



Exoplanets, unraveling a new paradigm

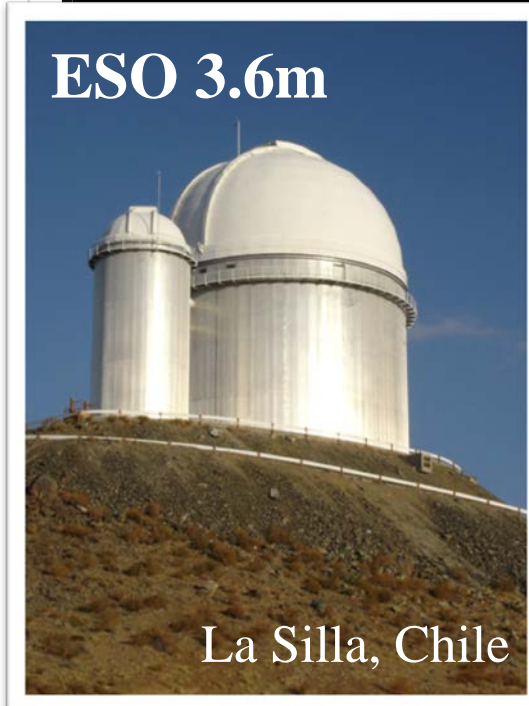
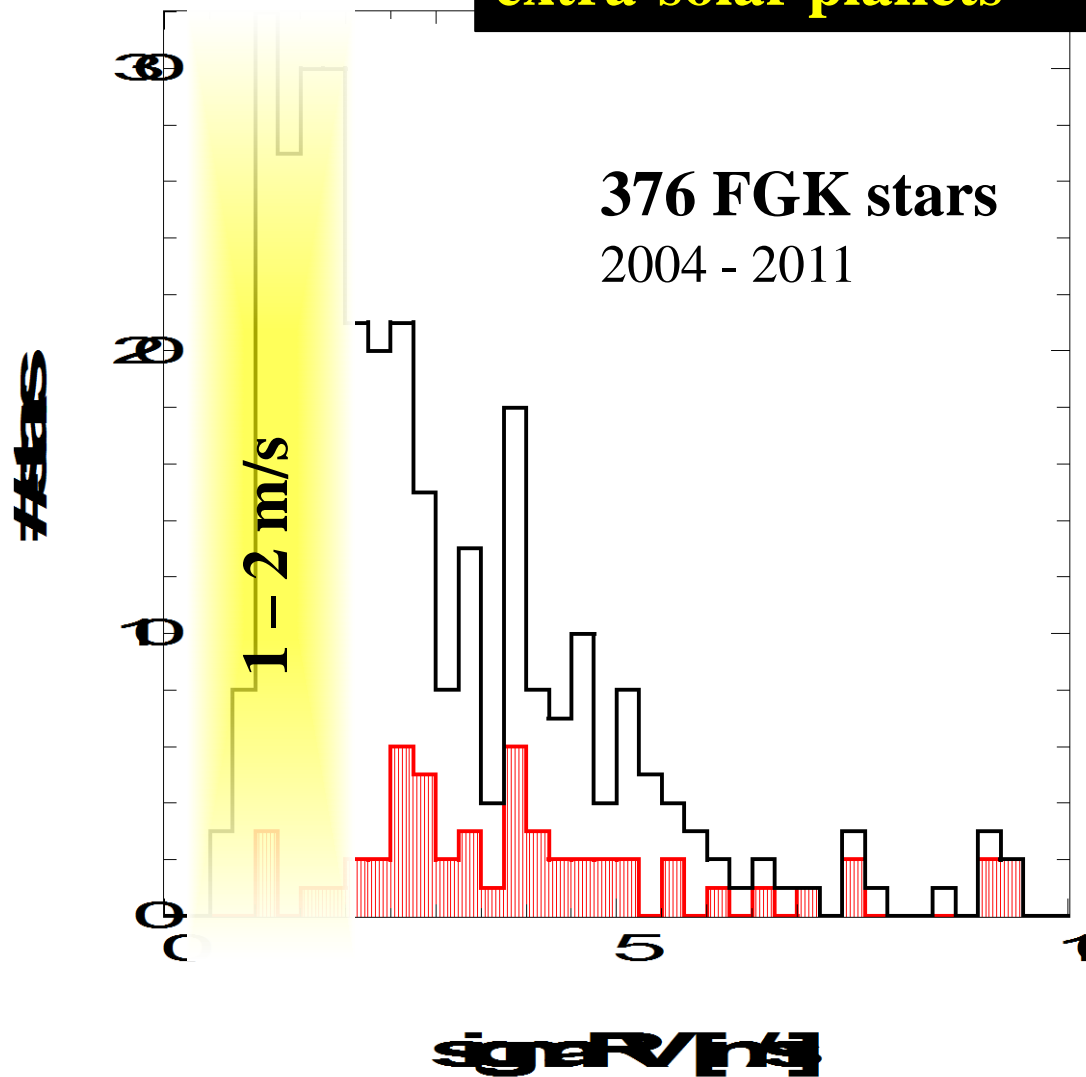


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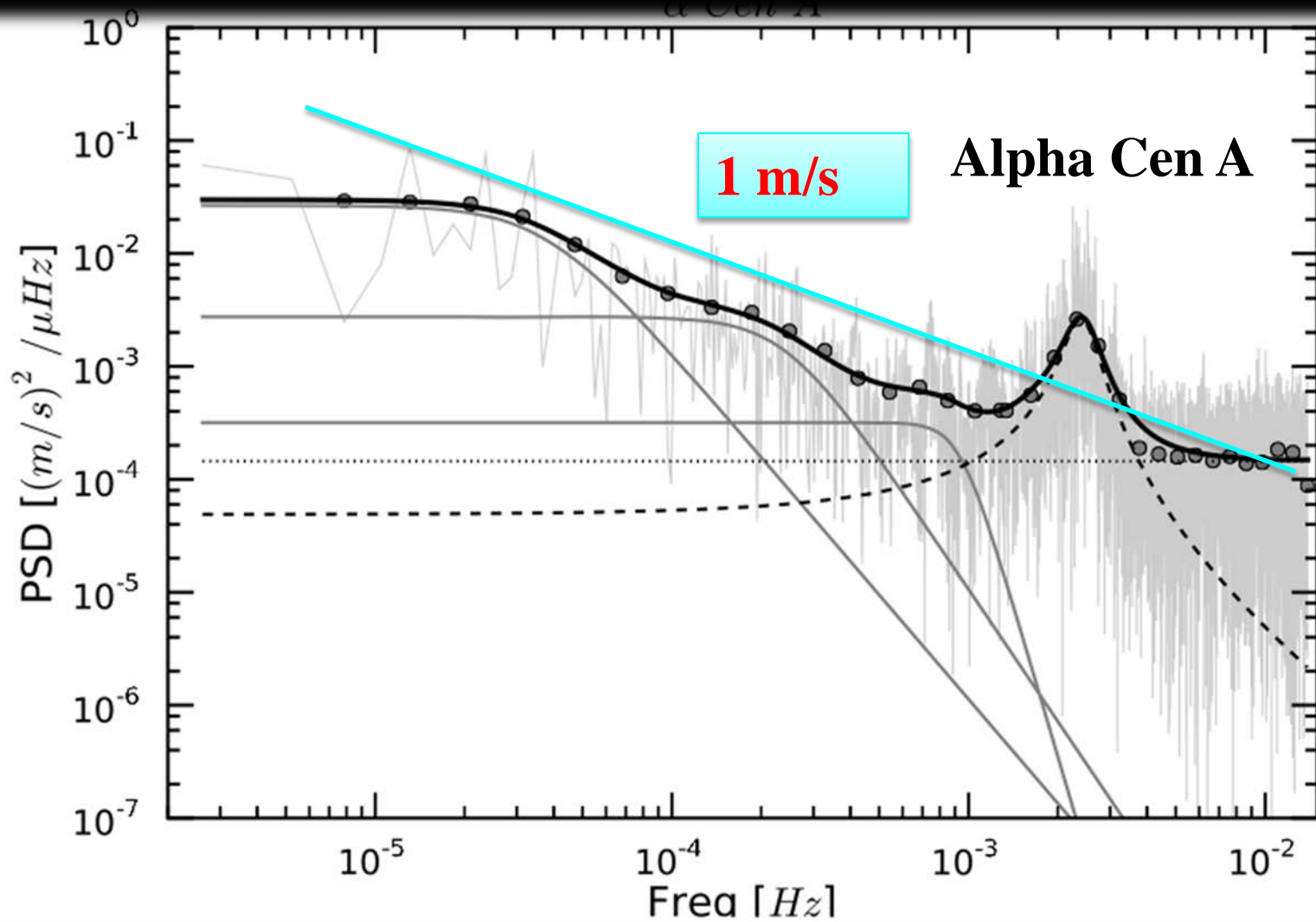
FACULTÉ DES SCIENCES
Département d'astronomie



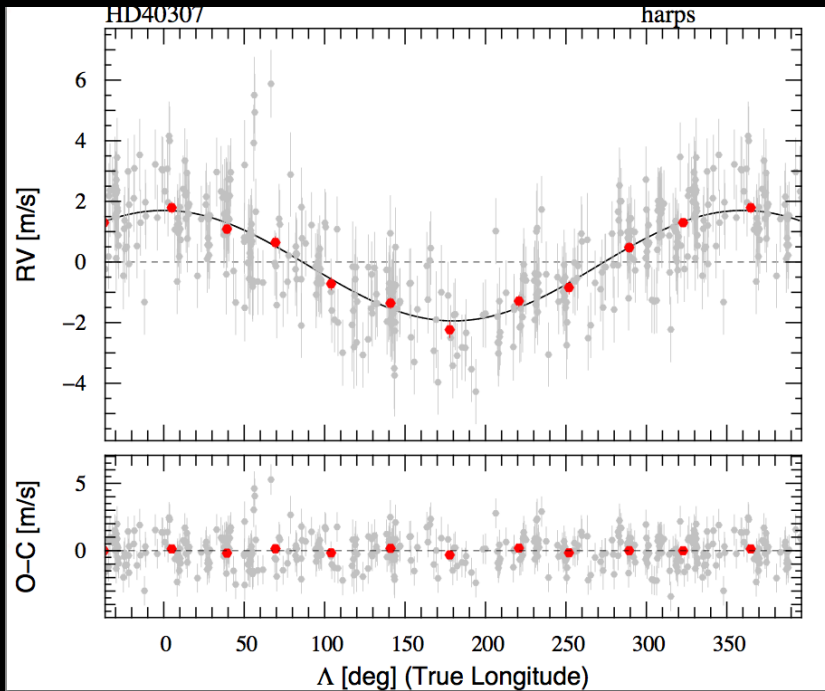
The HARPS search for southern extra-solar planets



