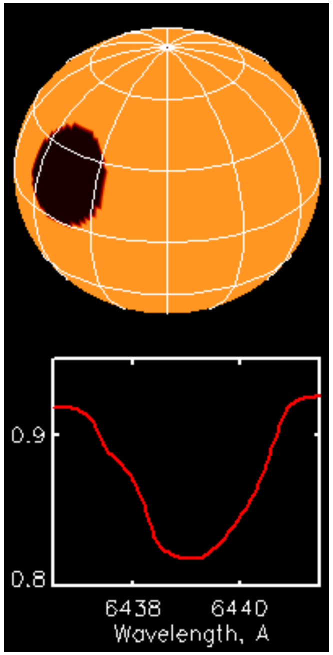
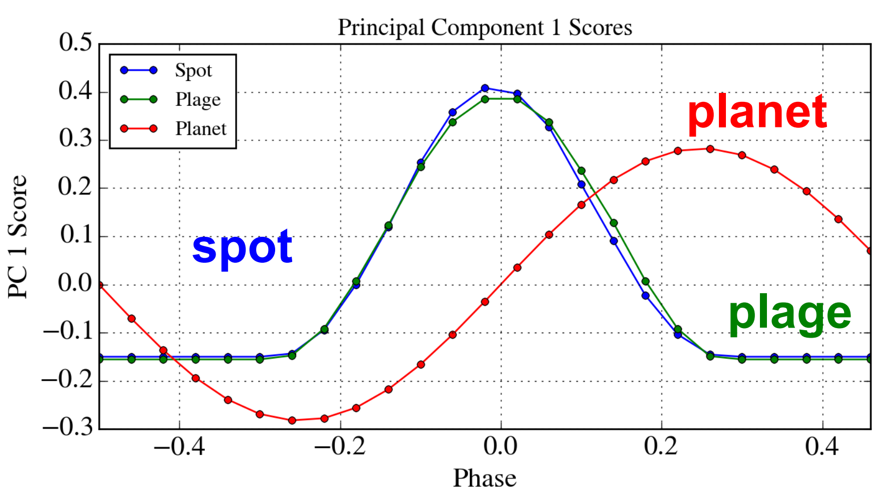
Allen B Davis
Yale University

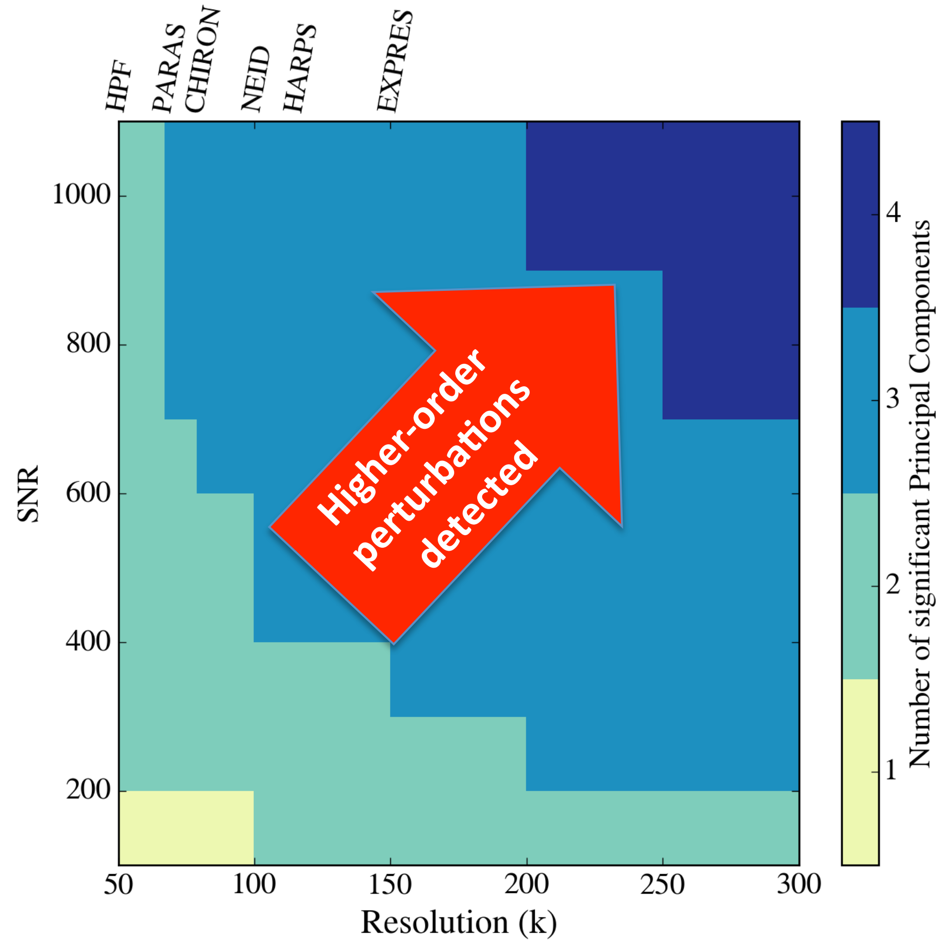
High resolution is valuable for measuring ***stellar jitter***



