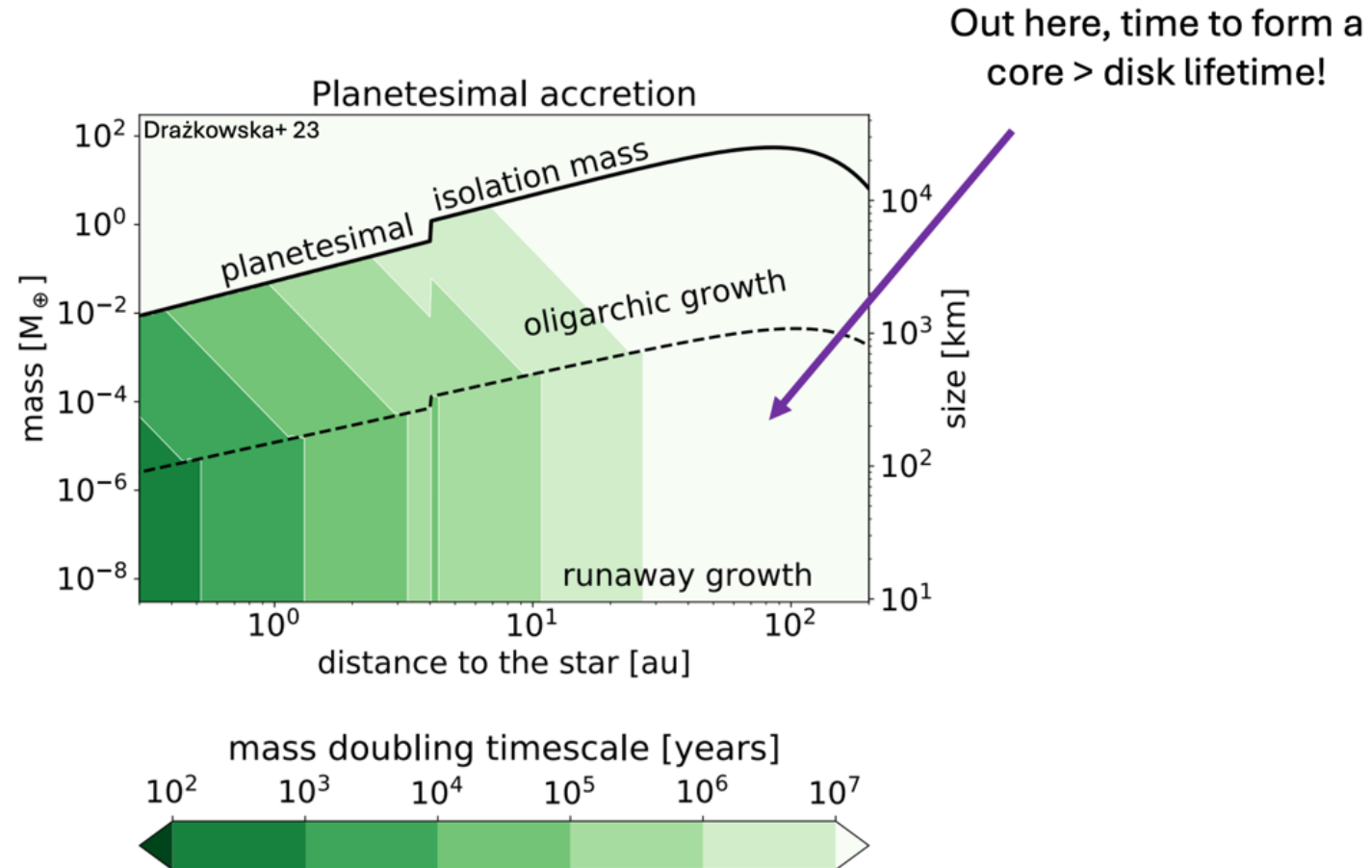


REFINING THE ORBIT OF THE YOUNG WIDE COMPANION GQ LUP B USING GRAVITY AND HIGH PRECISION RADIAL VELOCITY

Vidya Venkatesan, Sarah Blunt, Jason
Wang and the ExoGRAVITY Collaboration
University of California, Irvine
ExSoCAL Meeting 2025

Cold Jupiters big science question:

How do they form so far out?



