NGTS: Next-Generation Transit Survey

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Belfast, Cambridge, DLR Berlin, Geneva, Leicester, Warwick

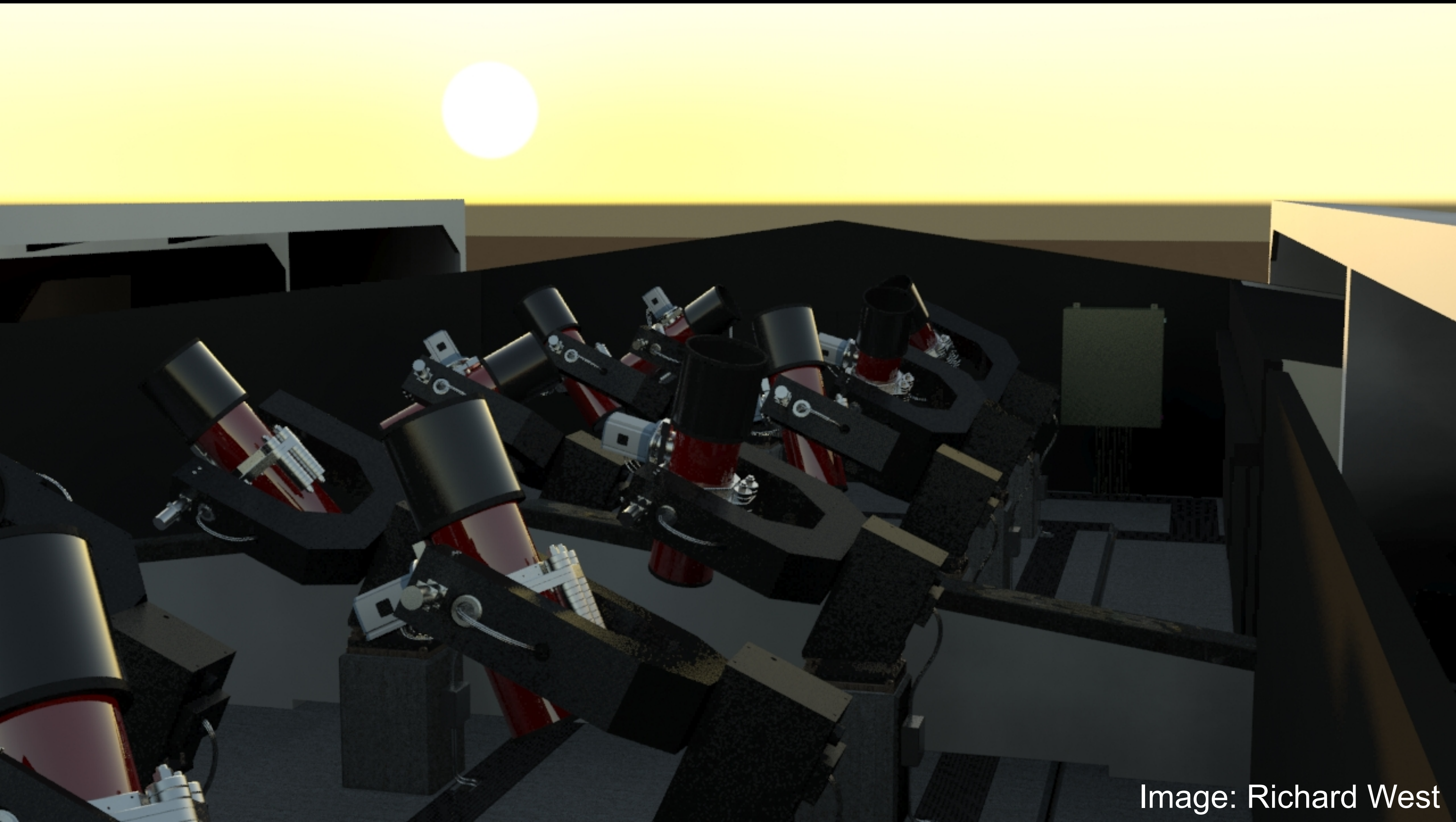
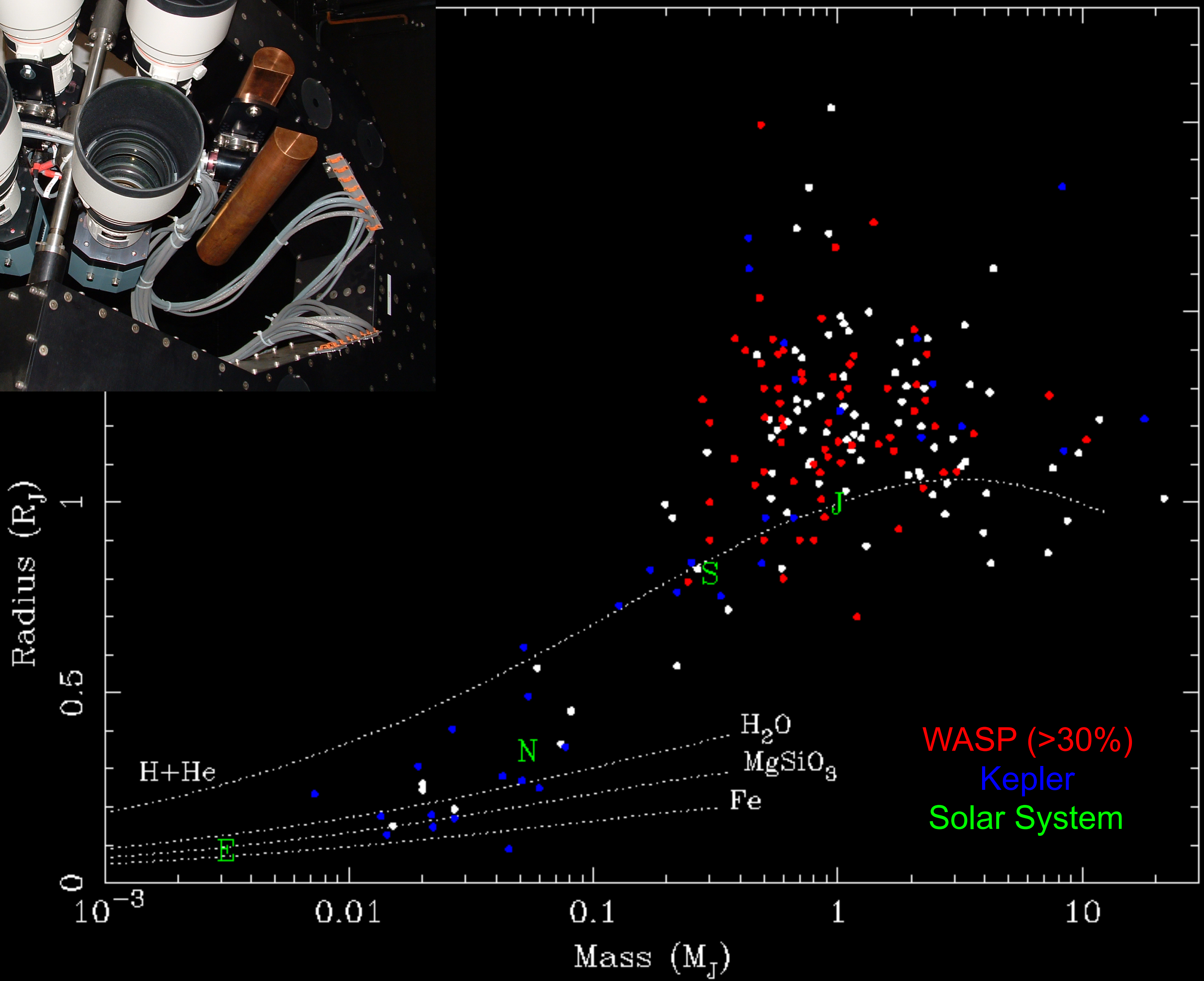
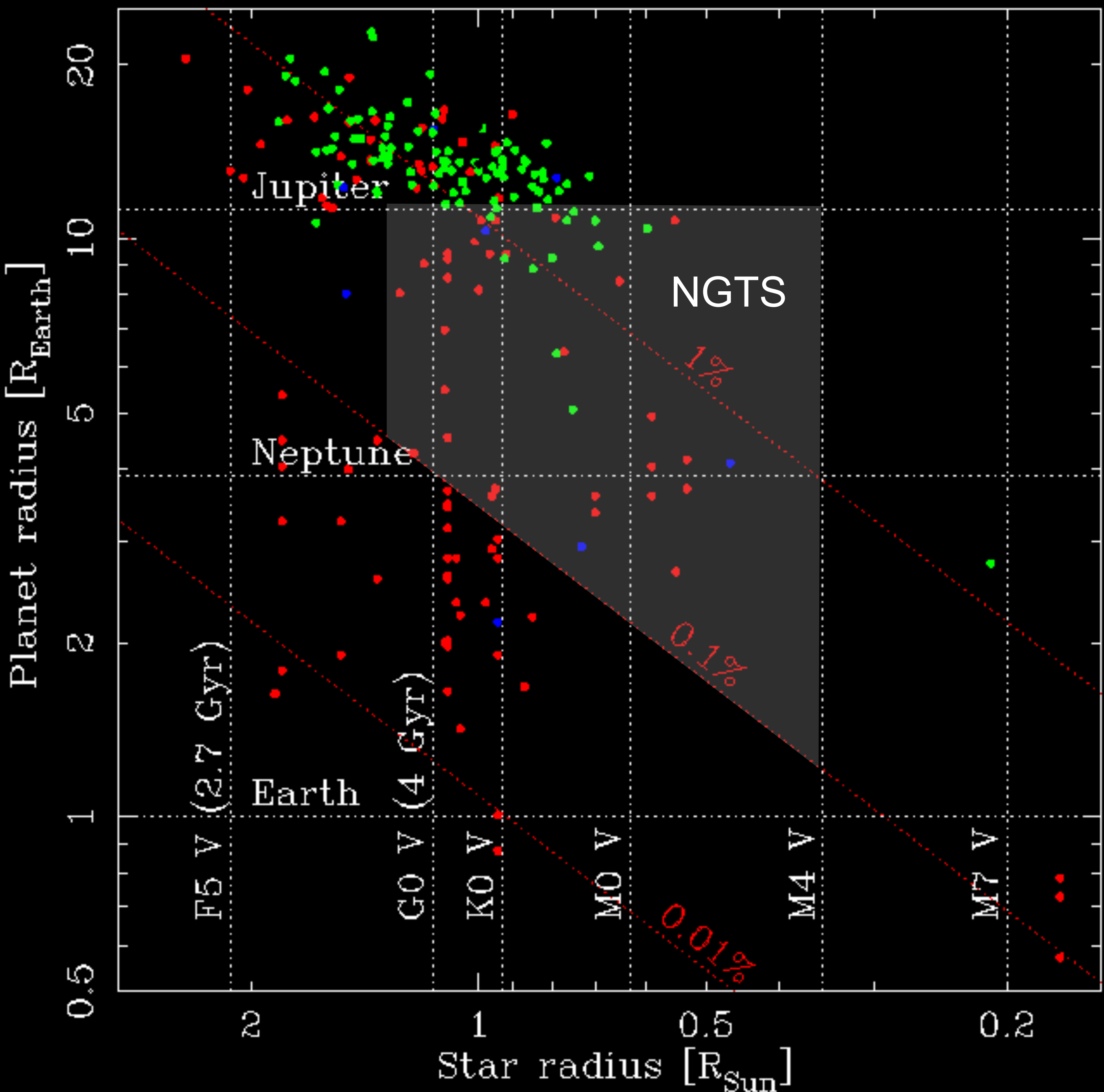


