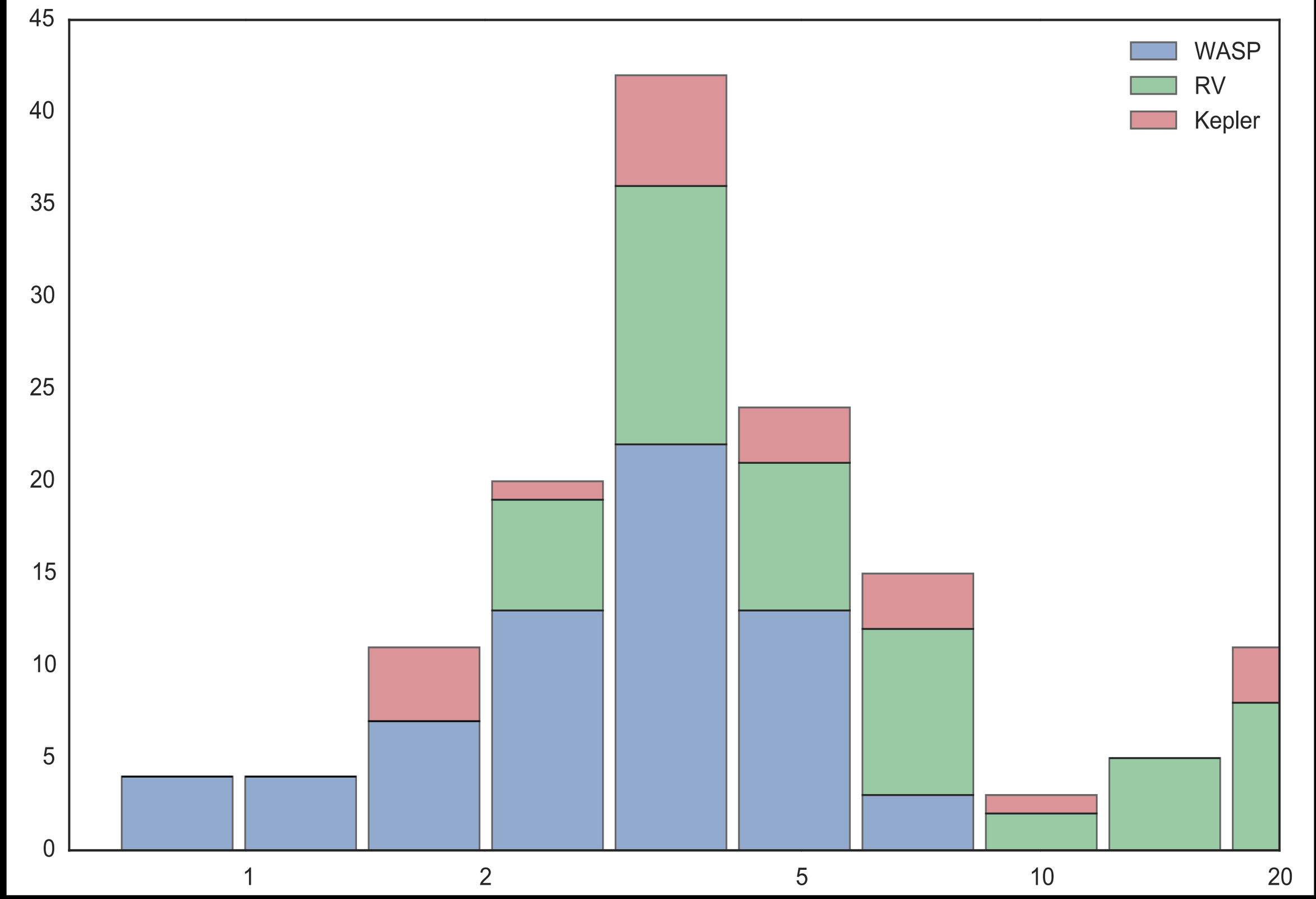
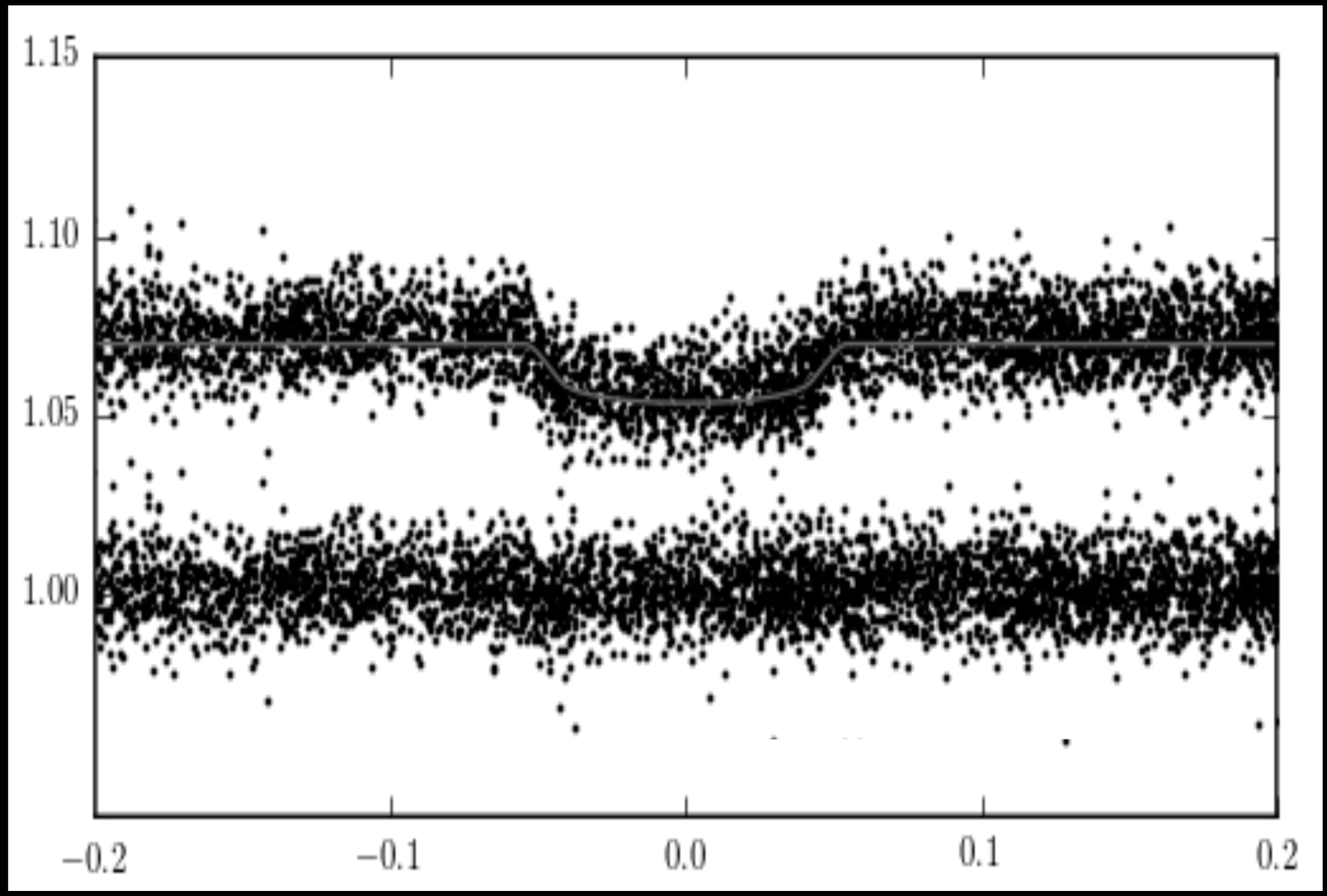
A characteristic orbital period of hot Jupiters from the WASP survey