Drawzkowska et al., 2022

FORMATION VIA SCATTERING

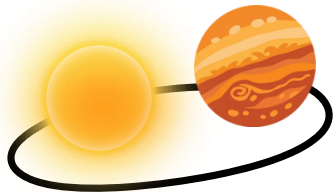


Scattering



Disk Dispersal

Low to moderate
eccentricity

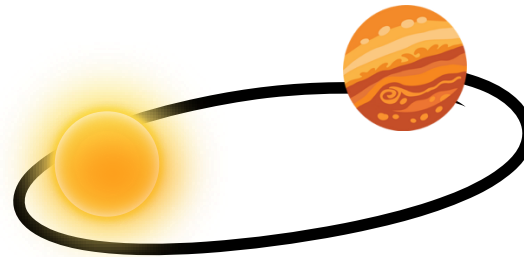


Disk Dispersal



Scattering

High eccentric orbit

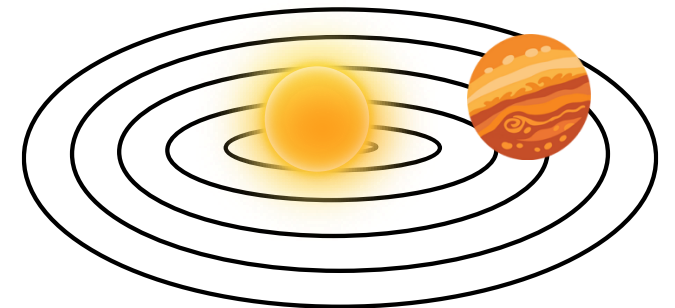


Marleau et al., 2019

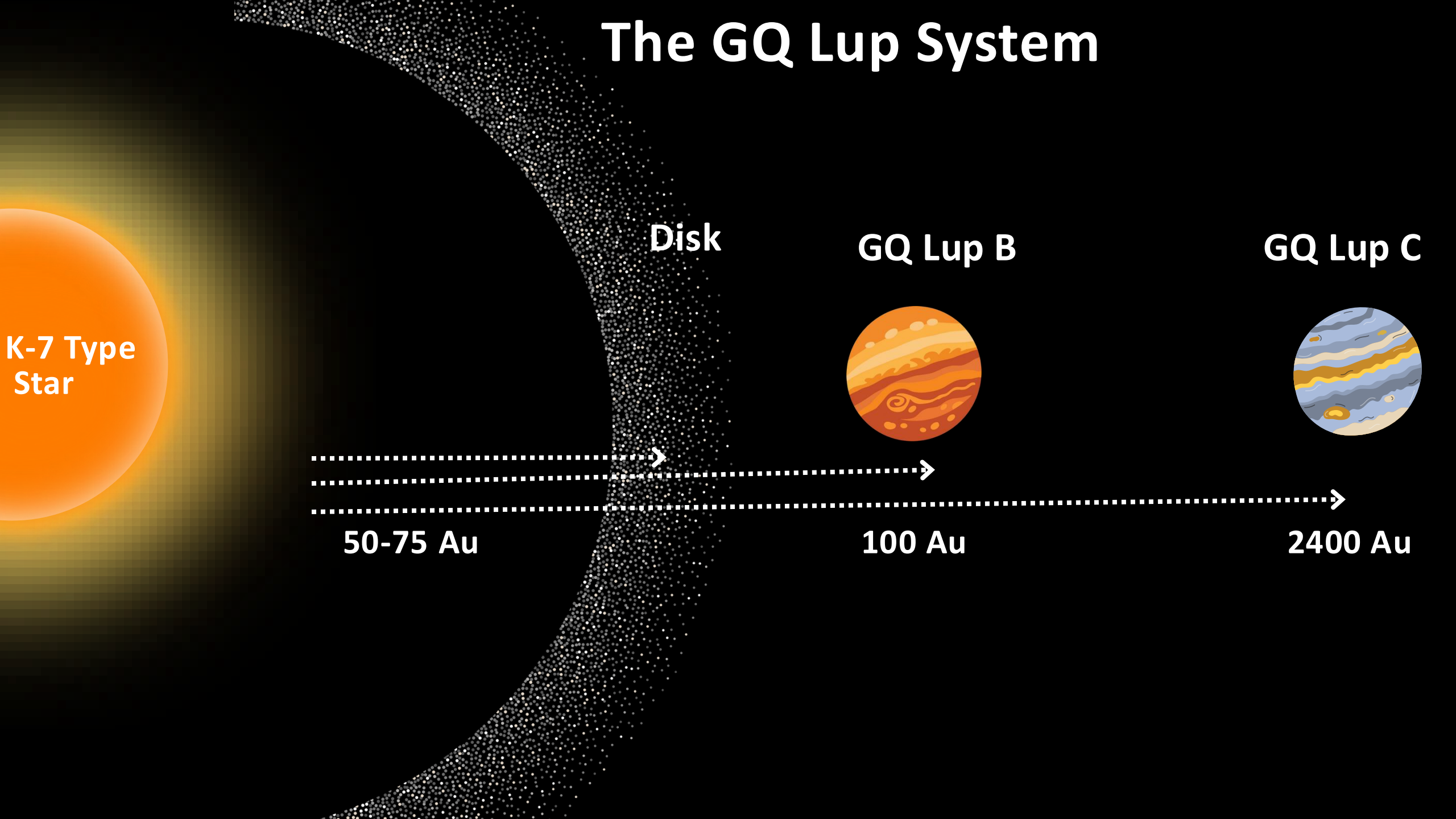
Others

in-situ
 $e=0$

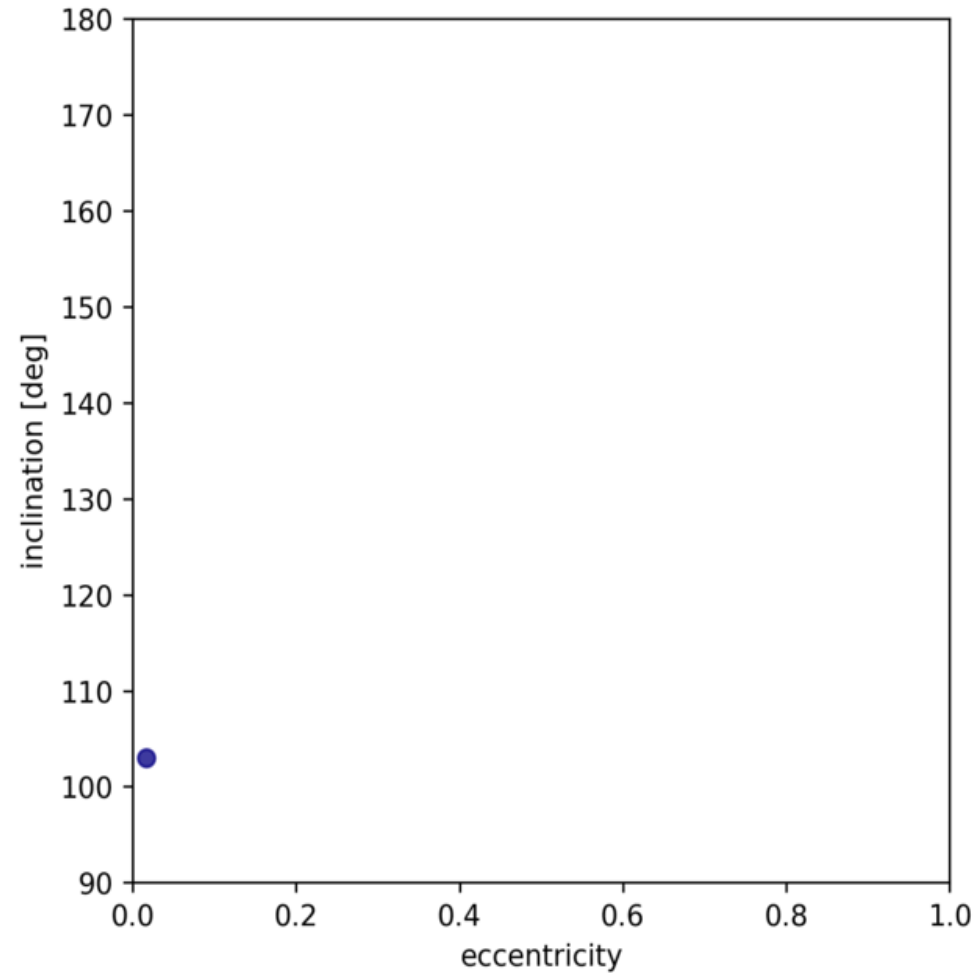
disk instability
varied eccentricity



The GQ Lup System

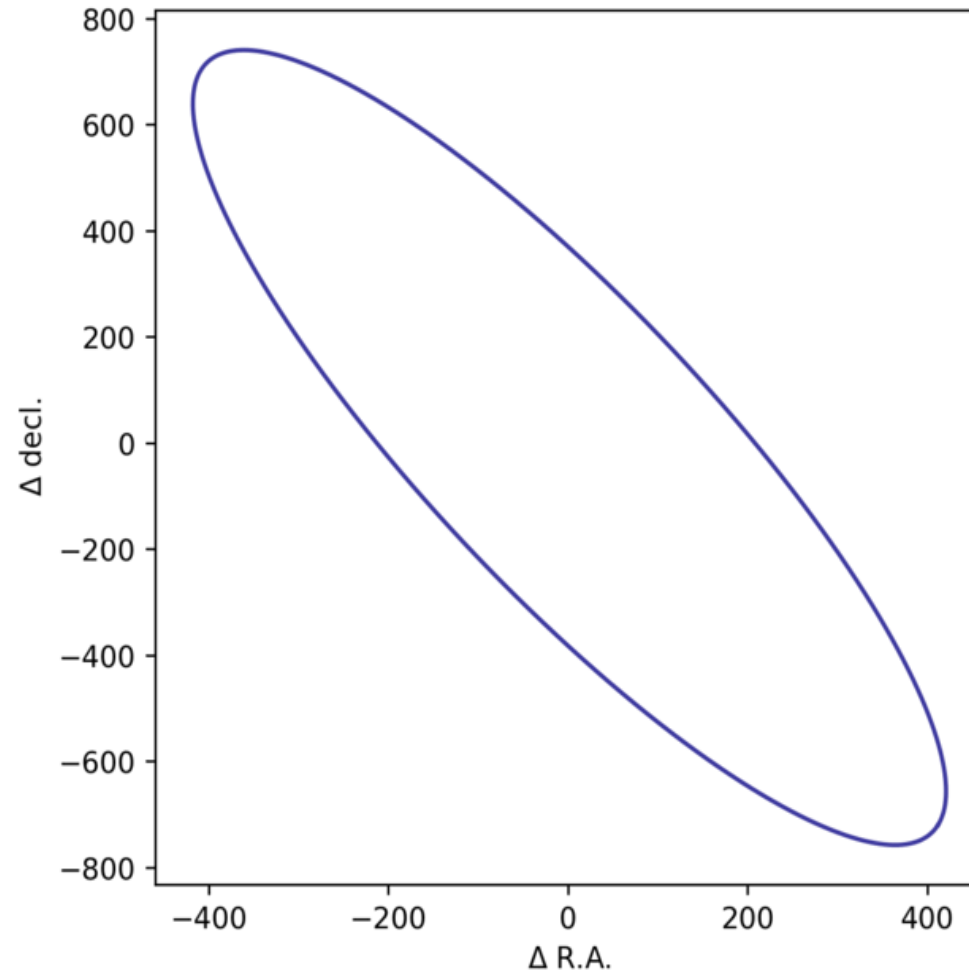
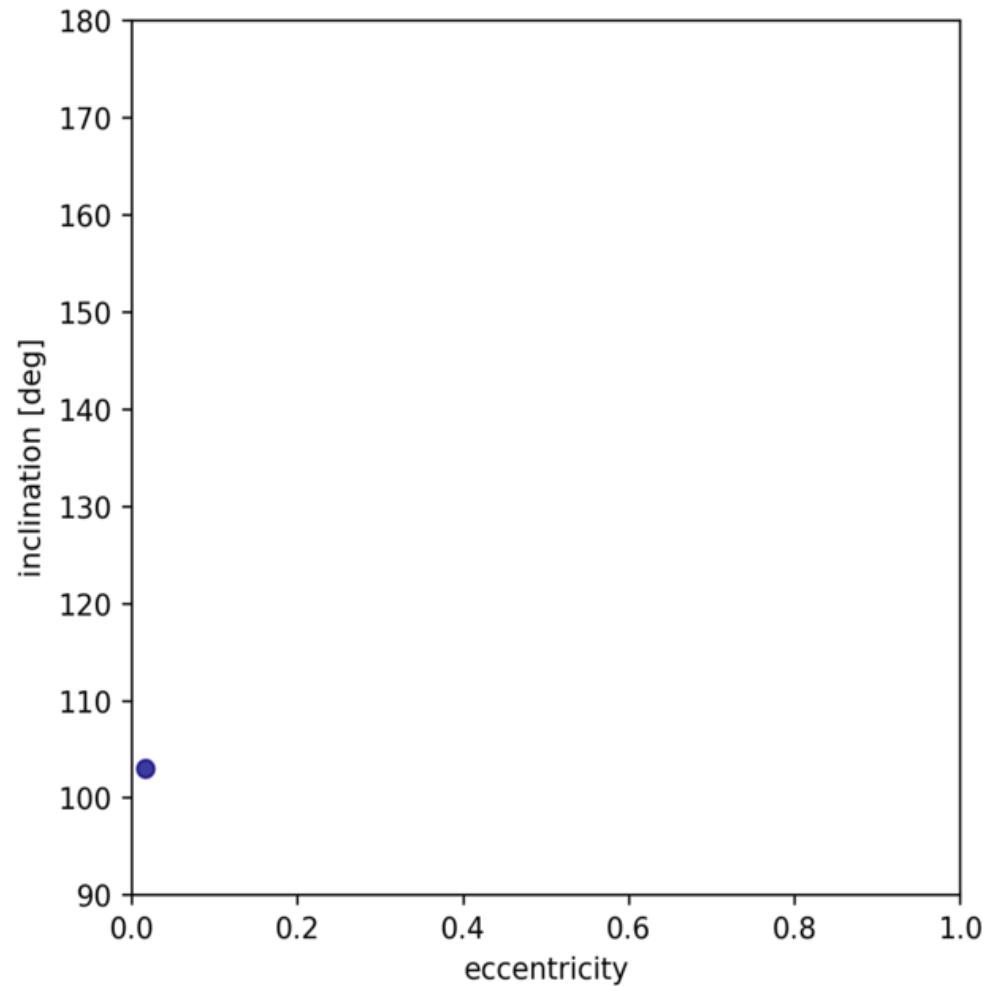