Image: Richard West

SuperWASP legacy



Transit discovery space

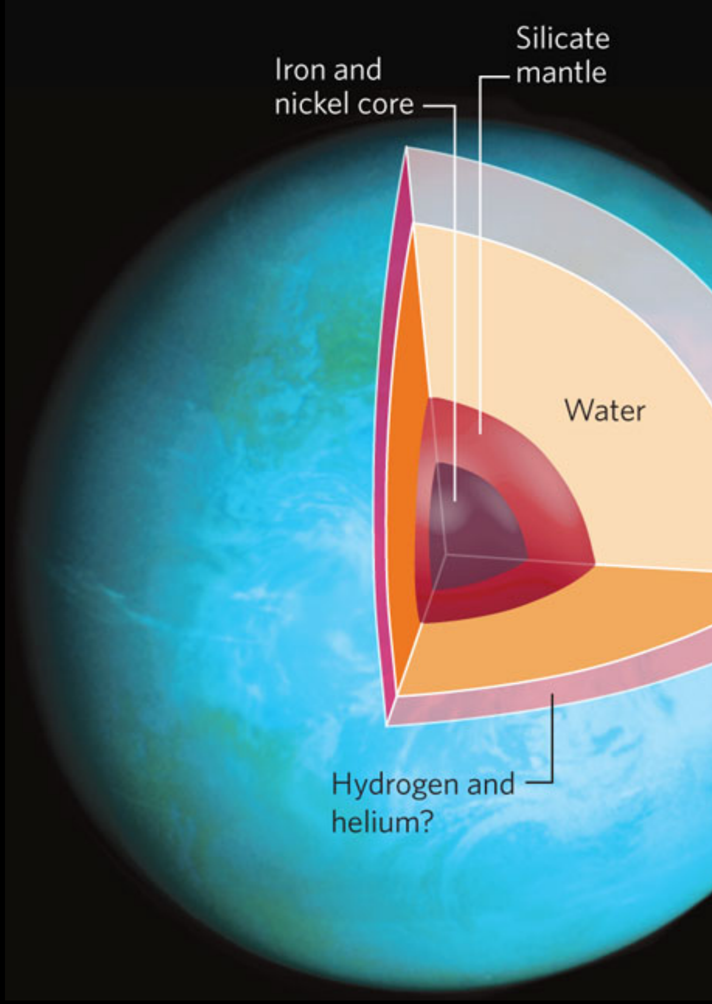


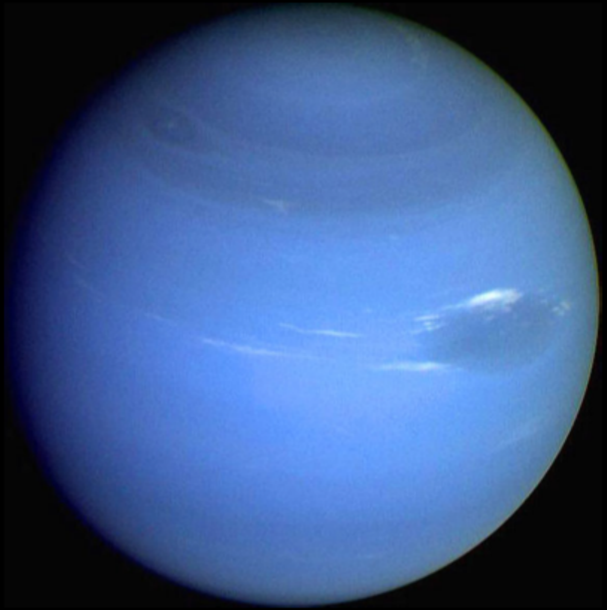
Ground-based
Space-based
Radial velocity

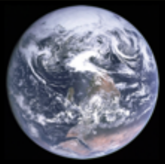
Key science goals:

- Statistical sample (>100) of Neptunes and Super-Earths with measured mass, density, orbital separation

- Very bright systems for atmosphere studies with VLT, E-ELT, JWST, EChO







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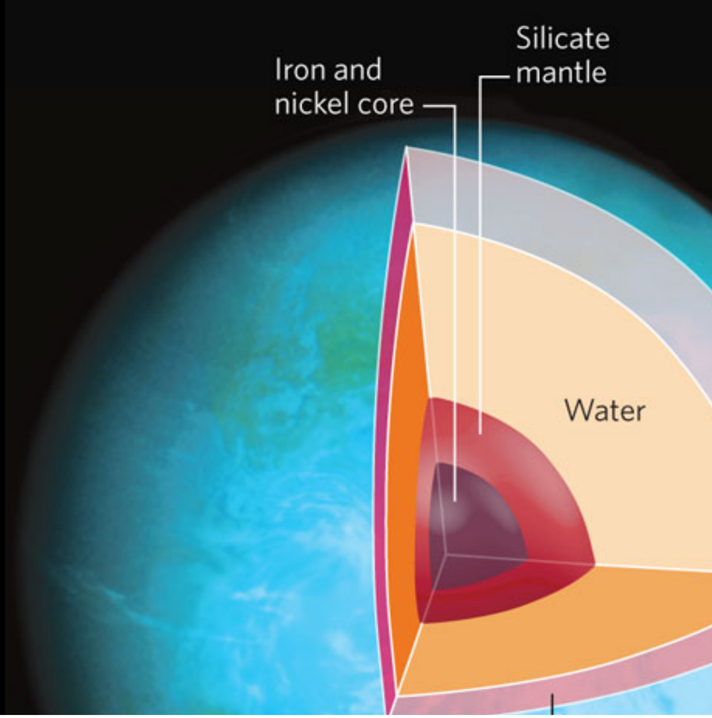
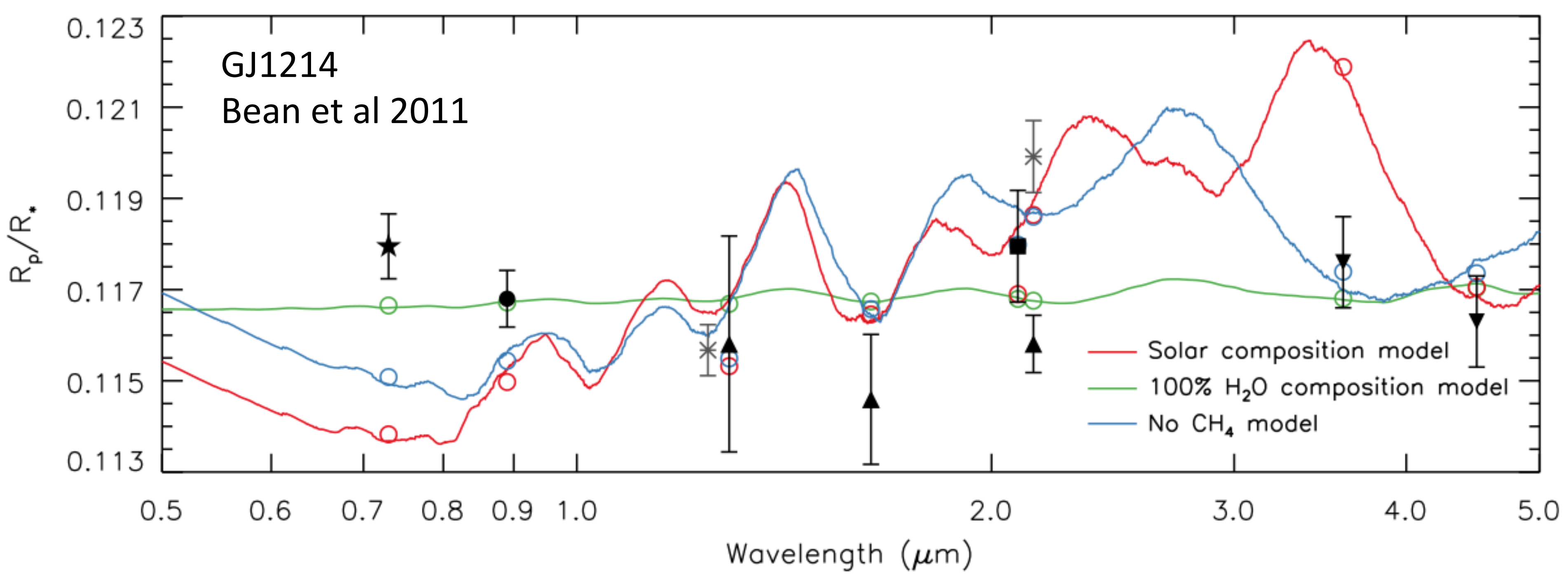
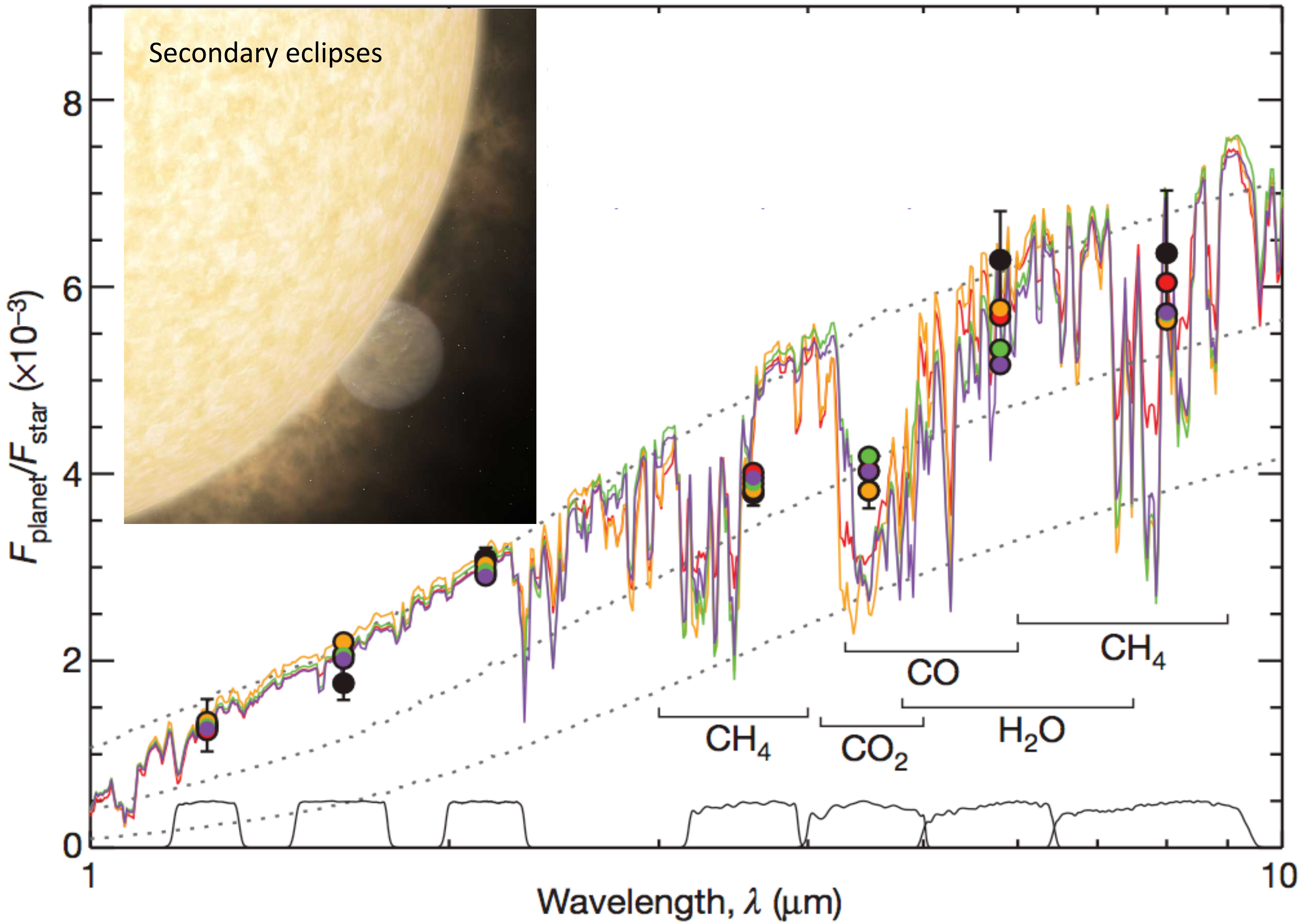




