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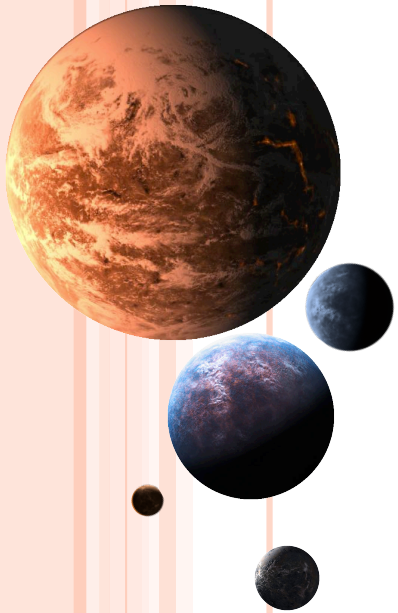
Radial Velocity Surveys of Low Mass Exoplanets:

The HARPS GTO dataset



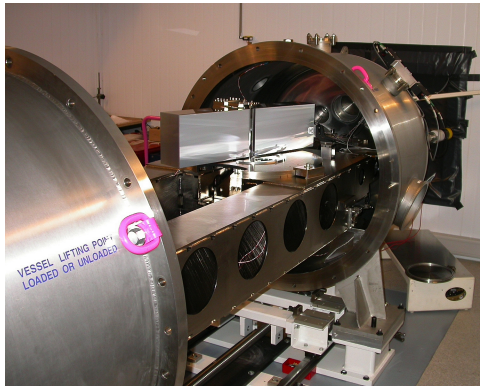
March 30, 2012

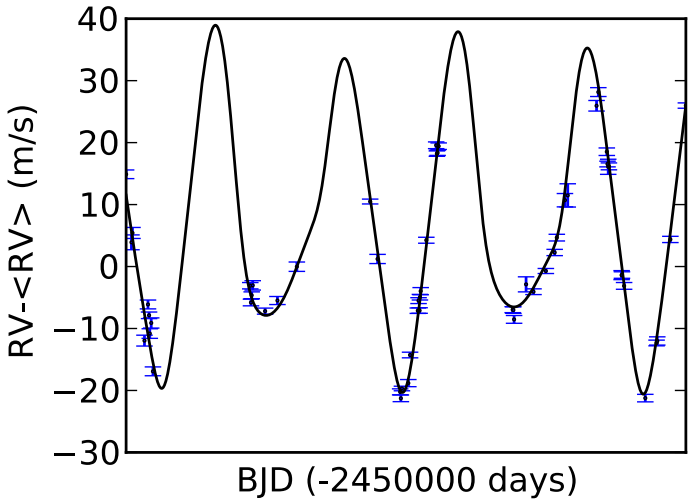
Alexander R. Pettitt

Supervisor: F. Pont

Introduction

- High Accuracy Radial velocity Planet Searcher
- The High Precision Sample:
  - ~450 FGK stars
  - Low scatter (<10m/s, CORALIE)
  - Slow rotators (<3km/s)
  - Distance limited
- Archive data from 2003-2009 freely available (bit of cleaning, jitter, Jovian hosts etc).