Simon Walker

Number of planets



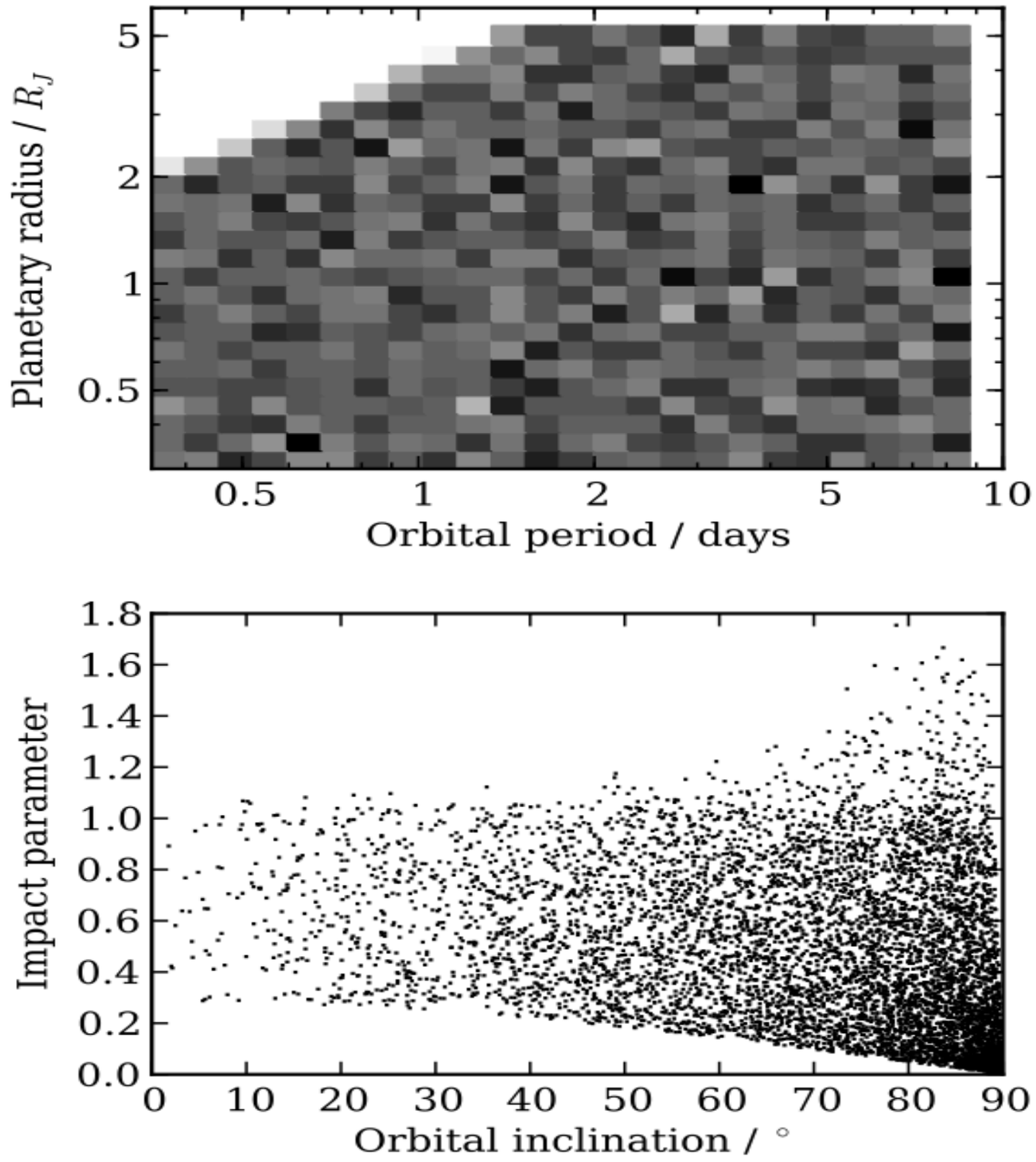
Orbital period



WASP-12 b

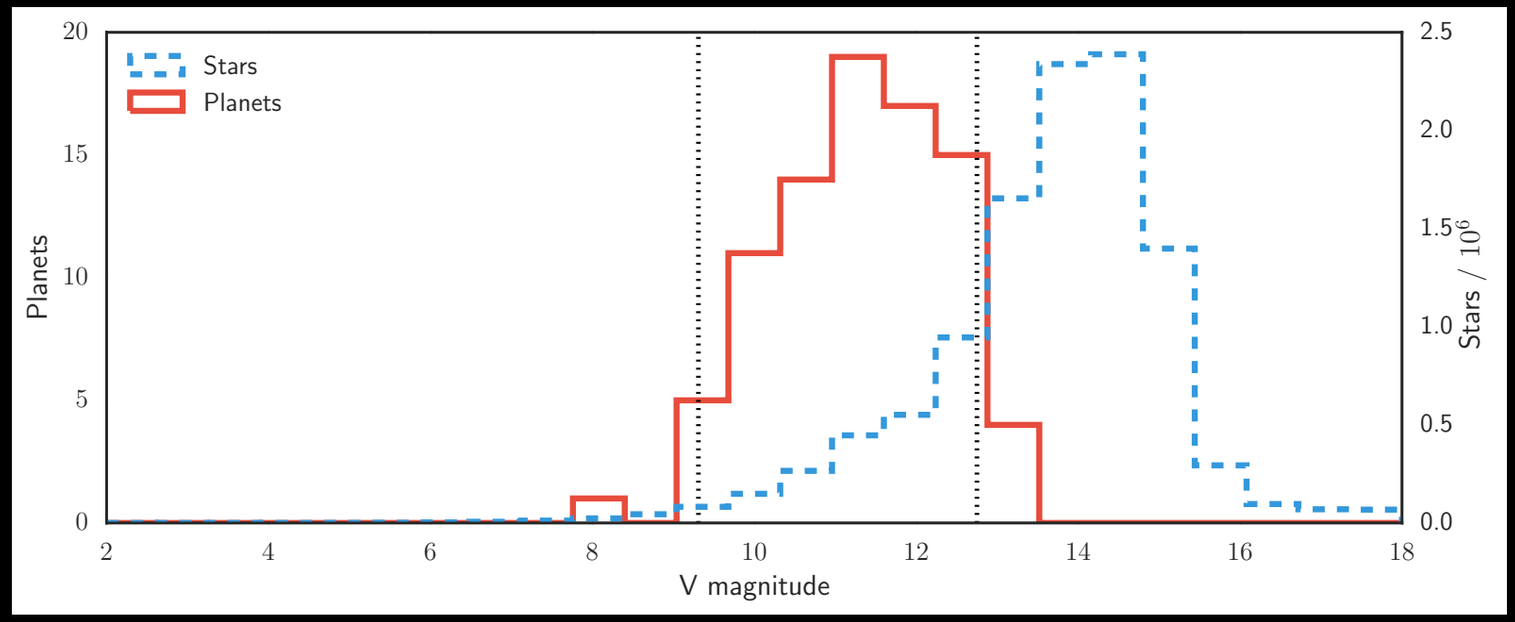
Residuals

3.4 million transits inserted into the light curves of 125,304 Solar-like stars