INCLINATION AND ECCENTRICITY ARE CORRELATED



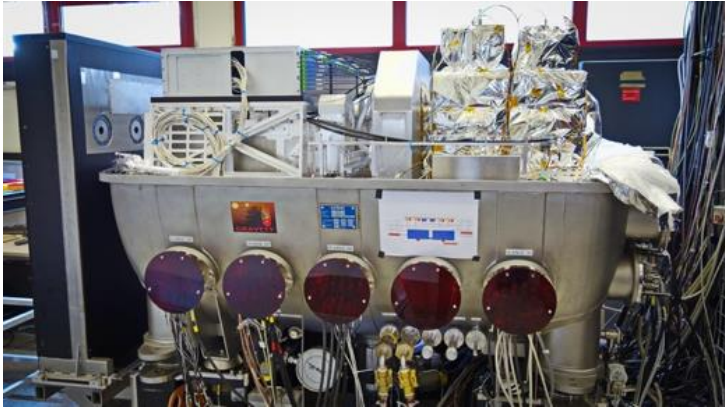
Sarah Blunt

WE NEED BETTER ASTROMETRY TO CONSTRAIN ORBITS



Sarah Blunt

GRAVITY INSTRUMENT



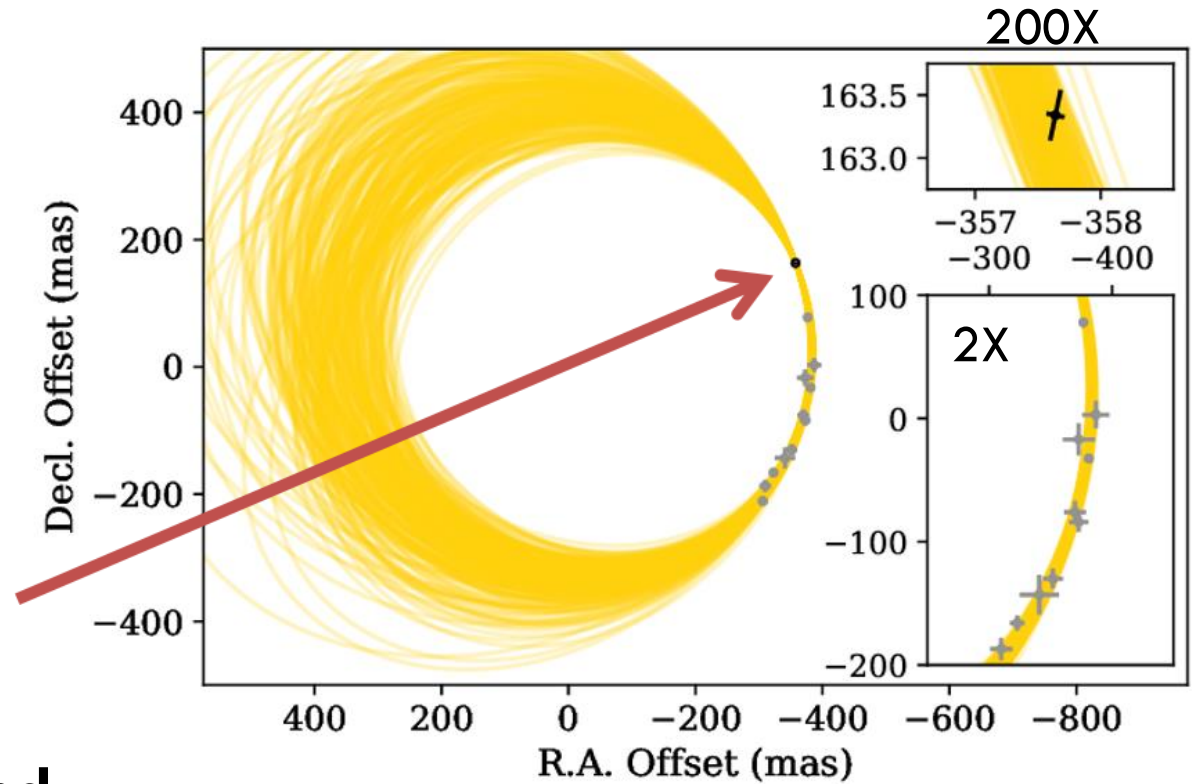
ESO

GRAVITY astrometry
for HR 8799 e

Band: Near-infrared **K-band**

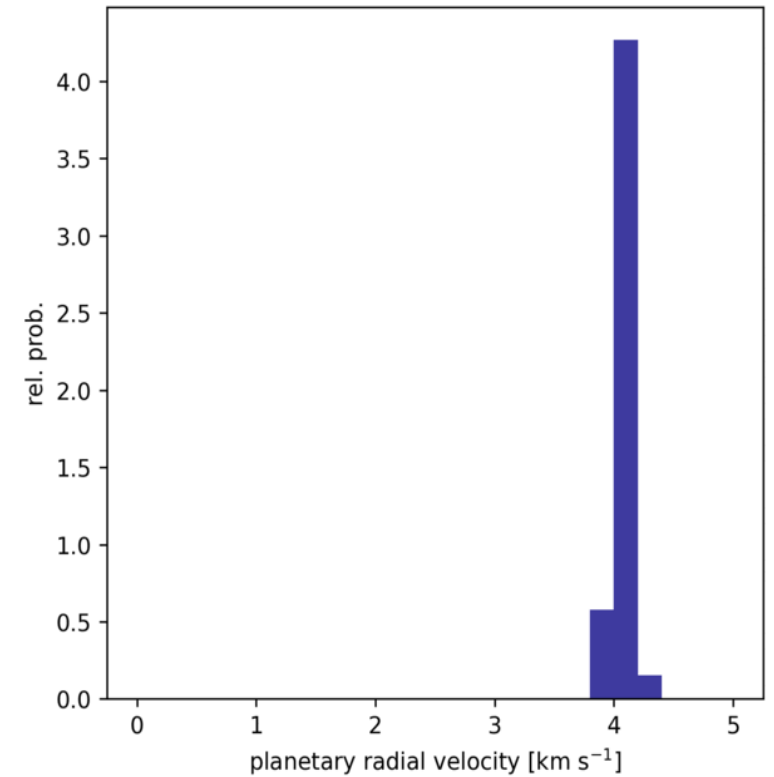
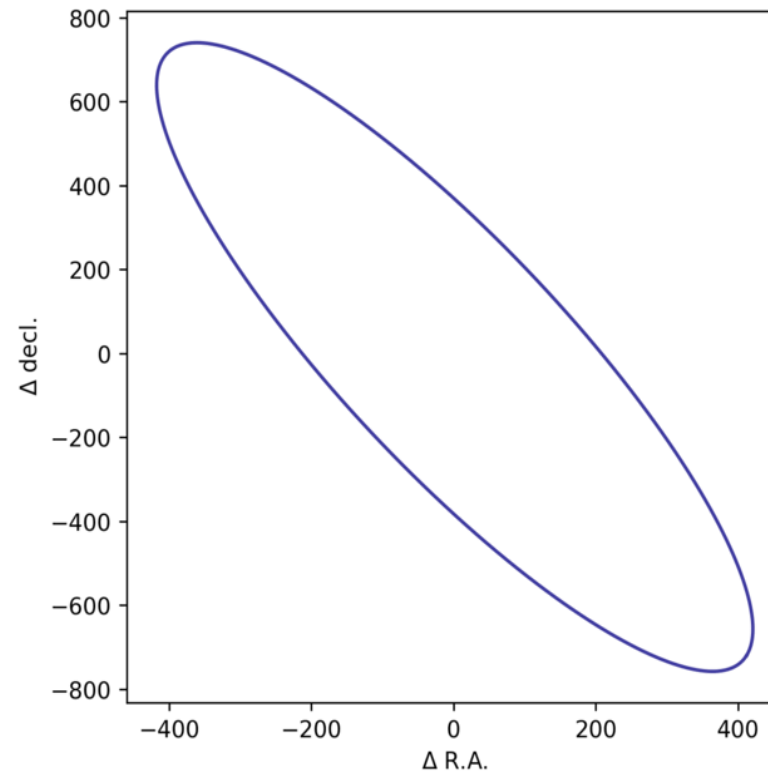
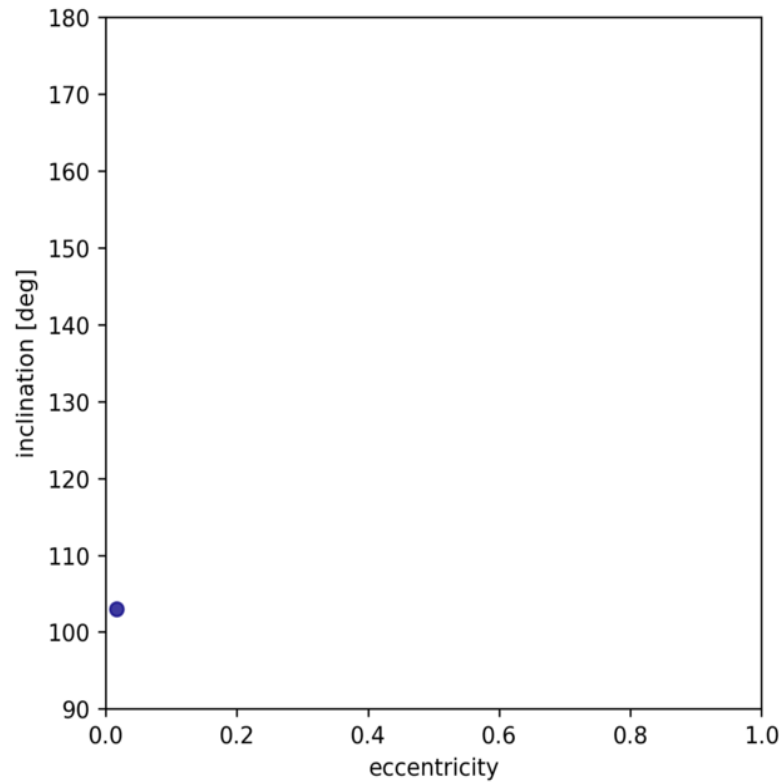
Astrometric precision: $\sim 10 \mu\text{as}$