Data can be found at: http://archive.eso.org/wdb/wdb/eso/repro/form

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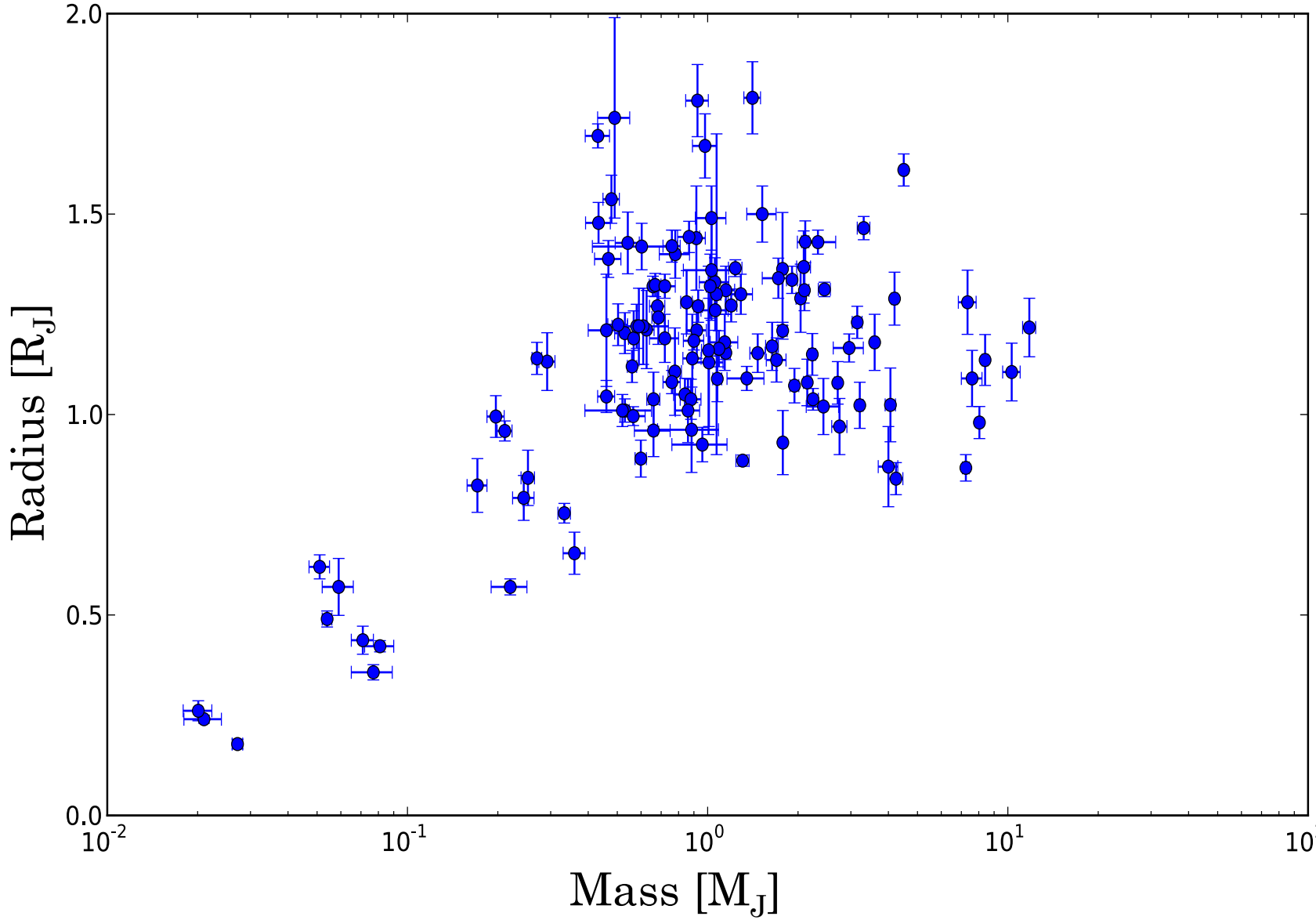

