# The Period Distribution of Close-In Extrasolar Giant Planets

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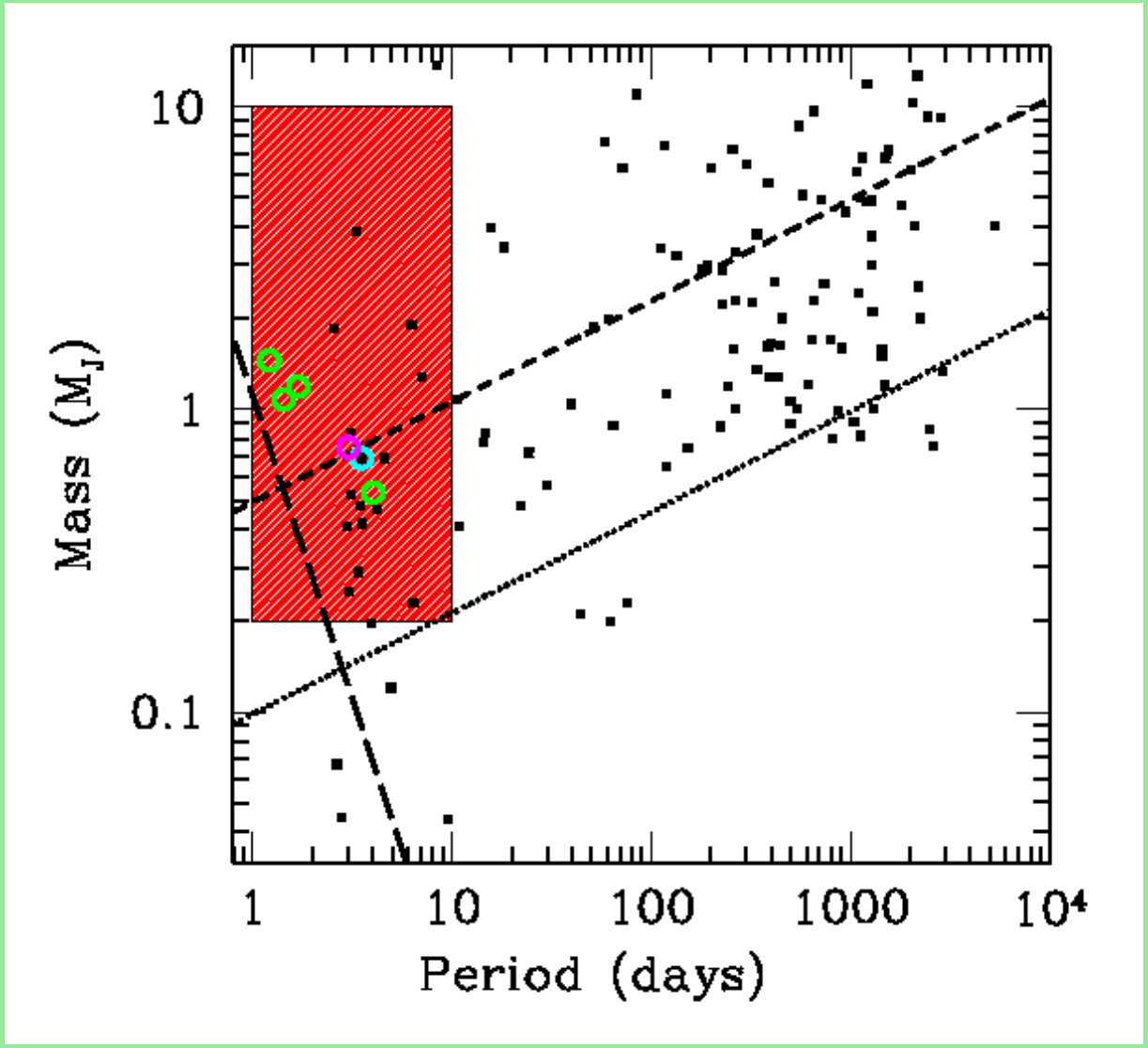
***watch for paper on astro-ph***