Spectral resolution: Up to $R \sim 4000$



Lacour et al., 2019

USING HIGH RESOLUTION RV DATA CAN BREAK THIS DEGENERACY



Sarah Blunt

CRIRES+ on the Very Large Telescope (VLT)

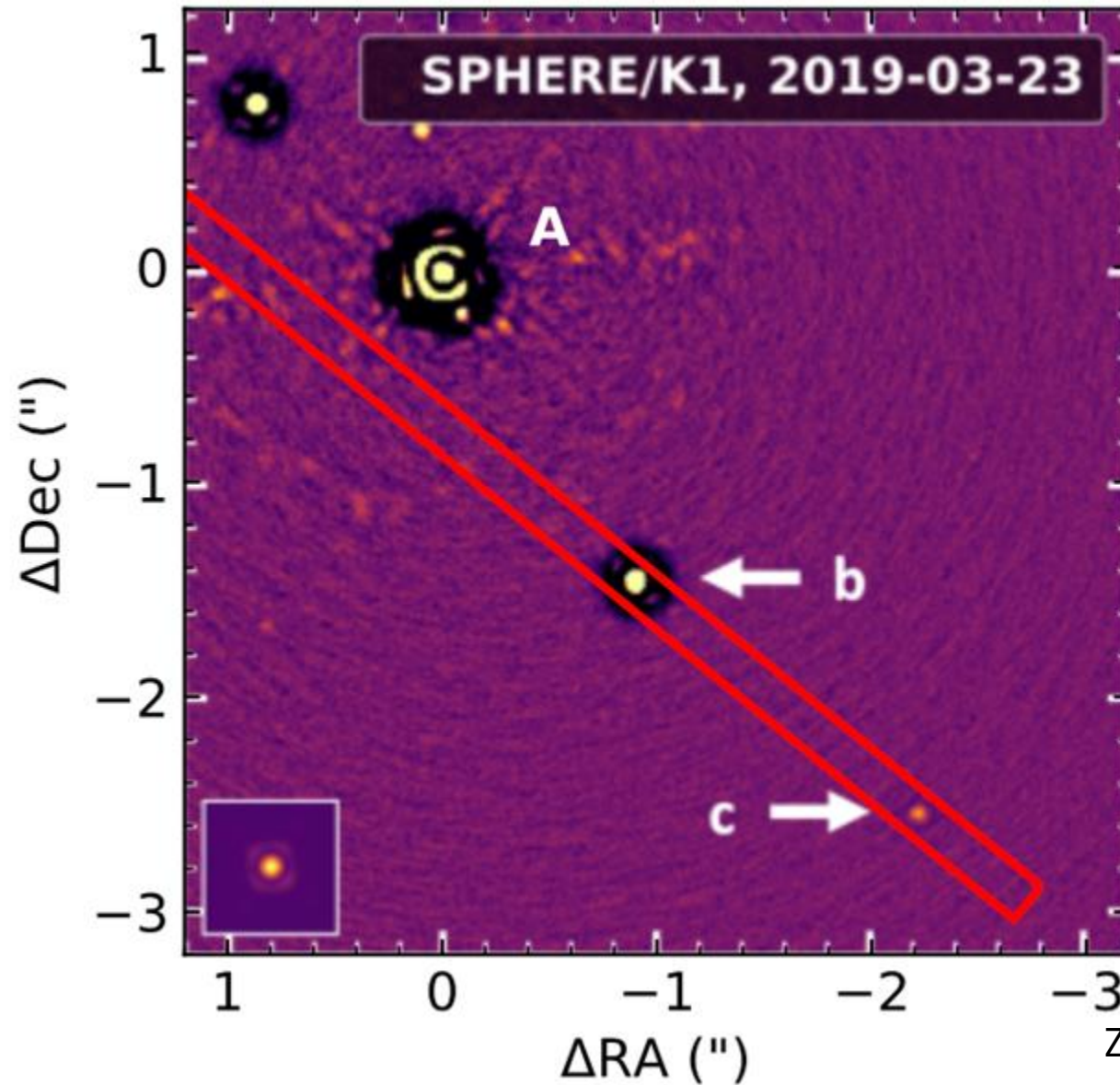


Wavelength coverage:
0.95 to 5.3 μm (Y to M
band)

Spectral resolution: Up to
 $R \sim 100,000$



Estimating RV of the Planet from High resolution data



Zhang et al., 2024

GQ Lup B DATA

Astrometry data from NACO, SPHERE, ALMA,

New data from GRAVITY

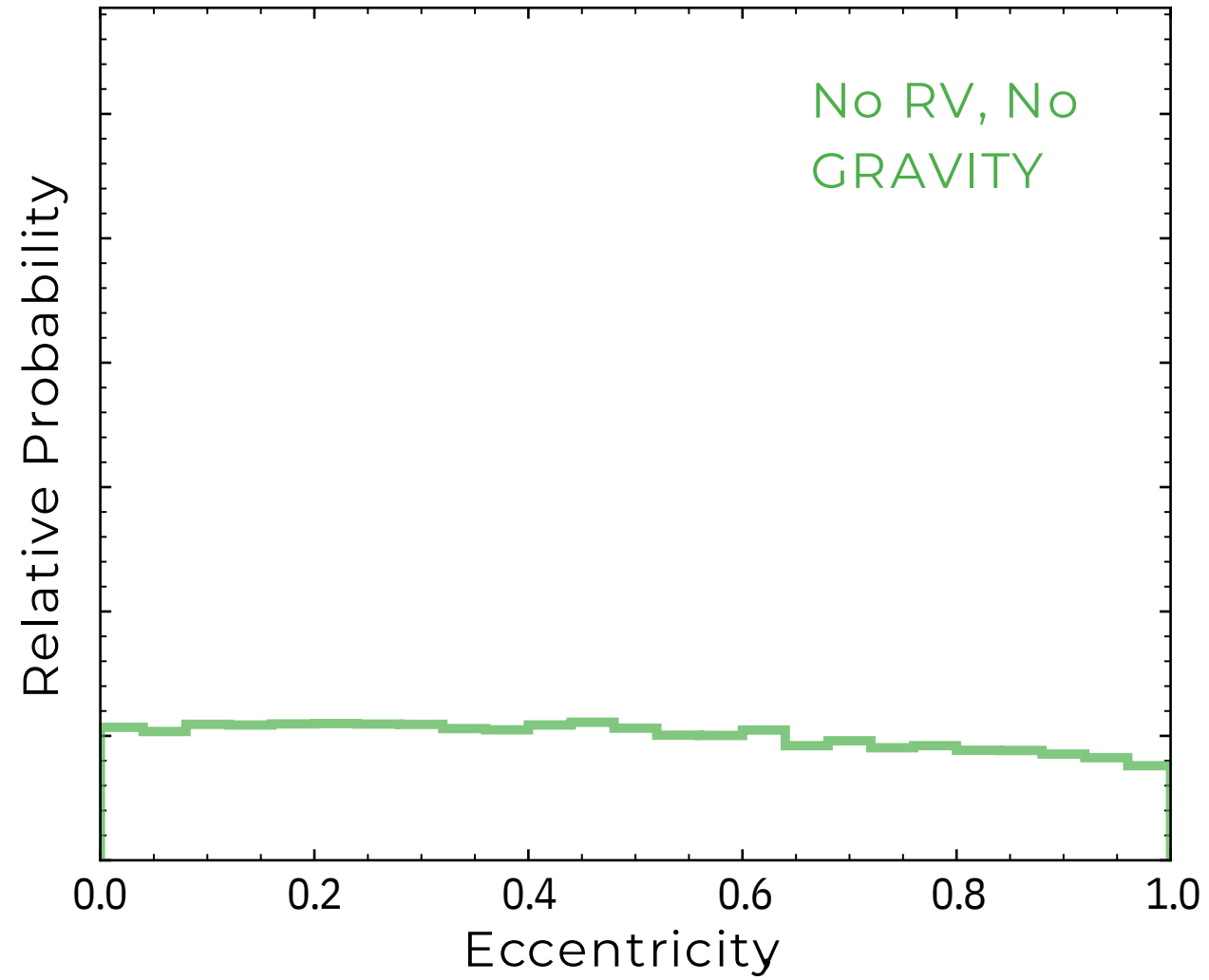
RV (**GH**) = $2.03 \pm 0.04 \text{ km/s}$ (CRIRES+)