- RV jitter hinders planet detection
- We run Principal Component Analysis on model spectra

- **Planets**: **simple** signatures completely contained in **one PC**
- **Spots** & **plage**: **complex** signatures spanning **many PCs**





- **High resolution** & **high SNR** unlock additional variability in the spectra that will help **expose activity**

Searching for planetary signals in doppler time series:

a performance evaluation of tools for periodograms analysis

Matteo PINAMONTI - Università degli Studi di Trieste

Alessandro Sozzetti - INAFOsservatorio Astrofisico di Torino

- High occurrence of low-mass small-size planets around M-dwarfs
- Small signal amplitudes – strong stellar activity noise
  - ➔ Need for strategies for robust identification

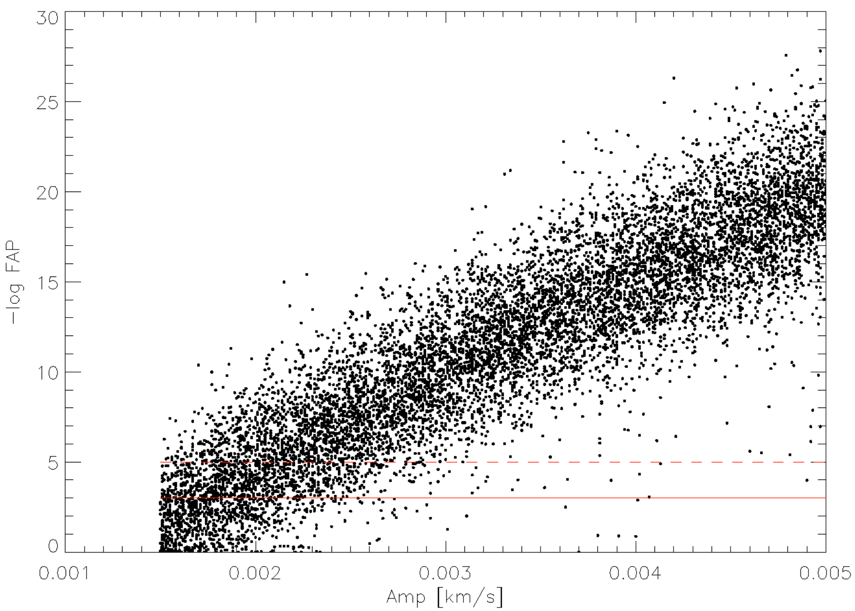
Numerical experiment of algorithm effectiveness