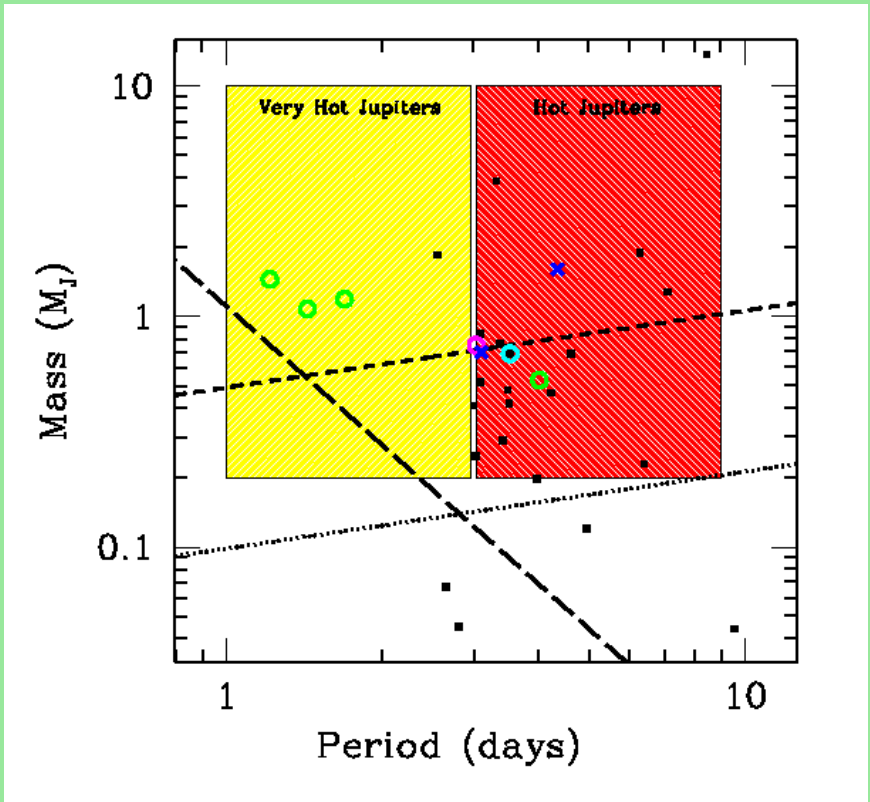
## Extrasolar Planet Surveys

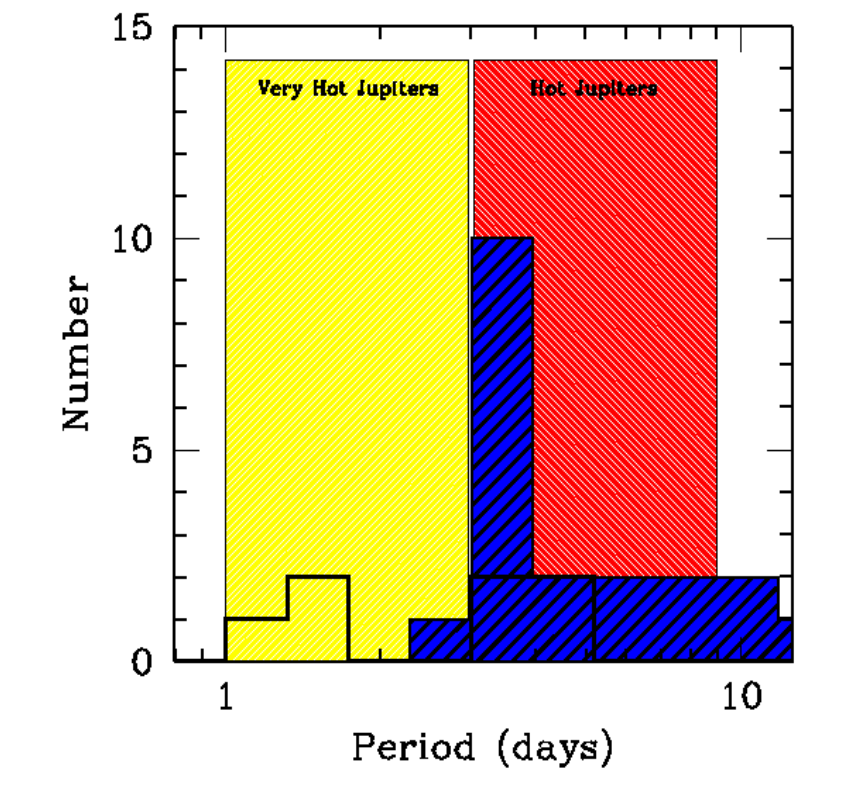



129 Planets Found

Radial Velocity, Transits, and Microlensing

# Radial Velocity Surveys




~3000 FGKM Stars