Retrieved from: http://exoplanets.org/

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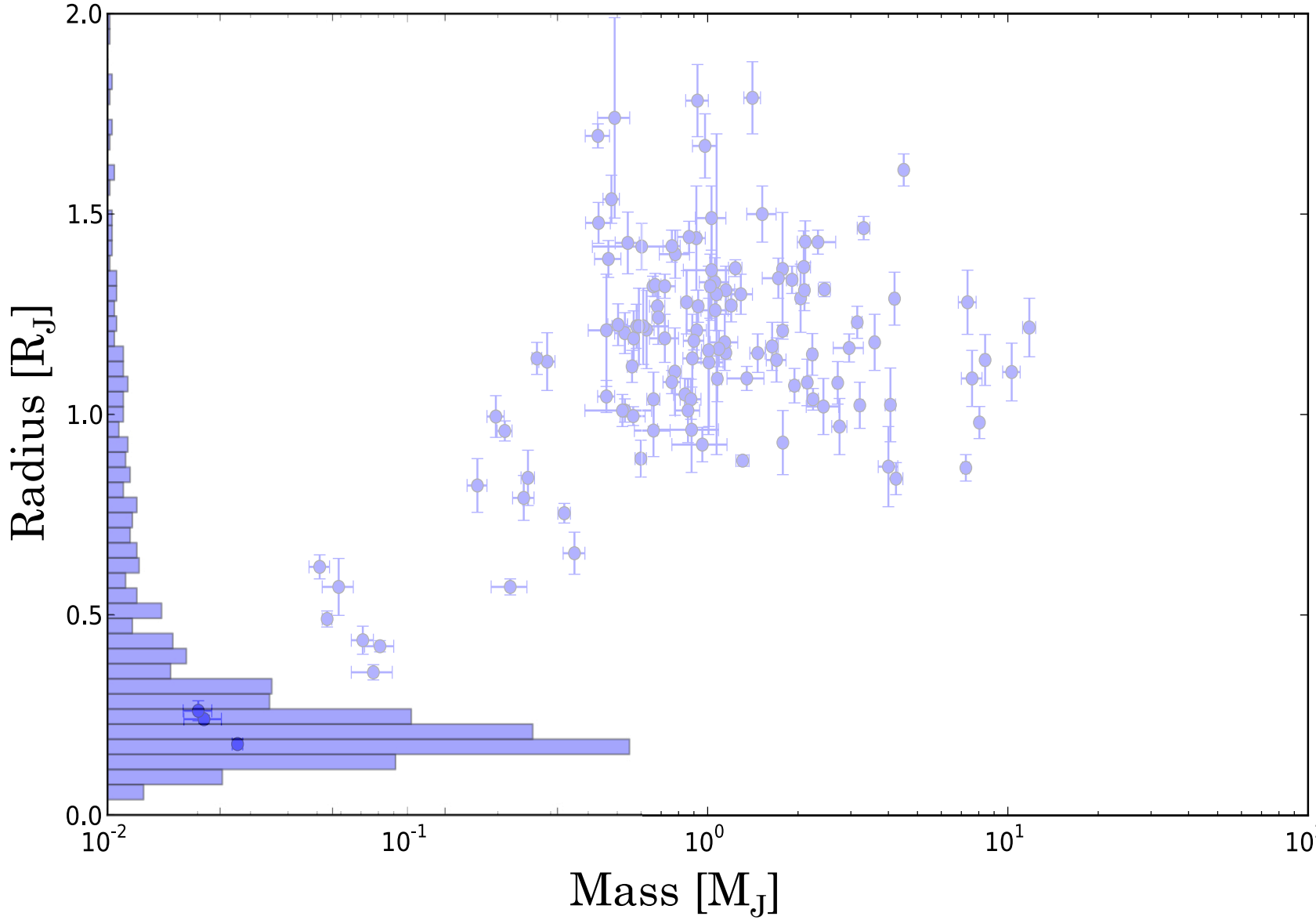