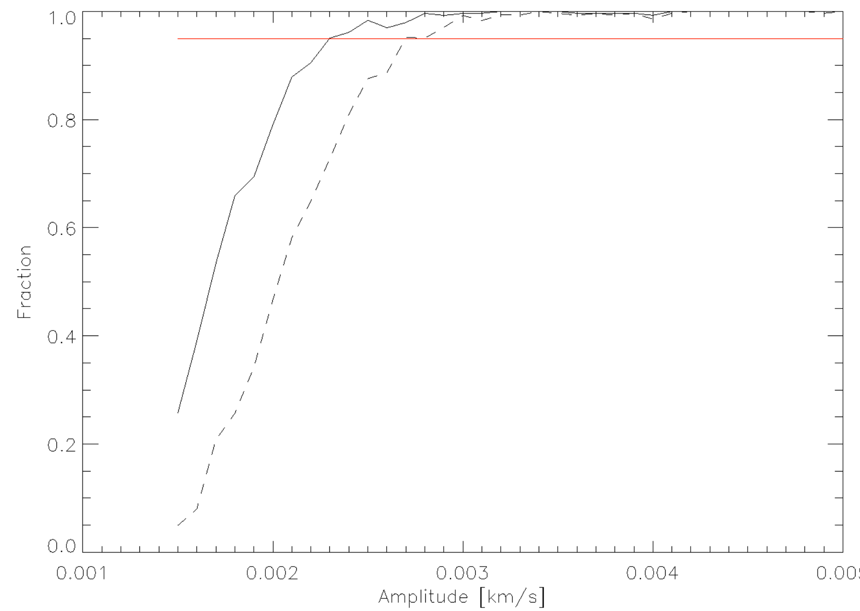
- Generalised Lomb-Scargle (GLS, Zechmeister & Kürster 2009)
- Bayesian formalism for GLS (BGLS, Mortier et al. 2015)
- FREquency DEComposer (FREDEC, Baluev 2013)

Searching for planetary signals in doppler time series:

a performance evaluation of tools for periodograms analysis

Single-planet system





Multi-planet system

	GLS	BGLS	FREDEC	Agreement
Correct identification	83%	79%	87%	96%
False positives	3%	14%	3%	38%

➔ Several analysis techniques needed

The Stellar parameters of host stars yield important effects on planet formation, size, occurrence rates, environment, and habitability