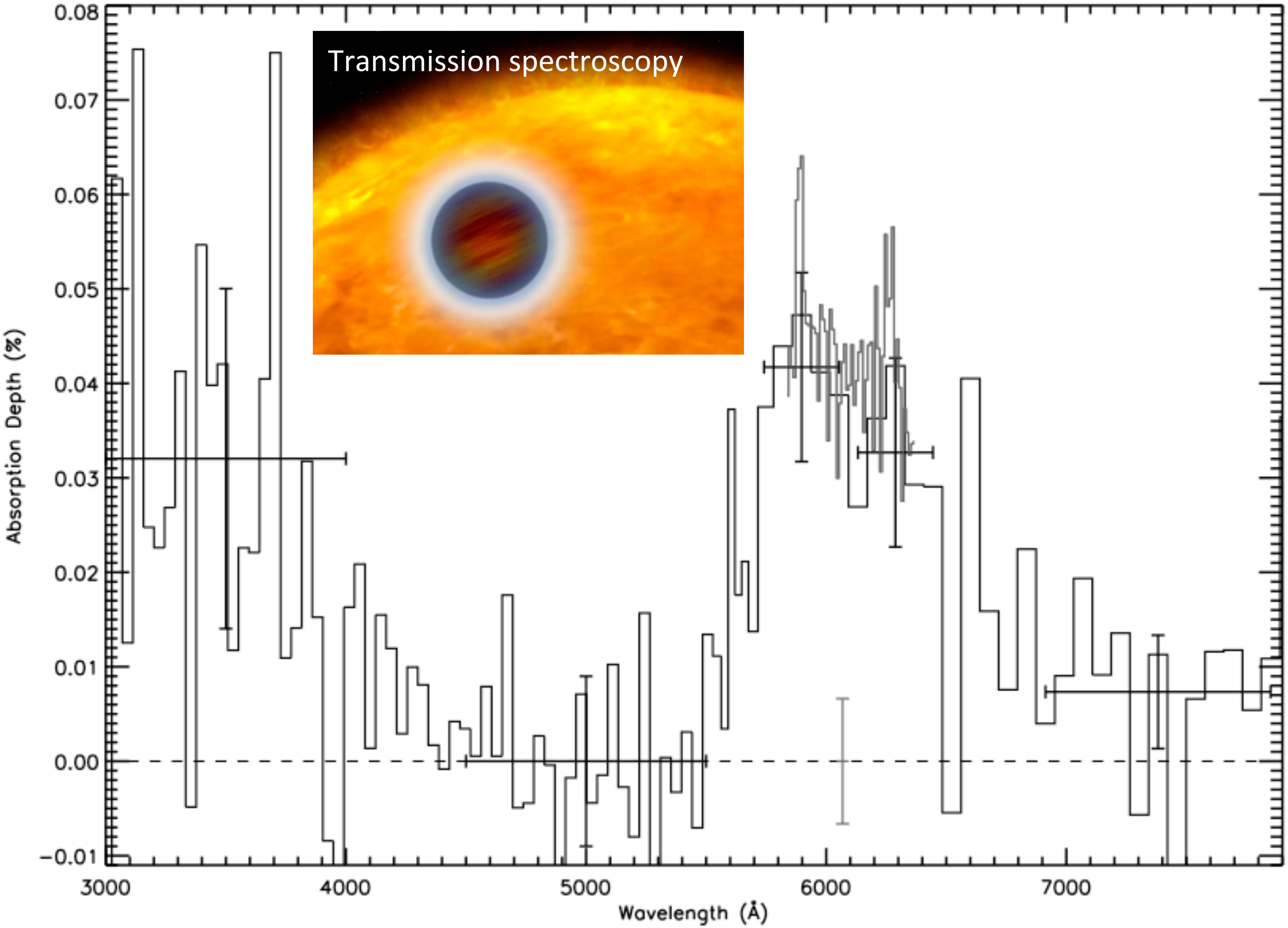
Carbon rich atmosphere in WASP-12b

Madhusudhan et al. 2010, Nature



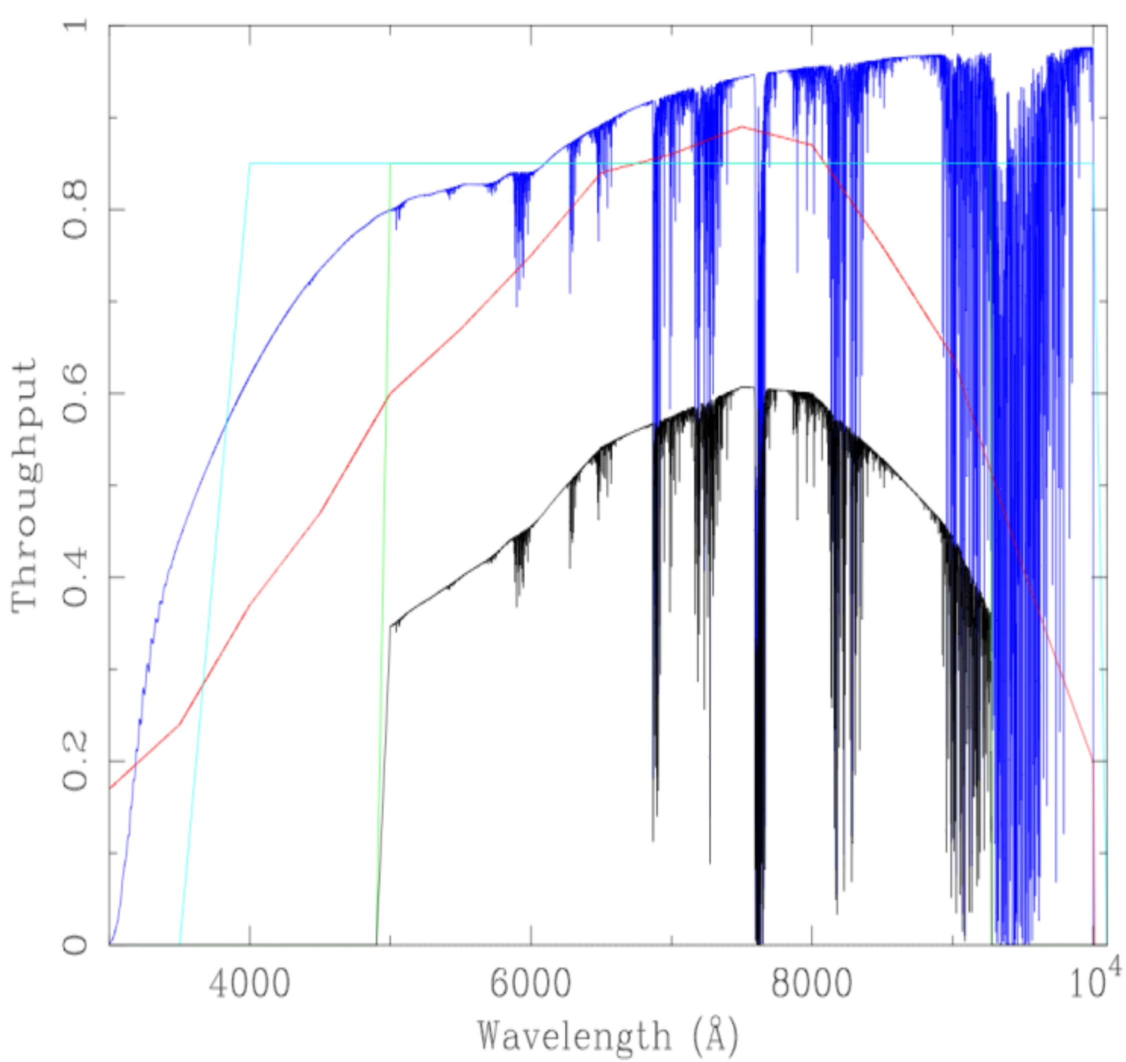
Rayleigh scattering and sodium in a planetary atmosphere

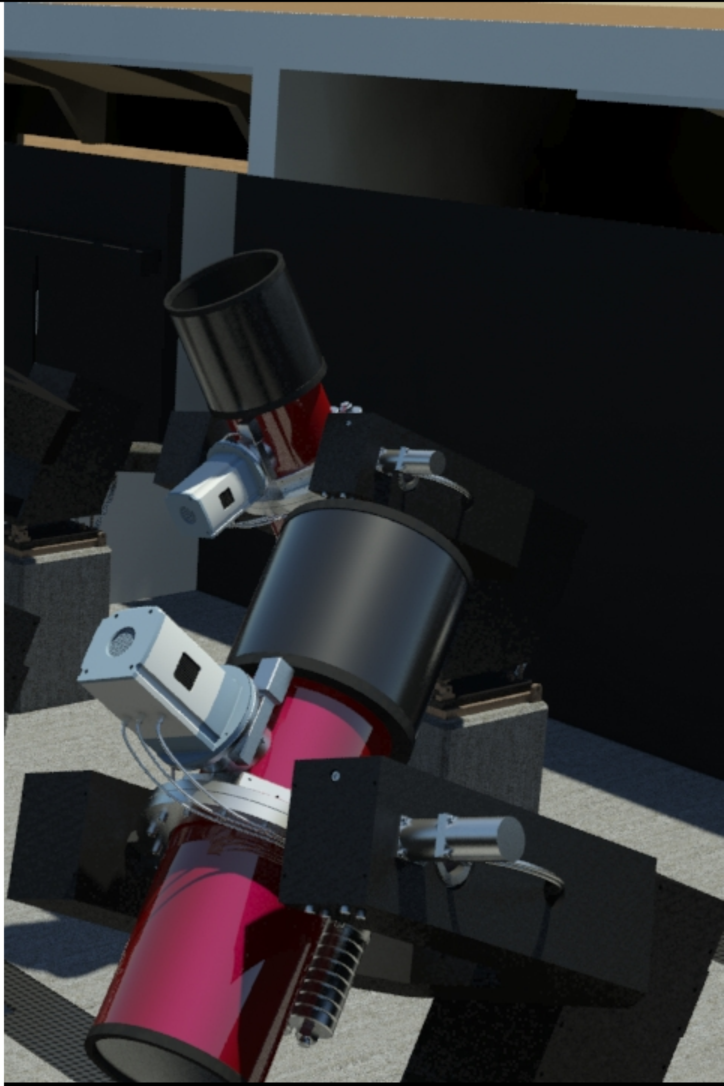
Sing et al. 2008



NGTS Design

12 x 20cm f/2.8 telescopes
110 sq deg
600-900nm





NGTS Facility

12 x 20cm f/2.8 telescopes
96 sq deg field of view
deep depletion CCDs (550-900nm)