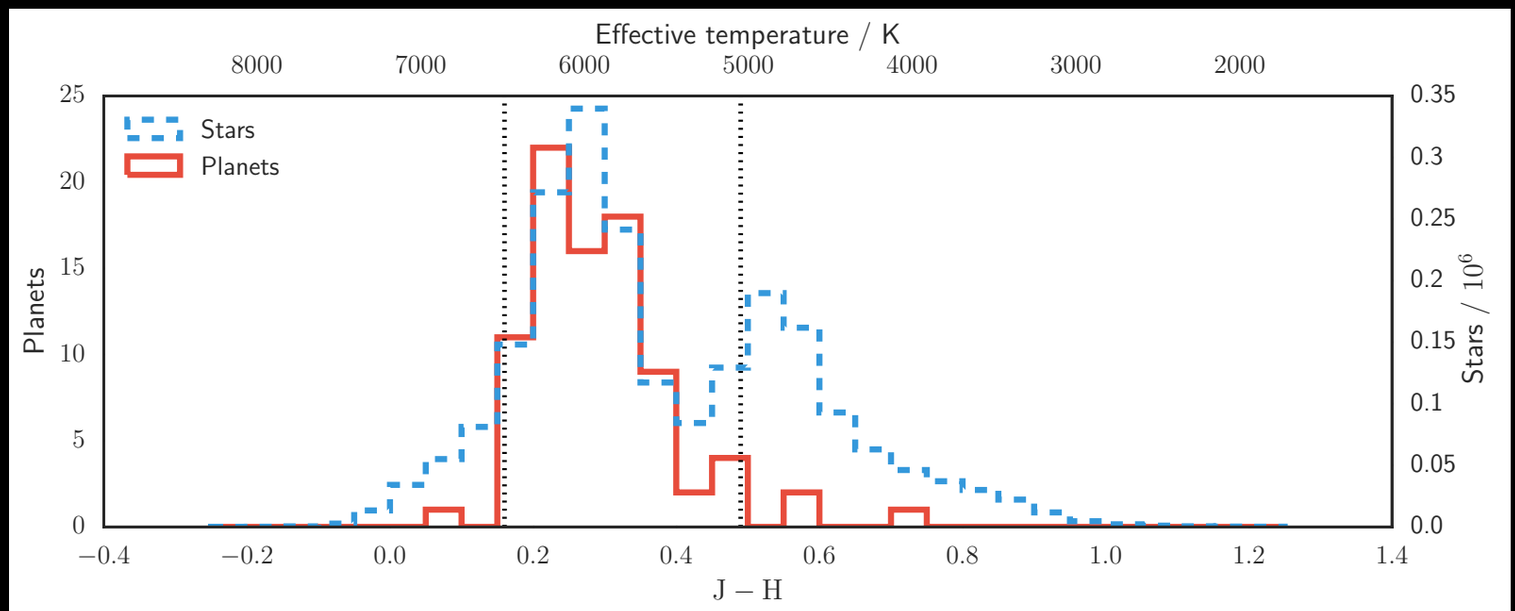


Even distribution in radius and period

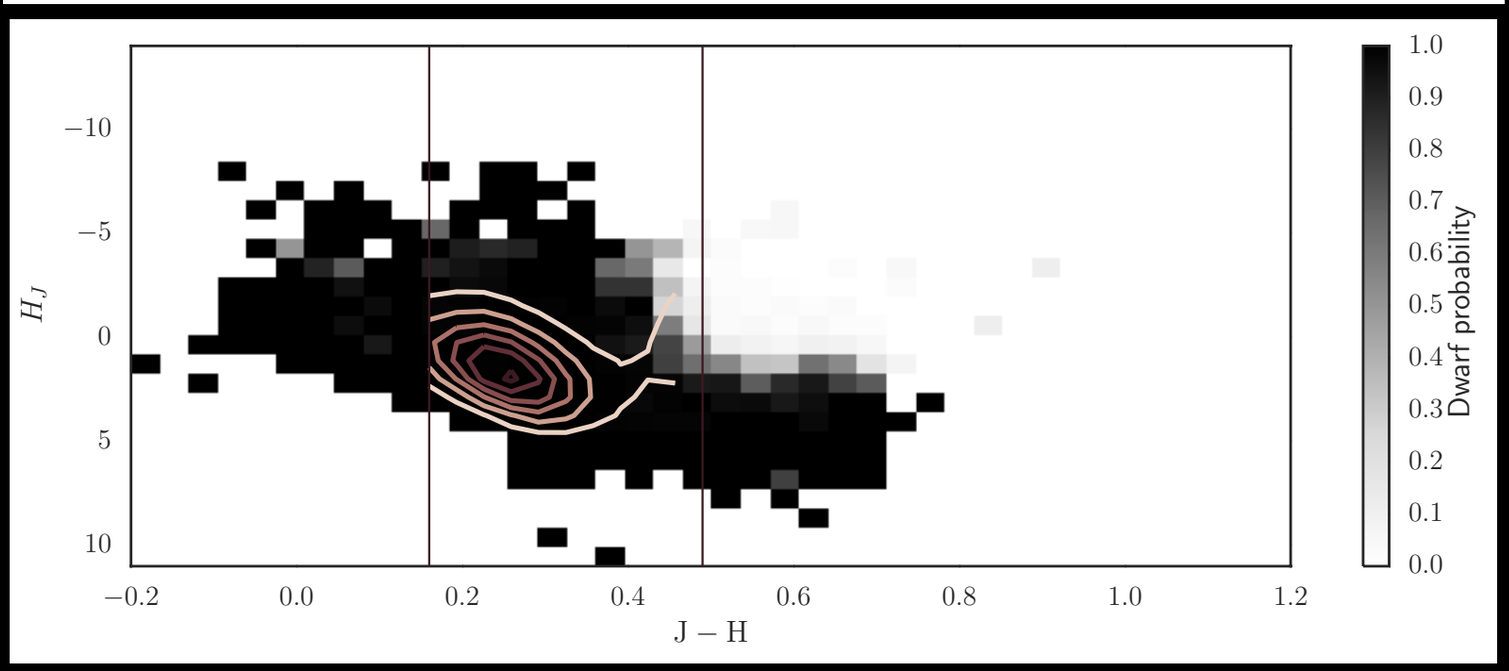
Randomised transit phase and inclination



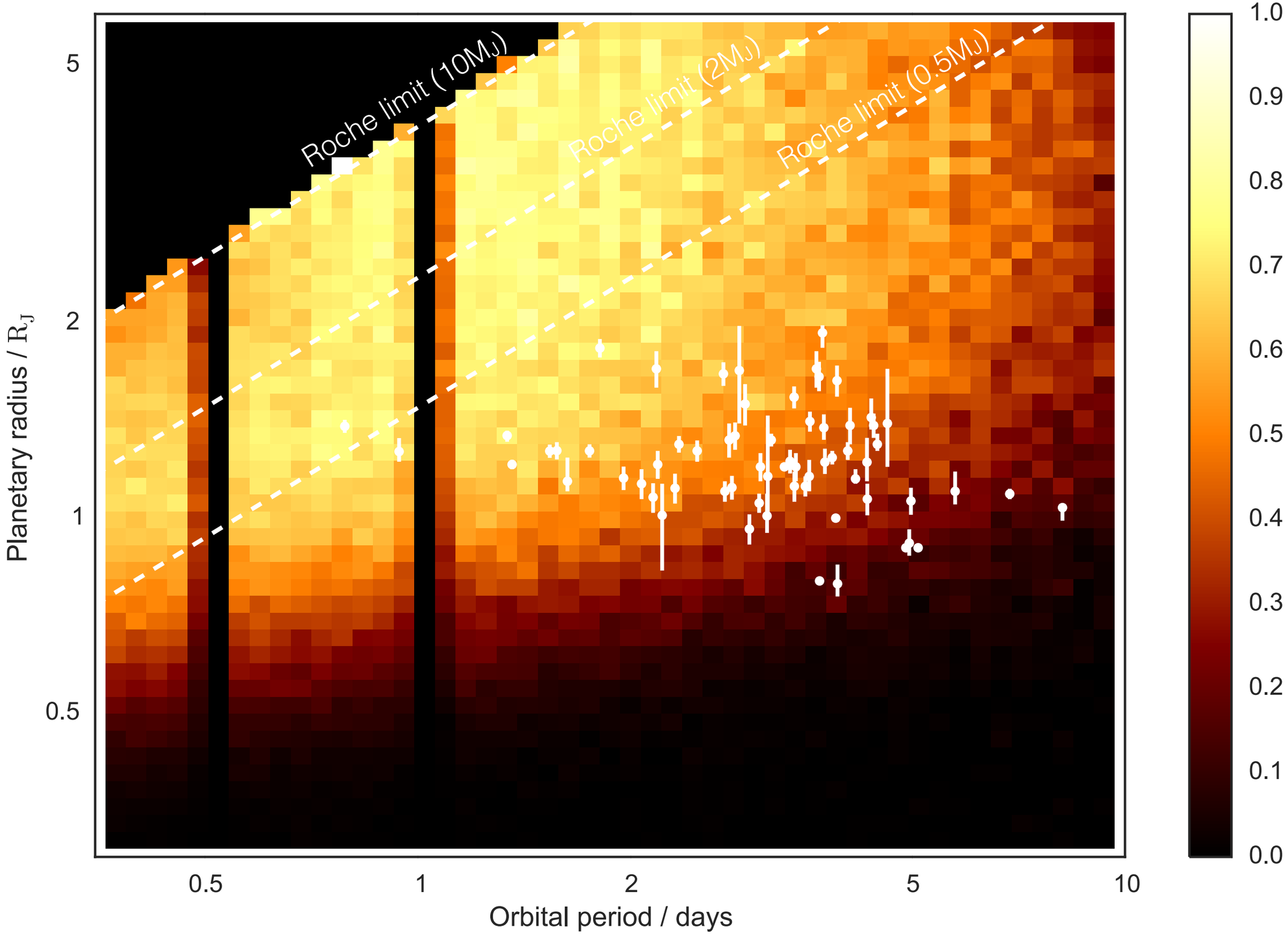
V magnitude
$9.3 \leq V \leq 12.8$
1,429,264 stars