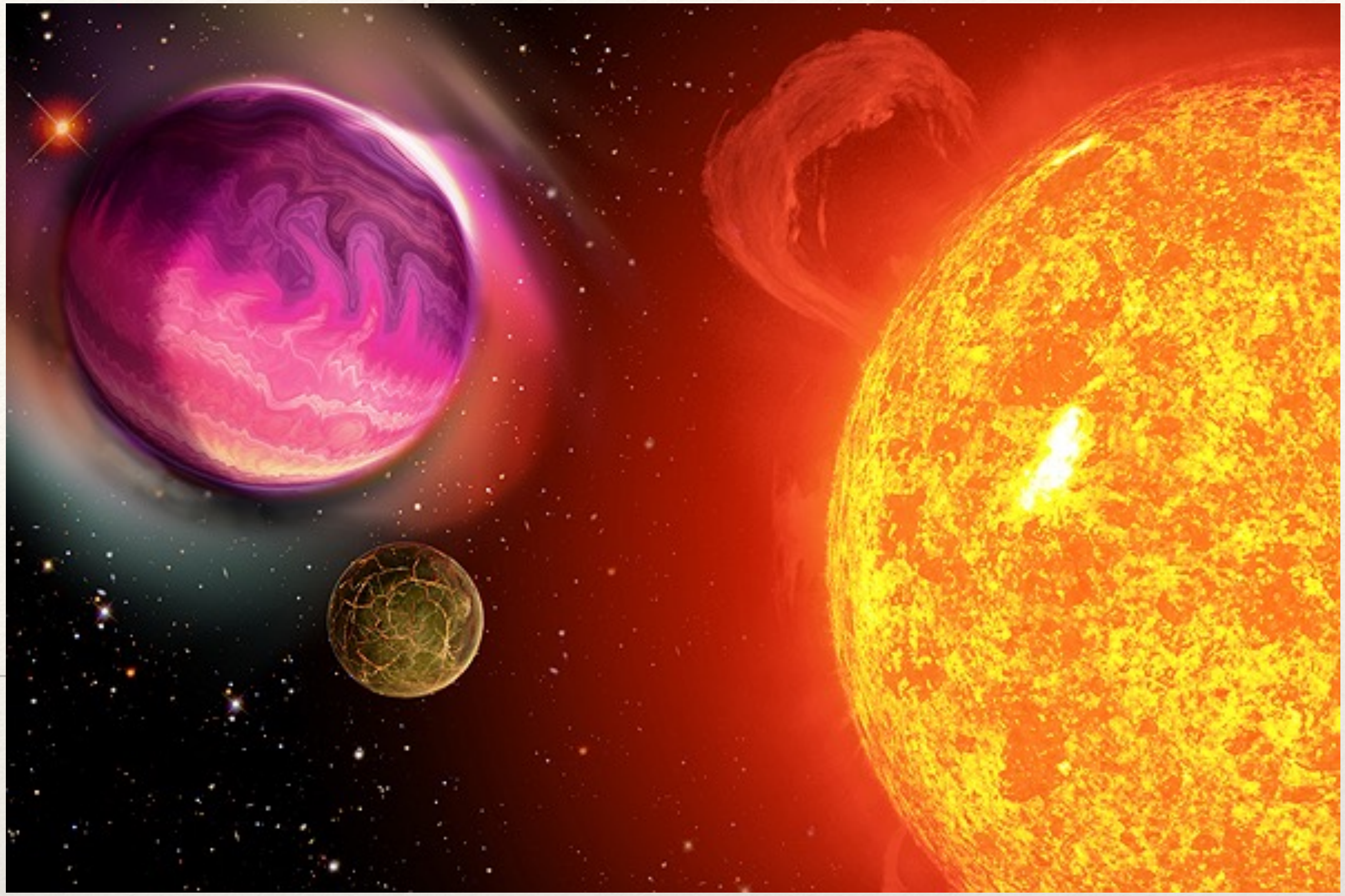


Image credit: T. Riecken

Stellar Parameters for FGK MARVELS Targets

Keara Wright, University of Florida

Advisor: Dr. Jian Ge, University of Florida

Important Parameters:

- Temperature
- Metallicity
- Surface gravity

Method

- Generate coarse grid from PHOENIX synthetic data
- Correct models for resolution, rotation, and variable dispersion
- Match entire spectrum for best guess coarse parameters
- Generate fine grid around estimated parameters
- Compare data to grid for lines sensitive to particular parameter changes
- Extract stellar parameters from best-fit model

Results

- Coarse grid steps 100K provide close match
- Fine grid matching agrees within error bars
- Next: Resolve issues with consistency in line choice for best-fit model

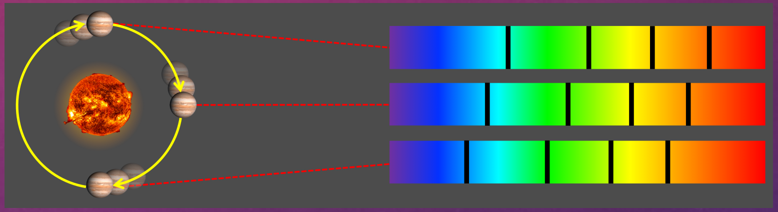
	HAT-P-1	HD49674	HD17156
Temp Ghezzi	6026±71	5632±31	6057±46
Grieves	6000±156	5680±96	6025±148
Wright	*6000*	*5687*	*6081*
Metallicity Ghezzi	0.17±0.06	0.33±0.01	0.19±0.05
Grieves	0.11±0.08	0.33±0.06	0.17±0.07
Wright	*0.19*	*0.28*	*0.19*
Logg Ghezzi	4.46±0.01	4.48±0.12	4.20±0.11
Grieves	4.35±0.21	4.53±0.17	4.22±0.19
Wright	*4.34*	*4.50*	*4.28*

Measuring the Effective Pixel Positions For the HARPS3 CCD

Richard Hall – University of Cambridge

HARPS3 will find **Earth-mass** planets orbiting **Sun-like** stars:

- 0.1 ms^{-1} **precision**
- 10 year intensive **observations**
- Observe each star ***every night***



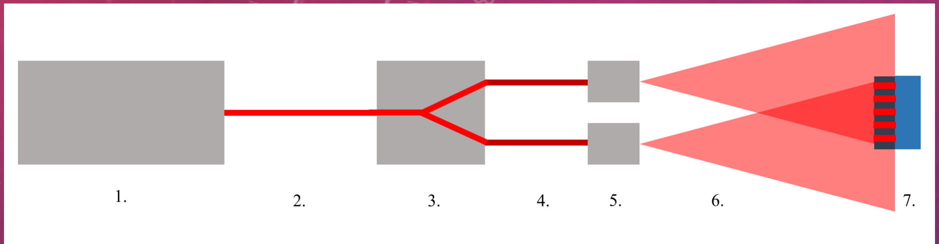
At Cambridge UK, we are working on the detector:

- **Characterisation** and **testing**
- Experiment **simulation**
- Pixel position **measurements**