£2m capital investment by Warwick, Leicester, QUB, Geneva, DLR Berlin, Cambridge

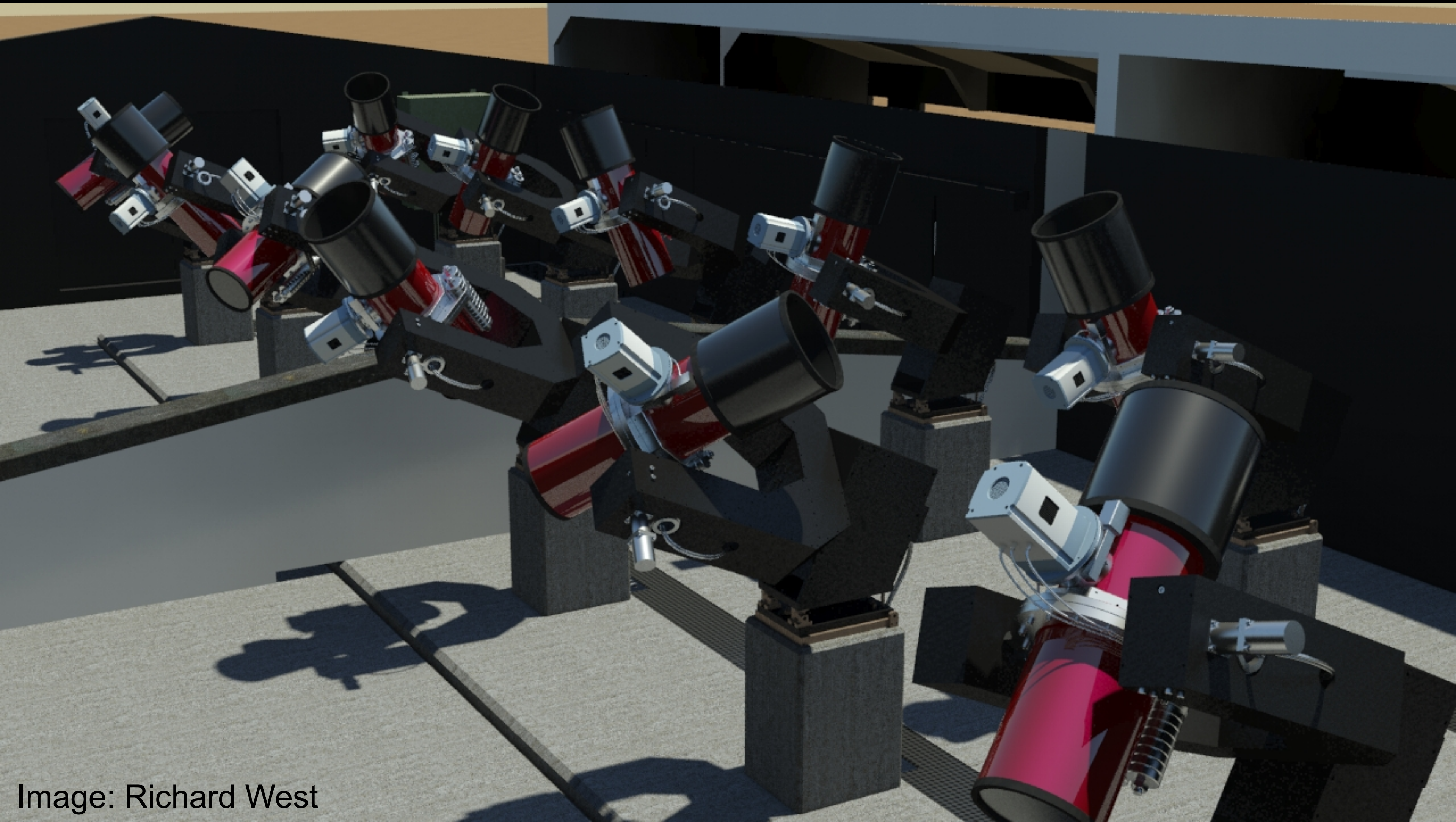
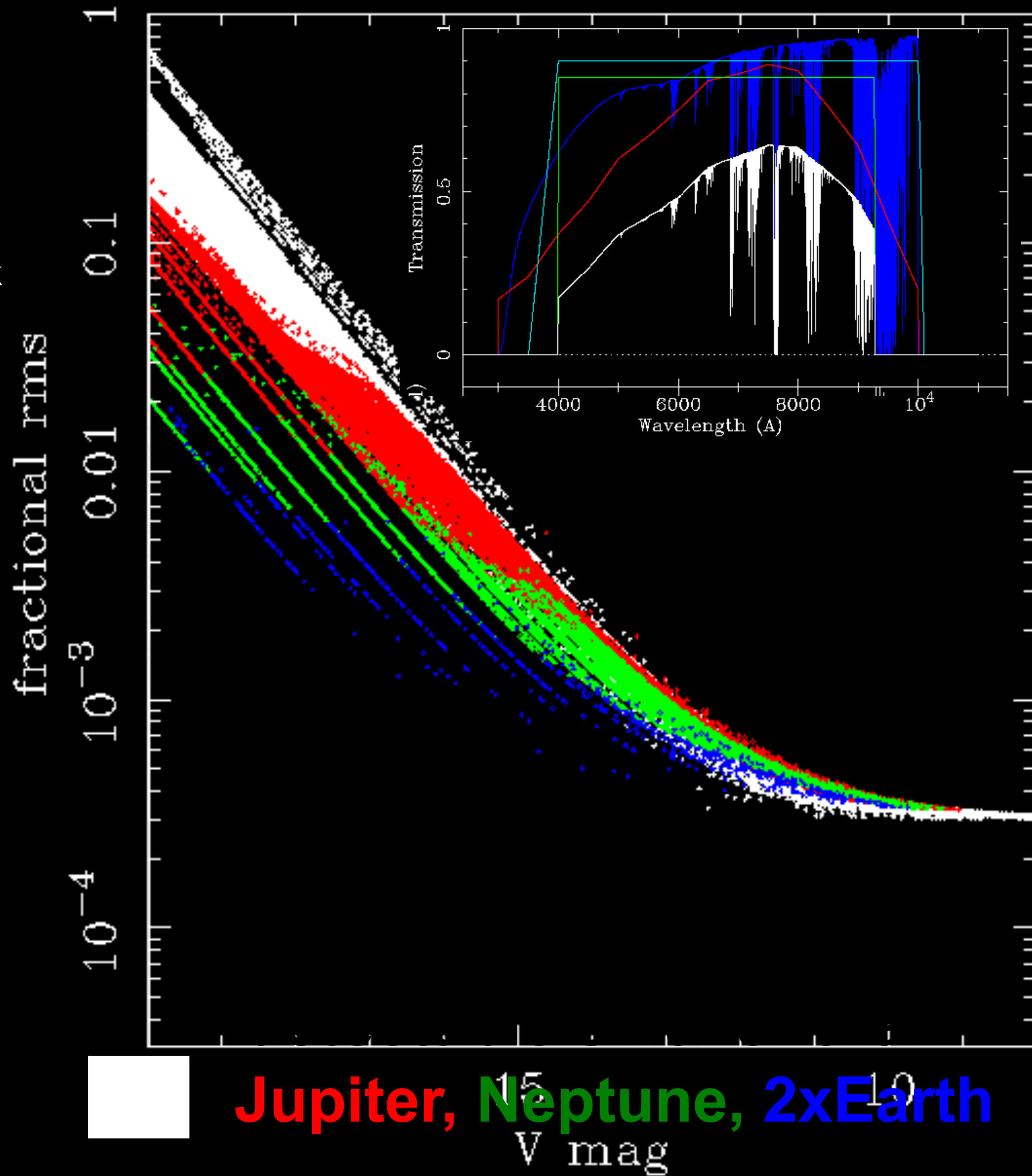


Image: Richard West

NGTS Site: ESO Paranal observatory, Chile

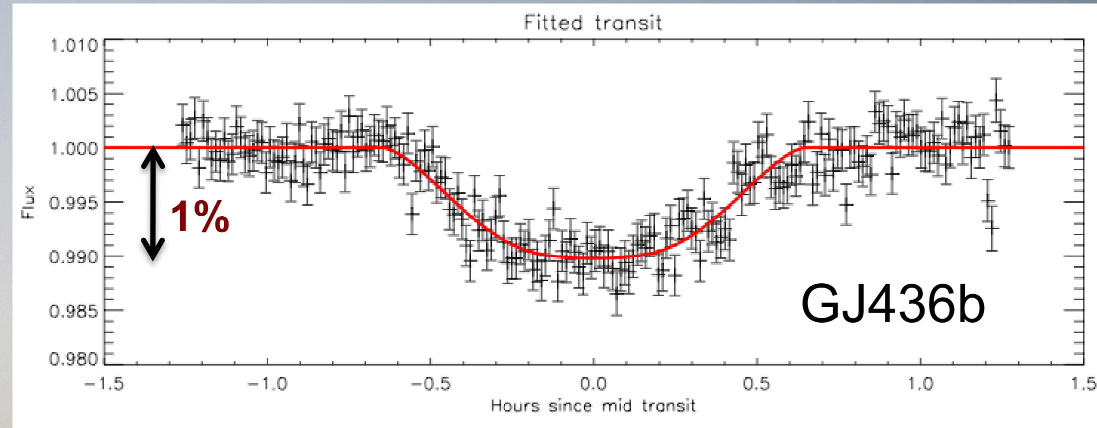
NGTS simulations

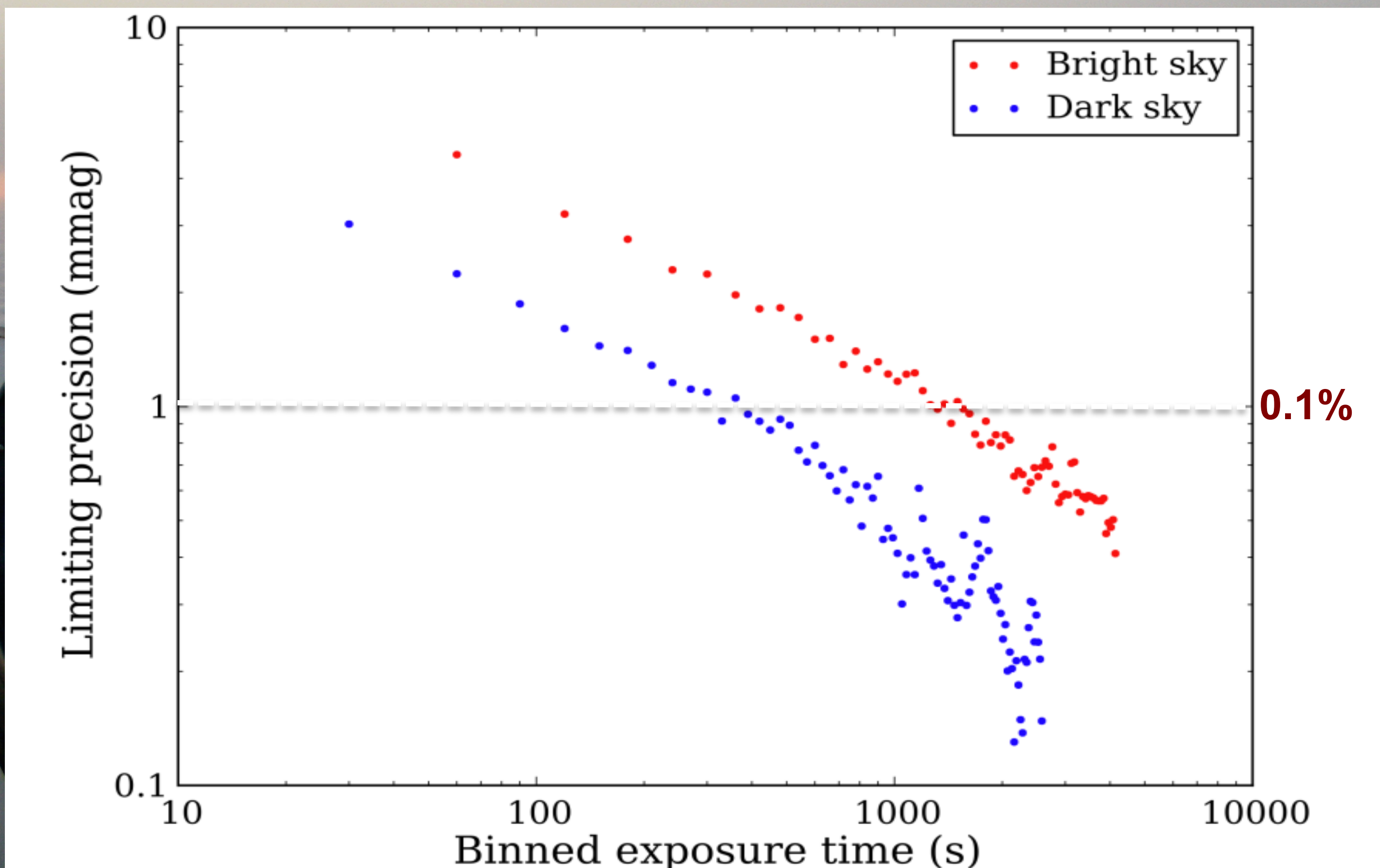
- >100 RV-confirmed Neptunes and super-Earths giving bulk composition
- ~20 Neptunes and super-Earths for detailed atmospheric characterisation (I<11.5)



