The Distant Giants Survey

(+some planet/BD occurrence rates)

Judah Van Zandt
Postdoc, UC Santa Barbara
OHP 51 Peg b October 7, 2025

SURVEY OVERVIEW

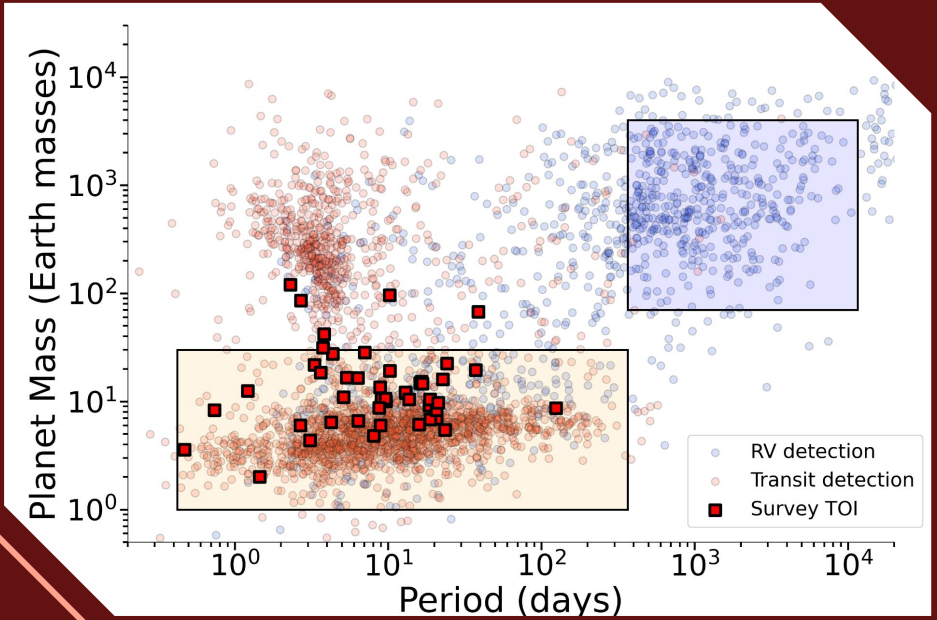
Duration	3 years
Method	Doppler spectroscopy
Sample	47 Sun-like SP-hosting TESS stars
Objective	Determine P(CJ | SP)
Result	P(CJ | SP)=30±10%, P(CJ) = 16±2%