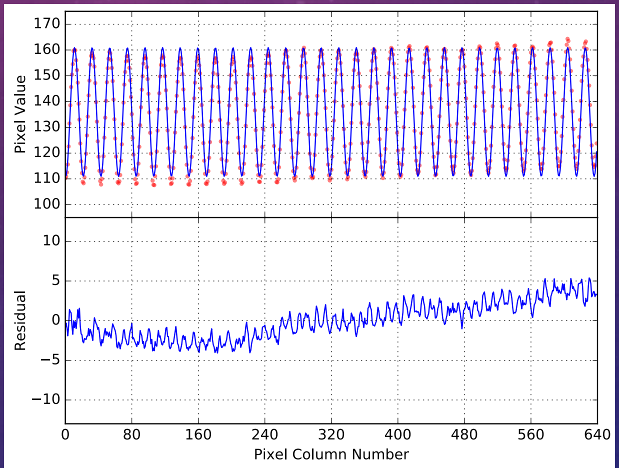
Using an optical experiment, we will measure the CCD pixel positions to 10^{-4} …

Current Stage of the Experiment

Optical interference of lasers => **predictable** fringe pattern



Precision control on all components → fringe **stability** + **modulation**

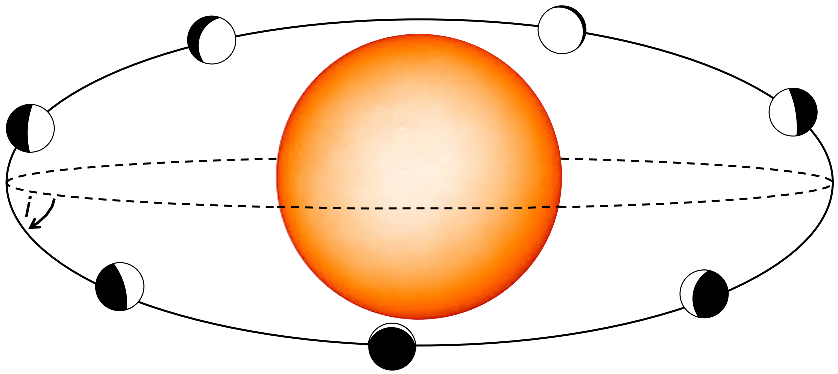


Monitor fringes over time → **identify** and **eliminate** environmental noise

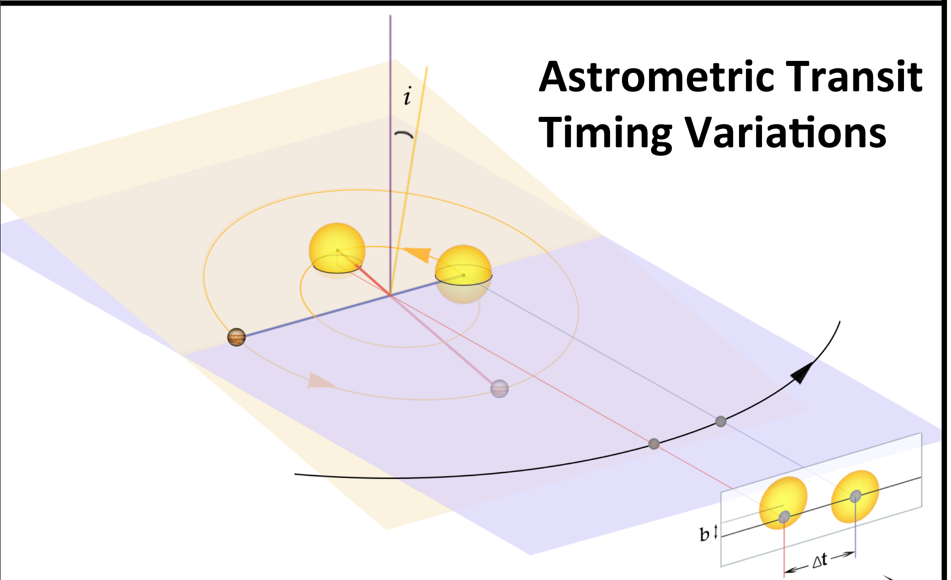
A Search for Non-Transiting Hot Jupiters with Transiting Super-Earth Companions