Stellar « noise »



Pushing down the limits



397 data points:

O-C=1.00 m/s

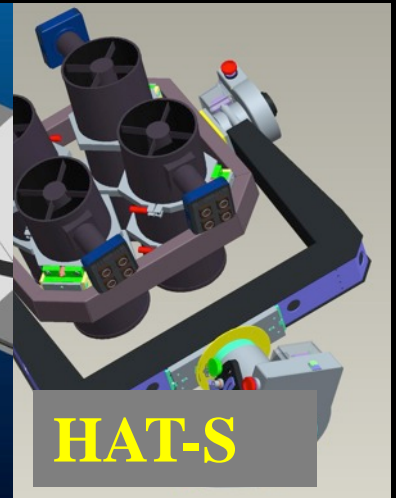
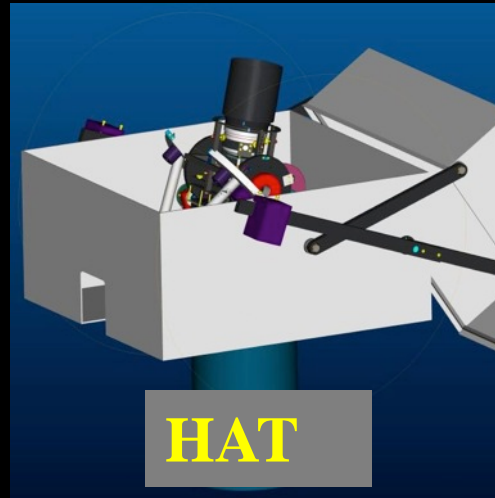
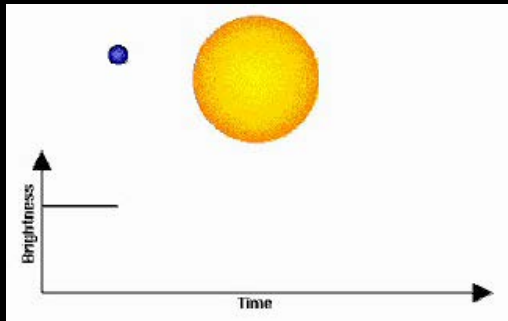
10 binned data points:

O-C = 18 cm/s

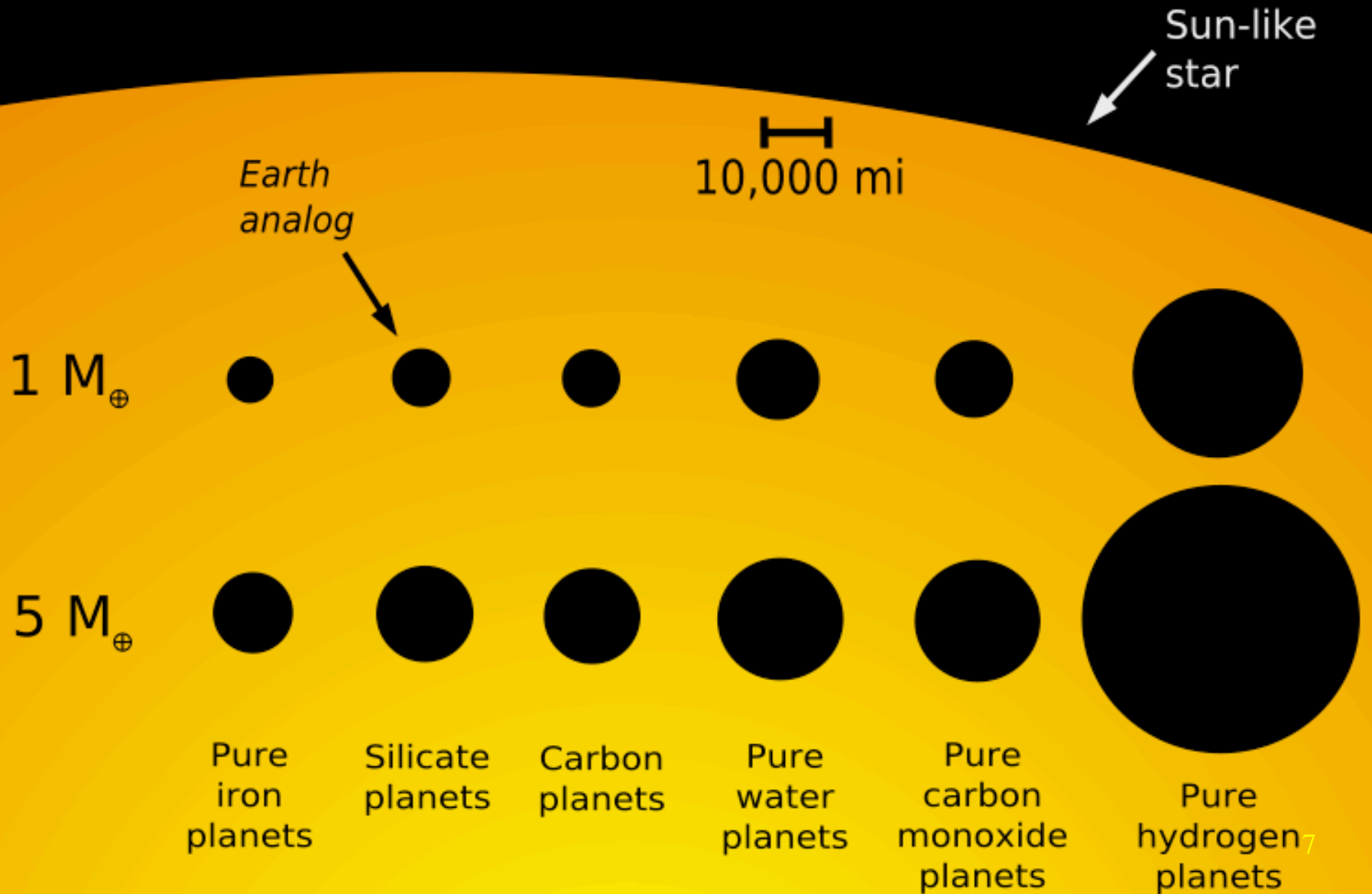
HD 40307
K2 V

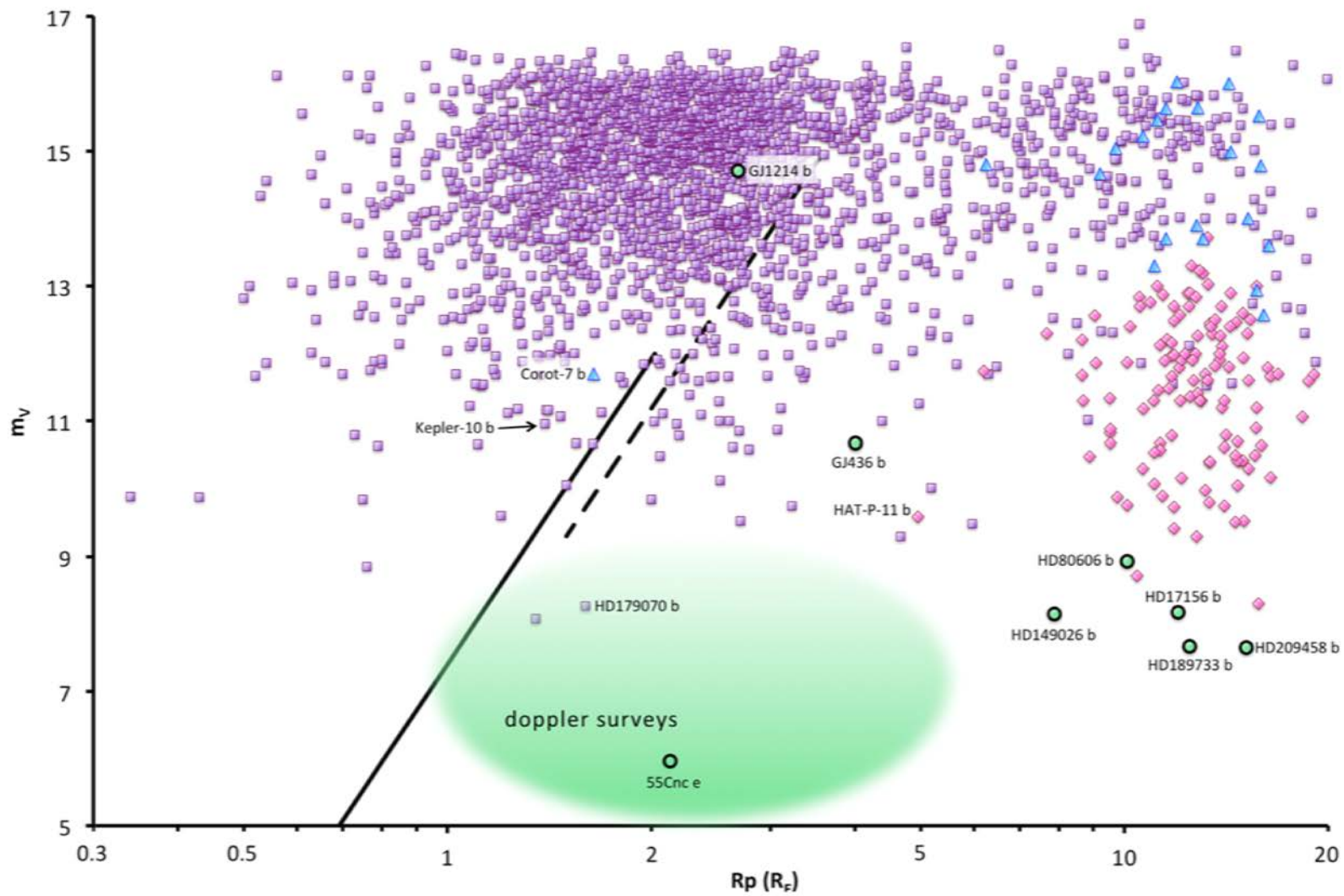
Parameter		HD 40307 b	HD 40307 c	HD 40307 d
P	[days]	4.3115 ± 0.0006	9.620 ± 0.002	20.46 ± 0.01
T	[JD-2 400 000]	$54\,562.77 \pm 0.08$	$54\,551.53 \pm 0.15$	$54\,532.42 \pm 0.29$
e		0.0	0.0	0.0
ω	[deg]	0.0	0.0	0.0
K	[m s ⁻¹]	1.97 ± 0.11	2.47 ± 0.11	4.55 ± 0.12
V	[km s ⁻¹]		31.332	
drift	[m s ⁻¹ /yr]		0.51 ± 0.10	
$f(m)$	[$10^{-14} M_{\odot}$]	0.35	1.53	3.59
$m_2 \sin i$	[M_{\oplus}]	4.2	6.9	9.2
a	[AU]	0.047	0.081	0.134