MOTIVATIONS

01. Resolve theoretical disagreements about the relationship between CJ and SP planets

02. Develop an understanding of the CJ-SP relationship for future habitability studies

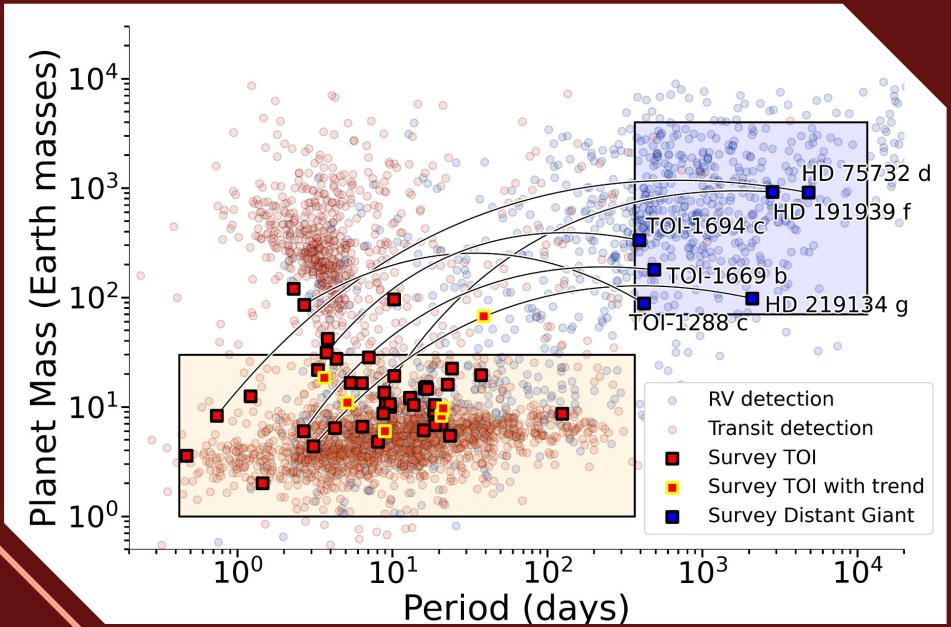
SURVEY DESIGN



01. Begin with 47 SP-hosting at least one transiting planet

02. Monitor with monthly RVs at 2 m/s precision for 3 years to look for giants

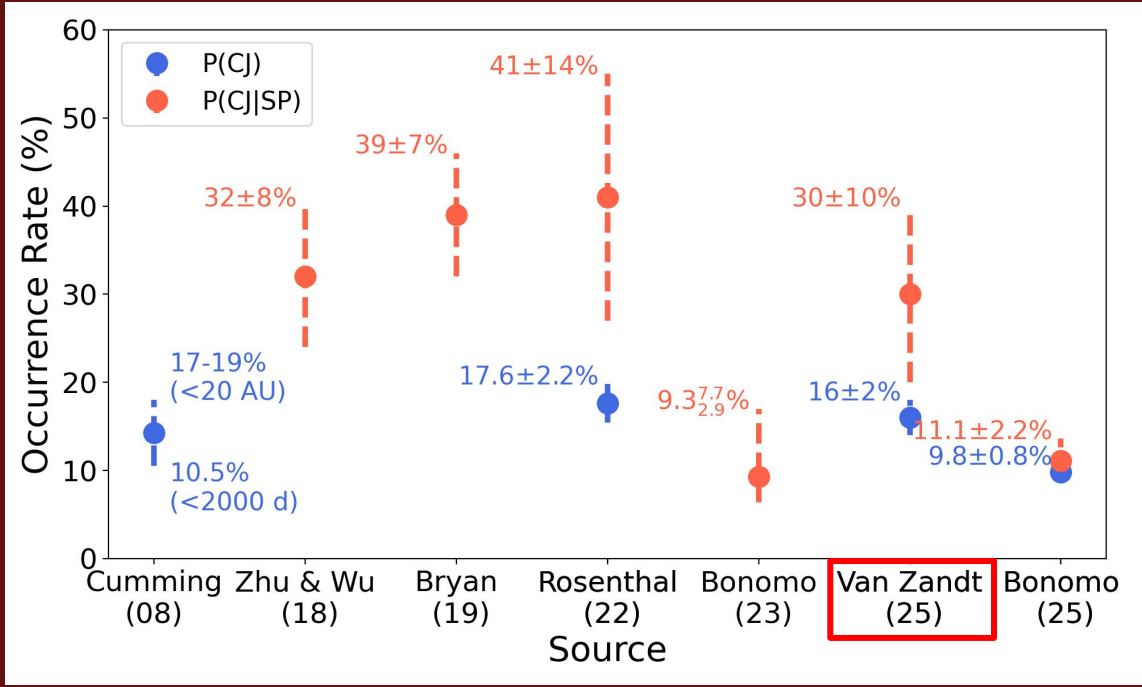
DETECTIONS



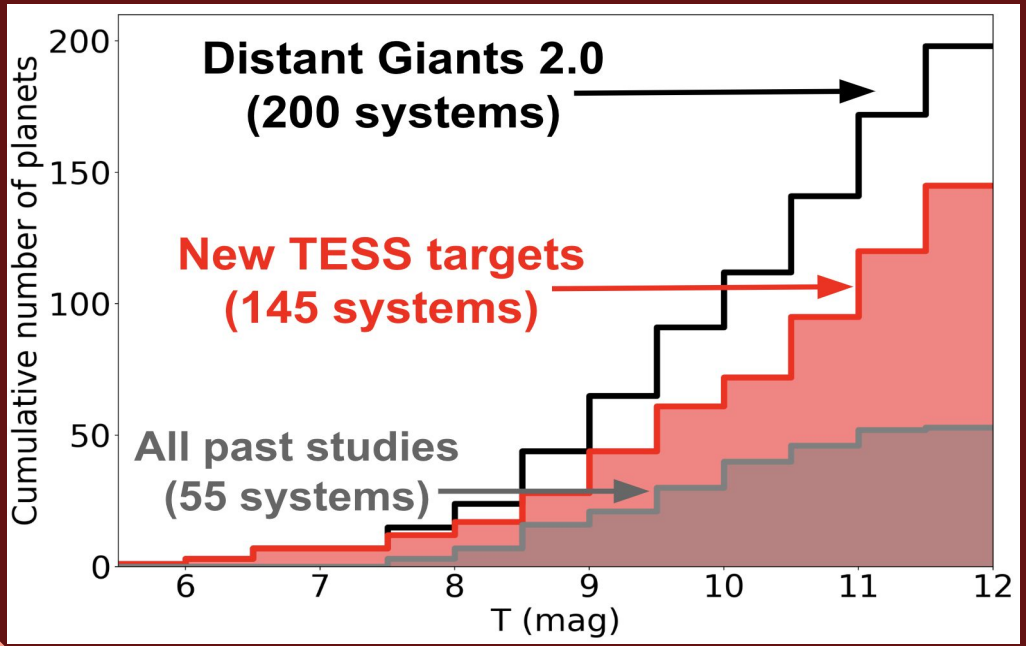
01. 4 new distant giants with fully measured orbits