Retrieved from: http://exoplanets.org/

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OBJECTIVE

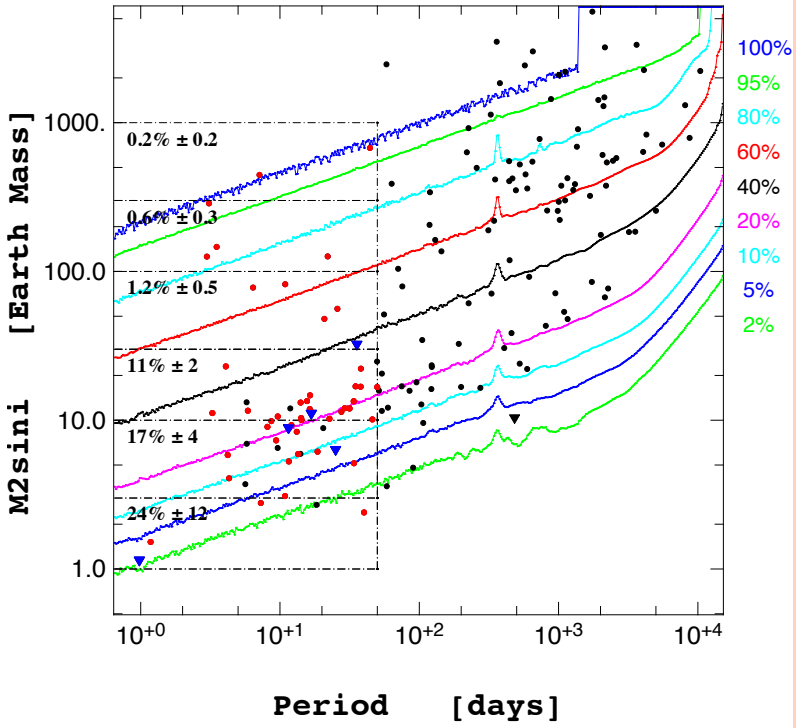
- What is the frequency of stars with planets?
- FSWP ($P < 50$d, $M_p \leq 30 M_E$) in the range of ~40% from Mayor et al. 2011.

- Values much lower for other low mass planet surveys:
  - AAPS: 18.5%
  - NASA η_{Earth}: 15%
  - …*Kepler* (NPPS, $R_p < 32 R_{Earth}$): 17%

- An independent analysis due…

Data

- A real mix…
- Long period trends.
- High activity stars
- Some very well sampled stars, some not so much.
- Other planets?
- N_{obs} updated from Lovis et al. 2011.
- High irregularity of the time-series sampling is not good for periodogram based analysis.