Gonzalez Picos et al., 2025

RV (**GL**) = $2 \pm 0.4 \text{ km/s}$ (CRIRES) [**Adopted**]

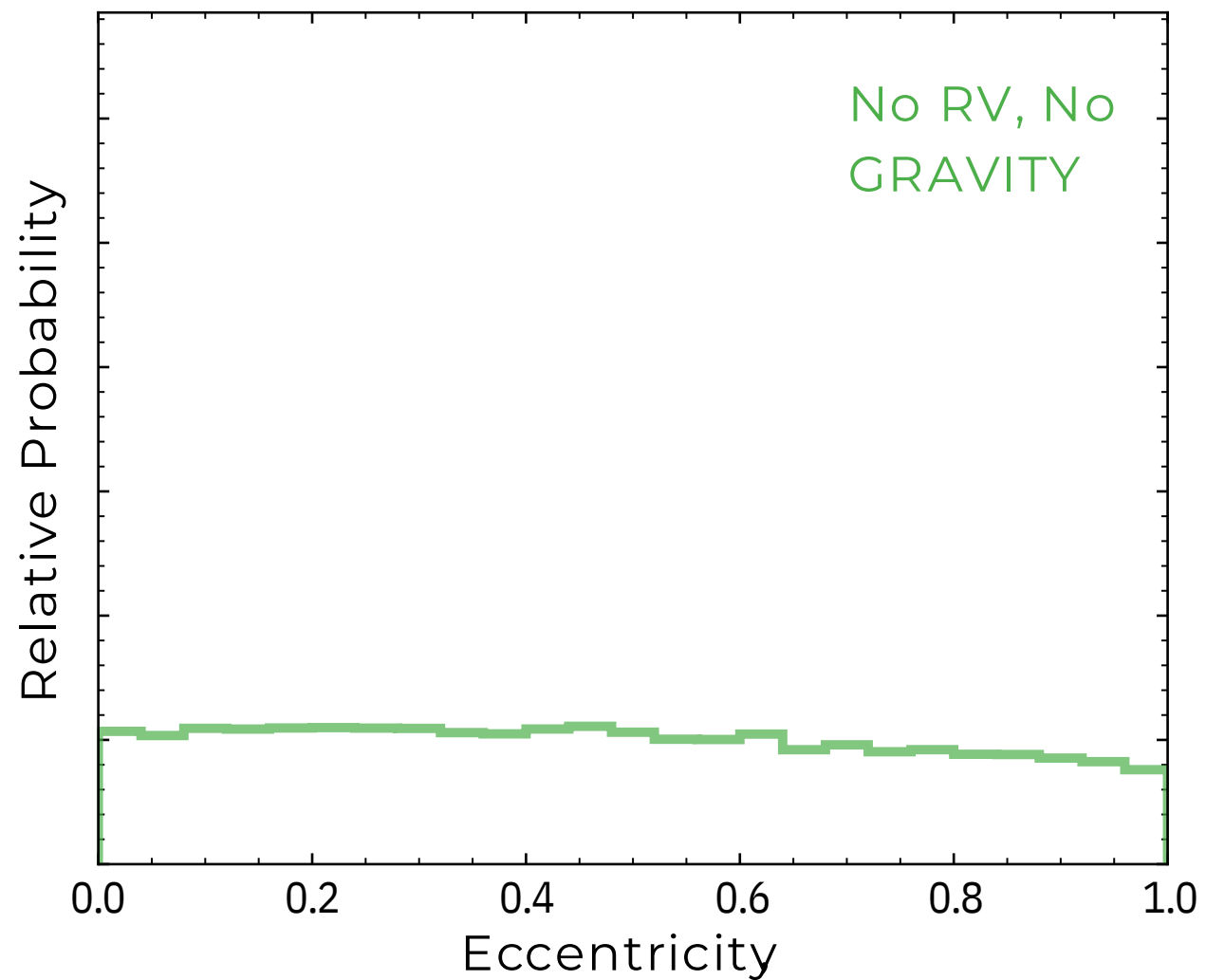
Schwarz et al., 2019

Without GRAVITY

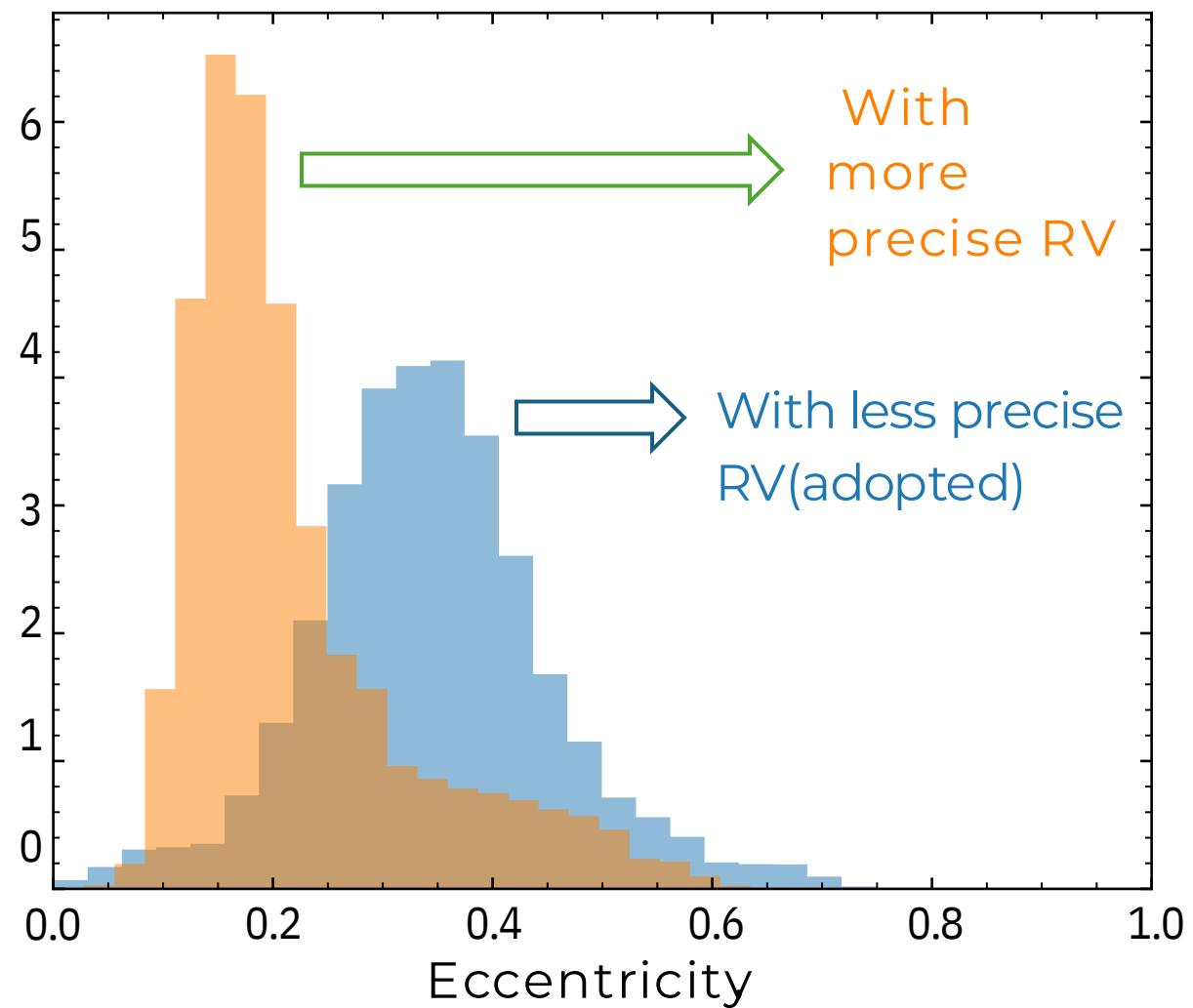


Venkatesan et al., (2025b)