123 Planets Found

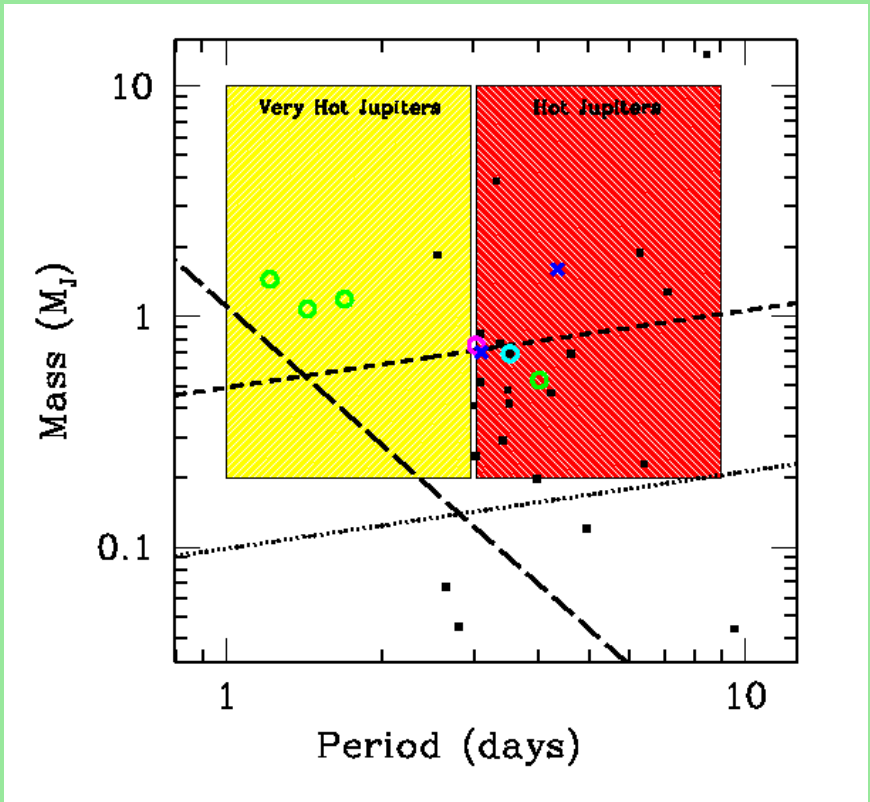
Shortest Period $P = 2.55d$

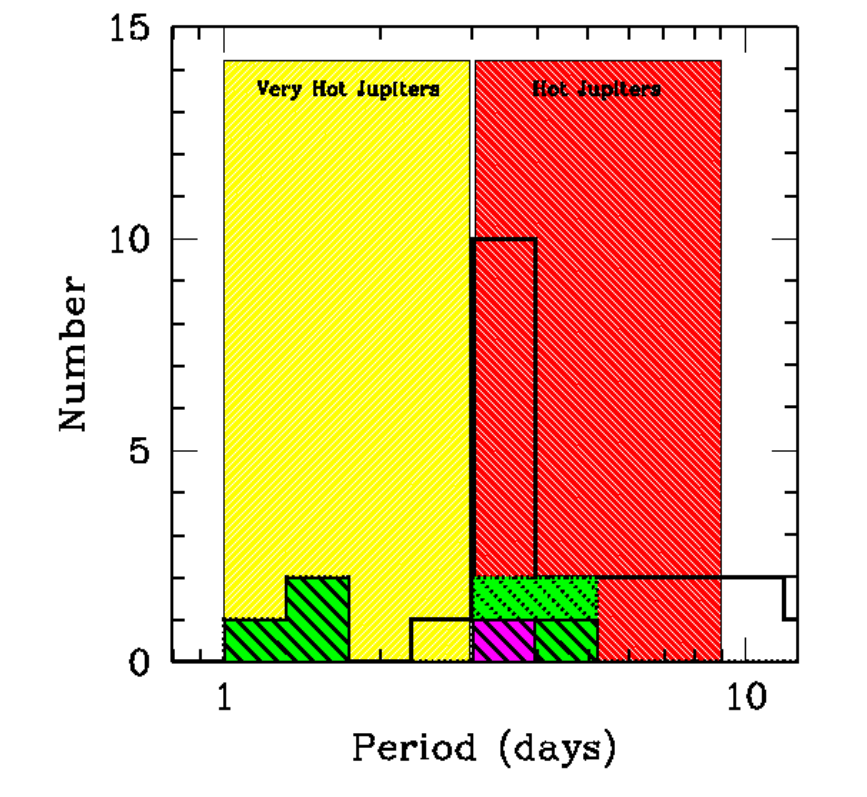
Single Measurement Precision $K = 1\text{m/s} - 3\text{m/s}$