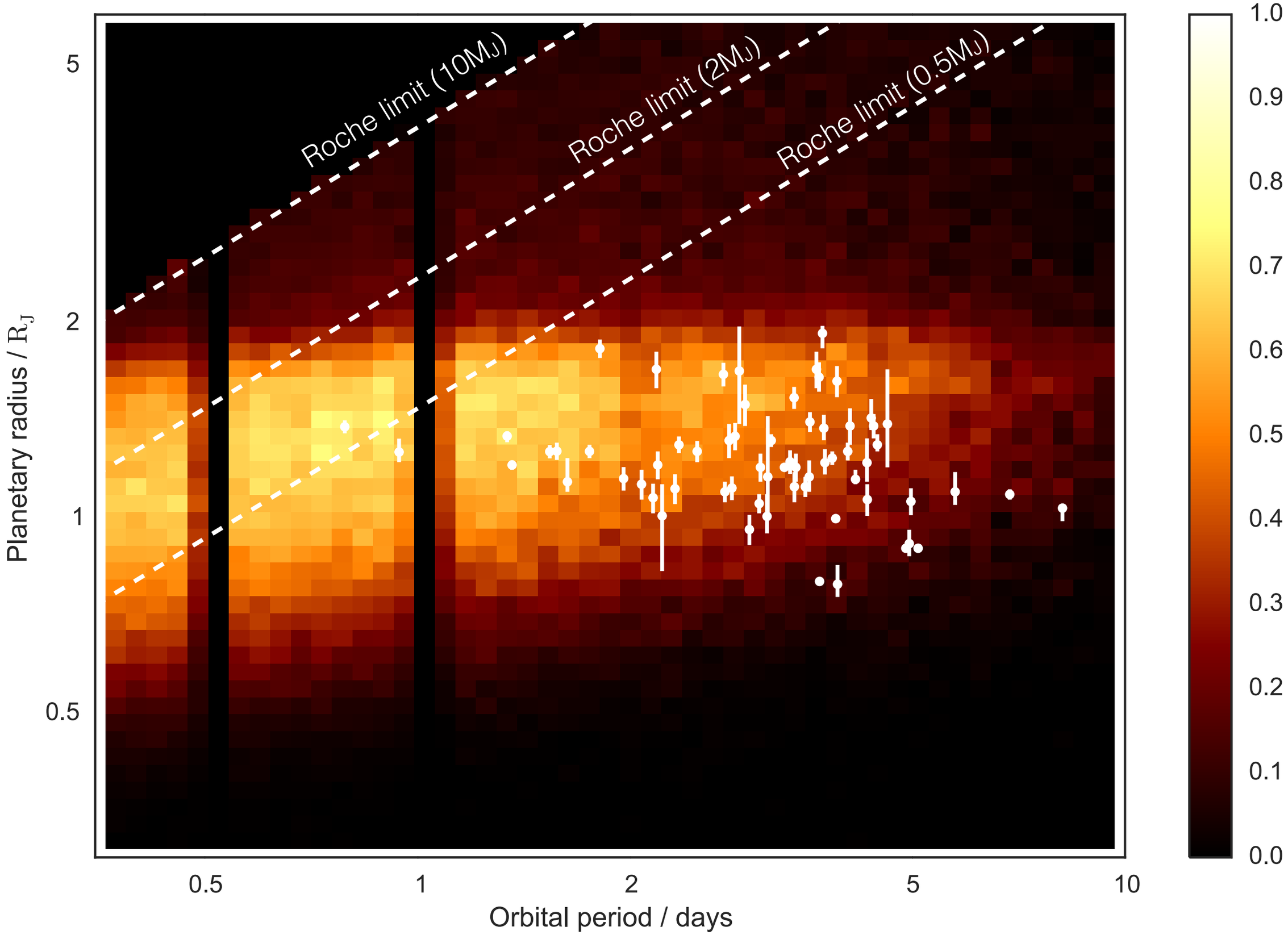


Effective temperature
$5050 \leq T_{eff} \leq 6500$
Mid F to early K
856,789 stars



Dwarf probability
$p \geq 98\%$
751,486 stars


Roche limit (10M$_J$)
Roche limit (2M$_J$)
Roche limit (0.5M$_J$)
Planetary radius / R$_J$
5
2
1
0.5
0.5
1
2
5
10
Orbital period / days
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0