Transit search surveys

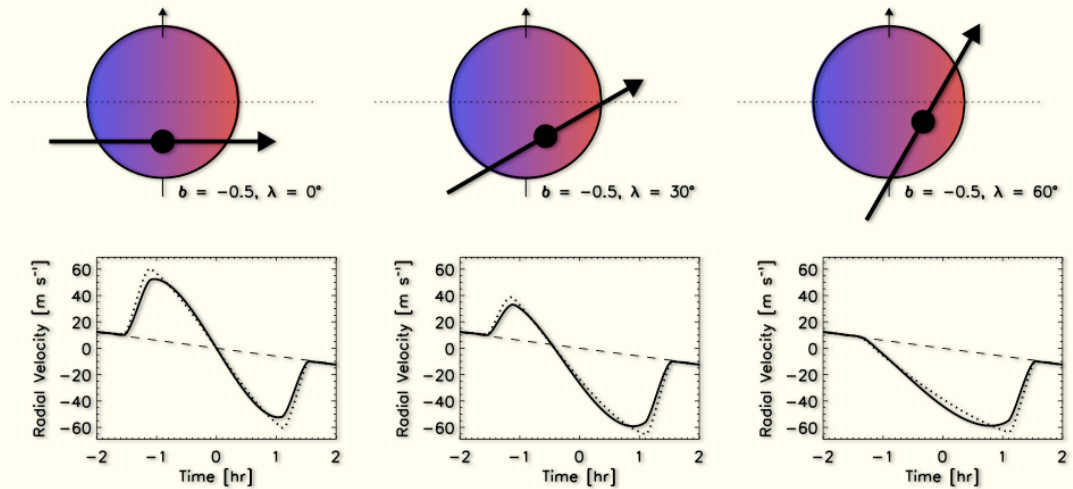
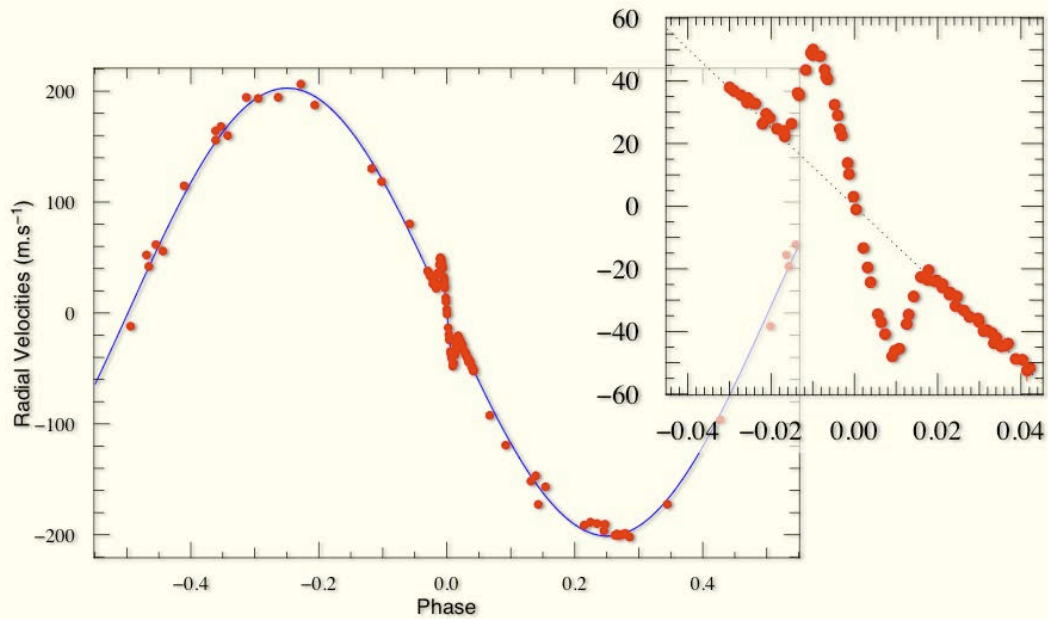


Predicted sizes of different kinds of planets



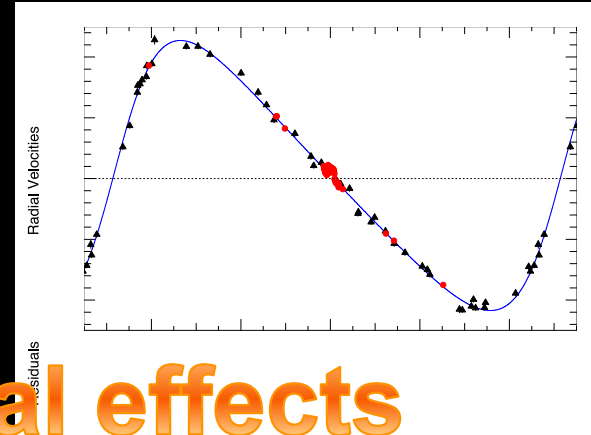
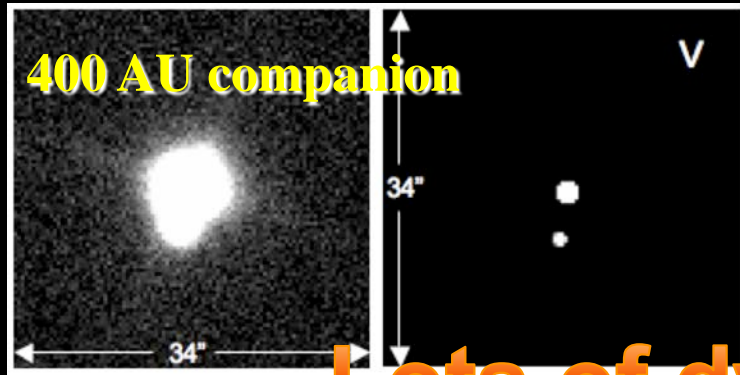


The Rossiter-MacLaughlin effect

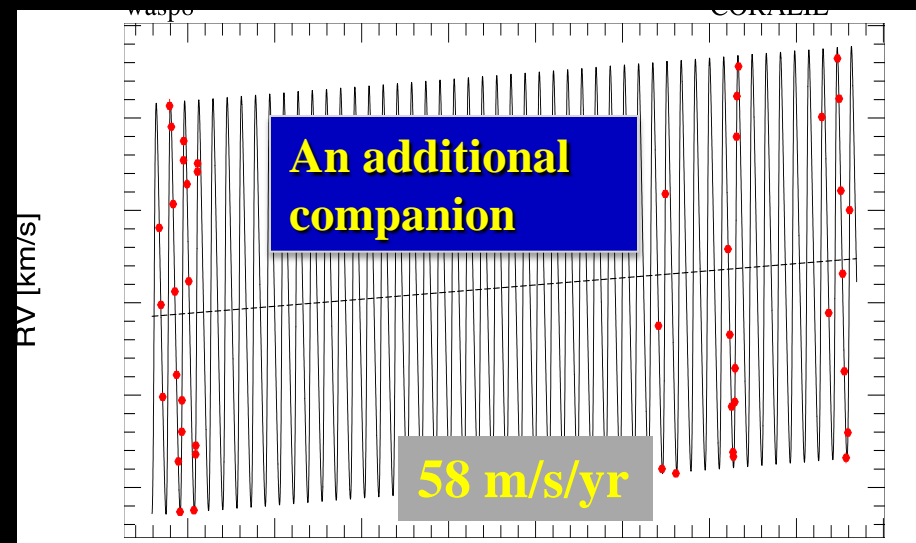
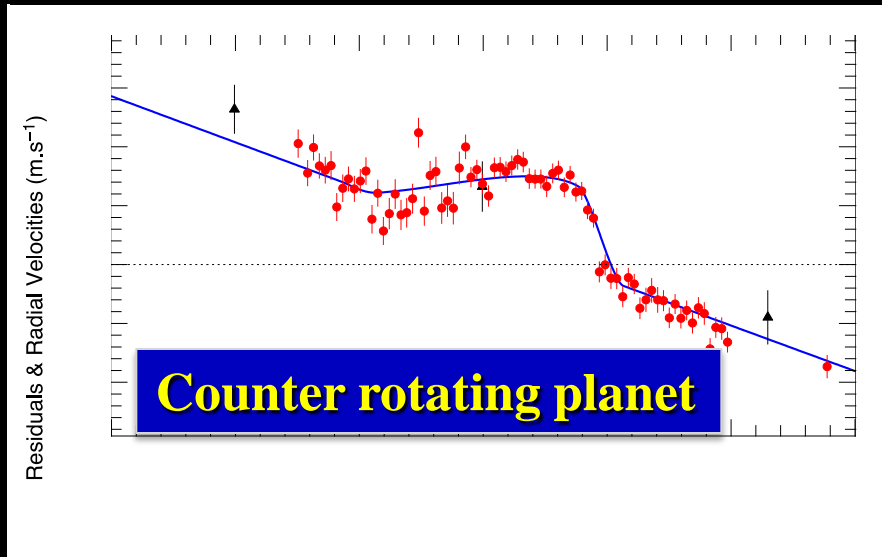