NGTS Prototype

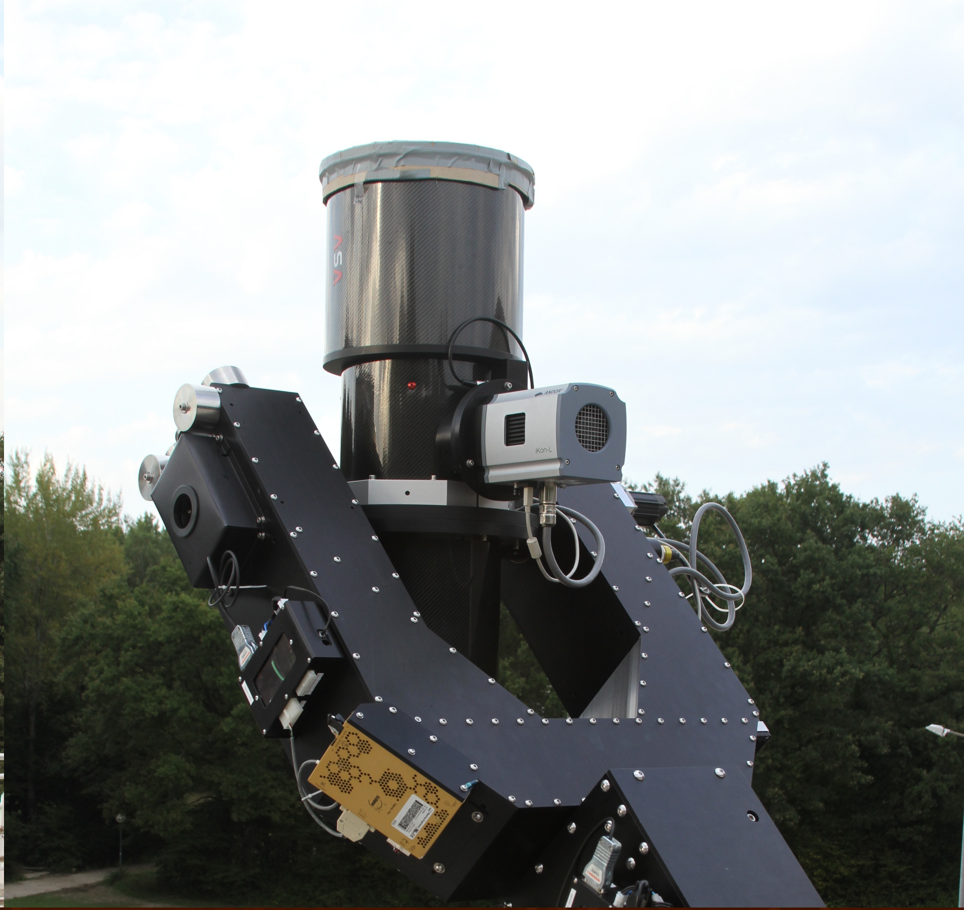
2010

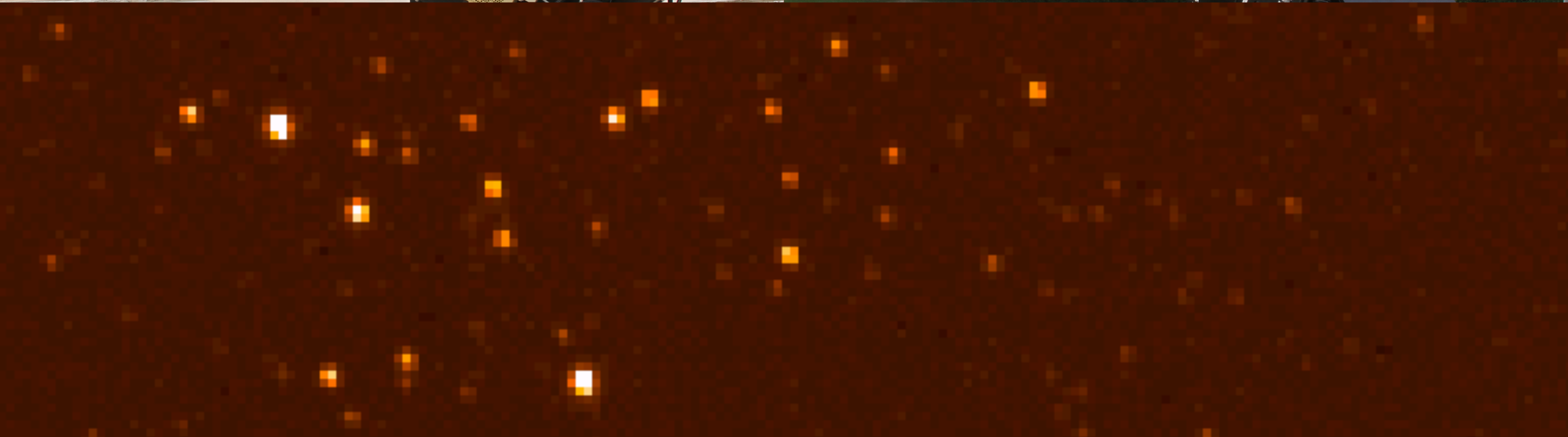




System testing in Geneva

August 2012





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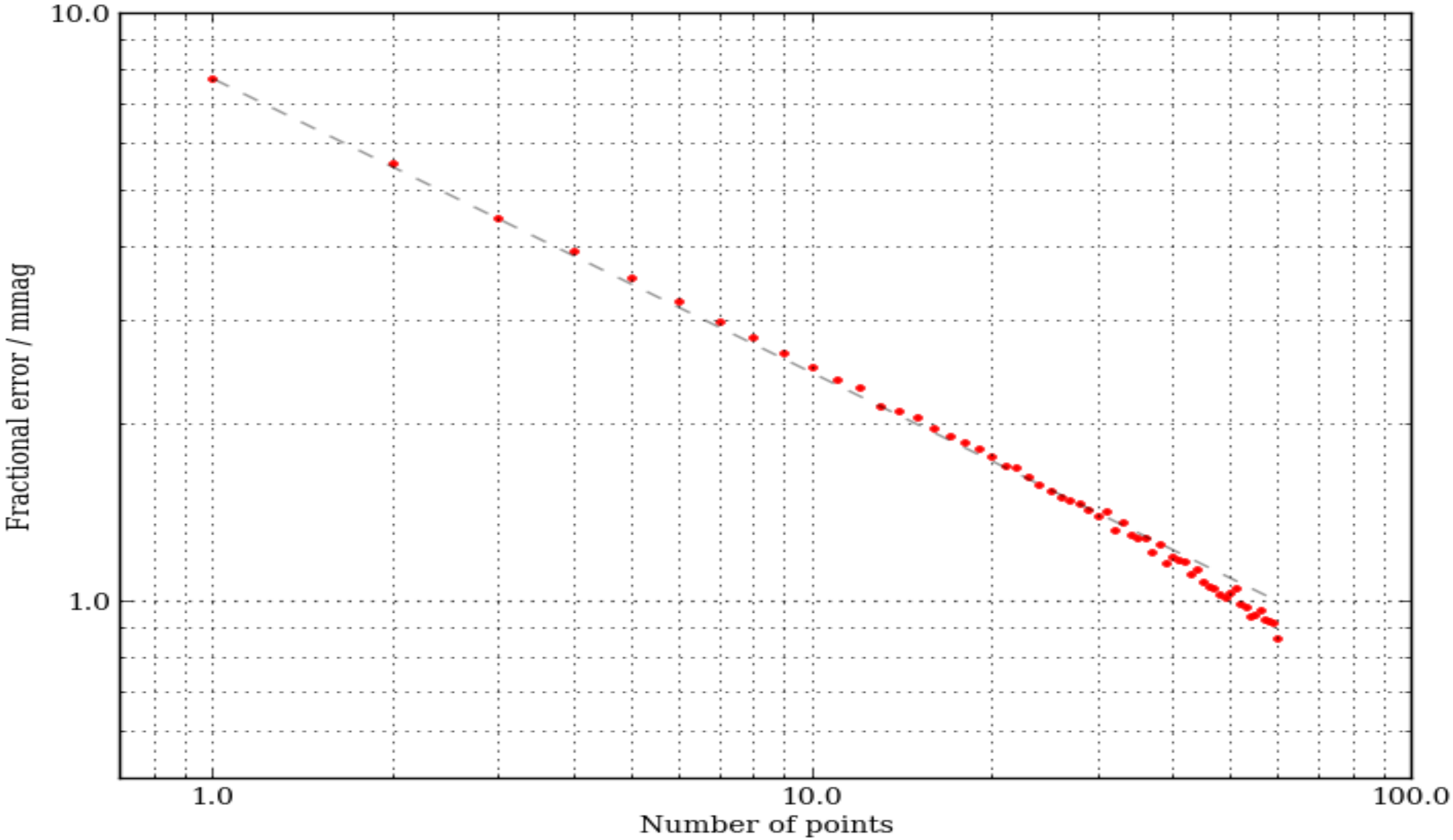

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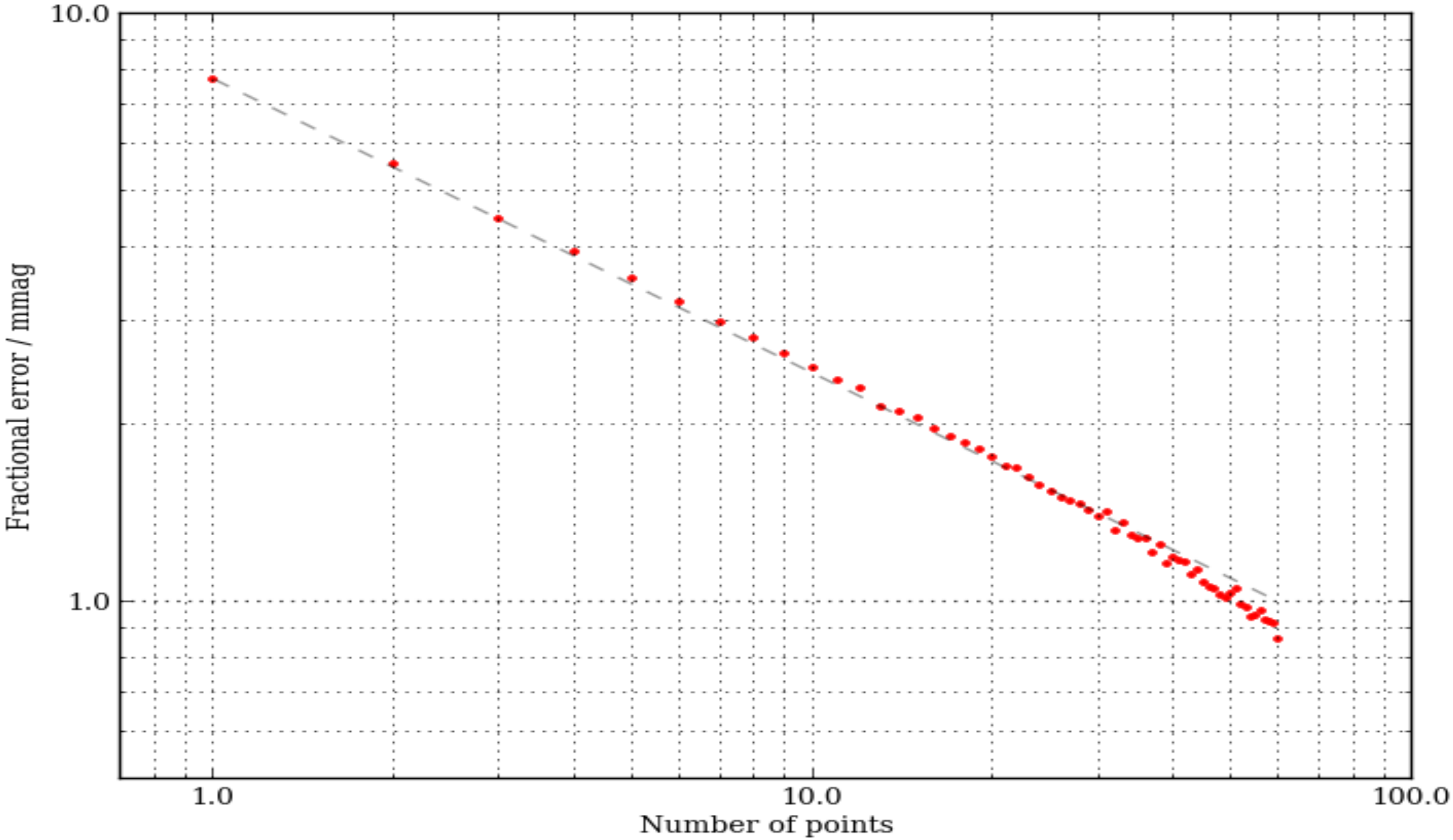