Roche limit (10M$_J$)
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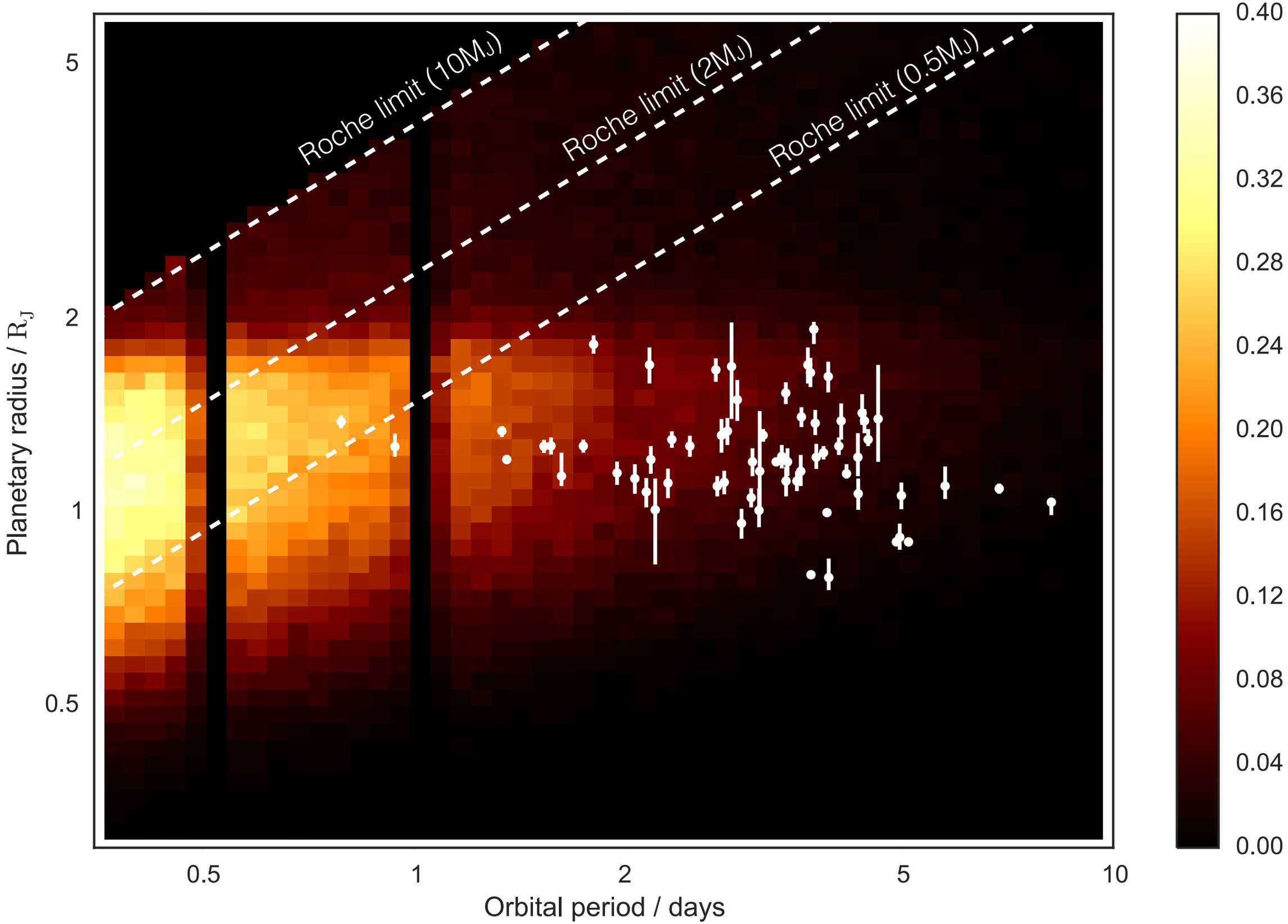
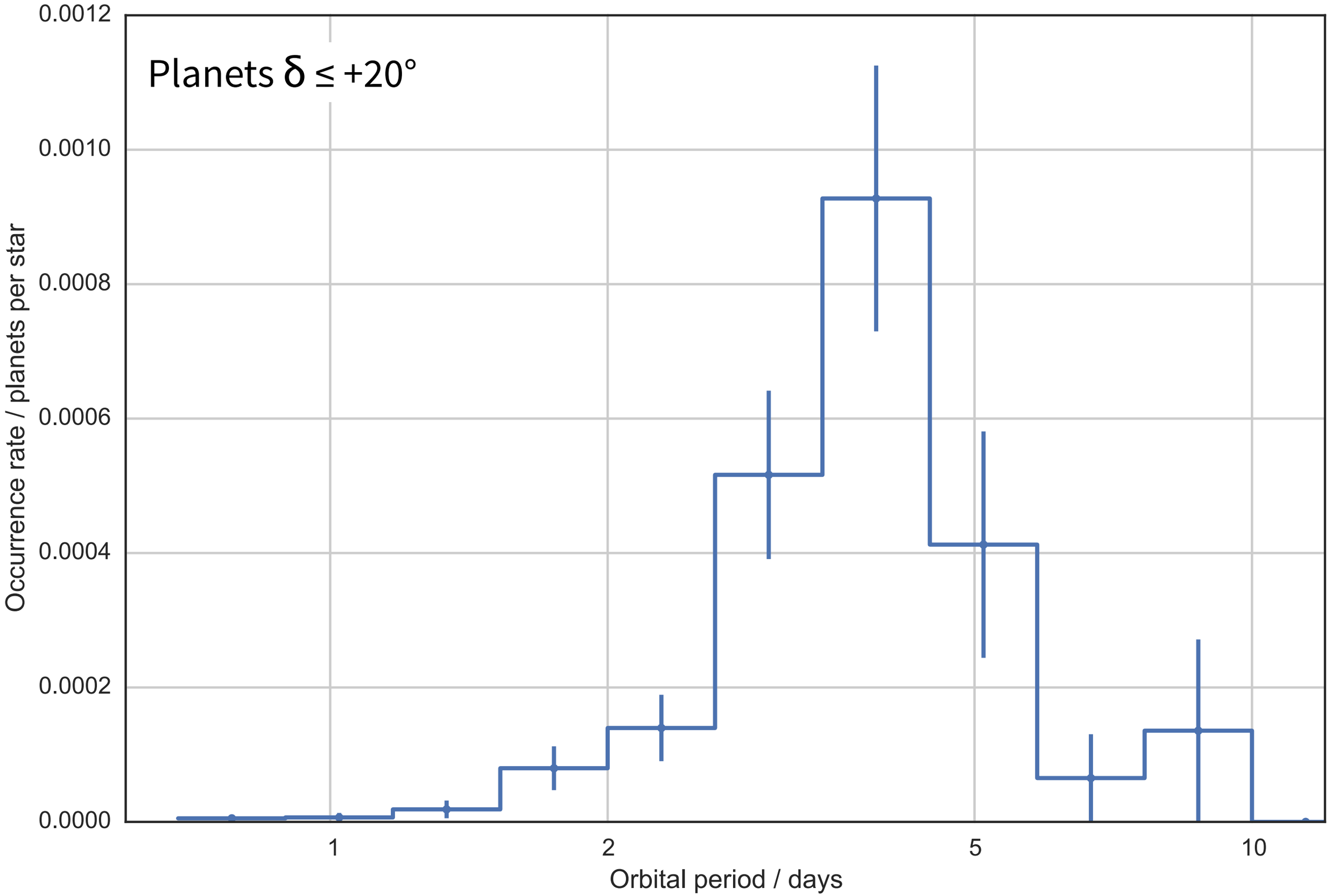
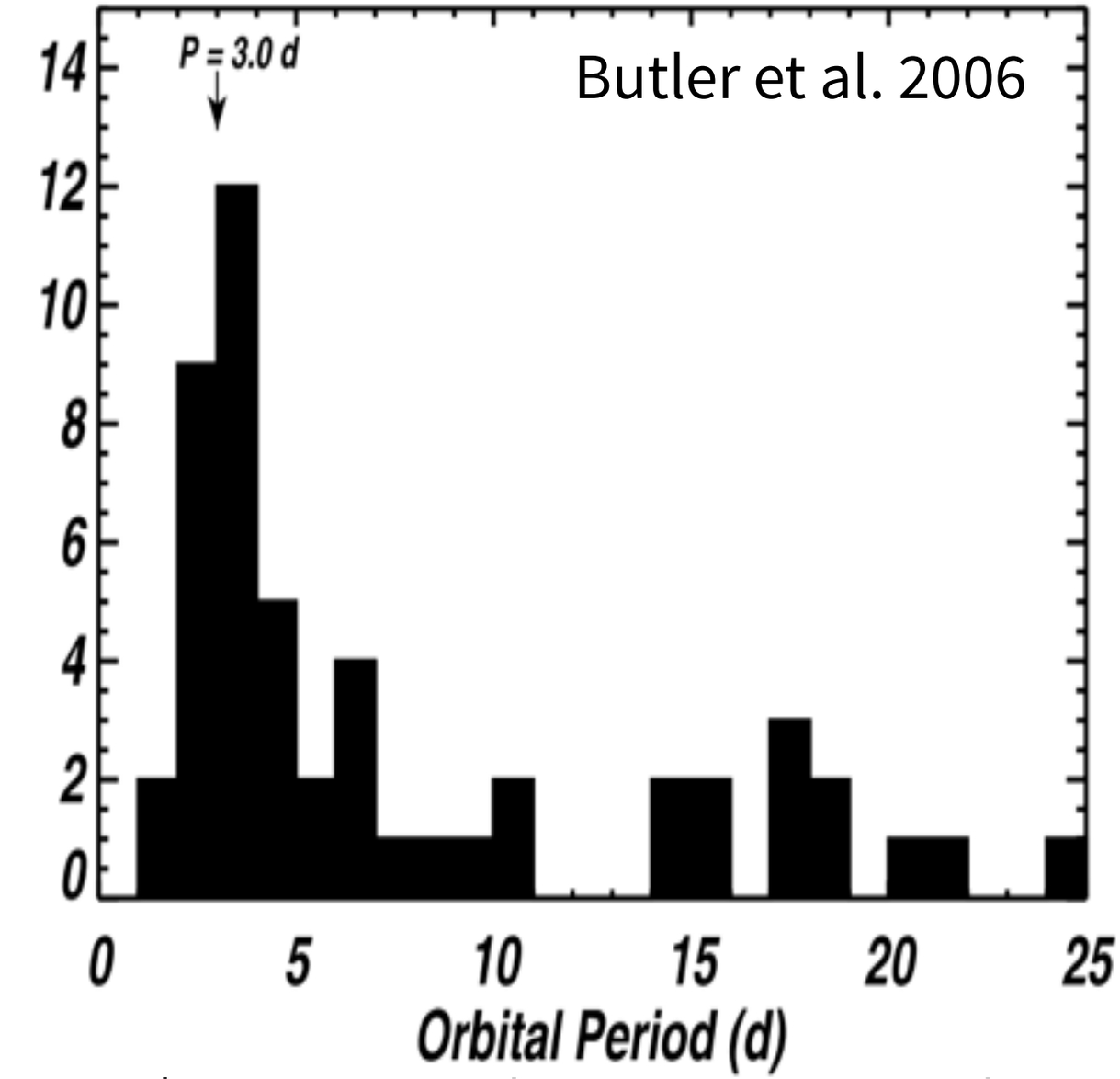
Planetary radius / R$_J$
5
2
1
0.5
0.5
1
2
5
10
Orbital period / days
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0