02. 6 RV trends which could be planetary

RESULT: a possible enhancement of CJs in SP systems



FUTURE DIRECTIONS: 47 targets → 200



01. TESS pool has quadrupled since 2020

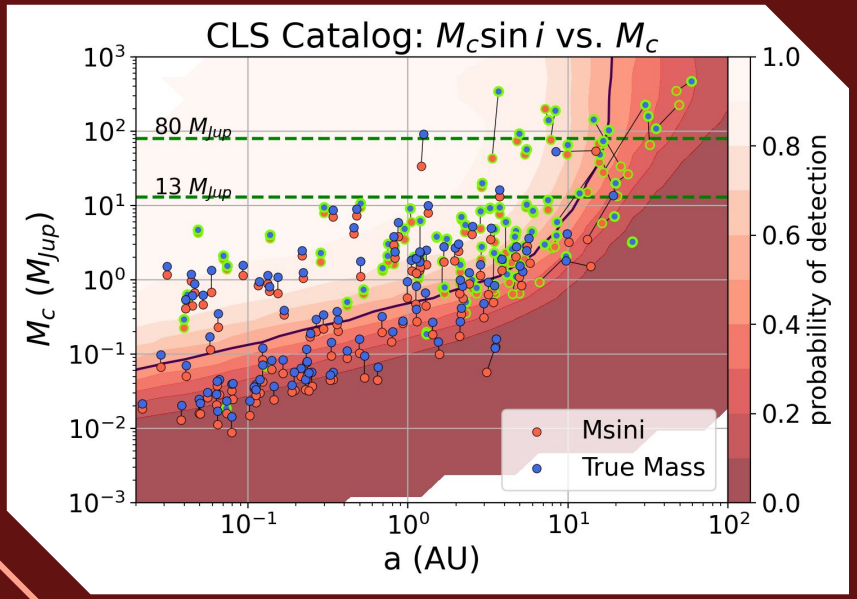
02. 4x the targets would shrink errors from 10%→5%

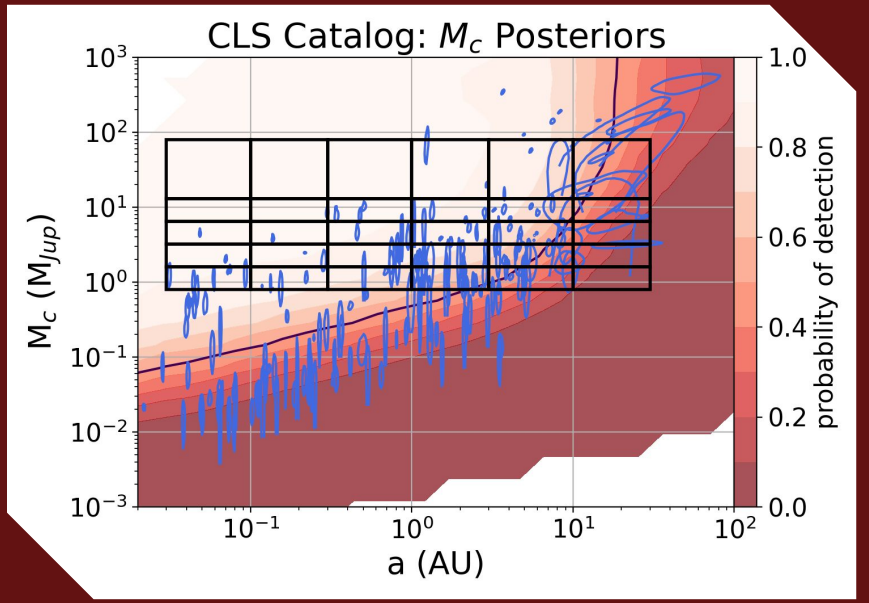
03. More efficient spectrographs: NEID, MAROON-X, KPF

The Occurrence of Giant Planets and Brown Dwarfs from RVs and Astrometry

Van Zandt et al. (submitted)

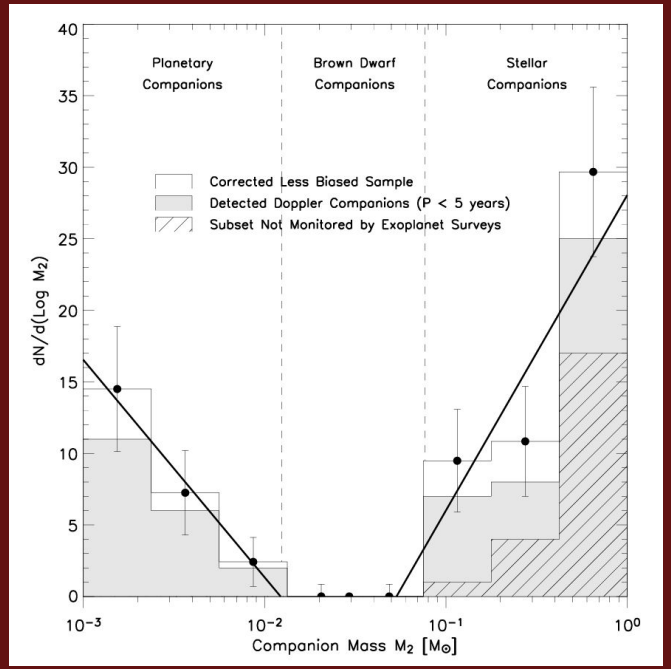
CLS REFIT: ~half of Doppler BDs are stars