[Mayor et al. 2011]

Data

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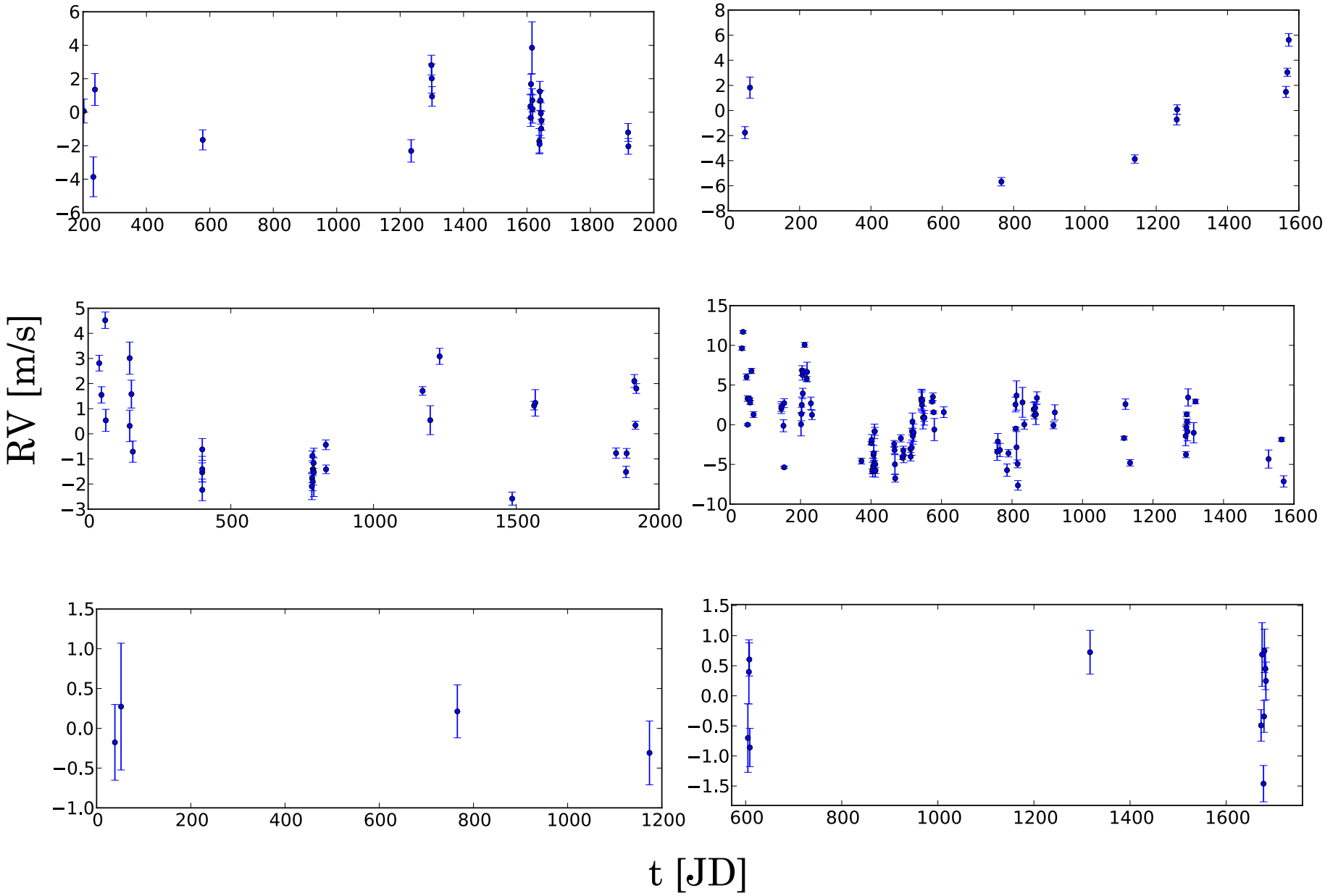
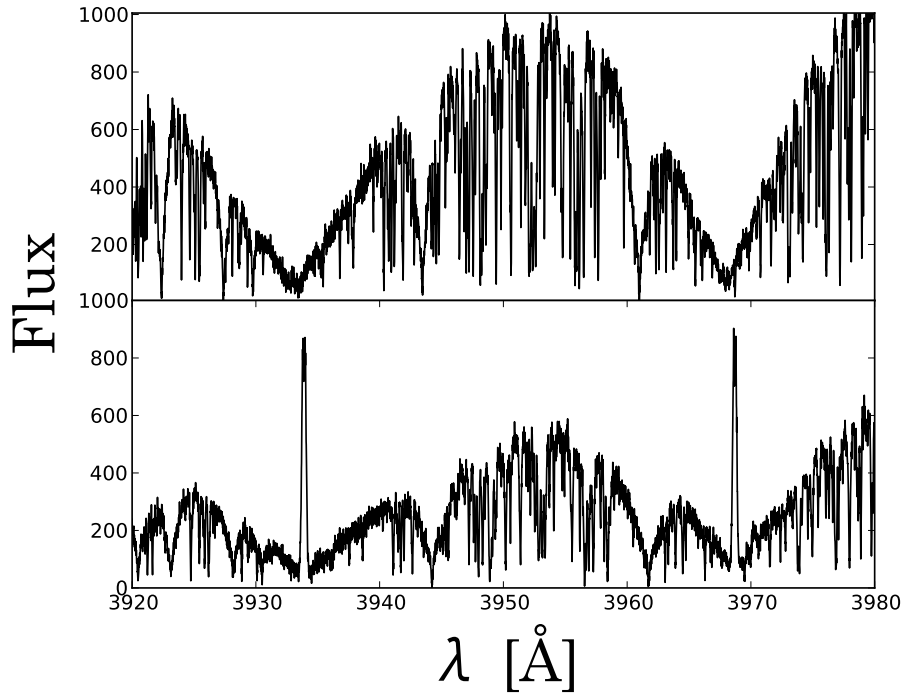