Roche limit (10MJ)
Roche limit (2MJ)
Roche limit (0.5MJ)
Planetary radius / RJ
5
2
1
0.5
0.5
1
2
5
10
Orbital period / days
0.40
0.36
0.32
0.28
0.24
0.20
0.16
0.12
0.08
0.04
0.00


Planets δ ≤ +20°
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Occurrence rate / planets per star
1
2
5
10
Orbital period / days



Butler et al. 2006

Mayor et al. 2011

Jupiter & cumulative rate [%]

20
15
10
5
0
1.0
10.0
100.0
1000.

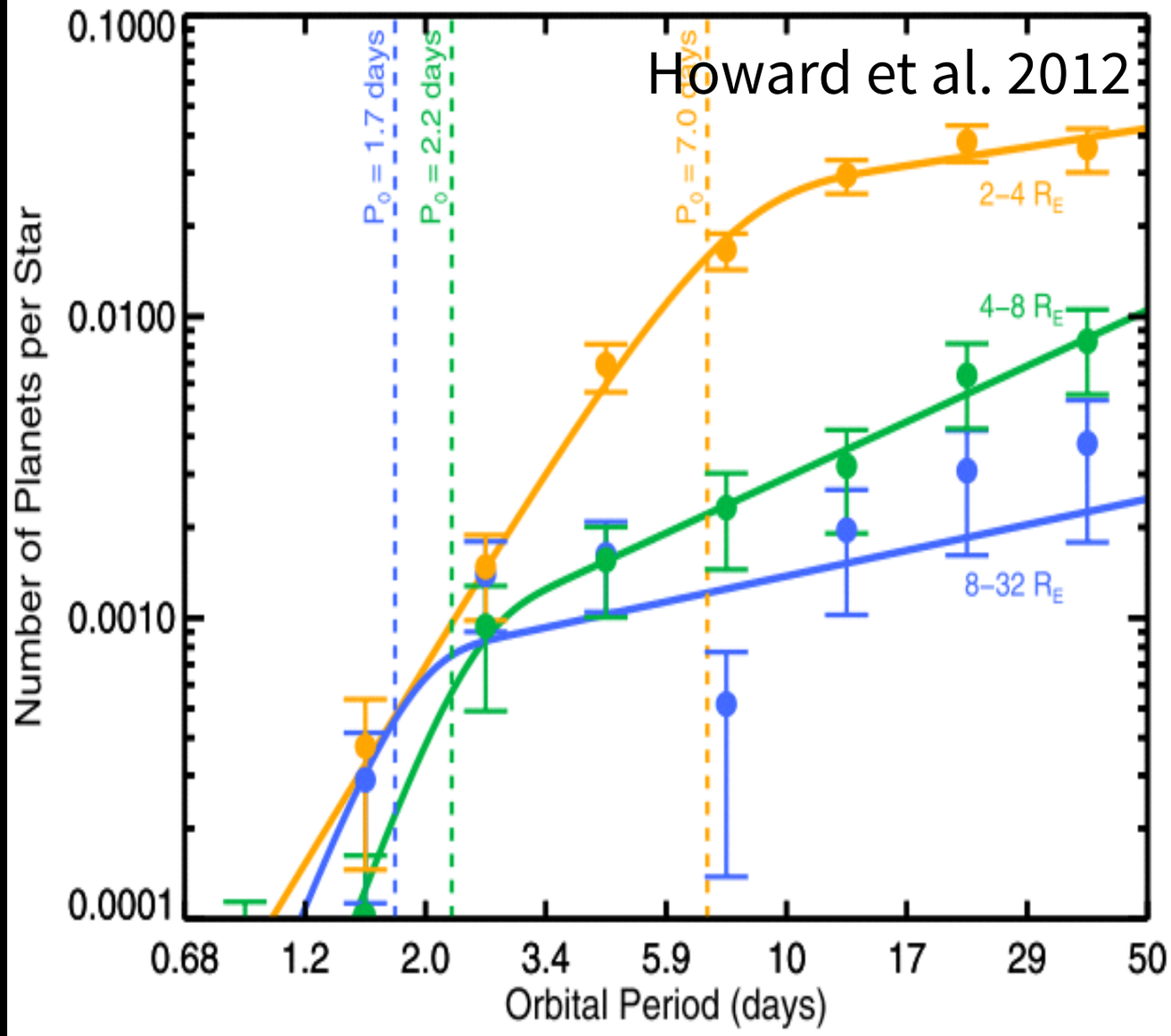
C

0.0002
0.0000

1
2
5
10

Orbital period / days

Howard et al. 2012



Kepler data
scaled

Gaussian Peak:
3.9±0.1 d

Gaussian width:
1.3±0.1 d

Power law index:
1.5±0.3

Number of planets per star

10^{-3}

10^{-4}

10^{-5}

10^{-6}

1 2 5 10 20 50

Orbital period / days

Number of planets per star

10^{-3}

10^{-4}

10^{-5}

10^{-6}

a_{circ} for $1R_J$

a_{circ} for $2R_J$

Dynamical migration

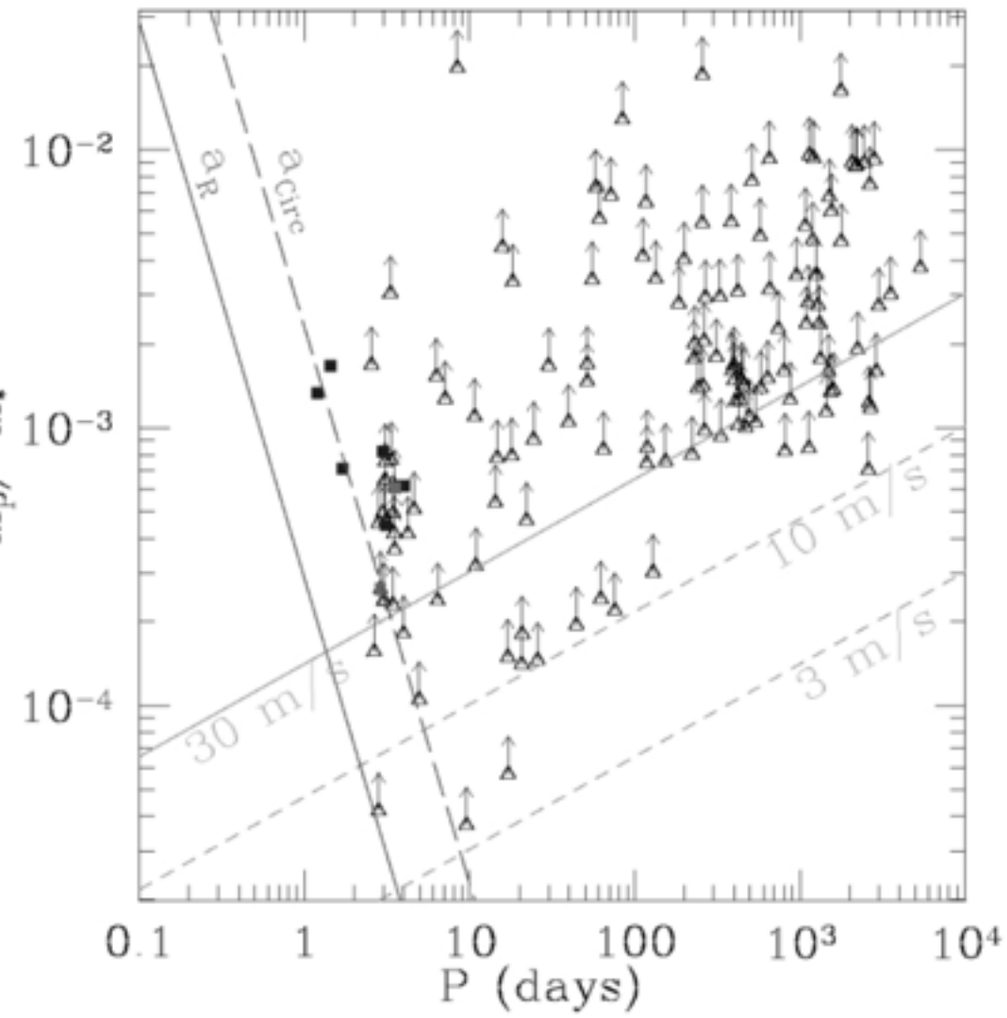
1

2

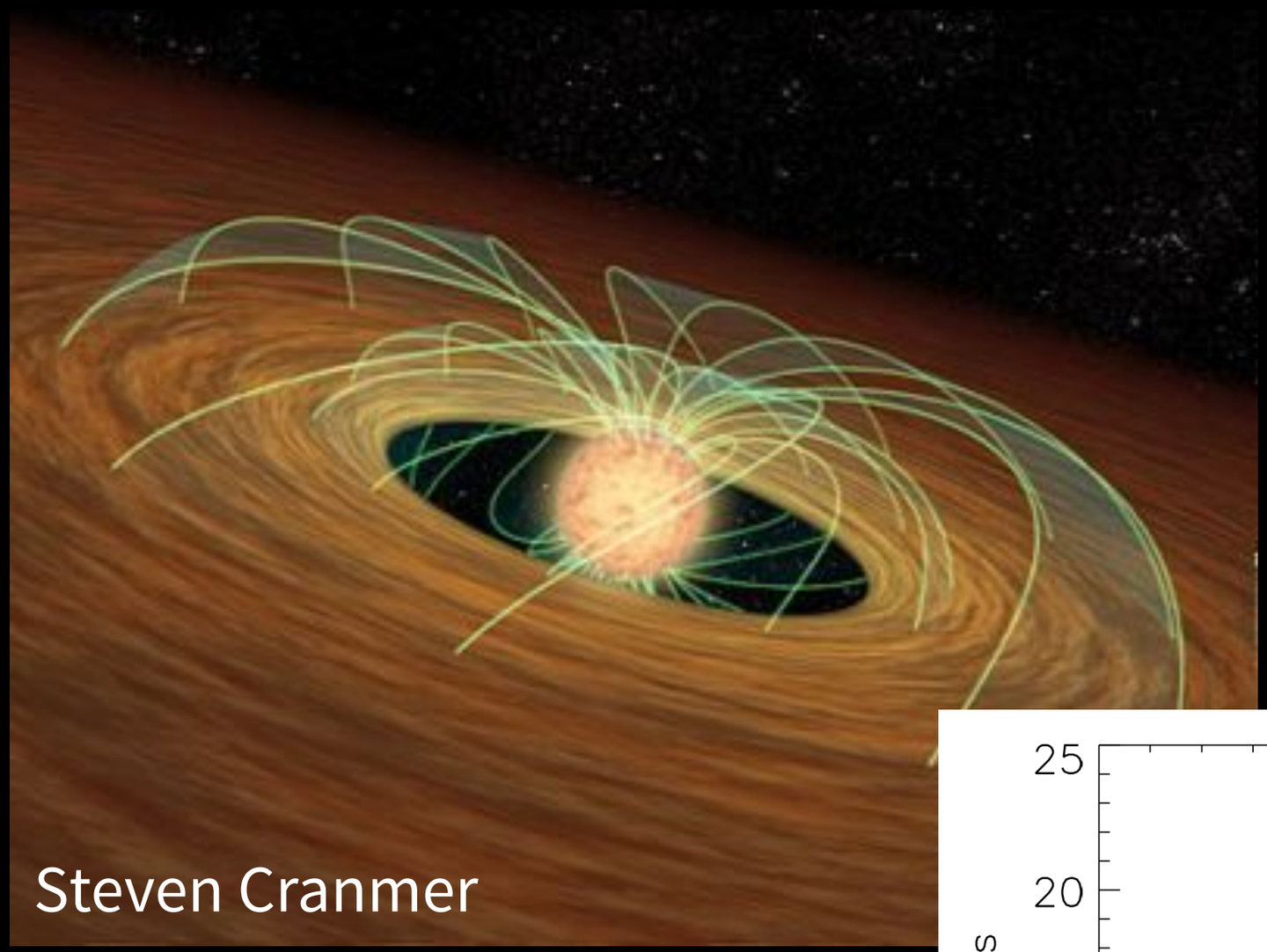
5

Kepler data scaled

Ford & Rasio 2005

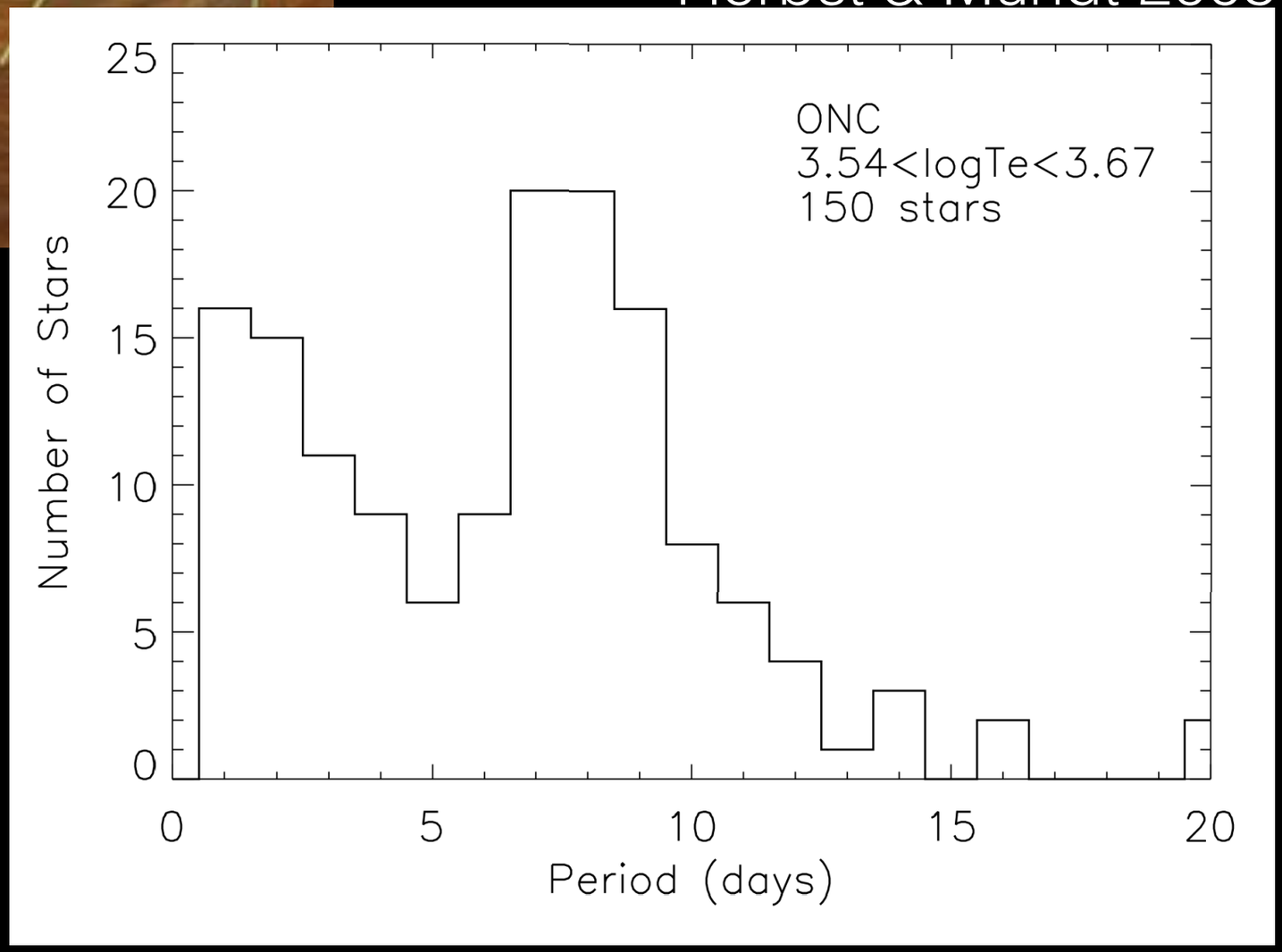


Orbital period / days

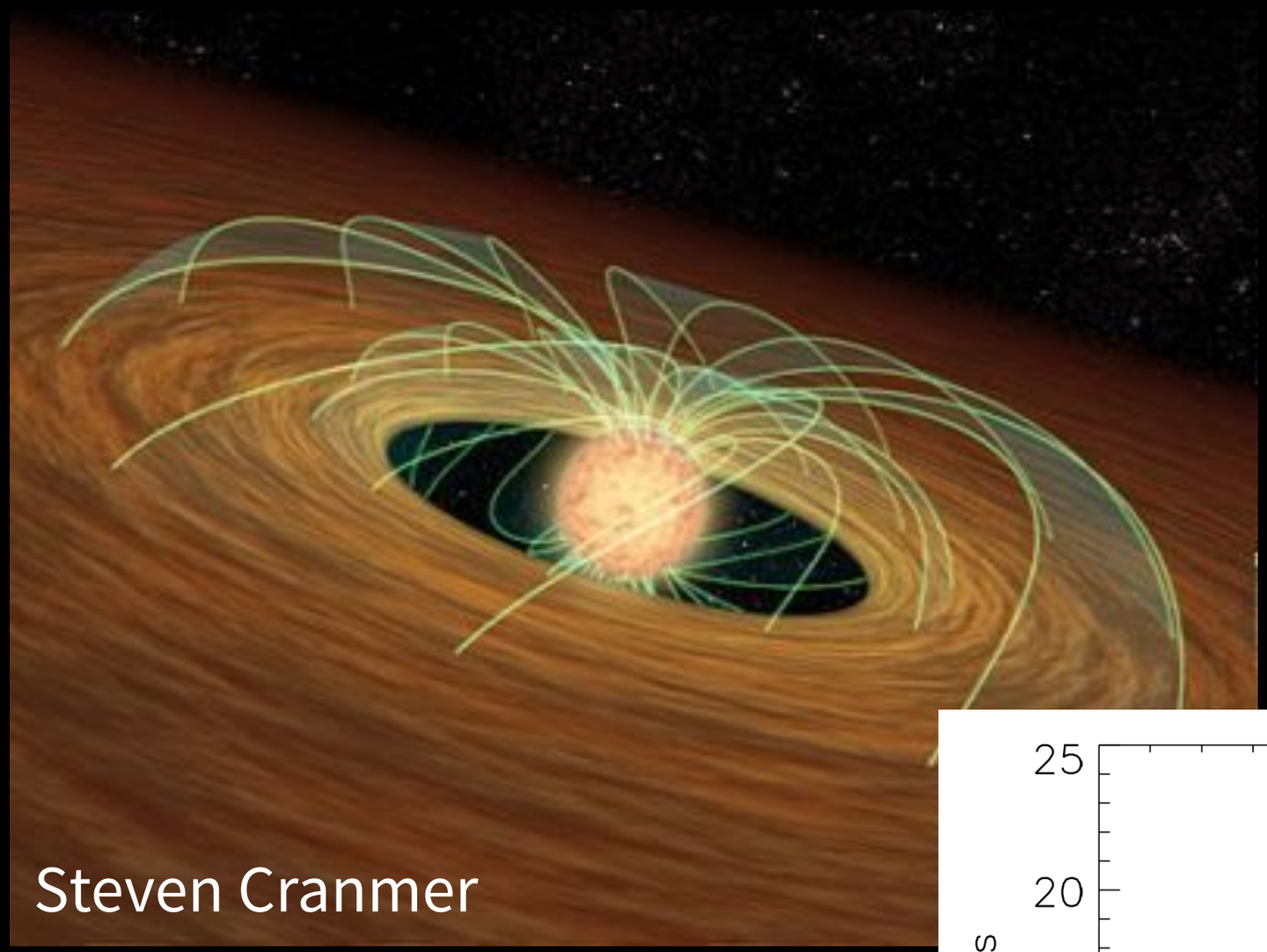


Disc migration

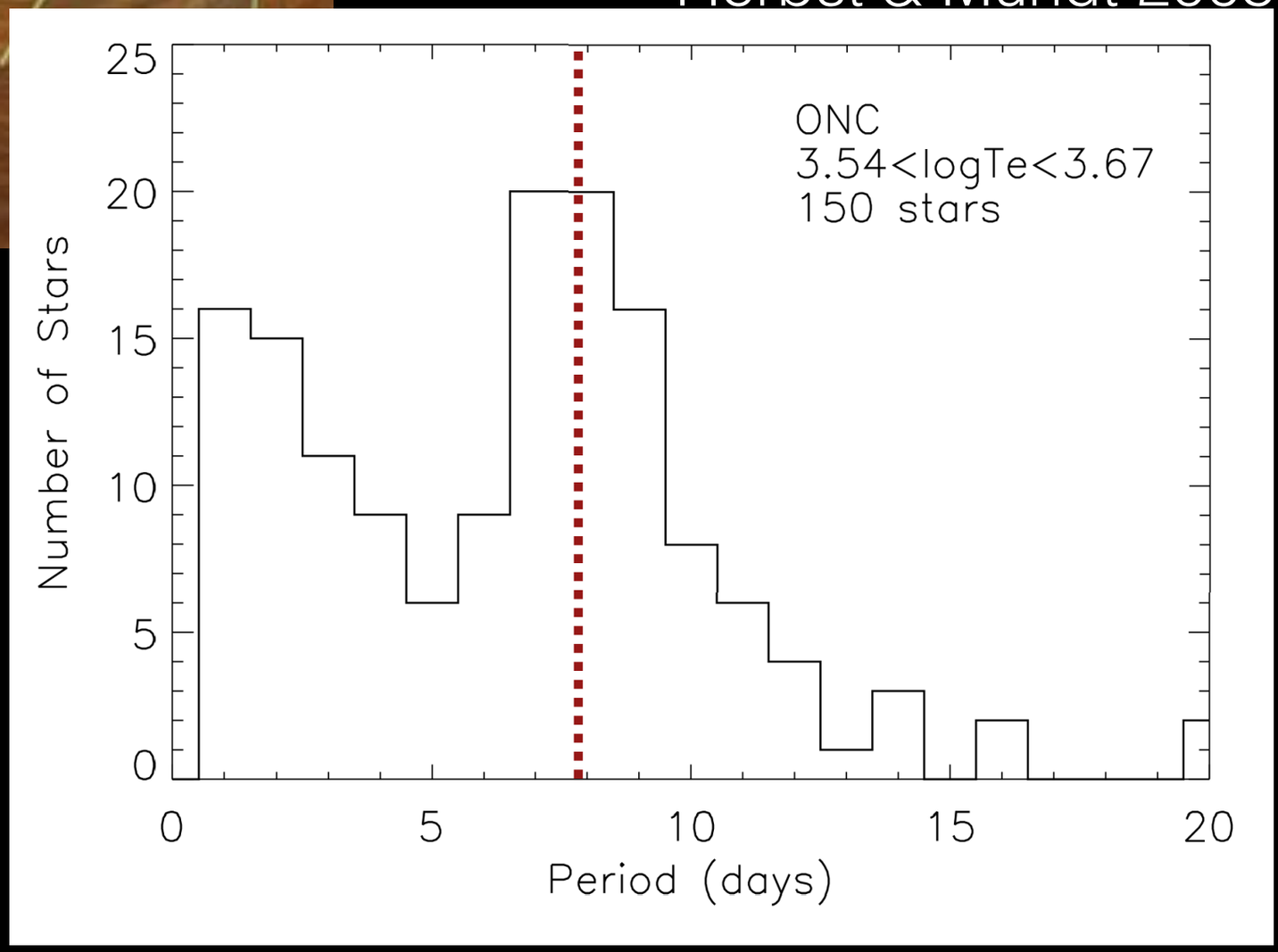
Herbst & Mundt 2005



Disc migration