Without GRAVITY

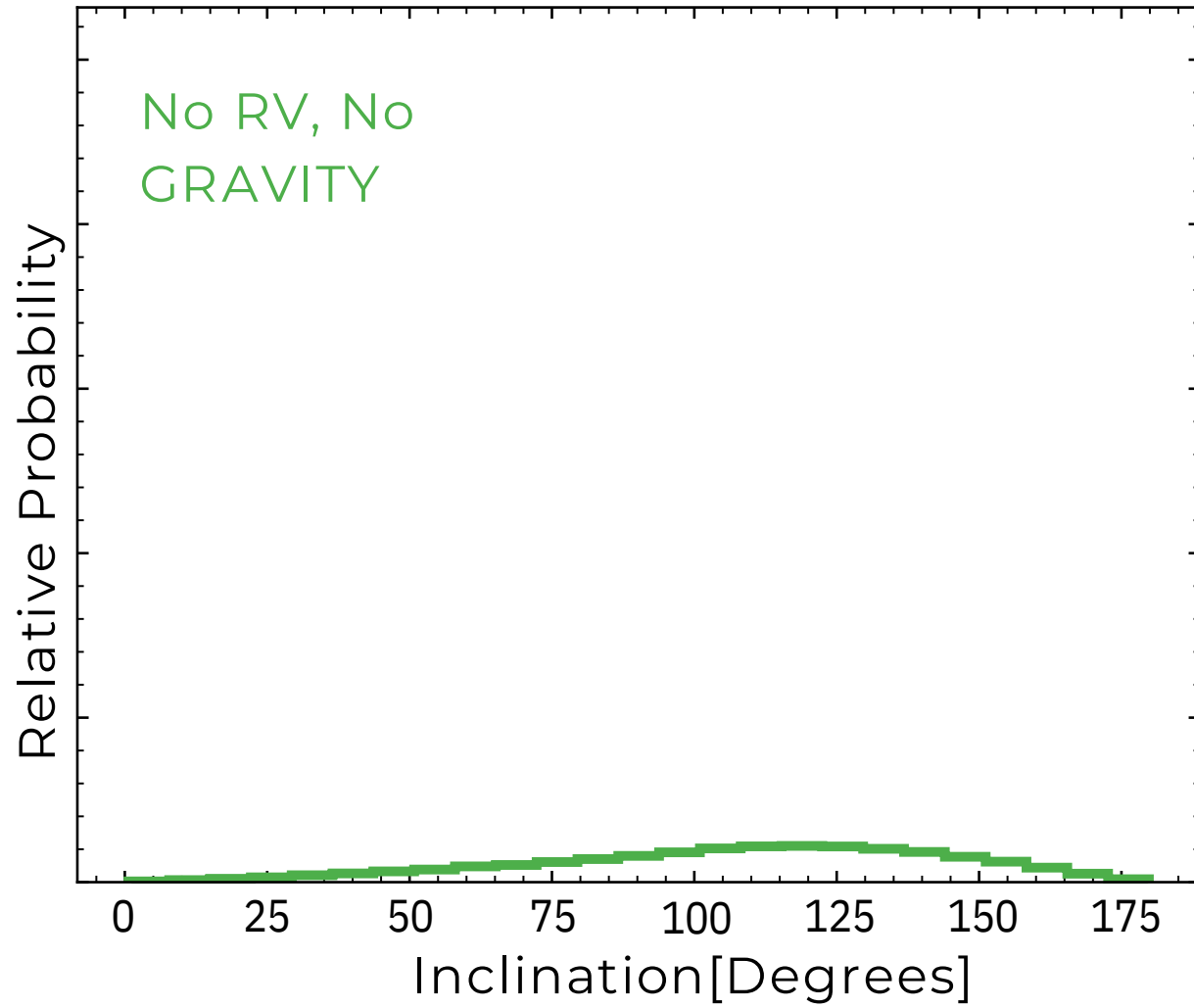


With GRAVITY



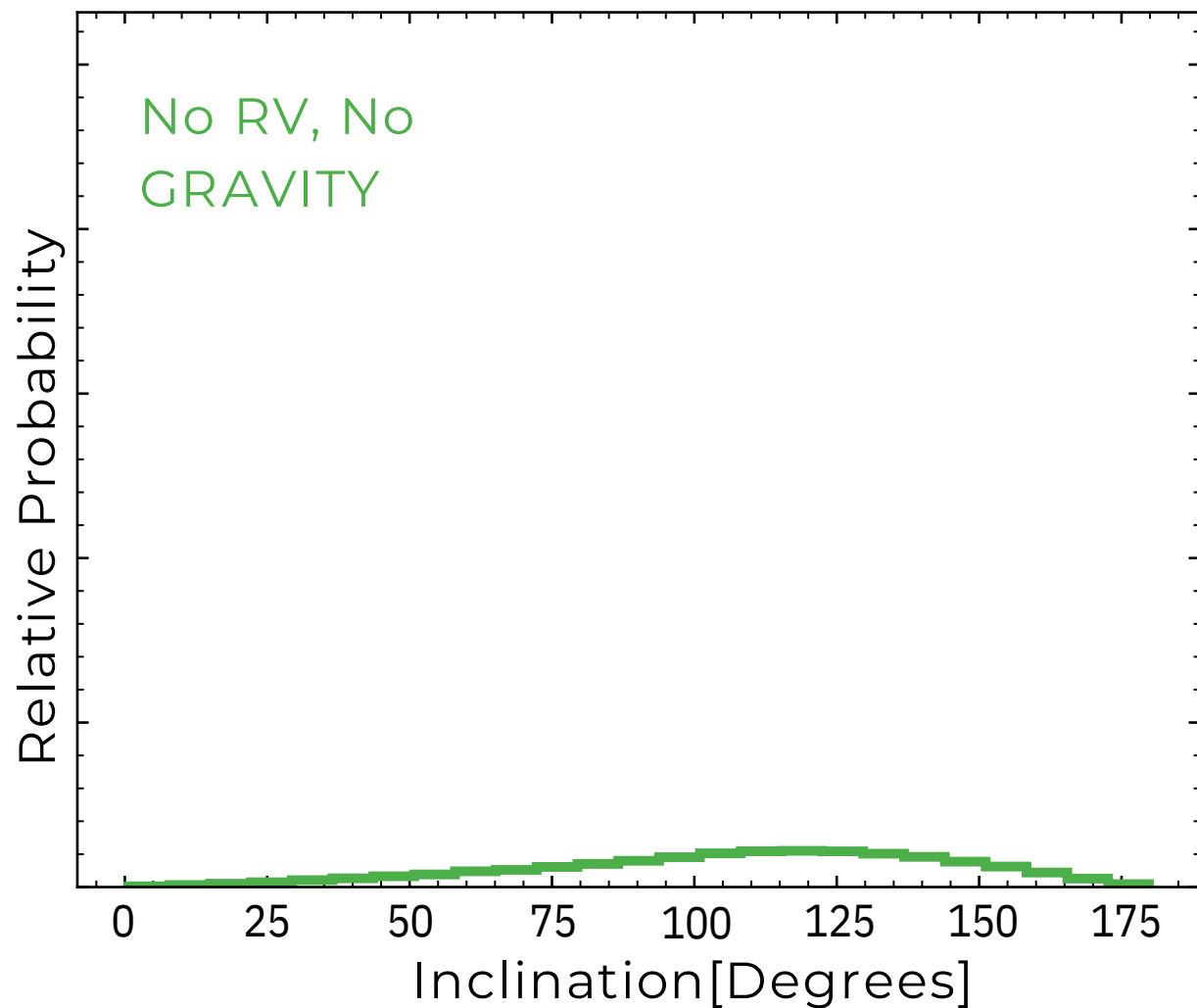
Venkatesan et al., (2025b)