NGTS planet catch simulations

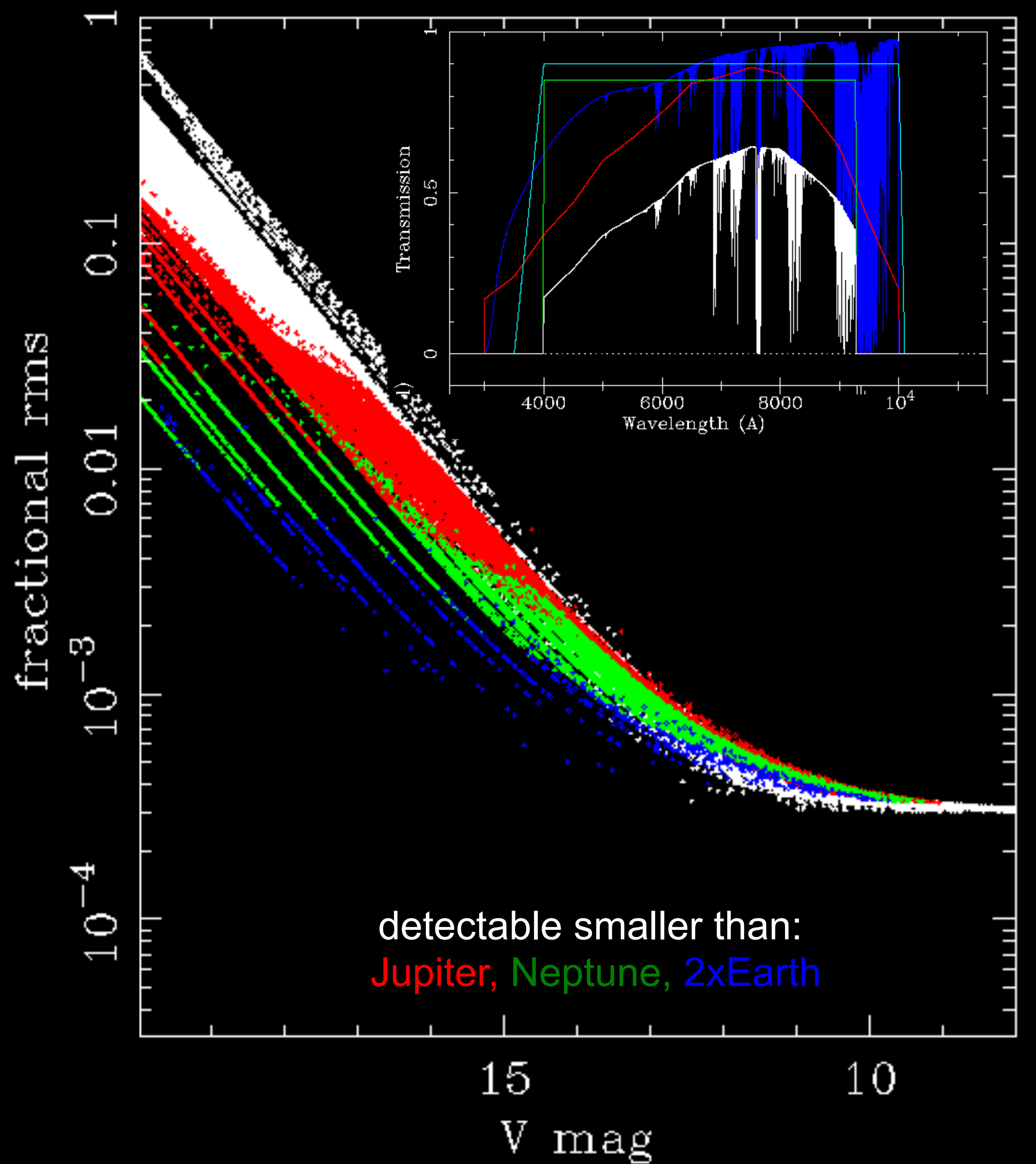
- Instrumental throughput
- Sky transmission
- Real sky background

- Galactic model
- Real stellar spectra
- Scintillation
- Red noise floor

- Planet distributions and occurrence rates from Kepler

- Weather at Paranal
- Period window function
- Transit detection probability

- Radial velocity sensitivity



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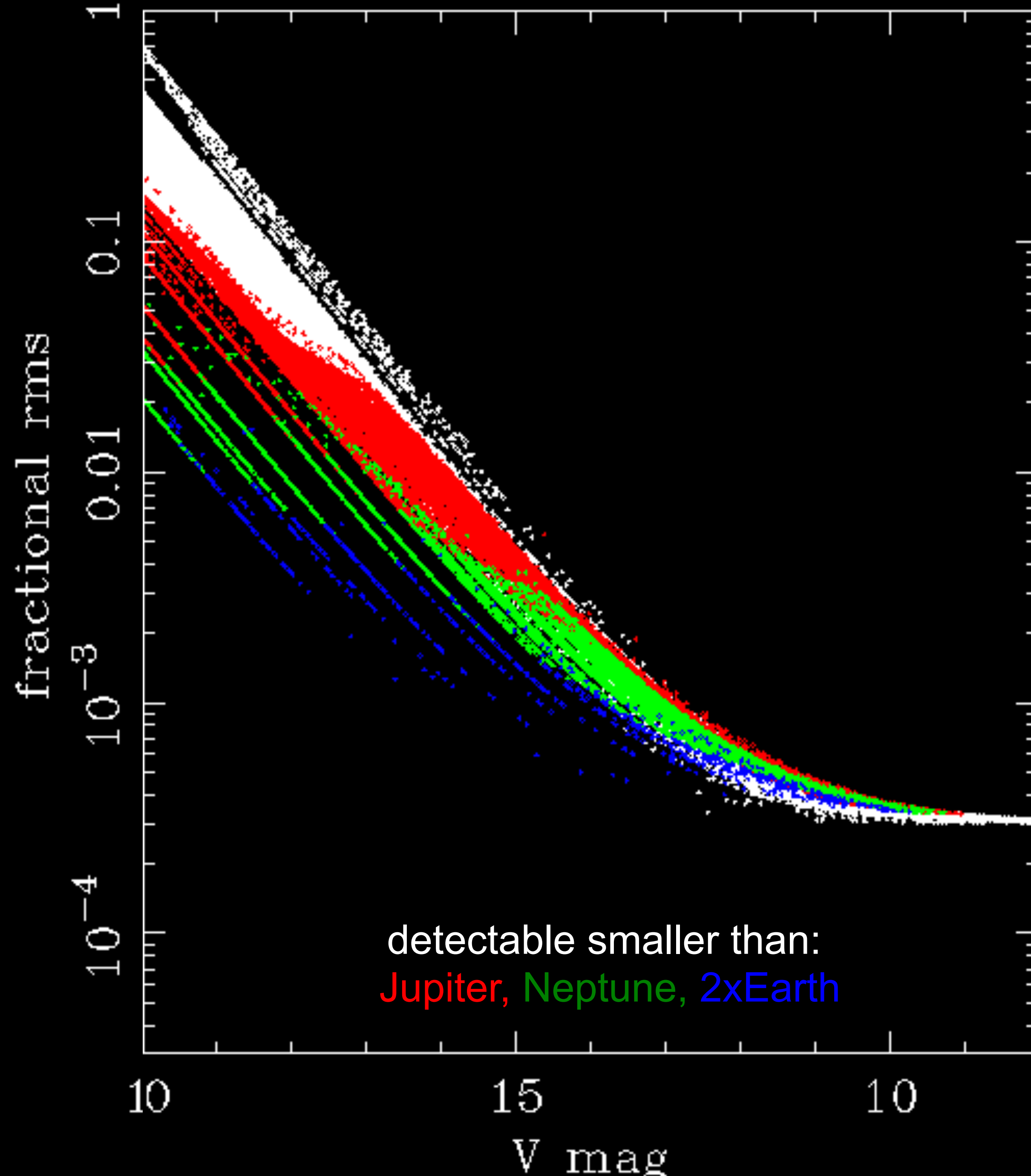