Sarah Millholland
UC Santa Cruz ⟶ Yale University

Optical Reflected Light Phase Curve



Astrometric Transit Timing Variations

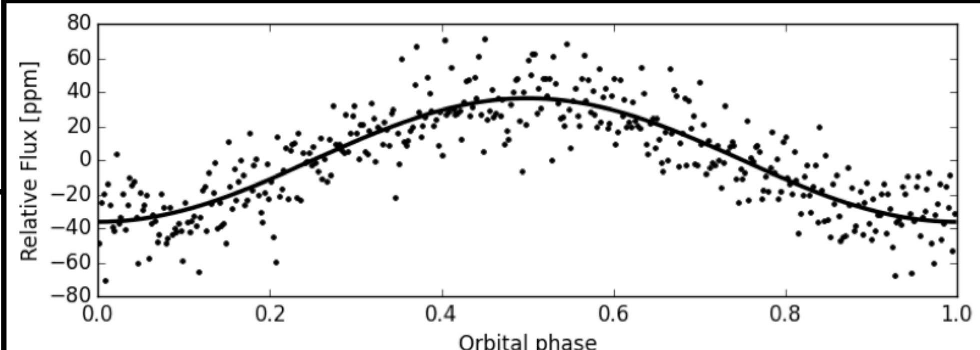


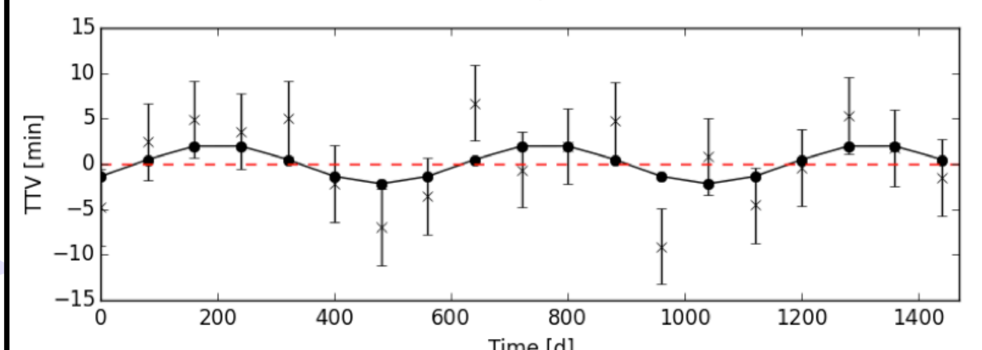
Synthetic phase curve & TTVs for a fiducial system