Complete to $K \approx 20\text{m/s} \longrightarrow M_p \sin i \geq 0.2 M_J$ for $P < 9d$

$$K = \frac{28.4\text{m/s}}{(1-e^2)^{1/2}} \left( \frac{M_p \sin i}{M_J} \right) \left( \frac{P}{1yr} \right)^{-1/3} \left( \frac{M_*}{M_{sun}} \right)^{-2/3}$$

# Transit Surveys




Over a Dozen Surveys

- All-Sky Shallow (V<10)
- Wide-Field Intermediate (9<V<14)
- Deep Galactic Plane (V>14)
- Stellar Systems (varies)

5 Planets Found (OGLE and TrES)

Discovered Very Hot Jupiters $P \approx 1d$

# Radial Velocity vs. Transits

## Round 1

**Very Hot Jupiters:**

**1**

**Hot Jupiters:**

**15**

$$r = 1/15 \approx 0.07$$

**Very Hot Jupiters:**

**3**

**Hot Jupiters:**

**1**

$$r = 3/1 = 3$$

**Inconsistency?**

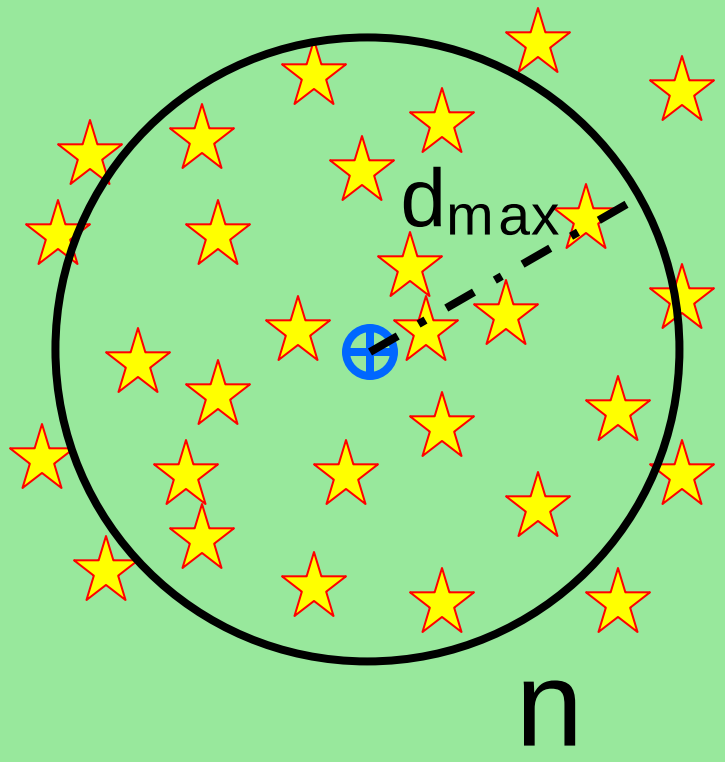
**Very Hot Jupiters not real?**

**Transit Surveys Bogus?**

**Different Populations?**

## Sensitivity of a S/N-limited survey

$$N = P_t \, fn V_{\max} = P_t \, fn \frac{\Omega d_{\max}^3}{3}$$



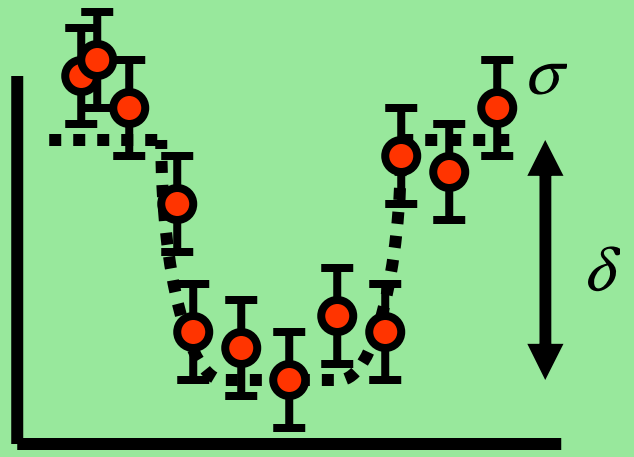

## Transit Probability

$$P_t = \frac{R_*}{a} \propto P^{-2/3}$$

## Signal-to-Noise

$$\frac{S}{N} = N_t^{1/2} \frac{\delta}{\sigma} \propto P^{-1/3} d^{-1}$$

$$\begin{cases} \sigma \propto F^{-1/2} \propto L^{-1/2} d \\ \delta = \left( \dfrac{R_p}{R_*} \right)^2 \\ N_t = \dfrac{R_*}{\pi a} \end{cases}$$