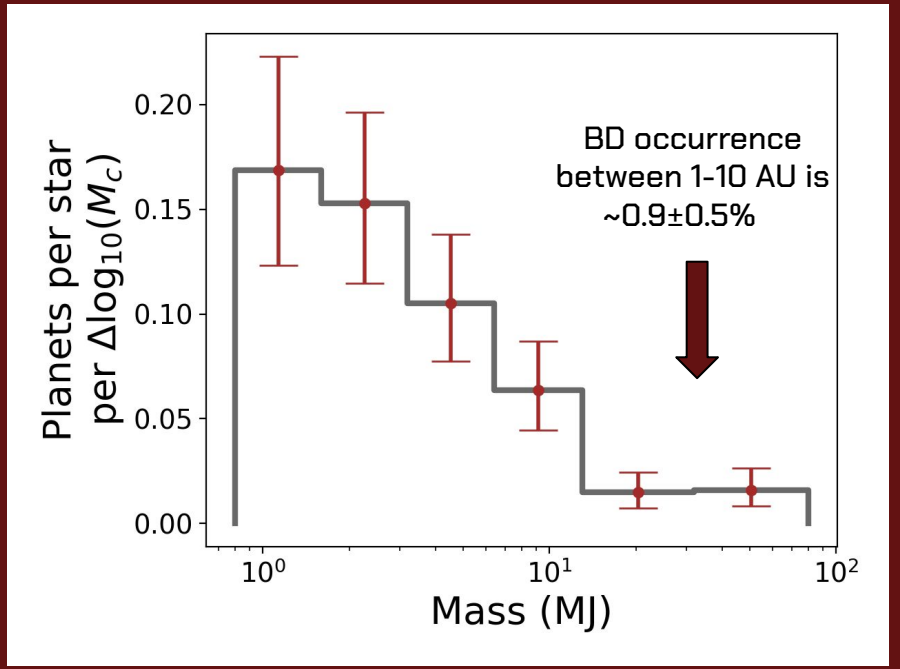
CLS REFIT: the BD desert extends to 10 AU

Occurrence rates for P<5 yr



Grether & Lineweaver (2006)

Occurrence rates between 1-10 AU



Van Zandt et al. (submitted)

KEY TAKEAWAYS

01. Measuring P(CJ|SP) is important, but difficult due to sample size and purity

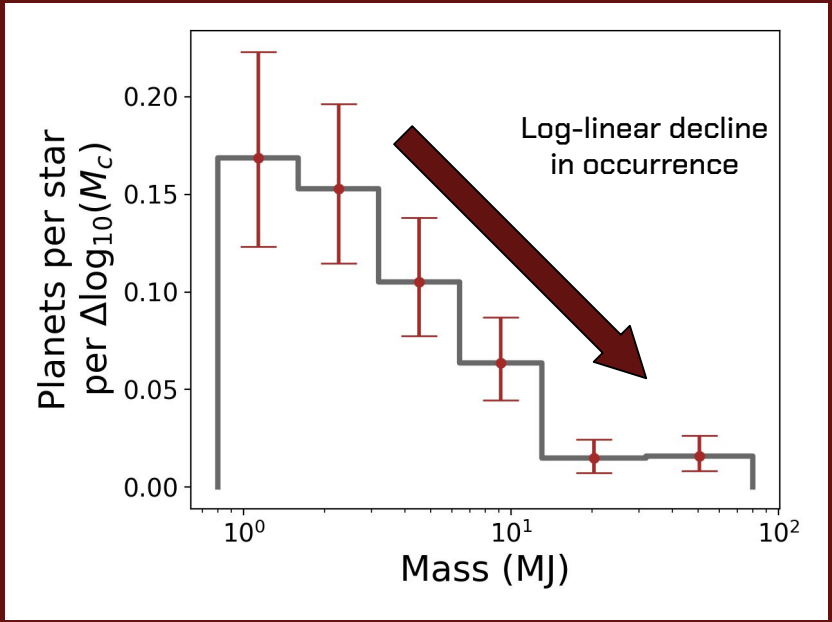
02. We found that **P(CJ|SP)=30±10%**, a ~1.5σ enhancement

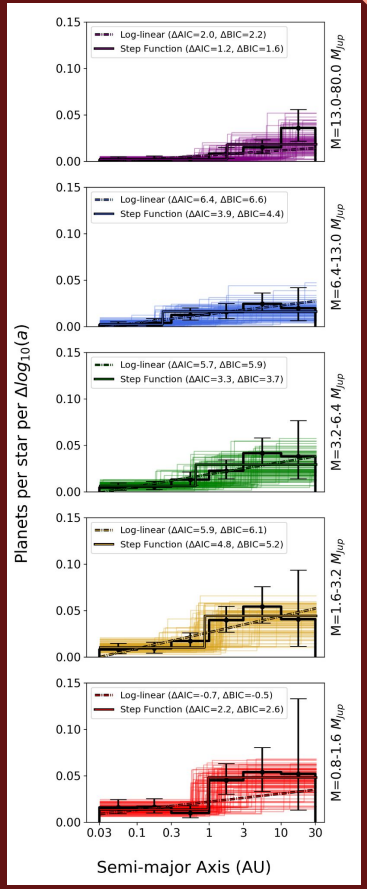
03. sin(i) contamination can be highly relevant for rare objects like BDs