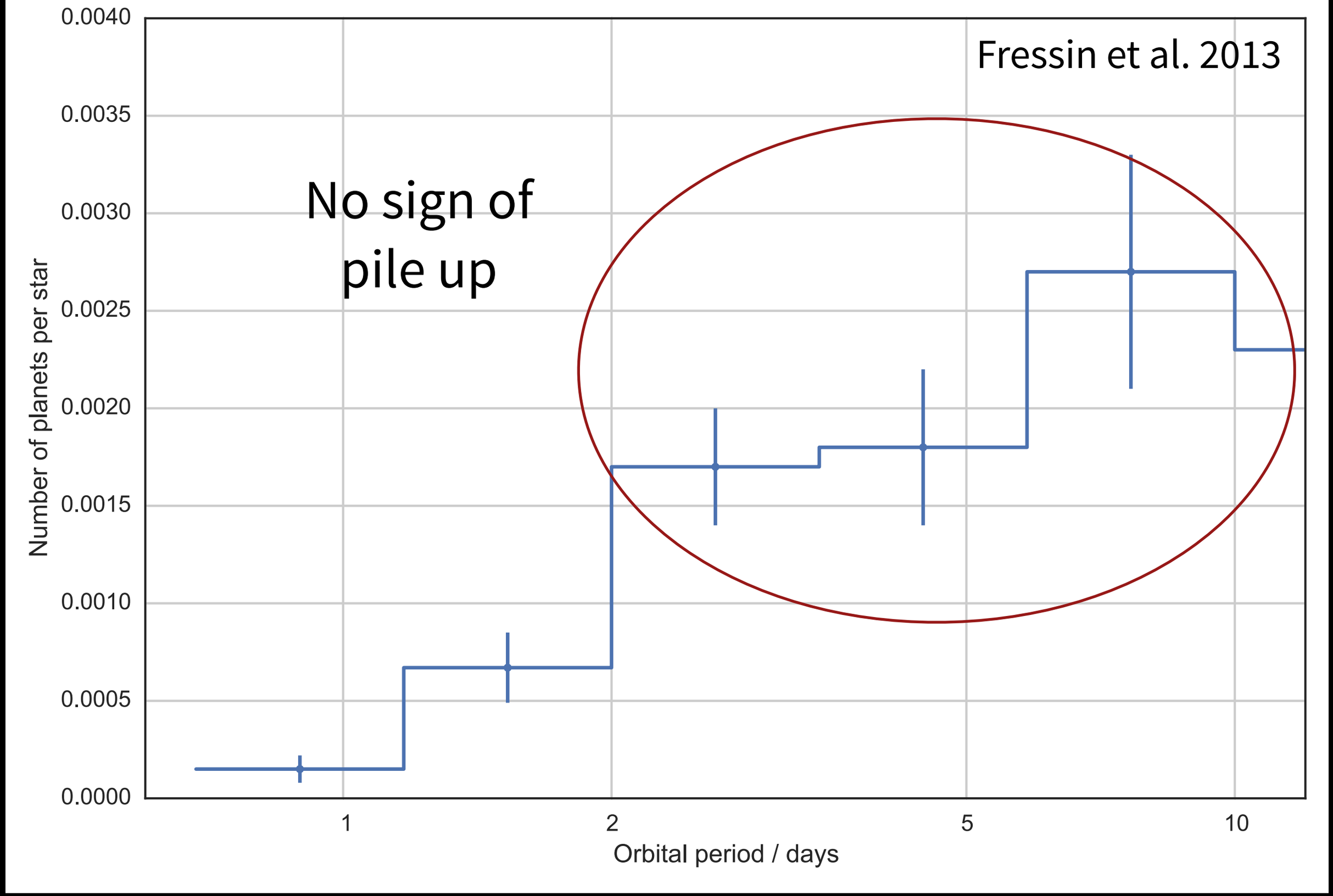


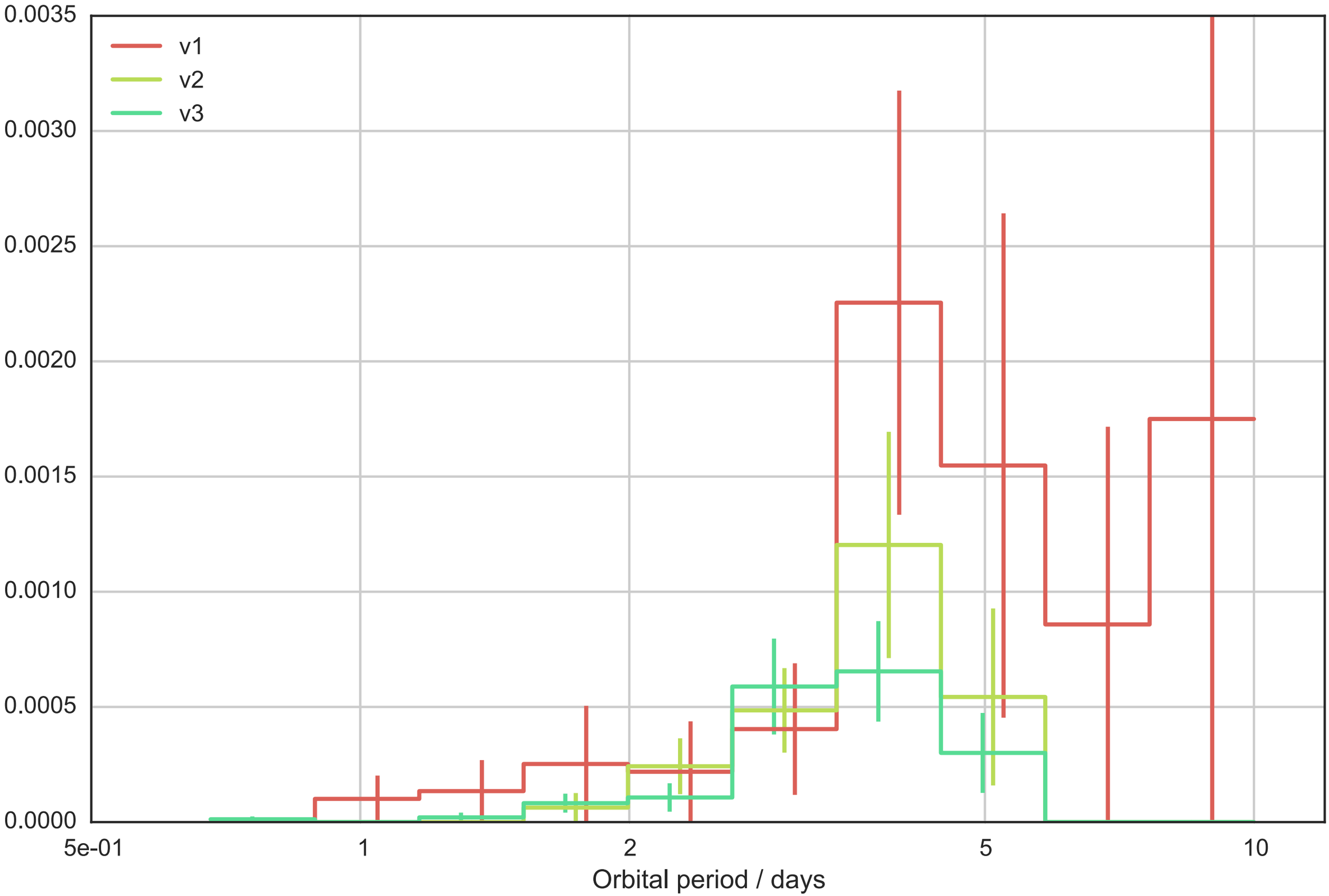
Herbst & Mundt 2005



Summary

- We have measured the selection effects in the WASP survey
- There is a pile up in the underlying distribution of hot Jupiters at 3.9±0.1 days
- This should be a useful constraint on migration models


Fressin et al. 2013
No sign of pile up
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Number of planets per star
1
2
5
10
Orbital period / days


v1
v2
v3
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
5e-01
1
2
5
10
Orbital period / days

Transit detection with BLS algorithm