Without GRAVITY

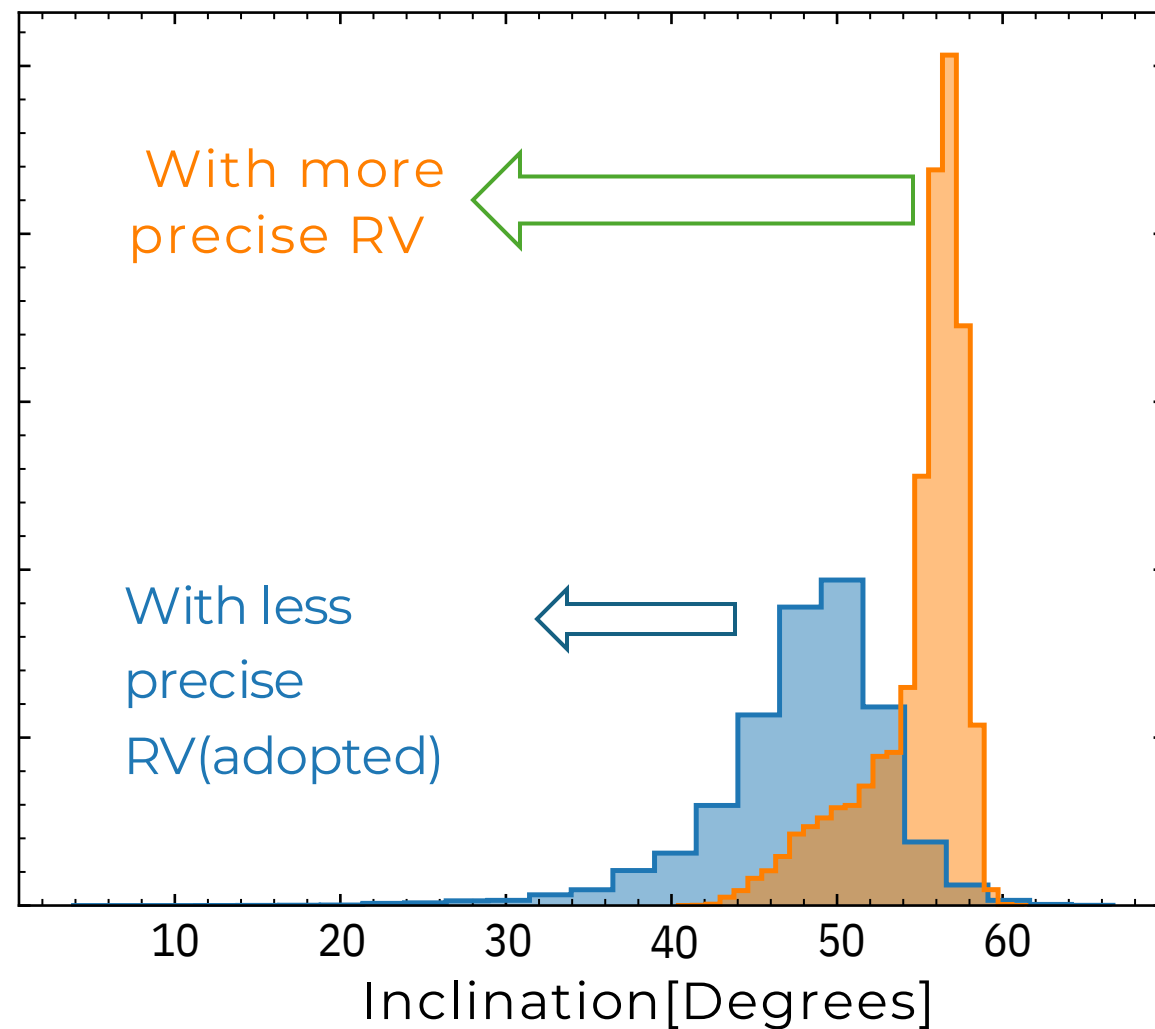


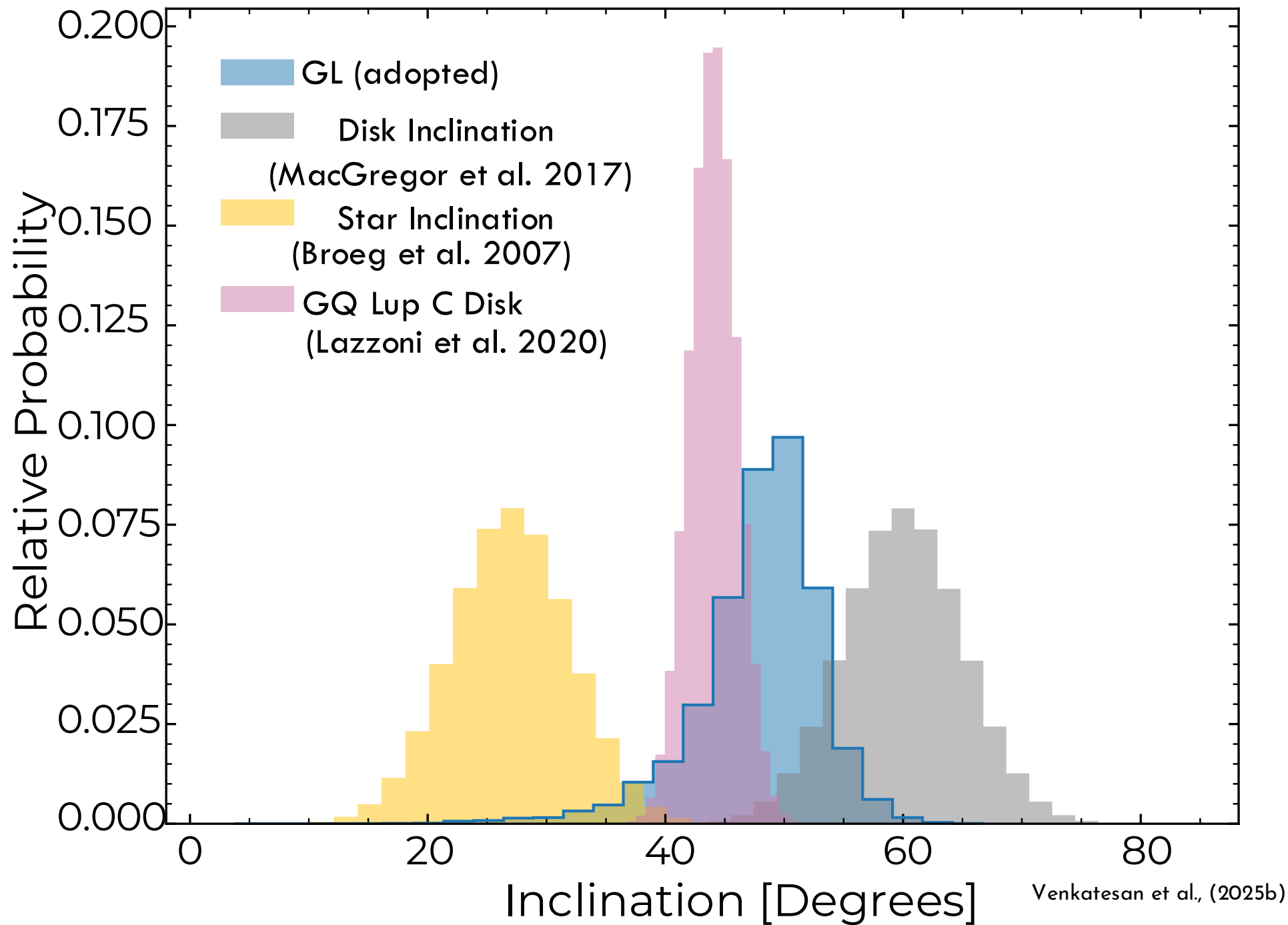
Venkatesan et al., (2025b)