Star: M_{Sun} , R_{Sun}

Non-transiting HJ: M_{Jup} , 1.3 R_{Jup} , P_{HJ} = 3.5 d

Transiting Super-Earth: P_{P} = 80 d

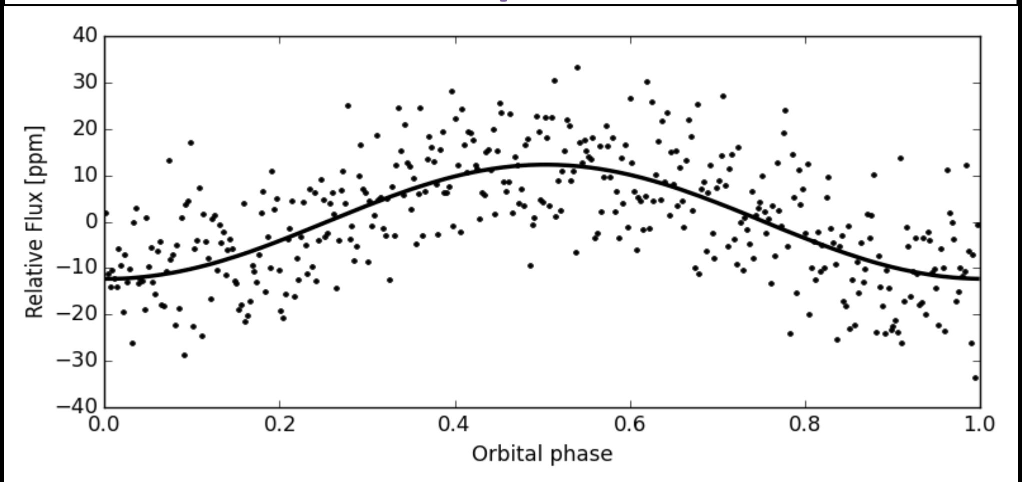




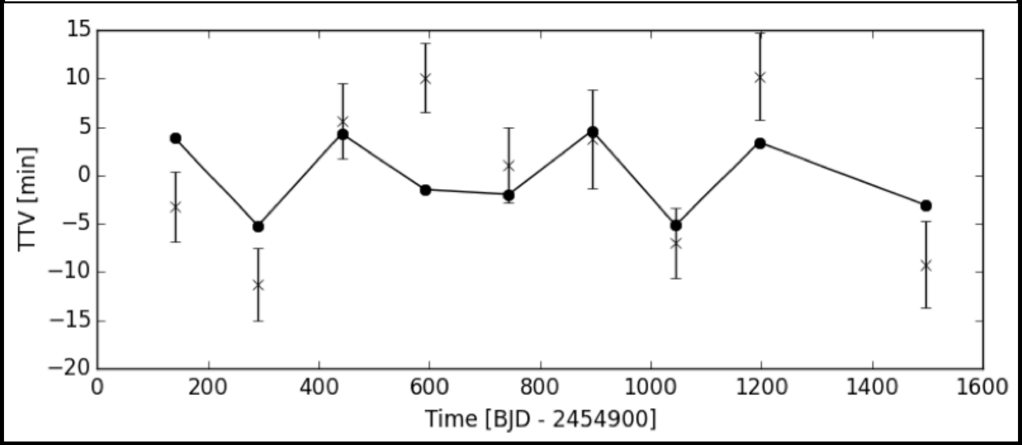
Millholland et al. 2016

A SEARCH AND FOLLOW-UP RADIAL VELOCITY SURVEY FOR NON-TRANSITING HOT JUPITERS IN *KEPLER* SYSTEMS

Candidate phase curve



Transit timing variations



Millholland et al. 2016

Example: KOI-1822

- 1.1 M_{Sun}/1.7 R_{Sun} host star
- 3.2 R_E transiting planet in 150.9 d orbit
- Candidate HJ in 3.9 d orbit

RV follow-up underway at the Automated Planet Finder (APF) telescope… stay tuned!

To illustrate the method of solution, we take equation for q_1 and q_2 only. These may be written as

$$\frac{d^2 q_1}{d\tau^2} + q_1 = A_{11,1} q_1^2 + A_{12,1} q_1 q_2 + A_{22,1} q_2^2 \quad (1.1)$$

$$\frac{d^2 q_2}{d\tau^2} + \beta_2 q_2 = A_{11,2} q_1^2 + A_{12,2} q_1 q_2 + A_{22,2} q_2^2 \quad (1.2)$$

where

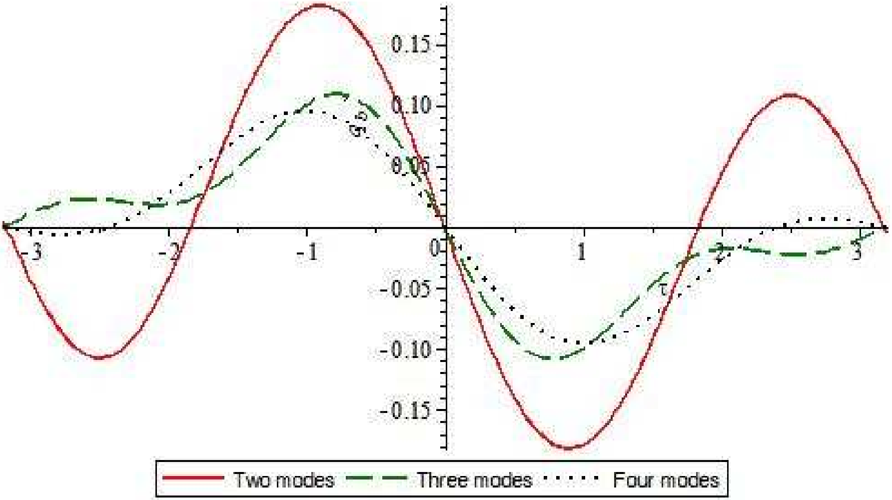
$$A_{ij,k} = \frac{1}{I_k \sigma_1^2} D_{ij,k} \quad (1.3)$$