04. The BD desert **extends to at least 10 AU**

05. The semi-major axis distributions of planets/BDs do not indicate a sharp divide

SUPPLEMENTAL – no sharp planet/BD transition evident from mass and SMA distributions

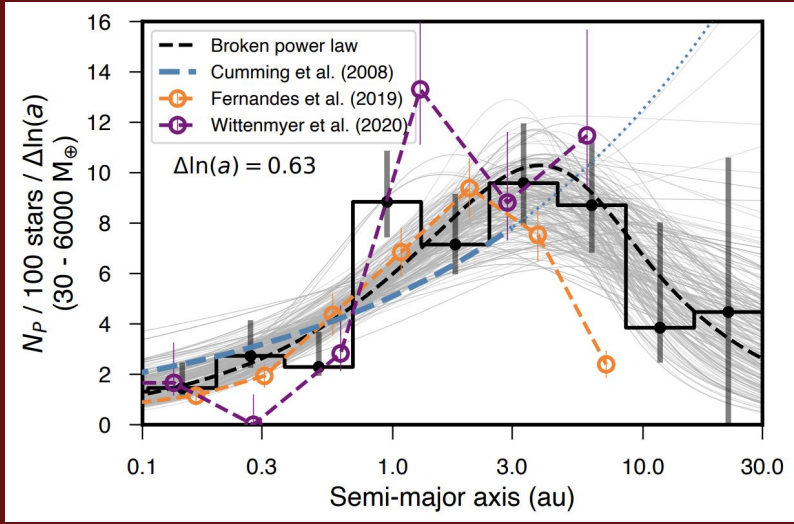




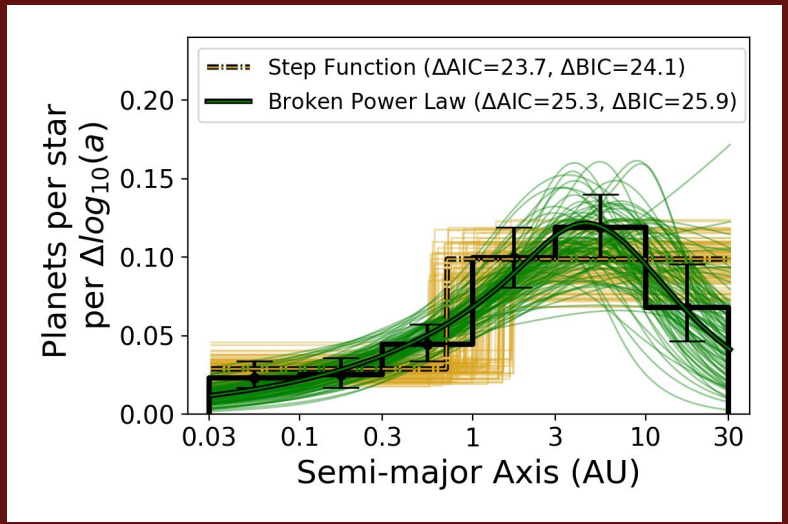
No clear evidence of a sharp distribution change

SUPPLEMENTAL – true mass distribution is consistent with Fulton et al. (2022)

Msini = 0.1-18.9 M_J (Fulton+2022)



M = 0.8-80 M_J (Van Zandt submitted)



Both distributions show a peak between 1-10 AU followed by a marginally significant fall-off at *a*>10 AU