WASP-8 complex system

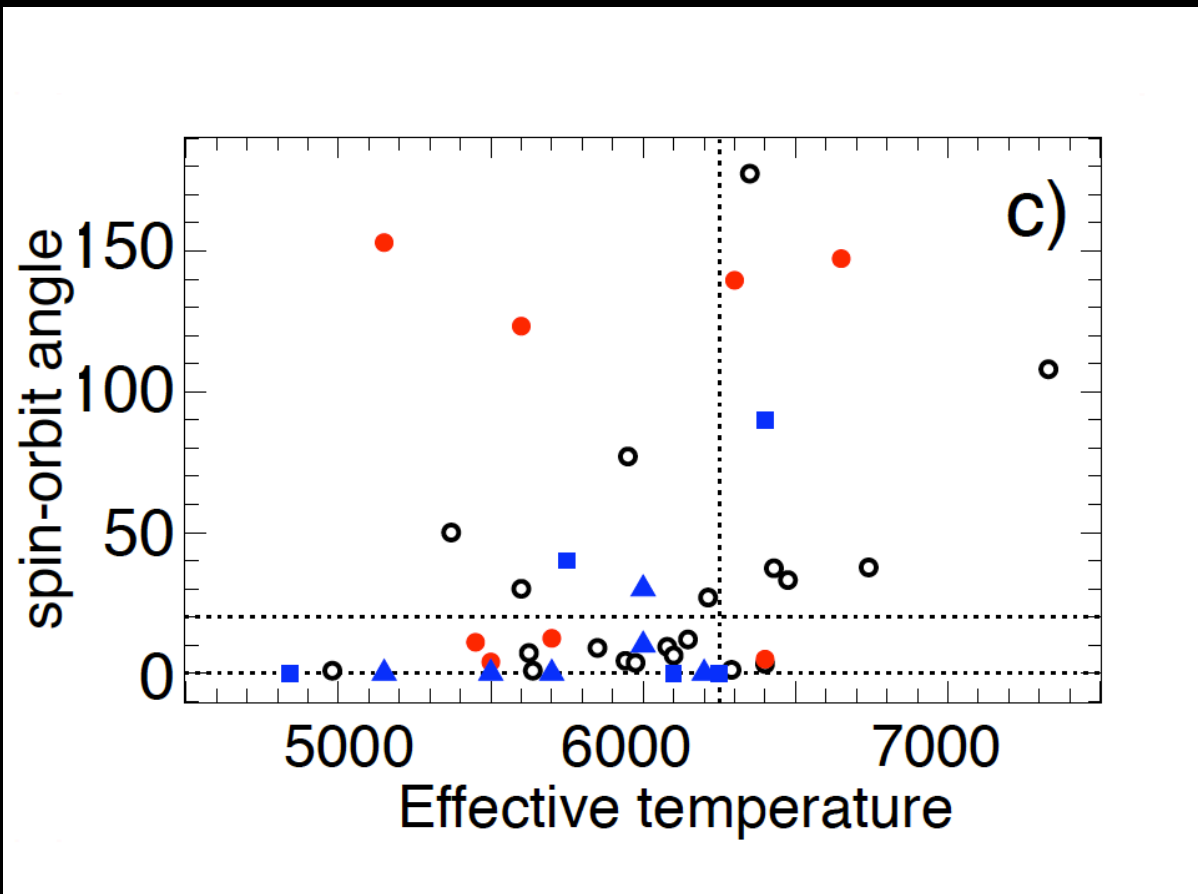
Eccentric P=8d orbit

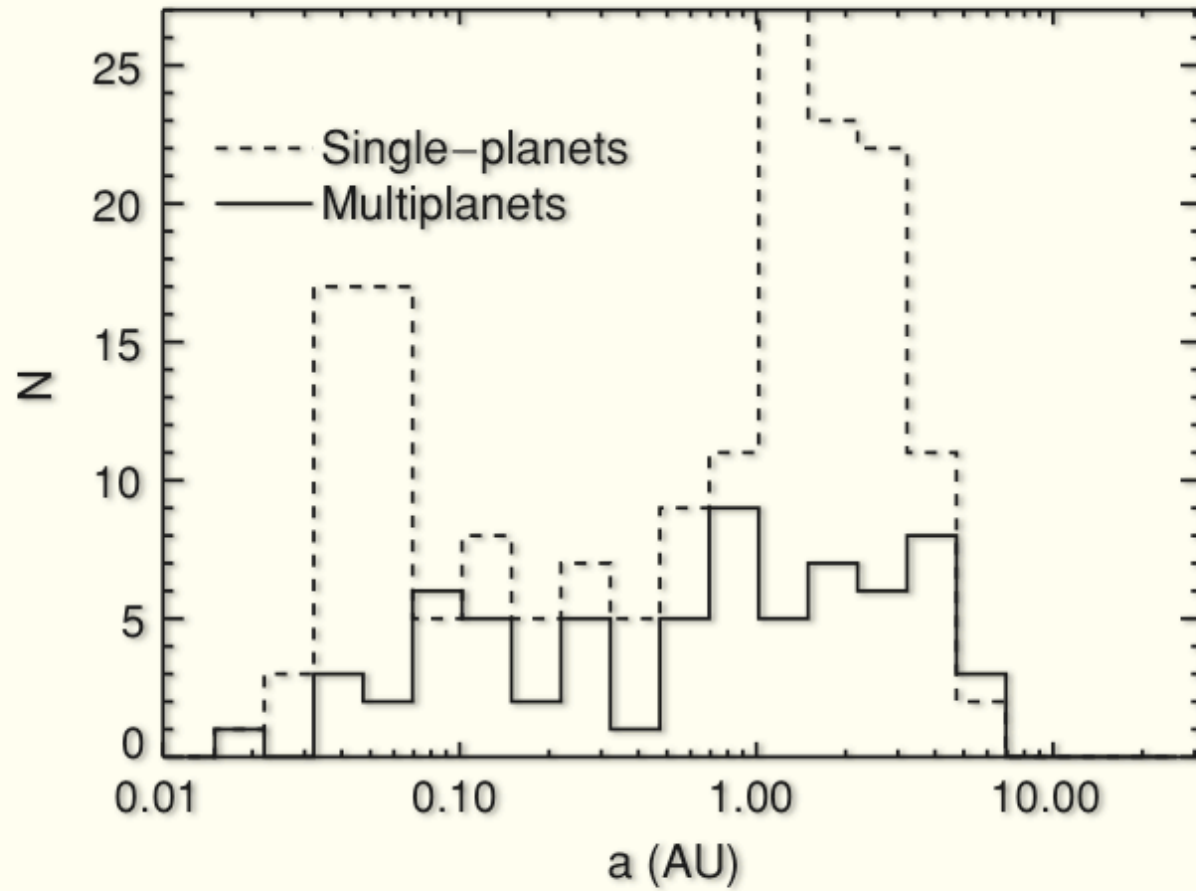


Lots of dynamical effects



Missaligned Hot Jupiters





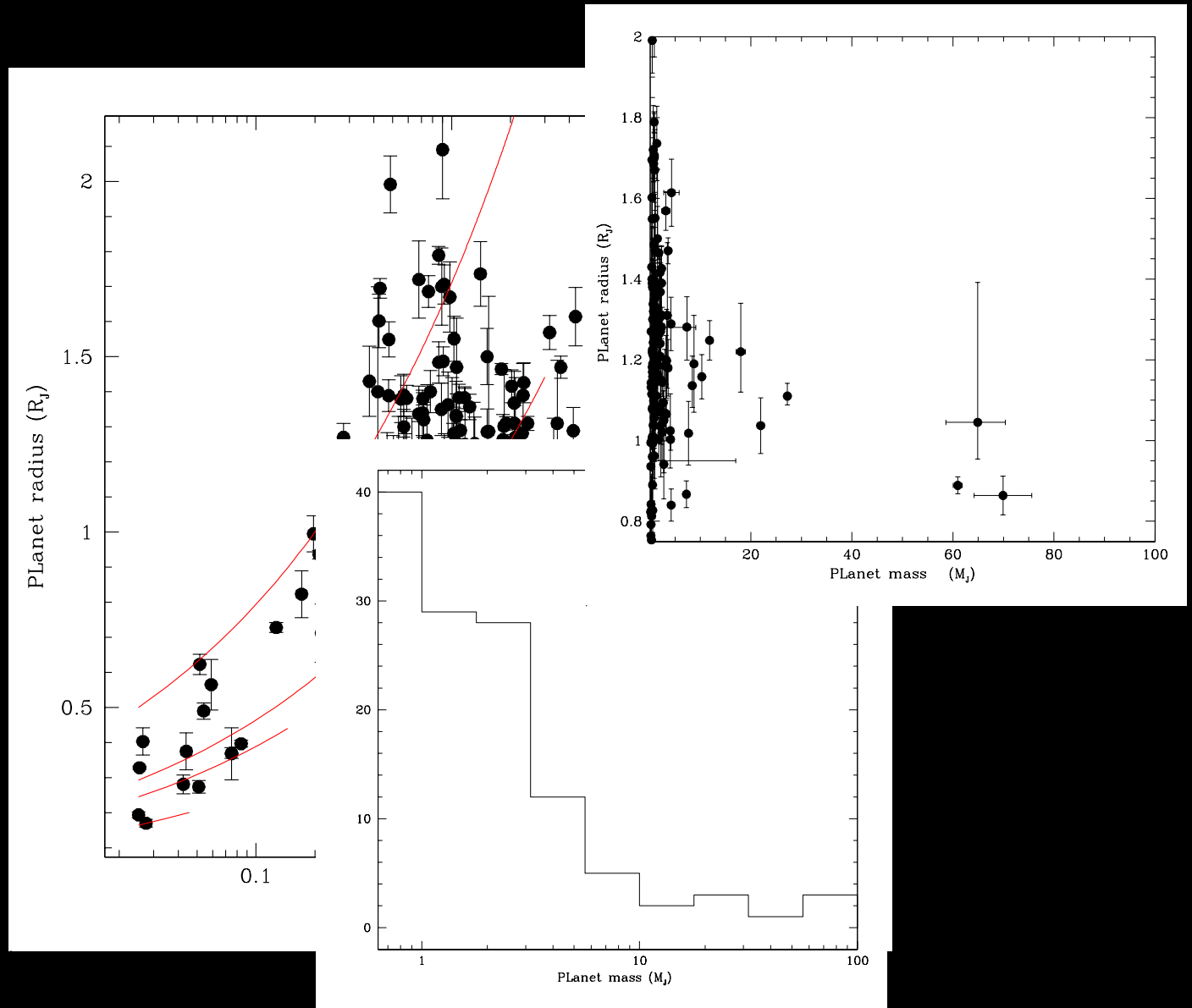
Wright et al. 2009

Less than 0.5% of occurrence...

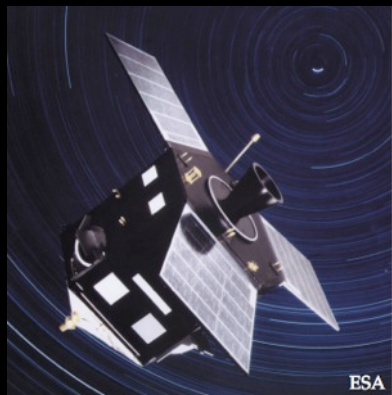