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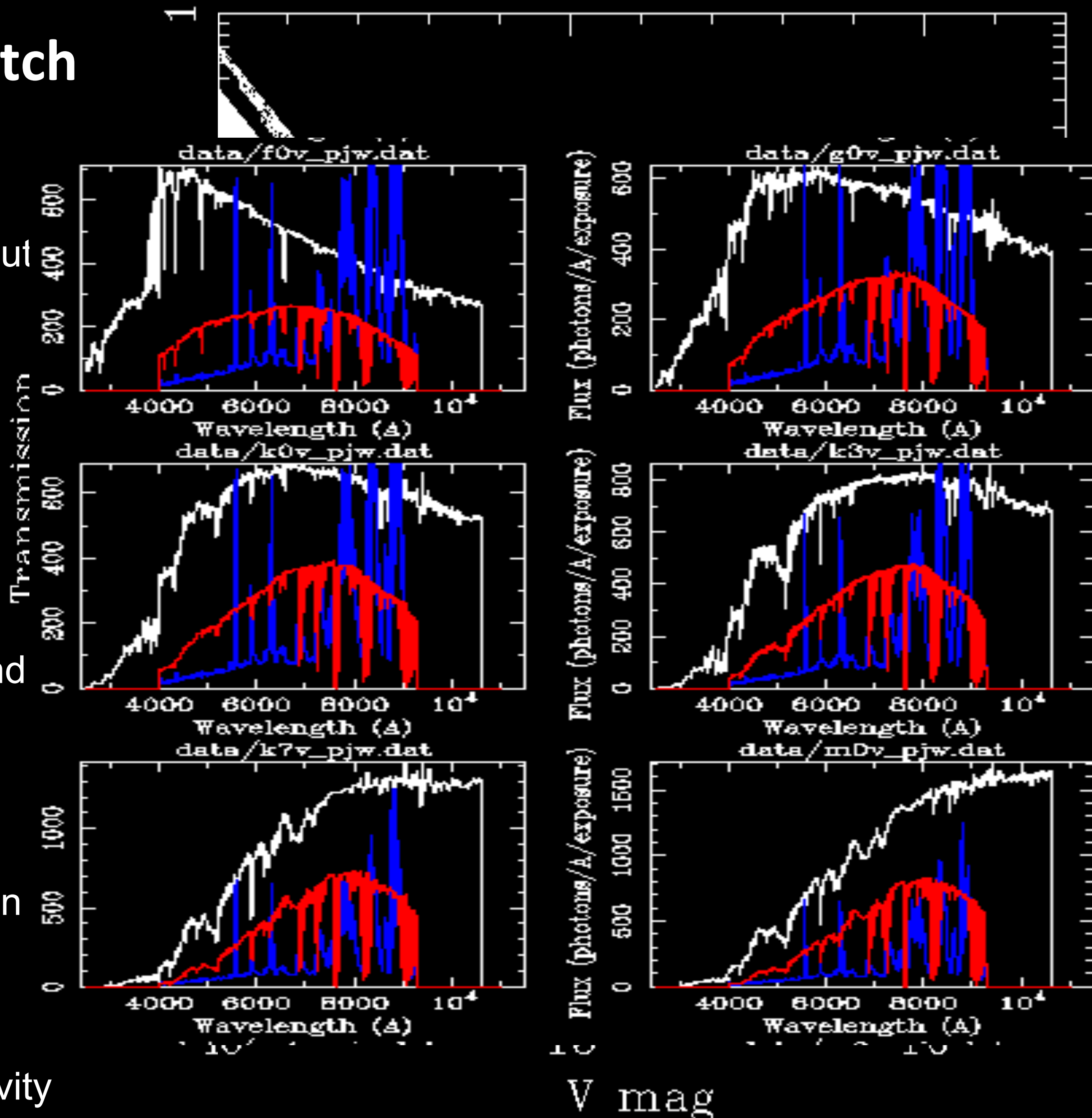
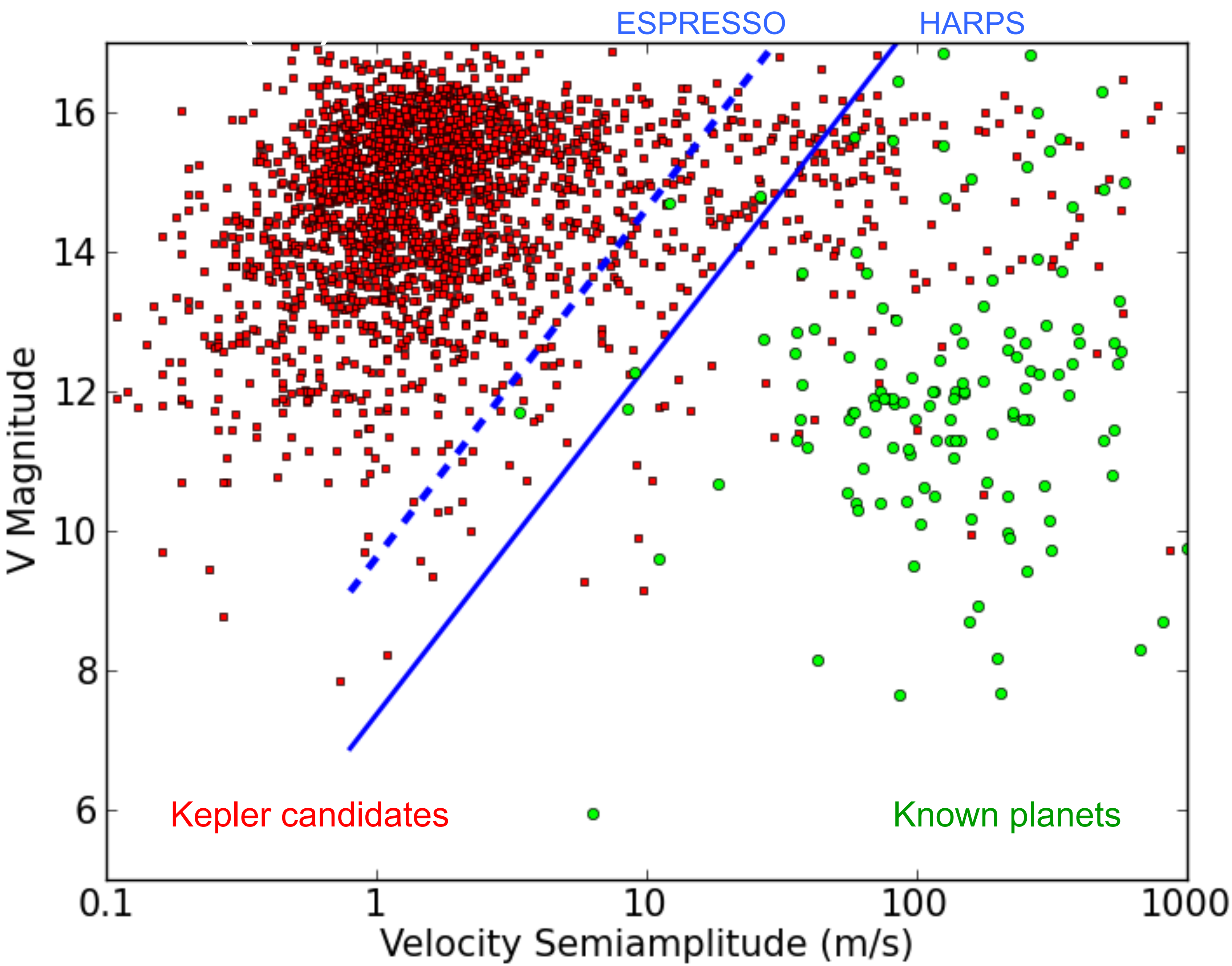
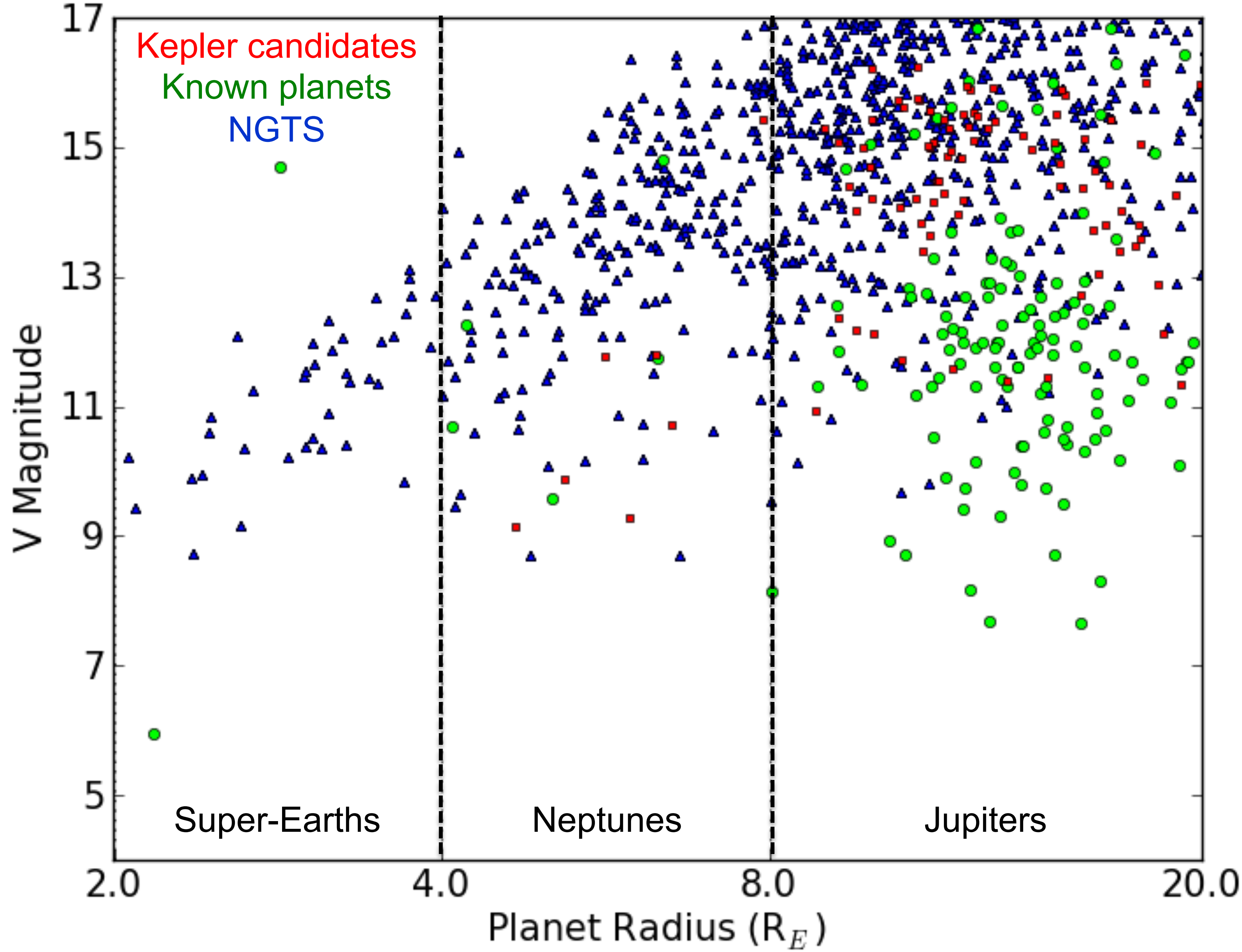
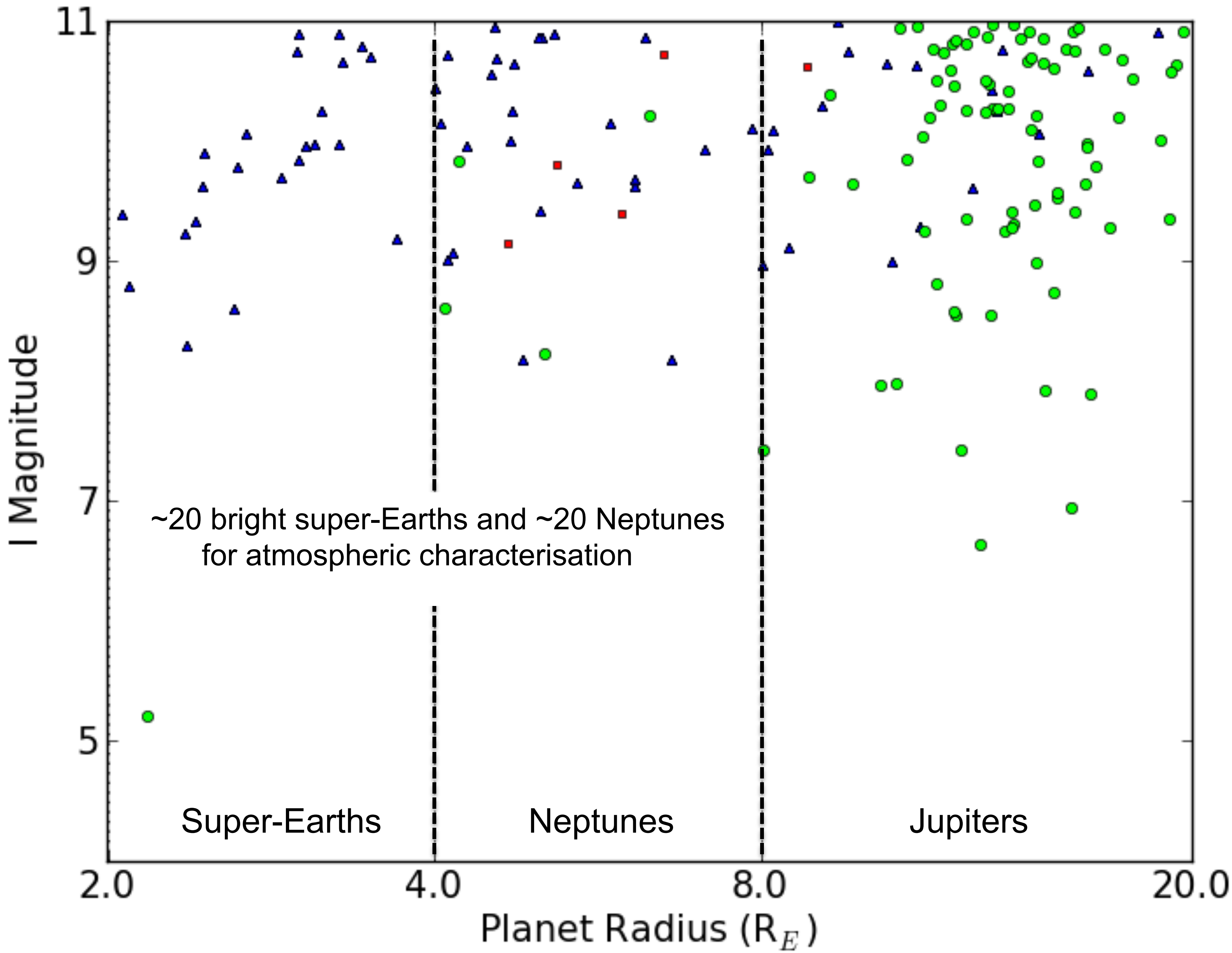