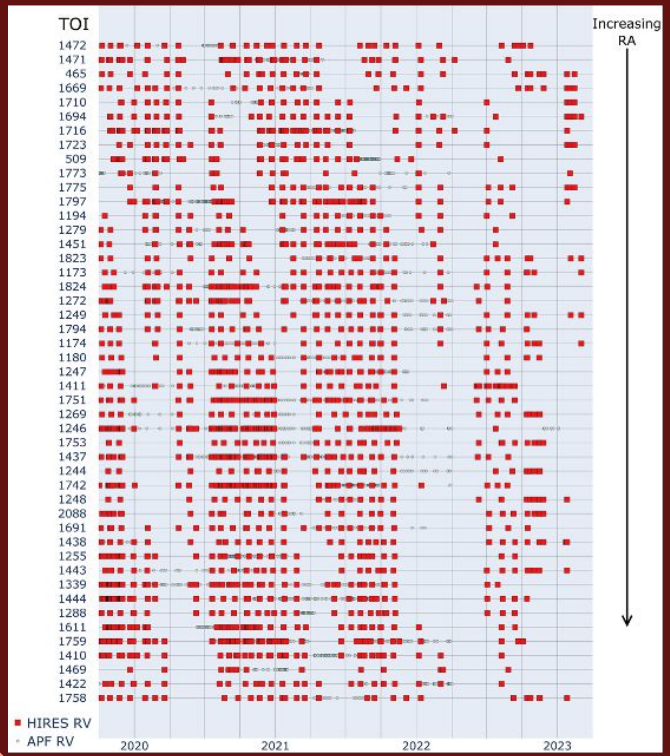
SUPPLEMENTAL - survey criteria

Table 1. Survey Criteria

Parameter	TKS	Distant Giants Survey		
		Photometric	Manual	Spectroscopic
Declination	$> -30°$	$> 0°$	—	—
V	< 13.0	< 12.5	—	—
Evolutionary State	MS or SG	MS	—	—
RUWE	< 2	< 1.3	—	—
R_P	< 22 $R_\oplus$	< 10 $R_\oplus$	—	—
Transit Pipeline	—	—	SPOC	—
Detection Significance	SNR > 10	—	MES > 12	—
Close Companion	$\Delta V > 5$ or sep > 2"	—	$\Delta V > 5$ or sep > 4"	—
$M_\star$	—	—	—	$0.5\ M_\odot < M_\star < 1.5\ M_\odot$
$T_{\rm eff}$	< 6500 K	—	—	< 6250 K
$v \sin i$	—	—	—	< 5.0 km/s
$\log R'_{\rm HK}$	—	—	—	< -4.7

Note—Filters applied to 2045 TESS systems to produce the Distant Giants sample. TKS filters are taken from Chontos et al. (2021). Although other filters were applied to produce the TKS sample, we show only those used in our survey's target selection process. MS and SG refer to main sequence and subgiant stars, respectively.