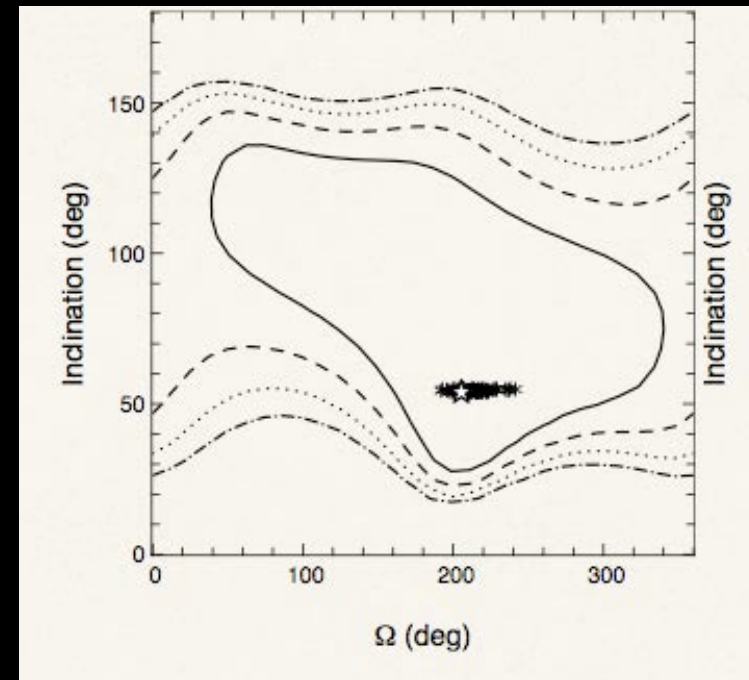
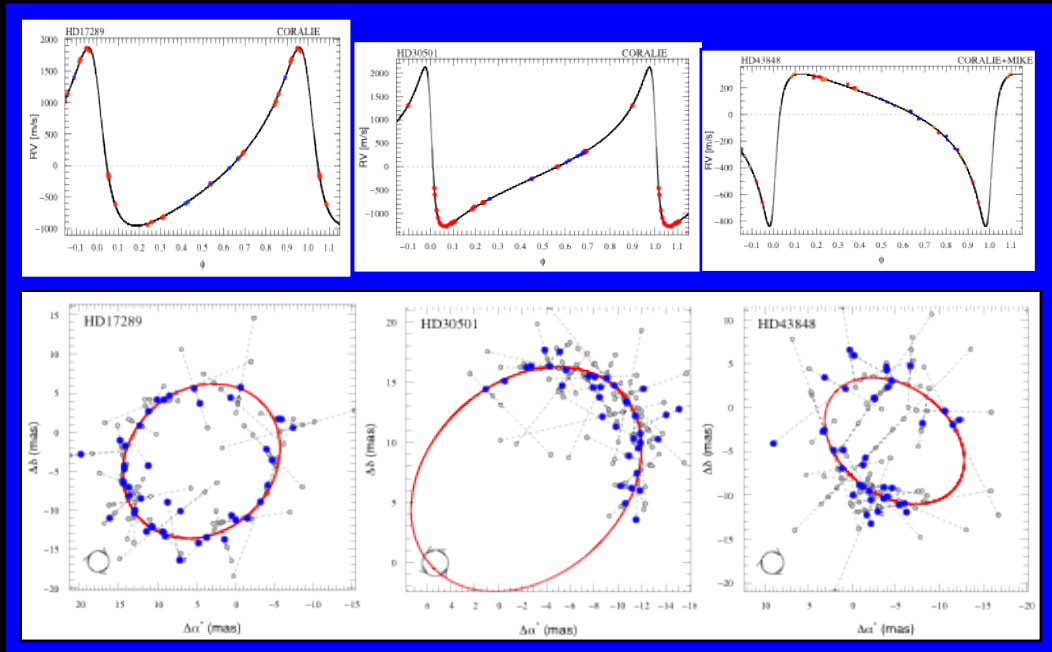
Found in single system

Hot Jupiter are likely the outcome
of a rare dynamical event

The upper mass of planets

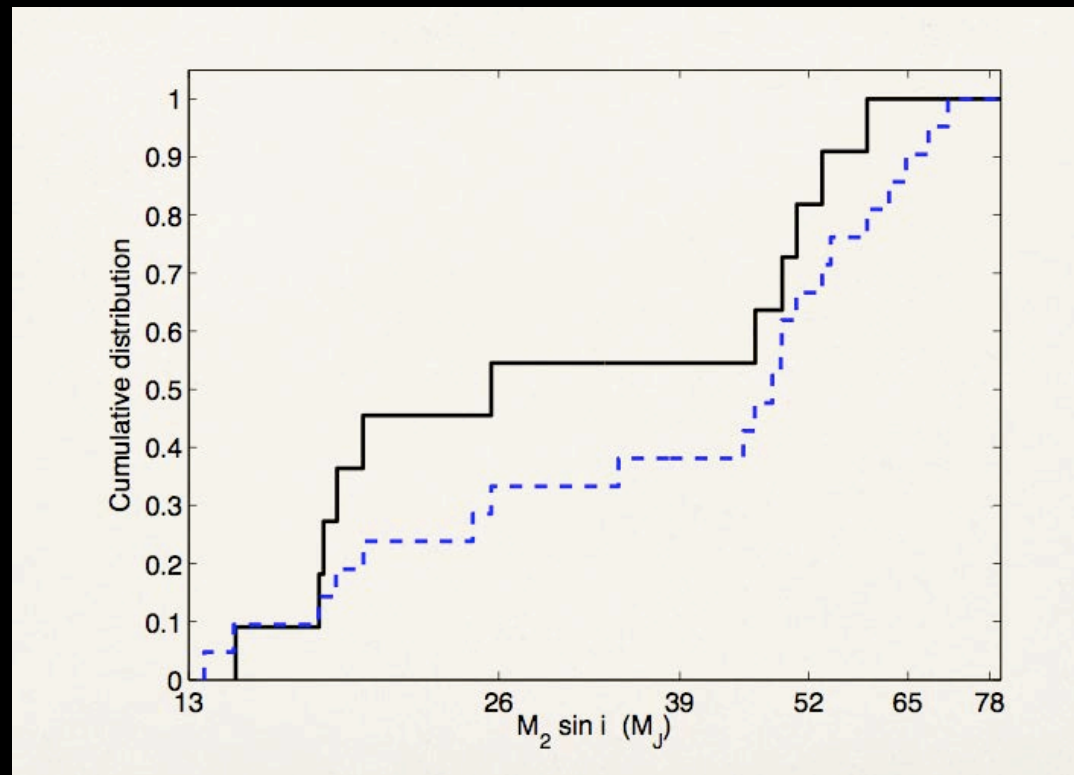


Combining astrometry and RV



(P, T_0, e, ω, K_1 from RV)

For longer period companions...