Data



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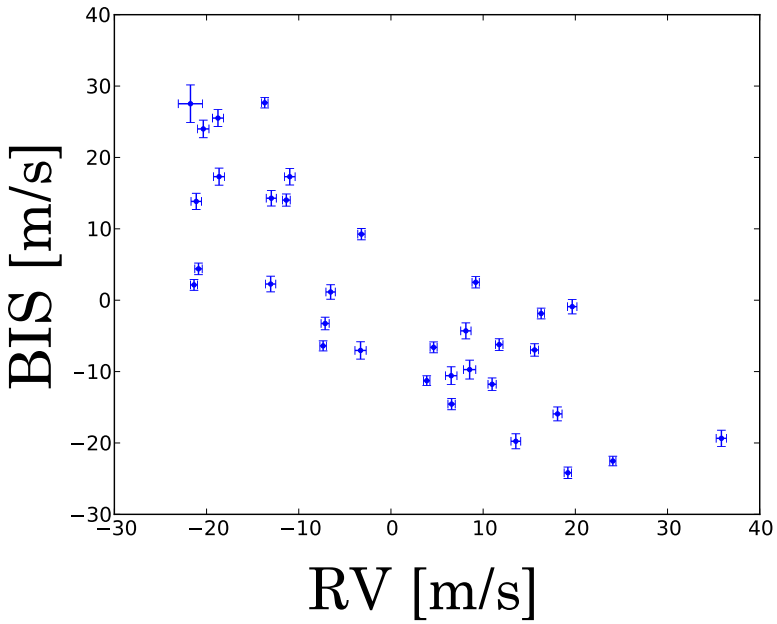
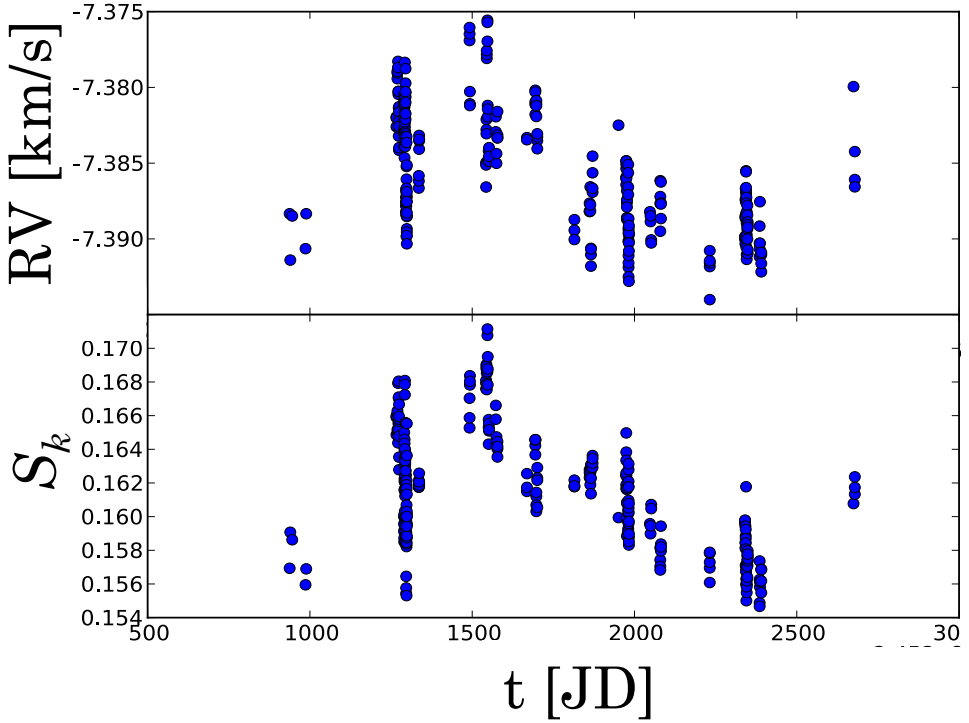
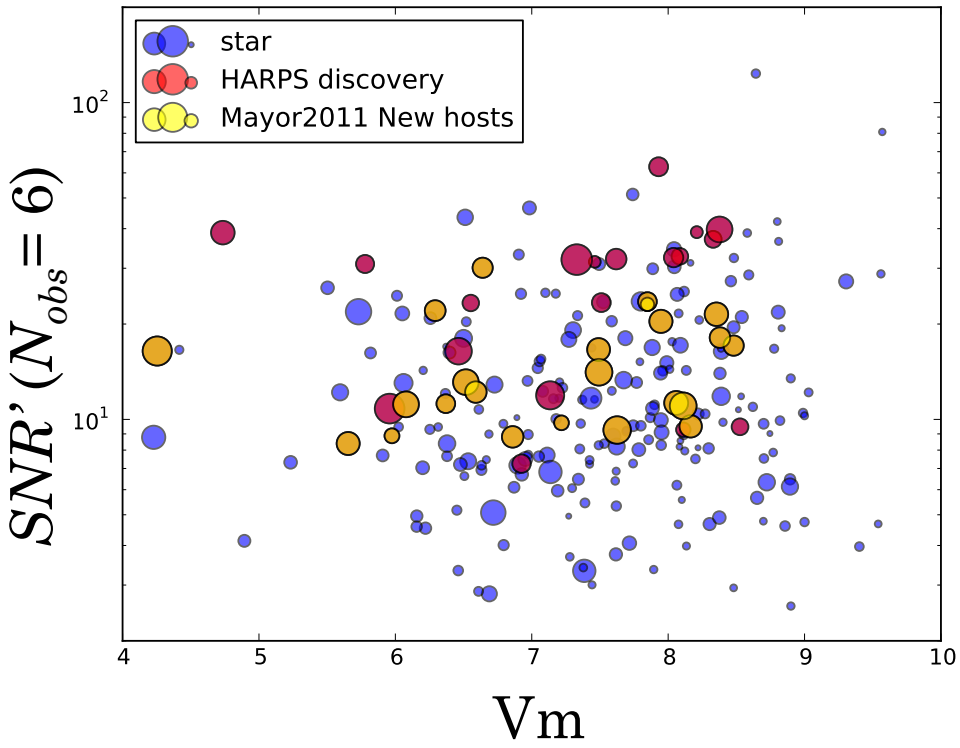
HD16270
S_k=0.40