SUPPLEMENTAL - observations



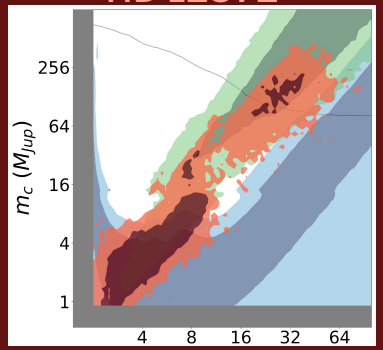
01. 3.5-year survey duration

02. 4000+ RV observations

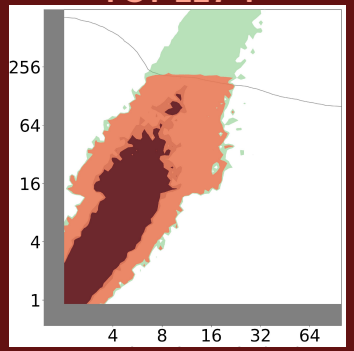
year-round observing for 3.5 years

SUPPLEMENTAL - trends

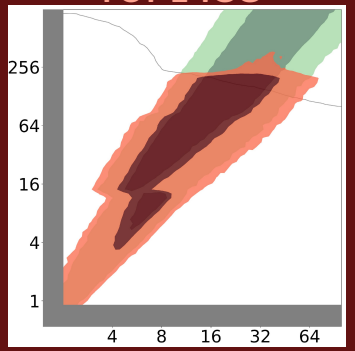
HD 12572



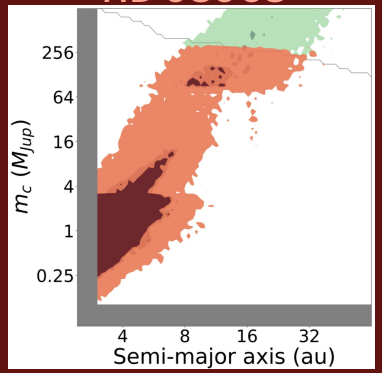
TOI-1174



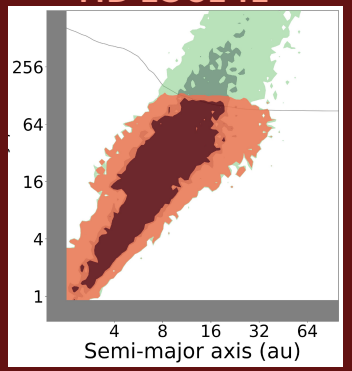
TOI-1438



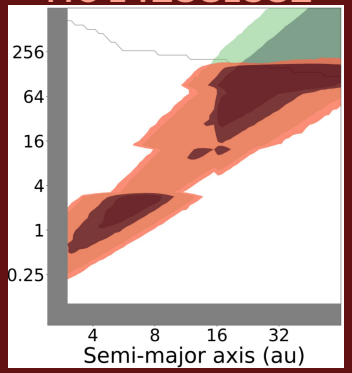
HD 93963



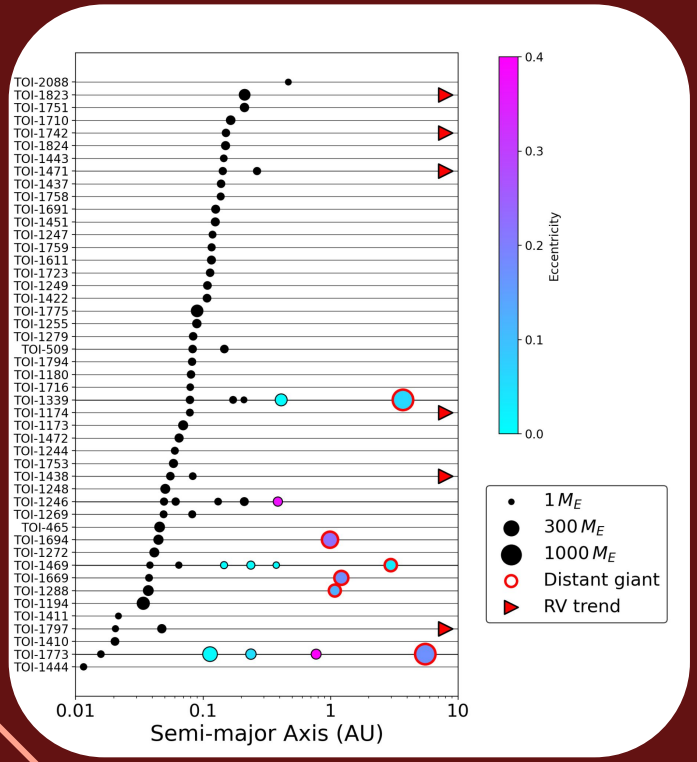
HD 156141

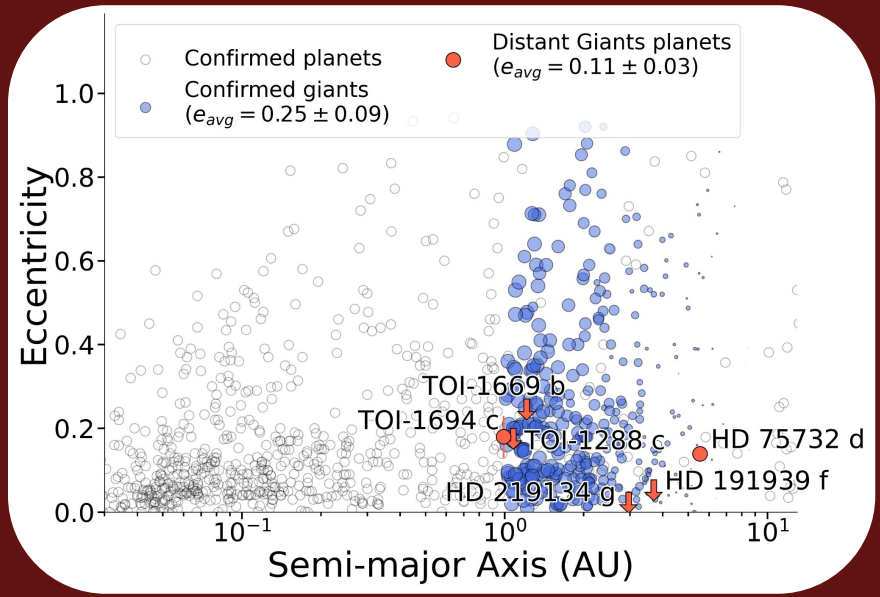