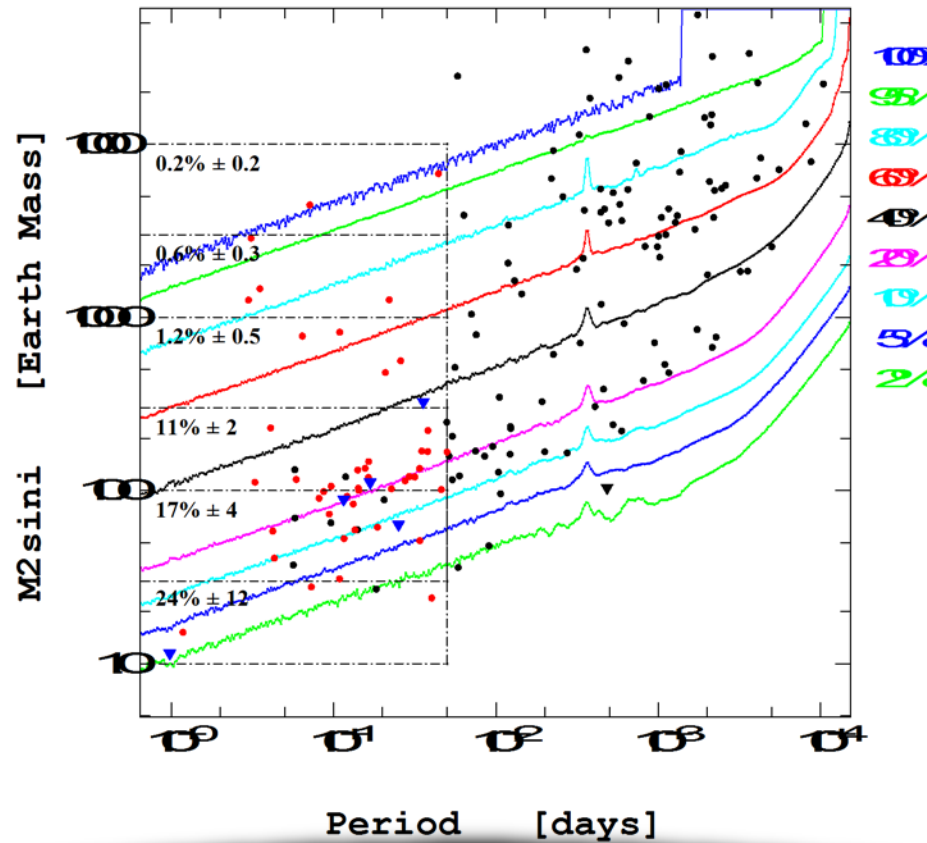
Sahlmann et al. A&A 525, A95

Upper planet mass is around 30 Mj

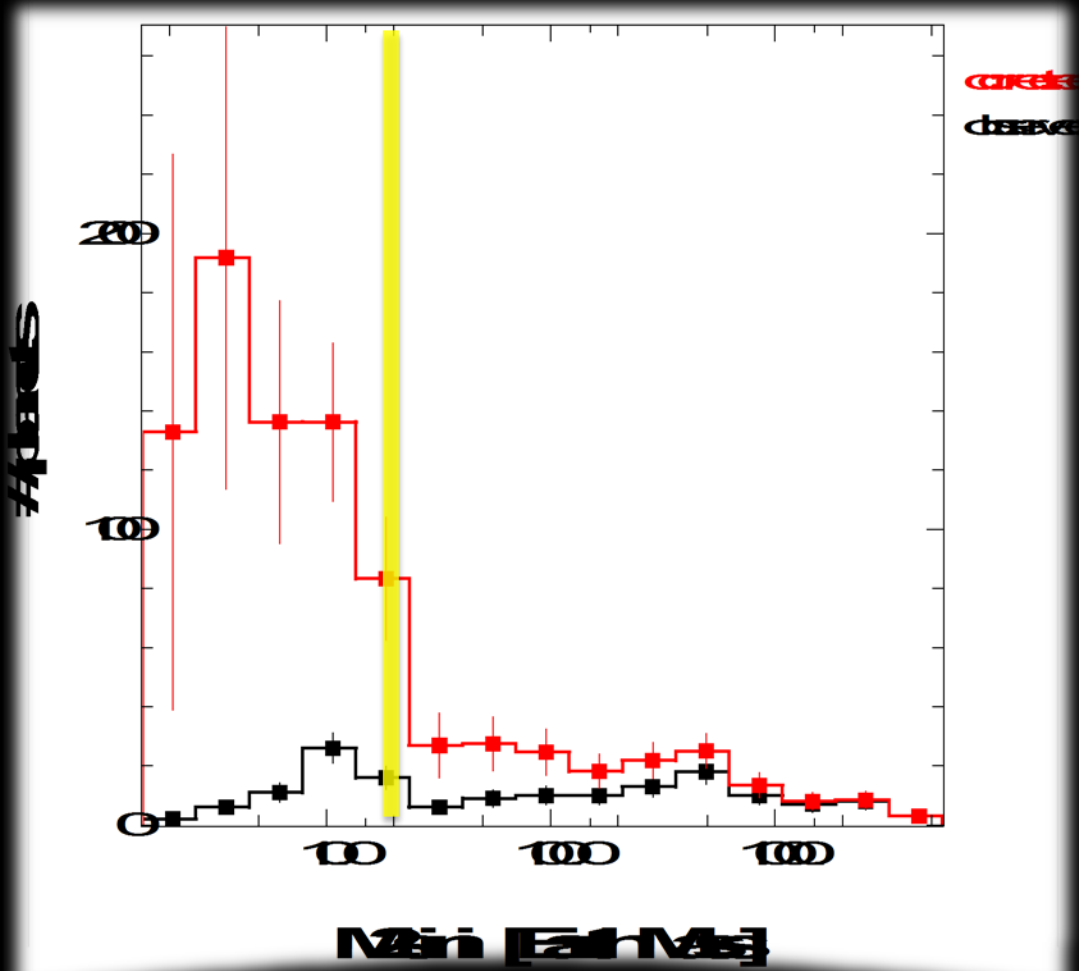
Lowest substellar companion is around 60 MJ

Core accretion – core collapse boundaries?