Without GRAVITY



With GRAVITY





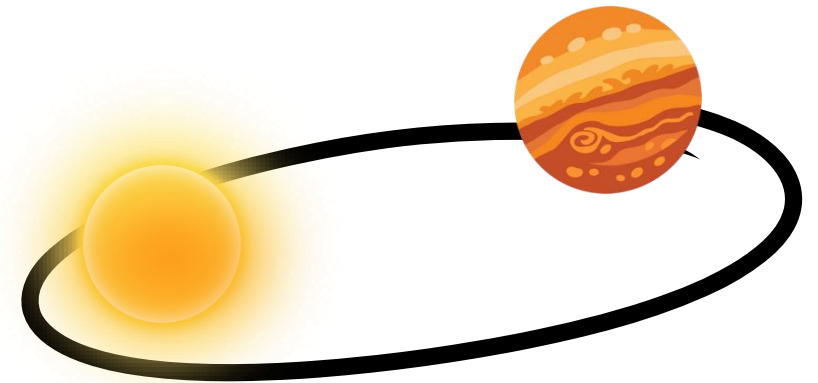
Conclusions

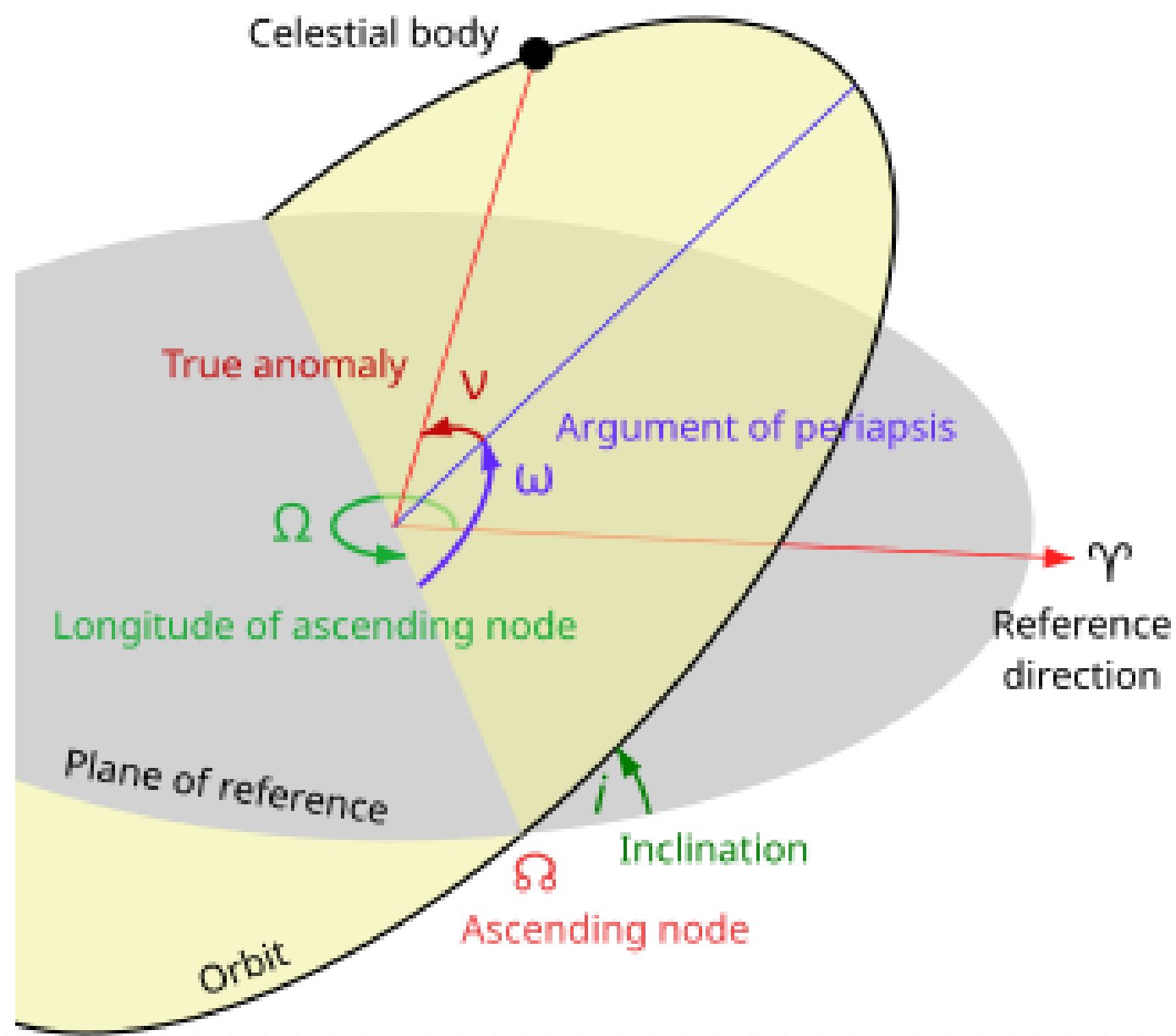
- Our orbit fit solution of GQ Lup B support formation via cloud fragmentation.
- Orbital alignment of GQ Lup B and C suggests co-formation in the same disk
- A combination of high precision astrometry and high-resolution RVs allows us to constrain dynamics of wide separation companions for the first time. Future work to apply this to more systems and study them at a population level.

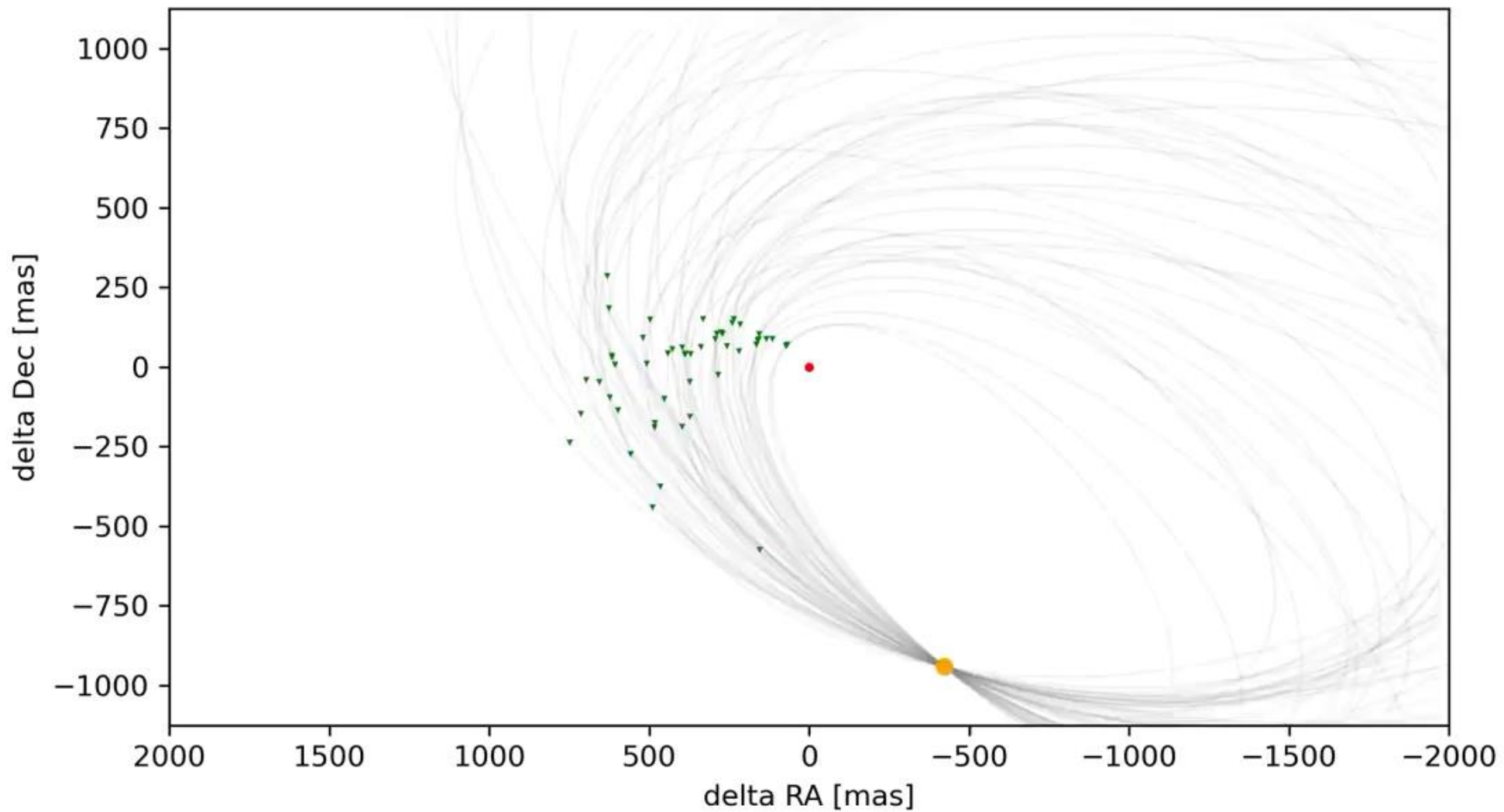
THANK YOU!



vidyav1@uci.edu

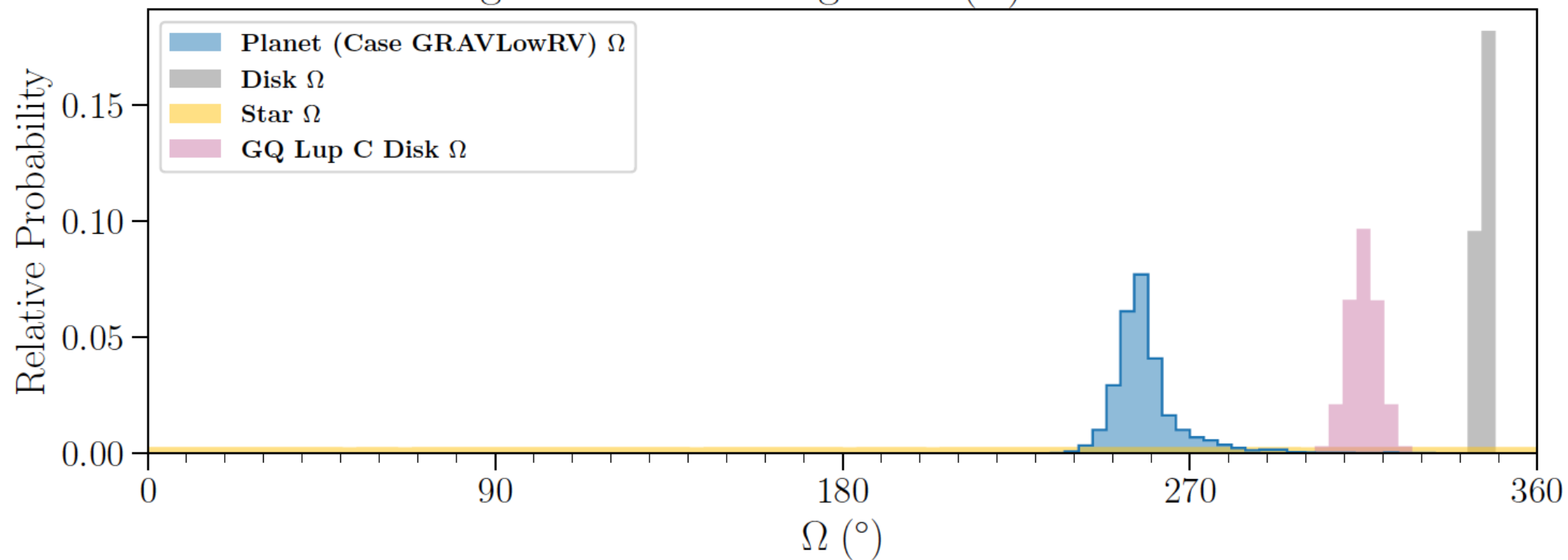






Matt Kenworthy

Longitude of Ascending Node (Ω) Distributions



Mutual Inclination Distributions