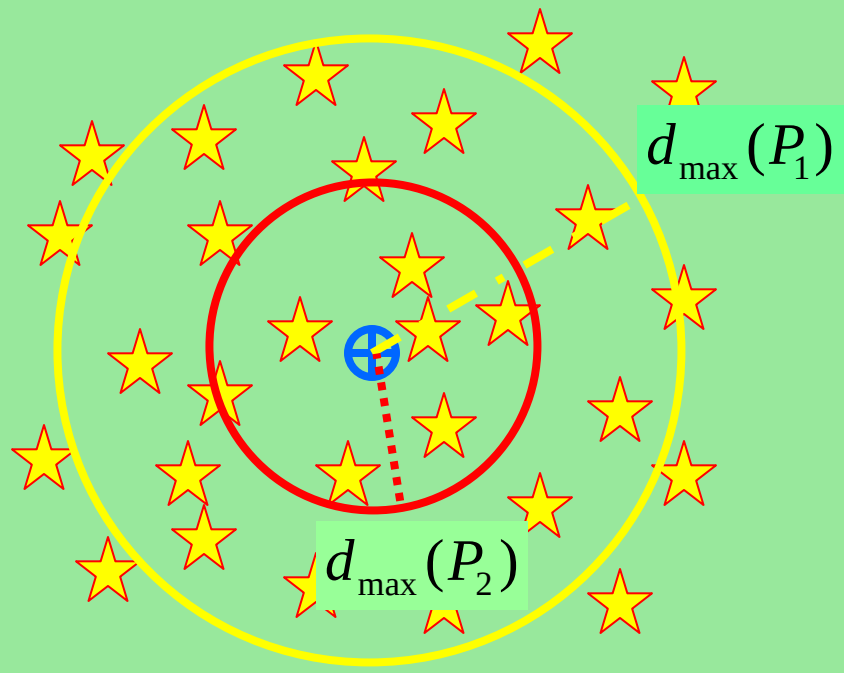


**Sensitivity of a S/N-limited survey**

$$\frac{S}{N} \propto P^{-1/3} d^{-1}$$

**At Limiting Signal-to-Noise:**

$d_{\max} \propto P^{-1/3}$ **and** $P_t \propto P^{-2/3}$




$$N \propto f(P) P_t d_{\max}^3 \propto f(P) P^{-5/3}$$

**Transit surveys are ~6 times more sensitive to 1 day period planets than 3 day period planets!