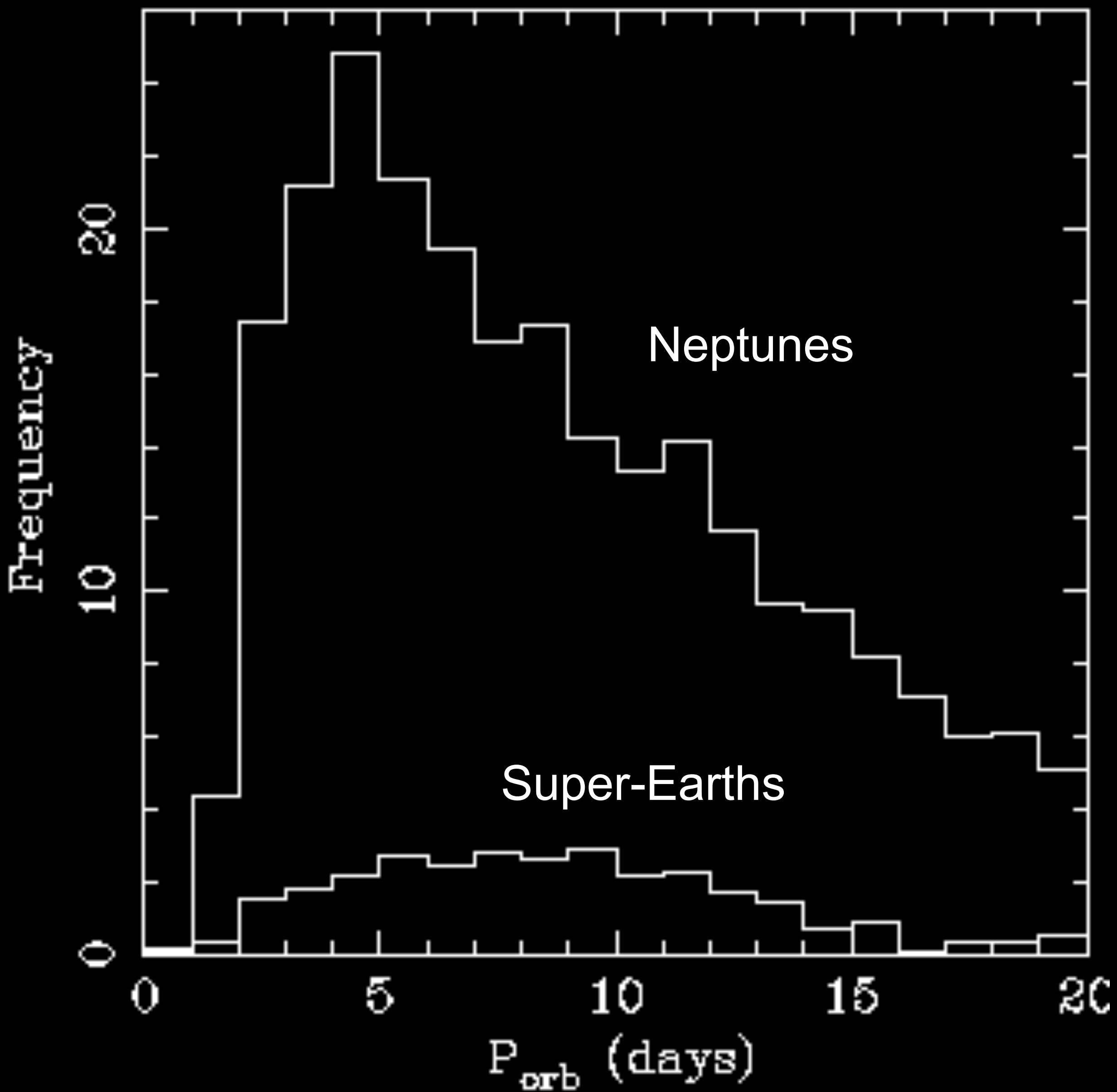
ESPRESSO
HARPS
16
14
12
10
8
6
V Magnitude
Kepler candidates
Known planets
0.1
1
10
100
1000
Velocity Semiamplitude (m/s)

~40 RV-confirmed super-Earths and
~230 Neptunes for bulk composition




11
9
7
5
I Magnitude
2.0
4.0
8.0
20.0
Planet Radius (R_E)
~20 bright super-Earths and ~20 Neptunes
for atmospheric characterisation
Super-Earths
Neptunes
Jupiters

Period distributions



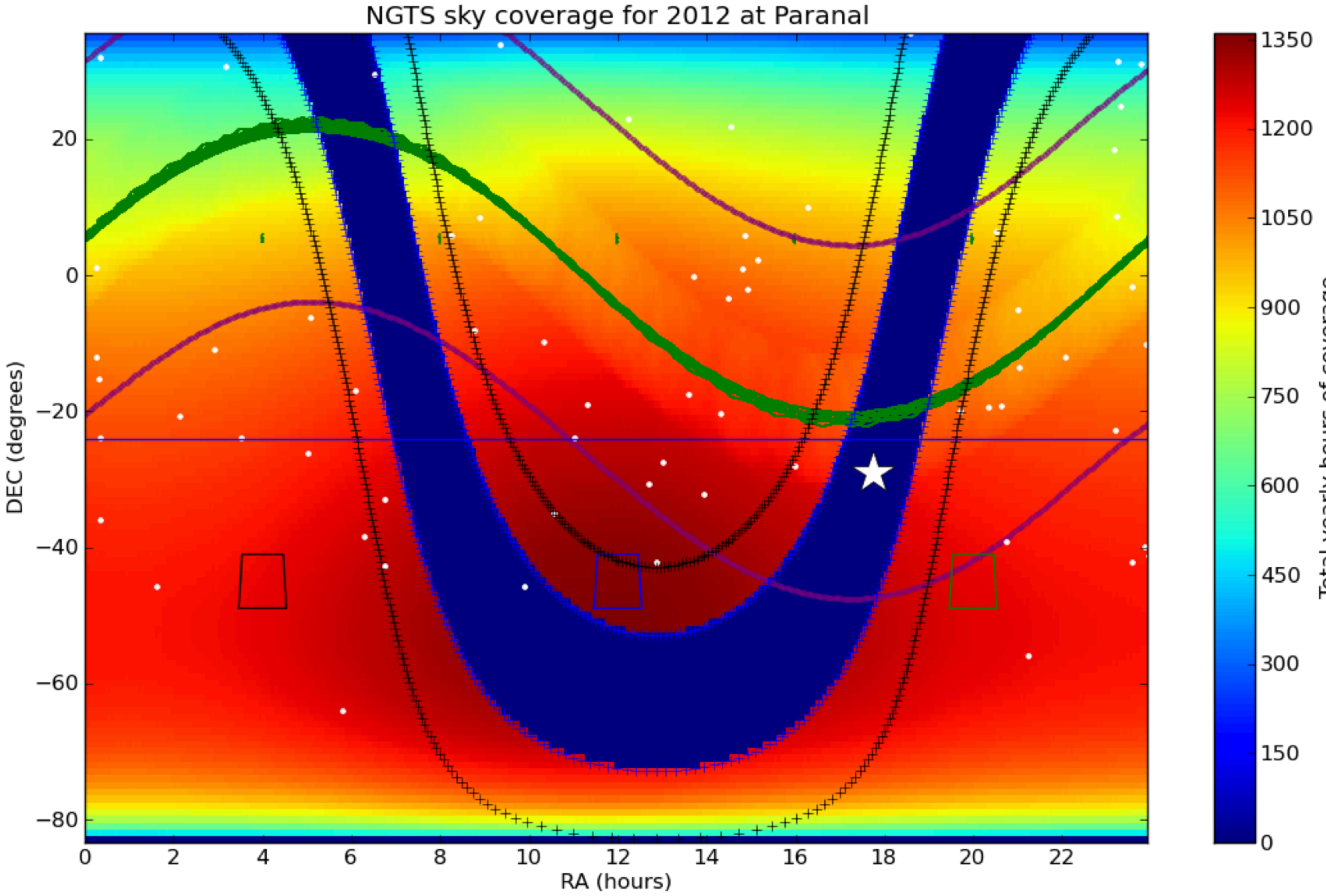
Probably some HZ objects and cool Jupiters

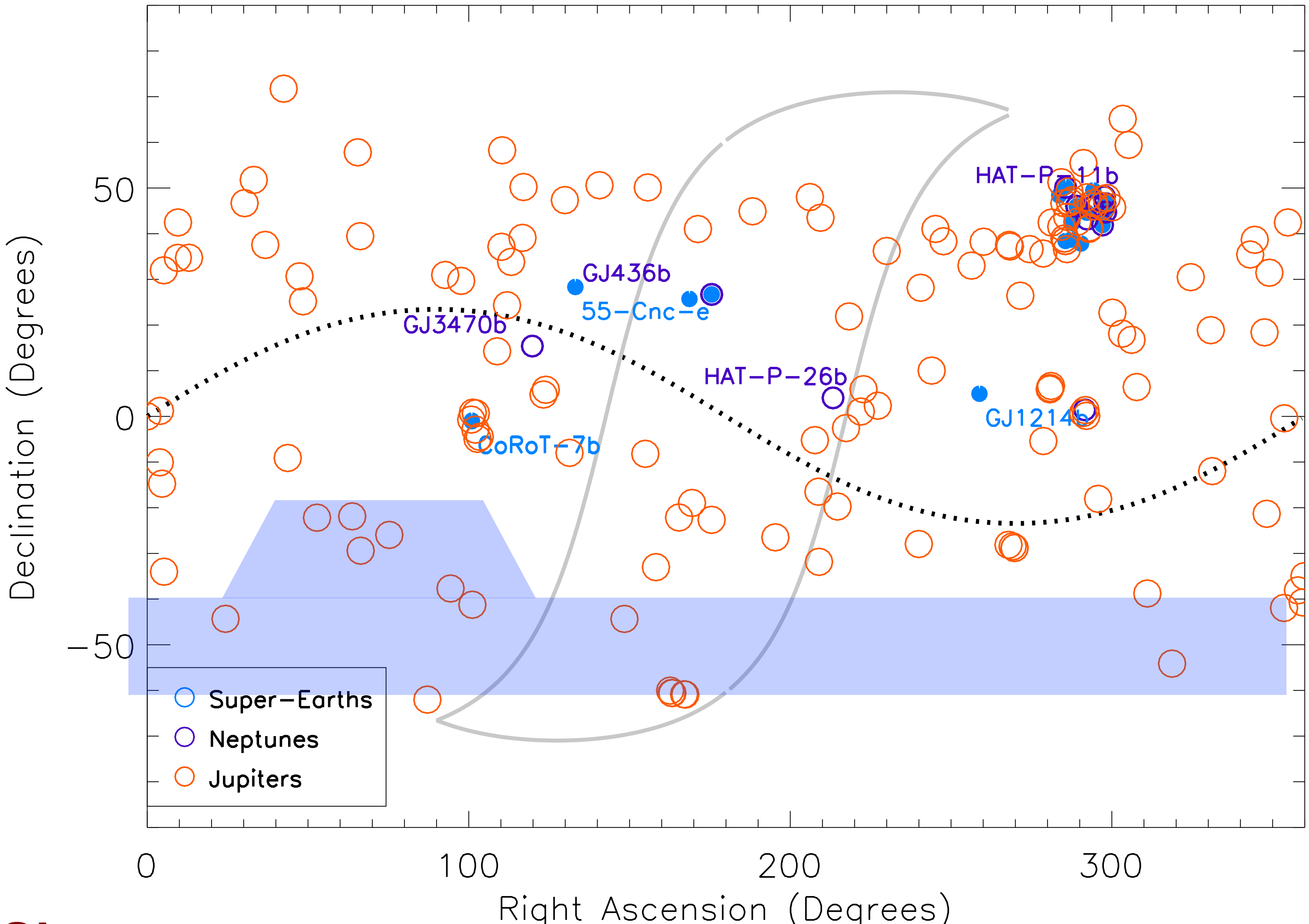
Simulated planet catch (Q3)

- 10 hours / object with HARPS / HARPS-N
  - 37 NGTS candidate Neptunes can be confirmed, cf 7 from Kepler
  - Together raising total known to 48
  - Neither mission sensitive to super-Earths (1 predicted from NGTS)

- 20 hours / object with HARPS-N
  - Kepler Neptunes increased to only 21, and only 1 super-Earth

- 10 hours / object with ESPRESSO (from 2016)
  - NGTS can confirm 231 Neptunes and 39 super-Earths
  - NGTS bright sample consists of 25 Neptunes and 23 super-Earths


NGTS sky coverage for 2012 at Paranal
DEC (degrees)
RA (hours)
Total yearly hours of coverage
20
0
−20
−40
−60
−80
0
2
4
6
8
10
12
14
16
18
20
22
1350
1200
1050
900
750
600
450
300
150
0



Sky coverage

Wheatley et al., 2013, arXiv:1302.6592
www.ngtransits.org

Belfast Berlin Cambridge Geneva Leicester Warwick