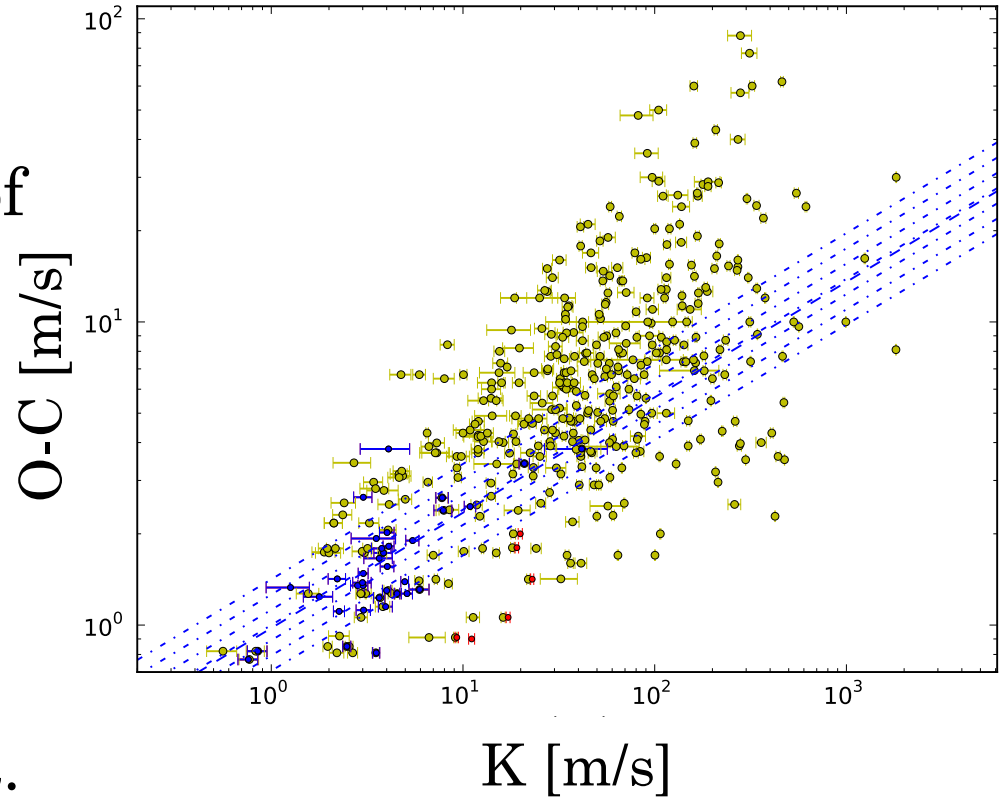
Analysis

- Want to constrain the concept of detectability (not just N_p/N_*).
- Initial idea: to look at observing history (key is N_{obs}), giving a low FSWP.
- HARPS team published ≈50 new planets, $N_{obs,new}$
- In light, observing strategy seems very inconsistent…



Analysis

- More straight-forward approach to assess the precision of RV data.
- Look at the precision of the host star as a function of the semi-amplitude of the planet.
- Effectively create a smaller stellar sub-sample for each planet.



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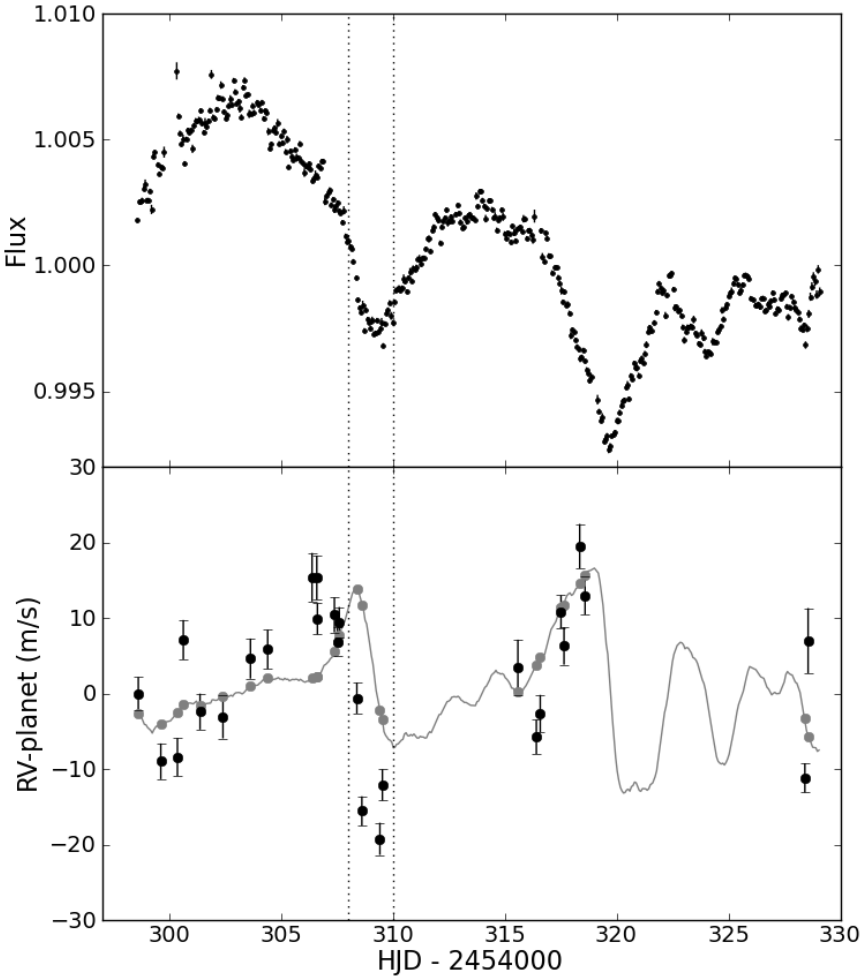
Analysis

- See if intrinsic scatter of a star is "precise enough" to exclude a planetary signal.
- Adjust effective stellar sample for that planet by $N_{*i}=N_{*i}+f_i$ with $f_i \leq 1$.
- f_i is dictated by the fraction of planet hosts above this precision level.
- $\mathrm{FSWP}_i = 1/N_i$, then sum over these to give total FSWP in the mass/period range of interest.

- Final value still forthcoming…
- Clear extension to map this to *Kepler* frequencies.