**

# Radial Velocity vs. Transits

## Round 2

**Very Hot Jupiters:**

**1**

**Hot Jupiters:**

**15**

$$r = 1/15 \approx 0.07$$

**Very Hot Jupiters:**

**3**

**Hot Jupiters:**

**1**

$$r = 3/(1 \times 6) = 0.5$$

**Still Inconsistent?**

# Radial Velocity vs. Transits

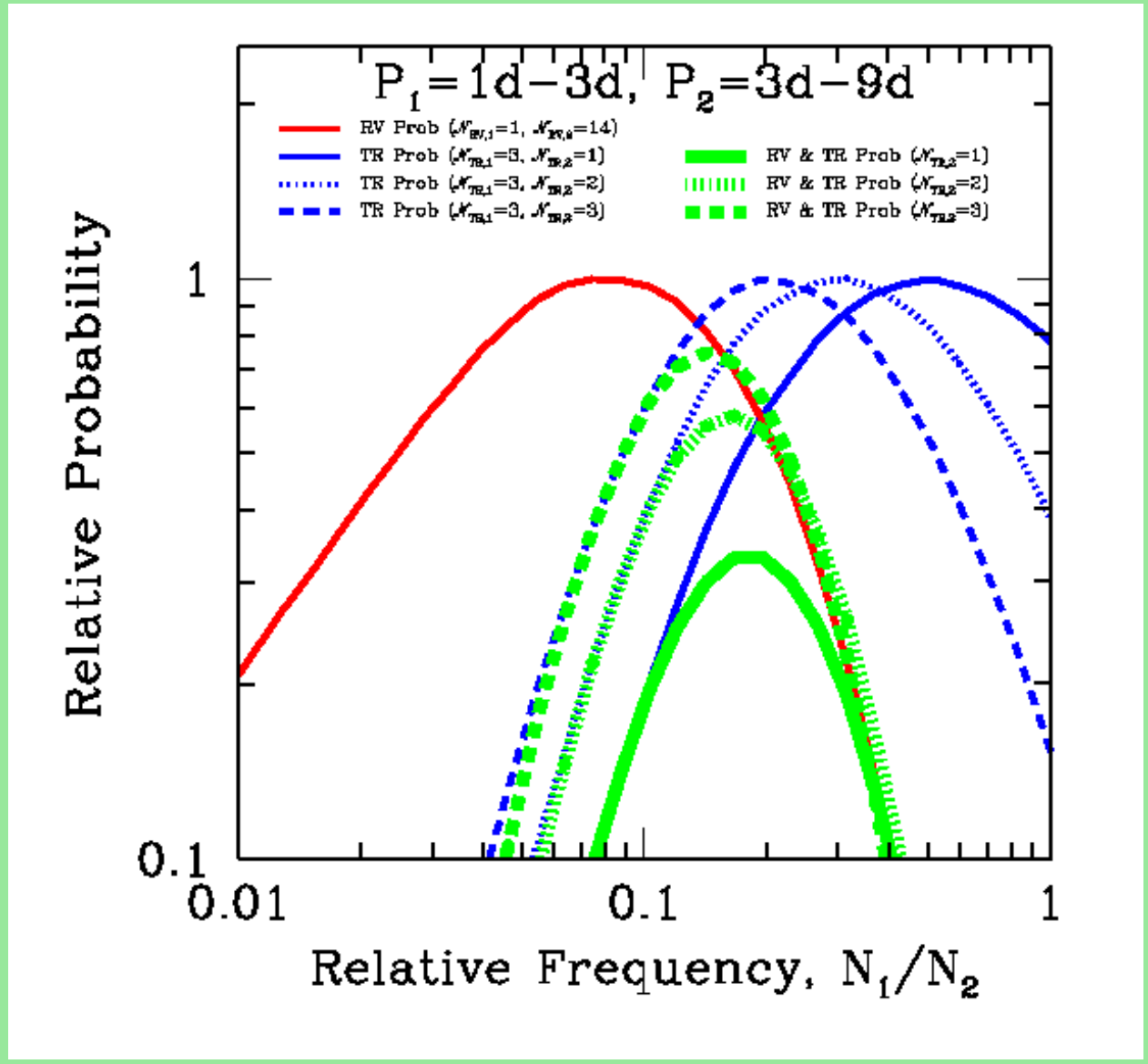