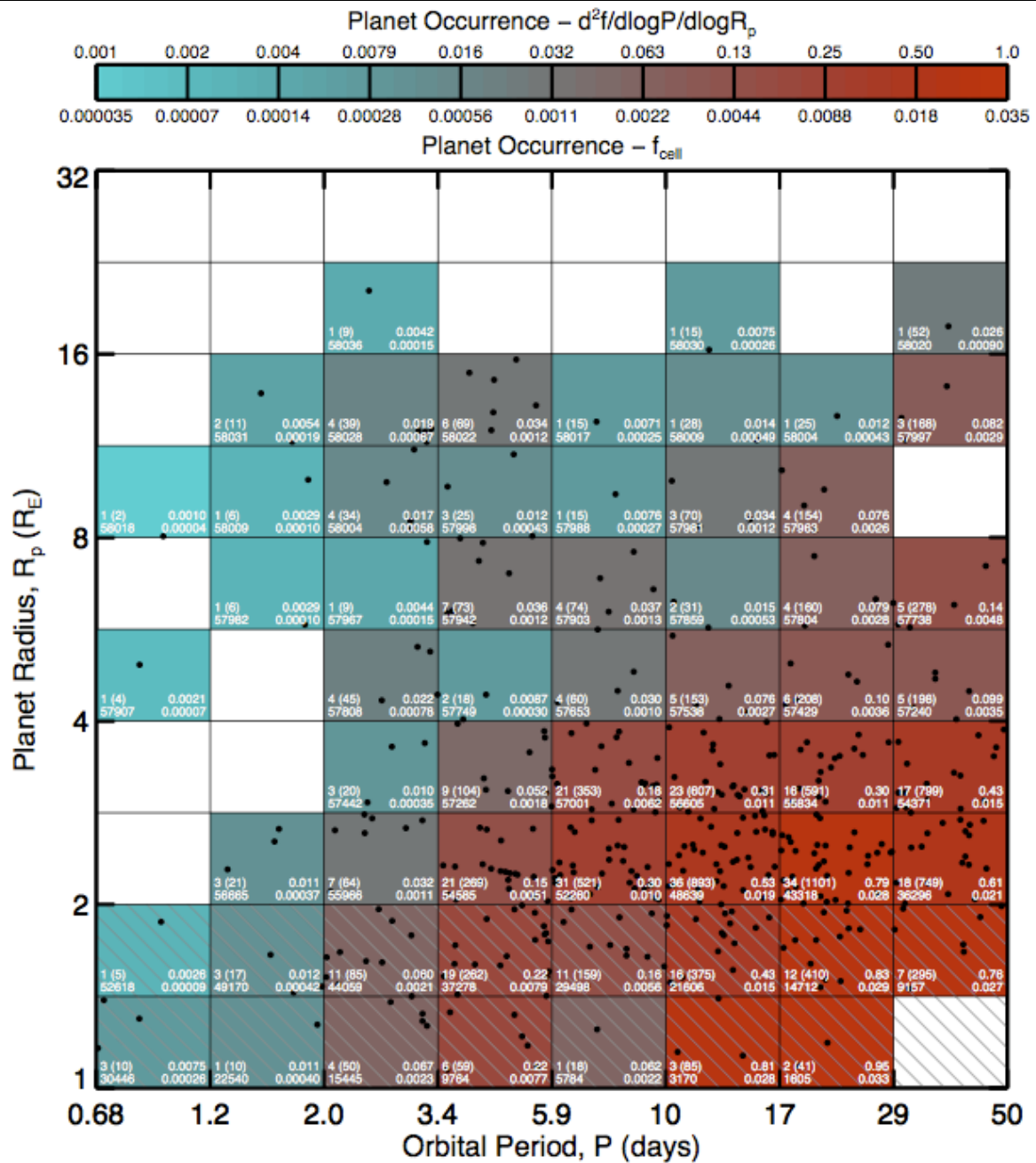
Super-Earths yield

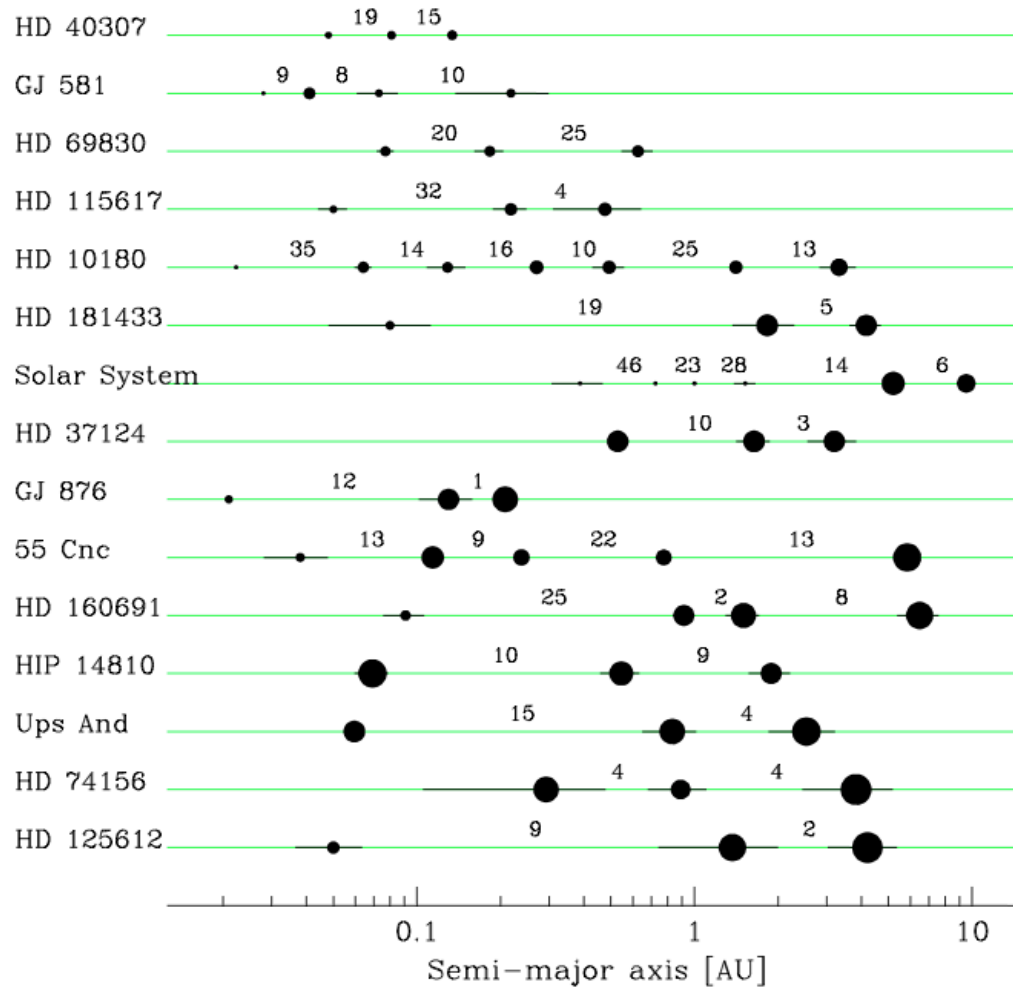


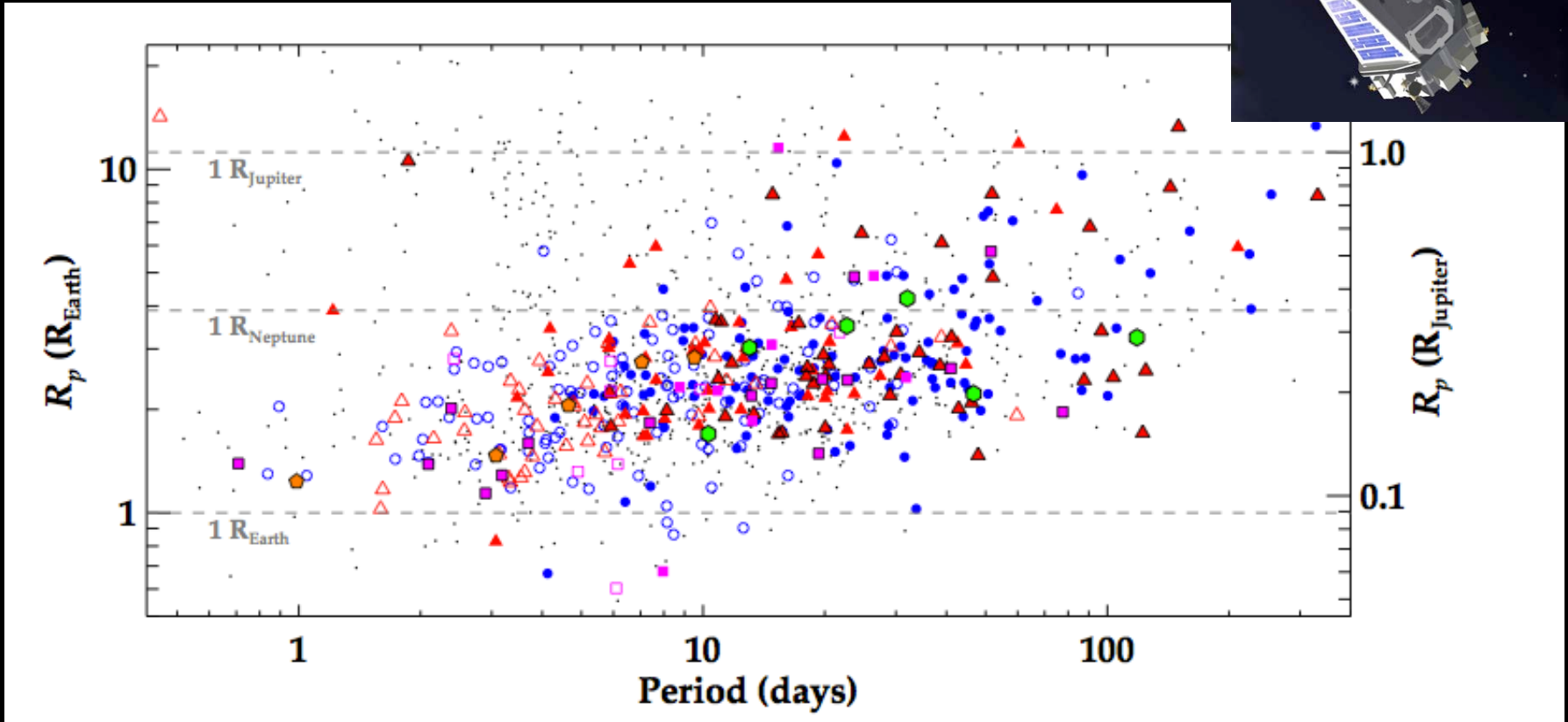
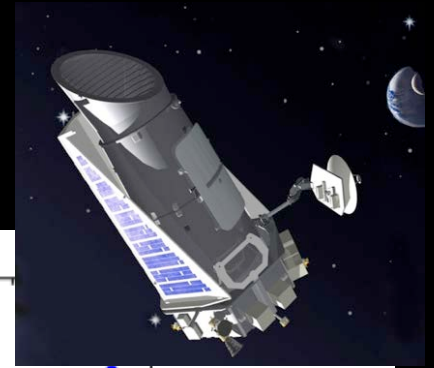
Mayor et al. 2011



Mayor et al. 2011







Lissauer et al. 2011

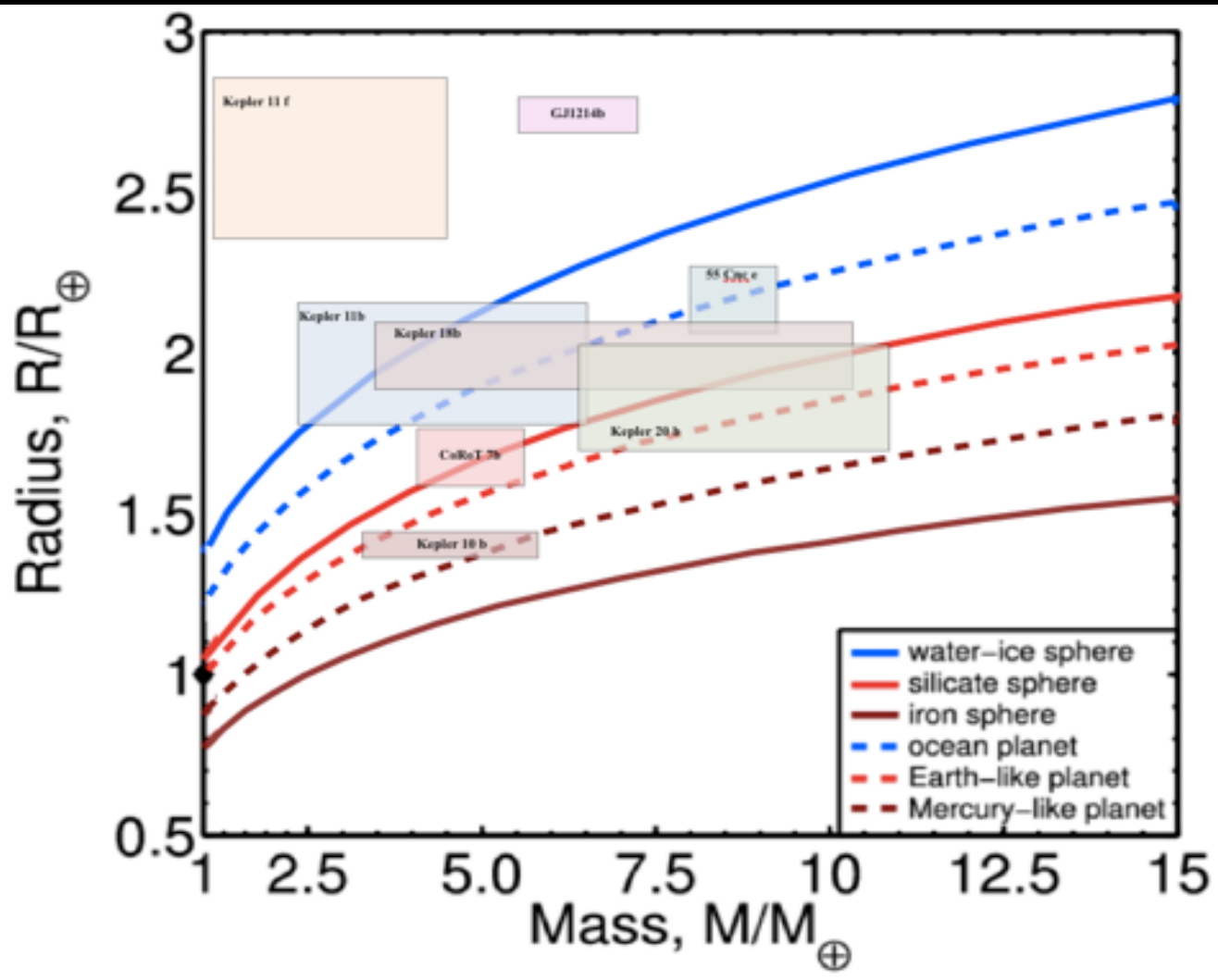
« It is immediately apparent that there is a paucity of giant planets in multi-planet systems »...