TIC 142381532



SUPPLEMENTAL: dynamical correlations



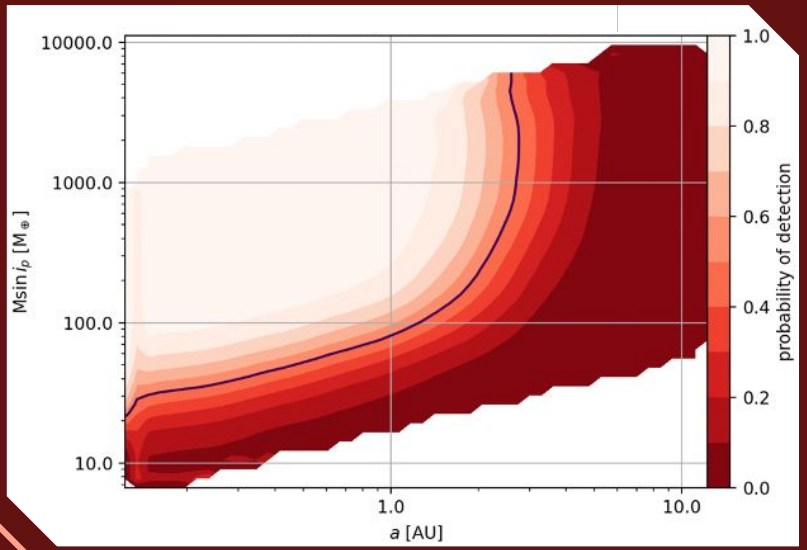


1) CJs may have shorter-period companions

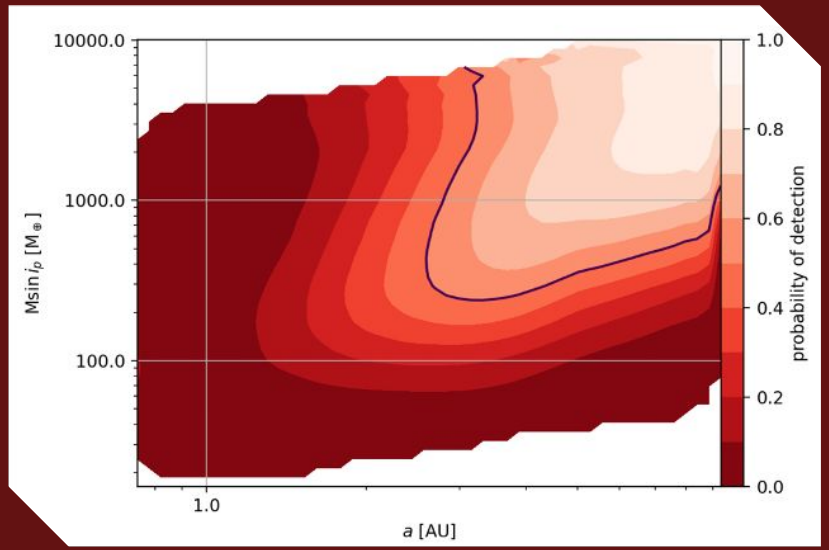
2) CJs may have lower eccentricities

SUPPLEMENTAL - completeness

Completeness to full orbits

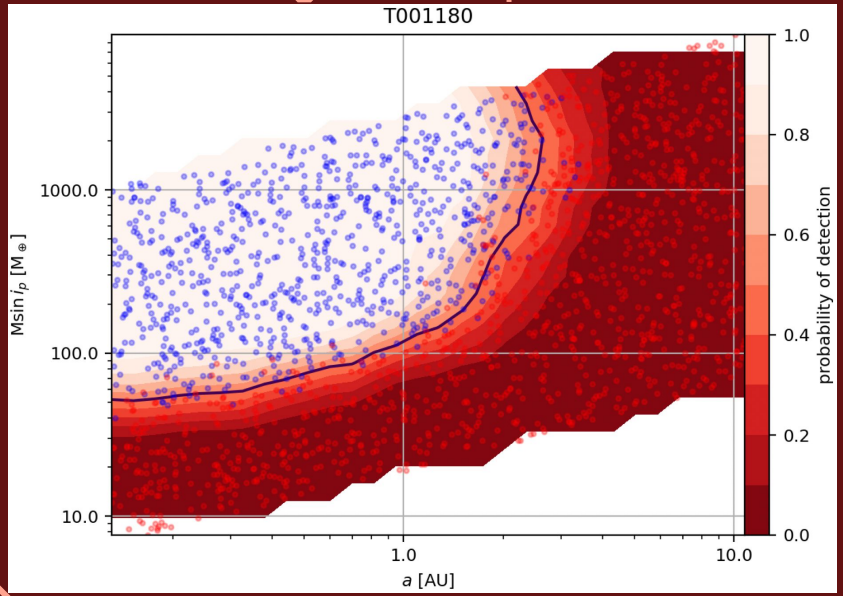


Completeness to trends

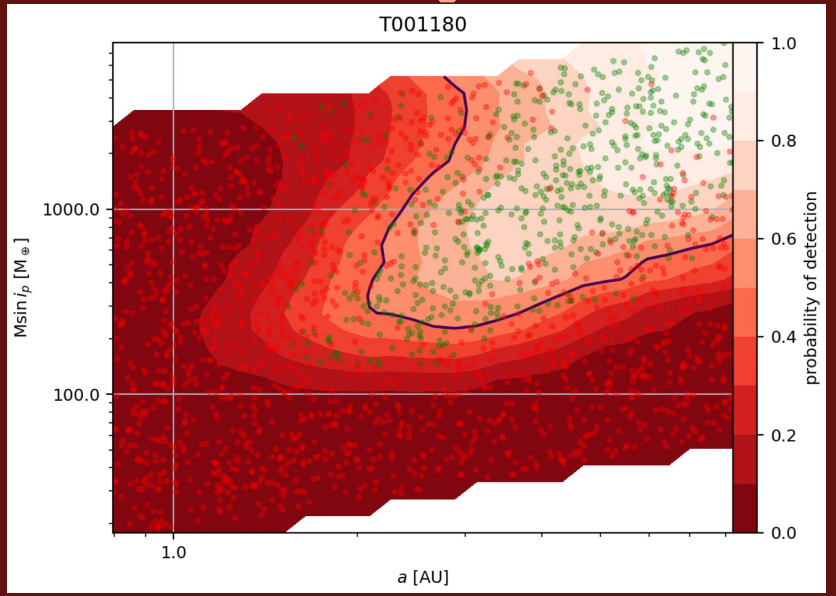


SUPPLEMENTAL - completeness

Sensitivity to complete orbits



Sensitivity to trends



SUPPLEMENTAL - occurrence