## Round 3

**Poisson Distribution**

$$P(N \mid M) = \frac{e^{-M} M^{N}}{N!}$$

$$r = 0.07^{+0.10}_{-0.05}$$

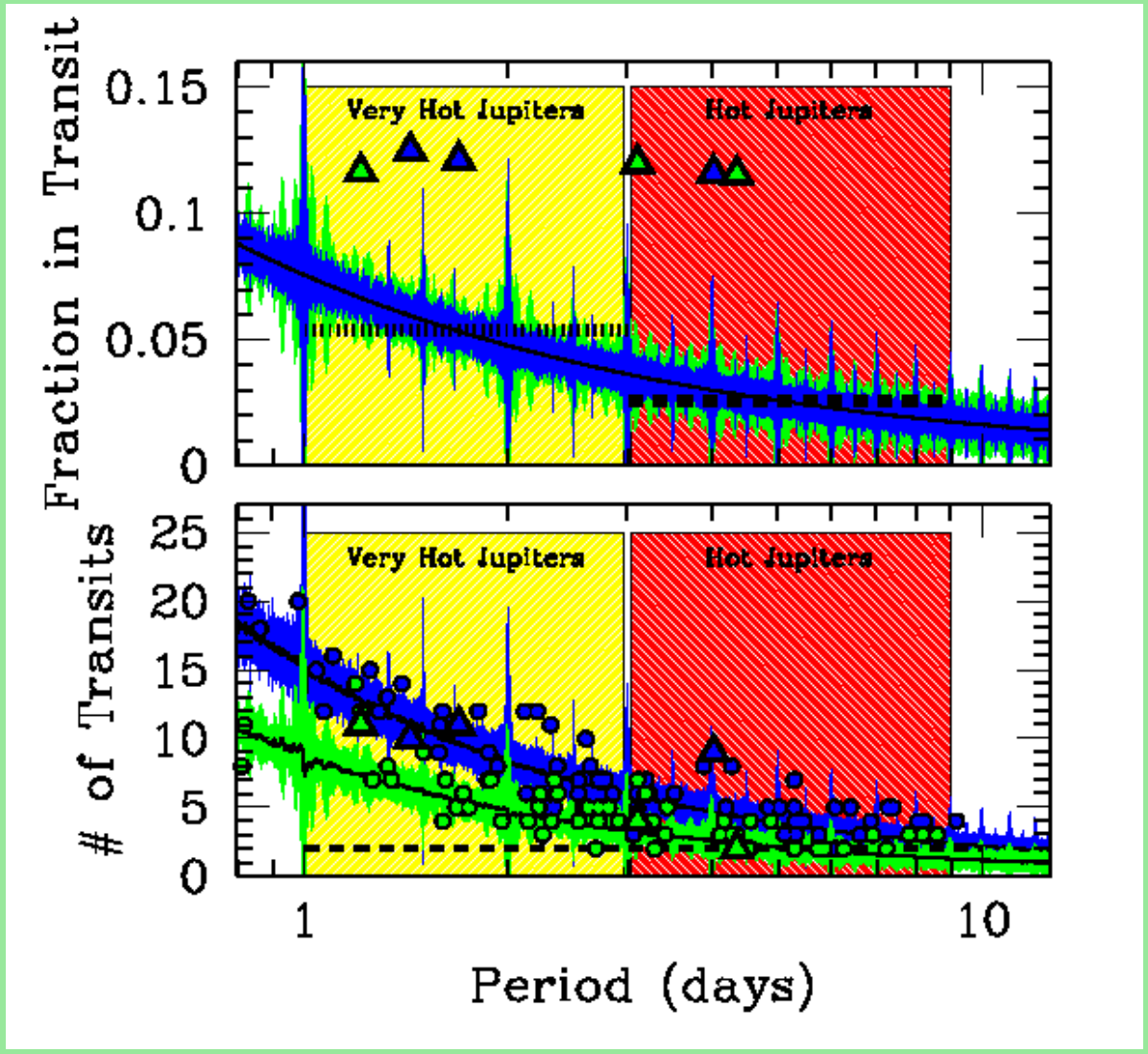
$$r = 0.5^{+1.5}_{-0.3}$$




Relative Frequency of VHJ to HJ is ~ 10-20%

# Additional Biases

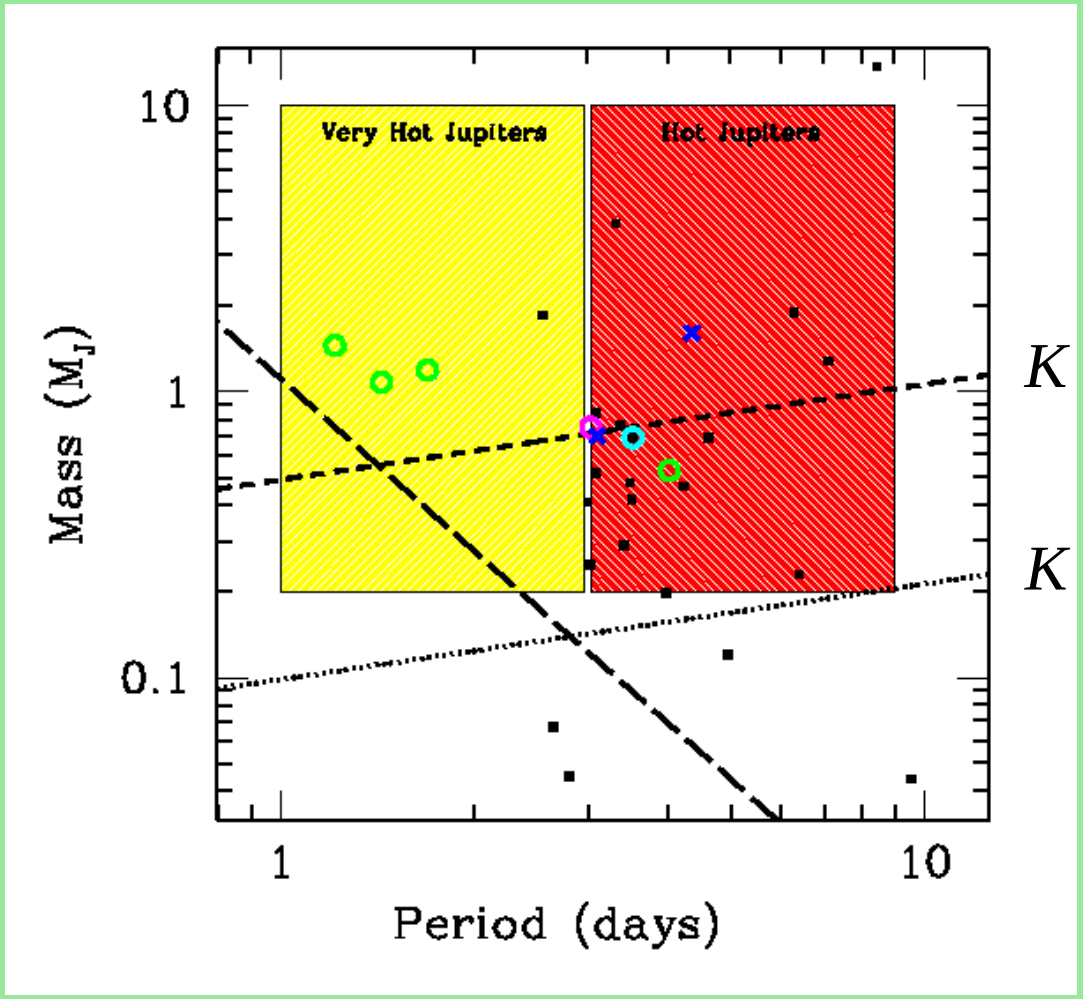
## 1. Uneven Sampling and Aliasing



# Additional Biases

## 2. RV Follow-up

Single Measurement Precision $K = 50\text{m/s} - 100\text{m/s}$



# Implications/Discussion

- Very Hot Jupiters = transiting Hot Jupiters
- One in ~500-1000 FGK Stars has a VHJ
- VHJs more massive?
- RV VHJ? (HD 73256b)
- Different (mass-dependent) parking mechanisms?
- Neptune-mass planets? (influenced by companions?)

Need more short-period planets!