ASIDE: *FF'*, HARPS-*KEPLER* COMPARISON

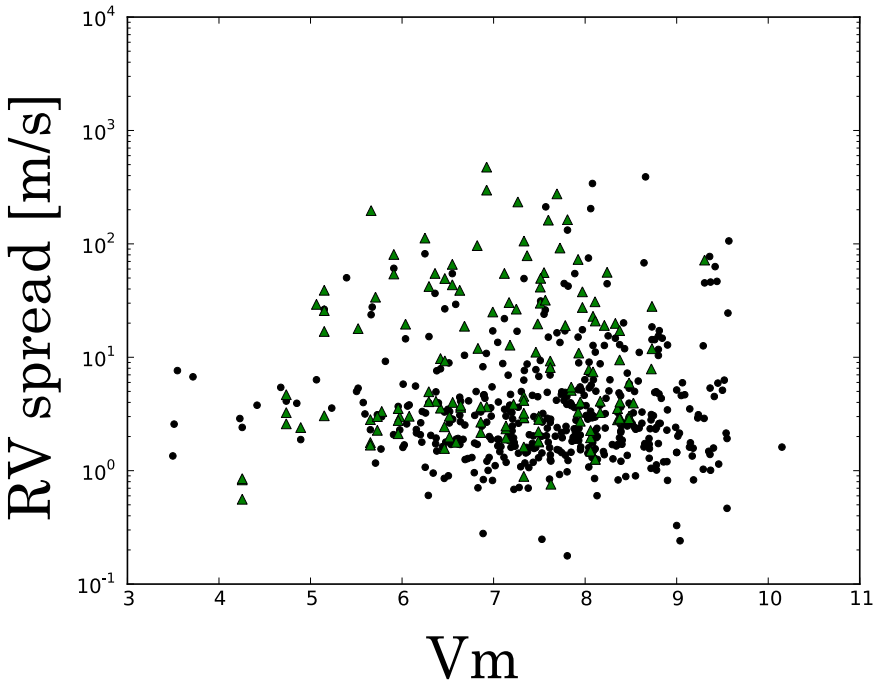
- Use method of Aigrain et al. 2012 to find scatter of RV from Kepler and compare to HARPS intrinsic scatter.
- See the limits of *M-P* range that can be inferred from *Kepler* through activity alone.



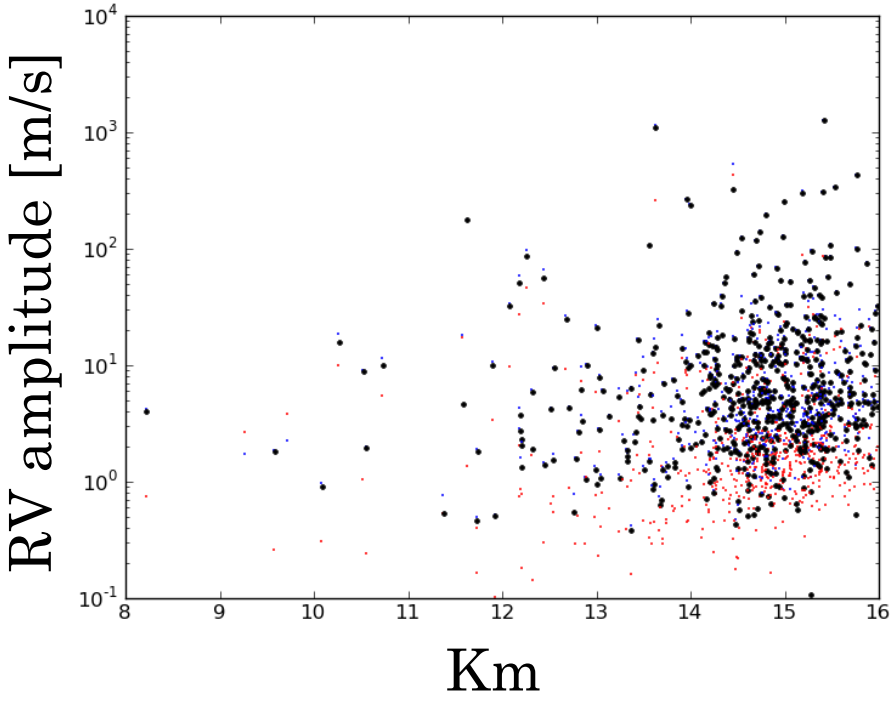
[Aigrain, Pont & Zucker 2012]

ASIDE: *FF'*, HARPS-*KEPLER* COMPARISON

HARPS GTO HPS:



Kepler FF':



[Aigrain, Pont & Zucker 2012]

THANK YOU FOR YOUR TIME & ATTENTION

[See poster:

constructing theoretical hot Jovian transmission spectra from line lists]