« super Earths »

Any small planet below Neptune mass! (unknown structure)

High rate occurrence per star
(30 to 100%)

Arise in multiple *compact* system



New Generation Transit Survey

Discover Neptune transiting planets on bright stars

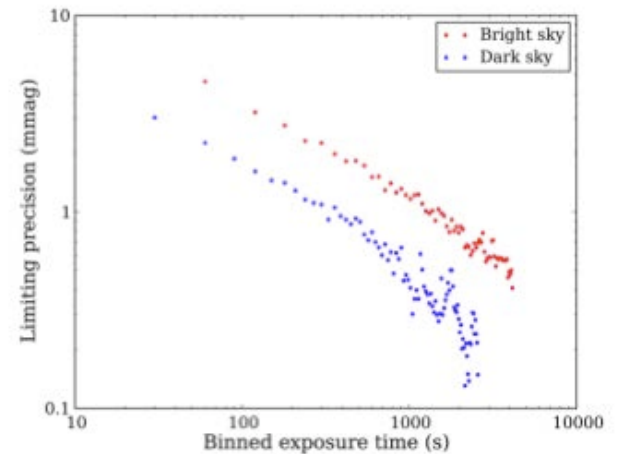
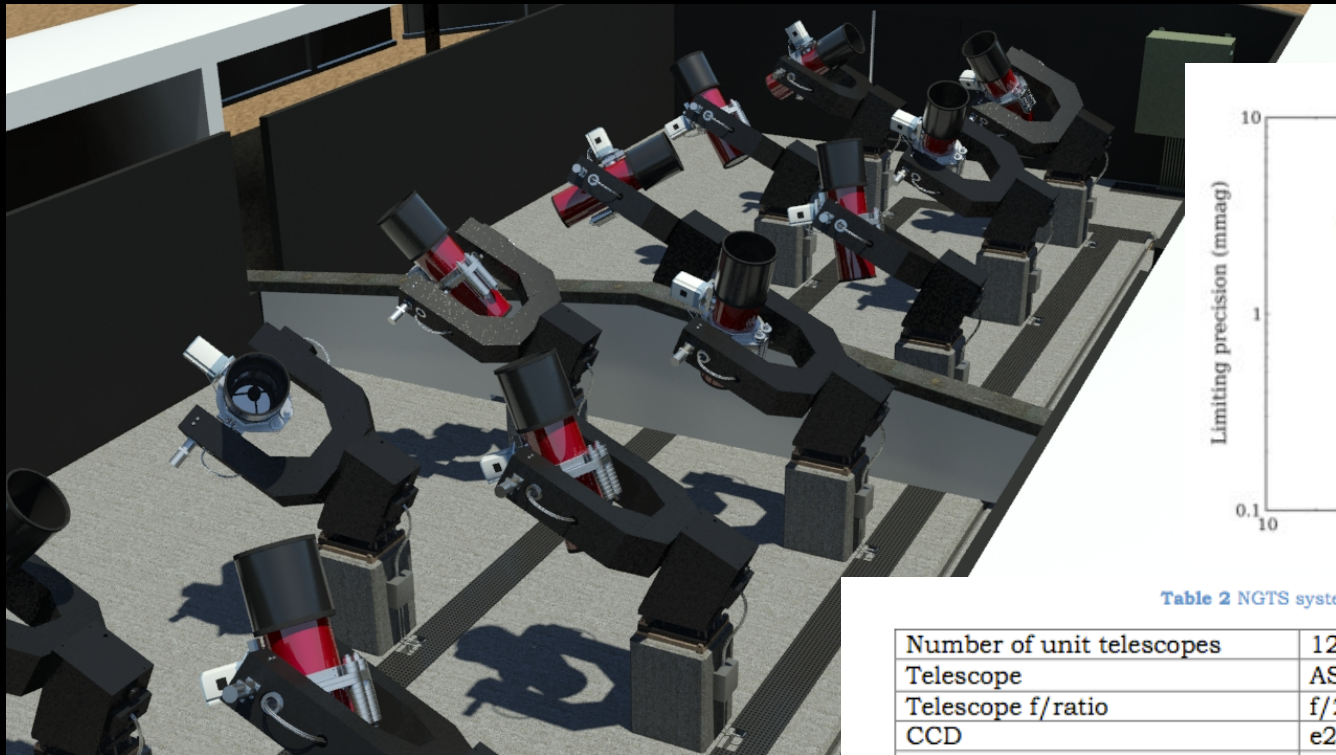
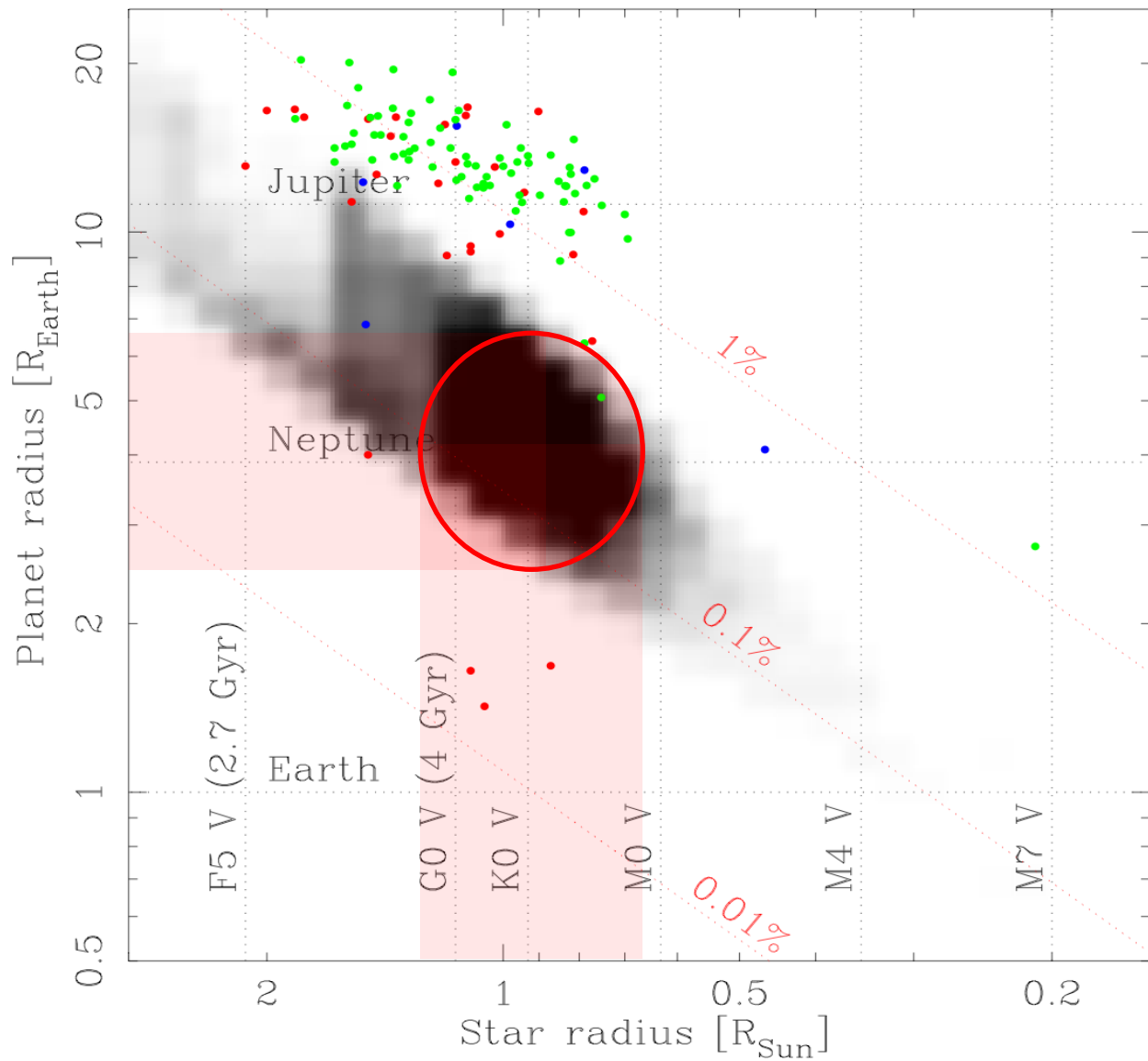


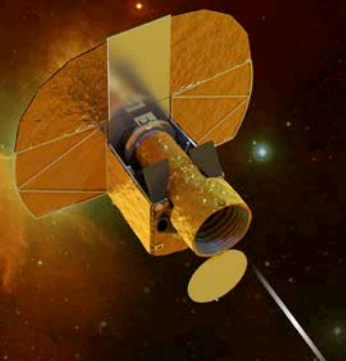
Table 2 NGTS system description

Number of unit telescopes	12
Telescope	ASA 8 inch (200mm)
Telescope f/ratio	f/2.8, 560 mm focal length
CCD	e2v 2kx2k DD chip, Ikon-L by Andor
Pixel	13.5 micron
Pixel size	4.97 arcsec
Telescope FOV	8.00 square degrees
Mount type	OMI equatorial fork, 1 per telescope
Building dimension	12m x 15m (including a 3m wide parking)
Pointing limit	Airmass < 2
Total FoV	96 square degrees

**Belfast, DLR Berlin,
Geneva, Leicester,
Warwick, U. Catolica**



Proposal in response to ESA Small Mission Call
June 2012



CHEOPS

CHARACTERIZING EXOPLANET SATELLITE