and

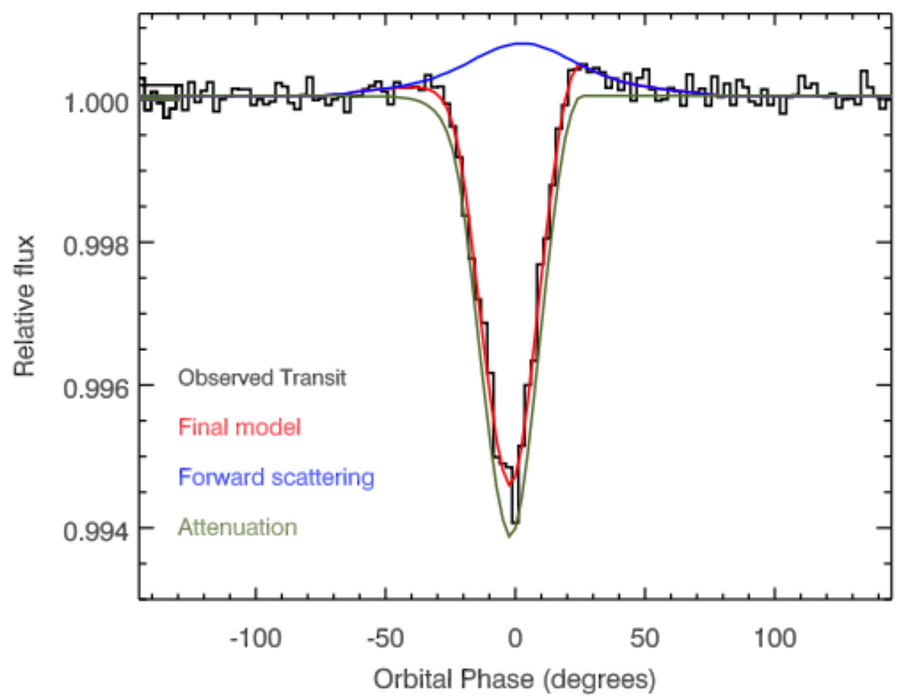
$$q_1 = a_{0,1} + a_{1,1} cos n\tau + a_{2,1} cos 2n\tau + a_{3,1} cos 3n\tau + ... \quad (1.4)$$

$$q_2 = a_{0,2} + a_{1,2} cos n\tau + a_{2,2} cos 2n\tau + a_{3,2} cos 3n\tau + ... \quad (1.5)$$

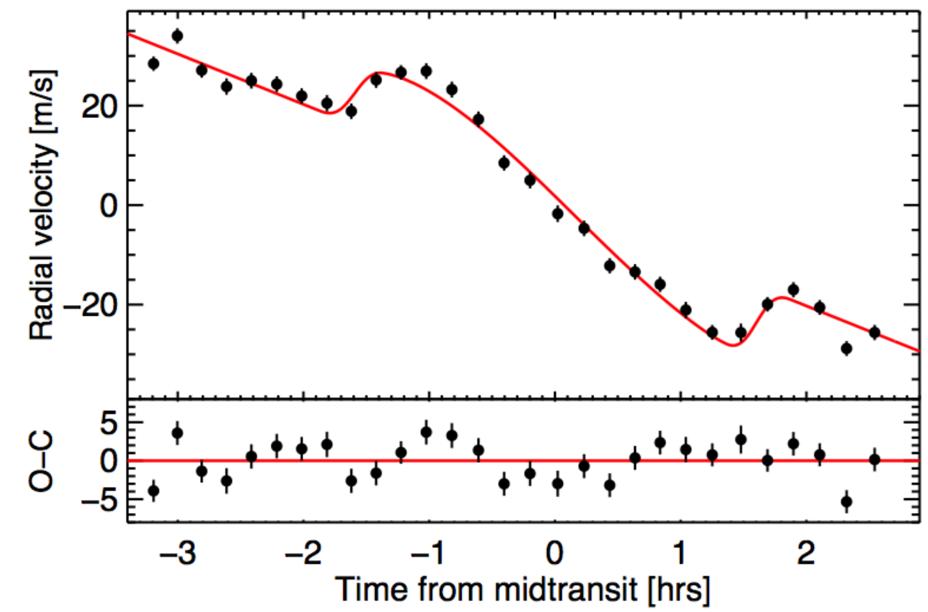
Radial velocity curves of Polytropic Model of Index N=1.5



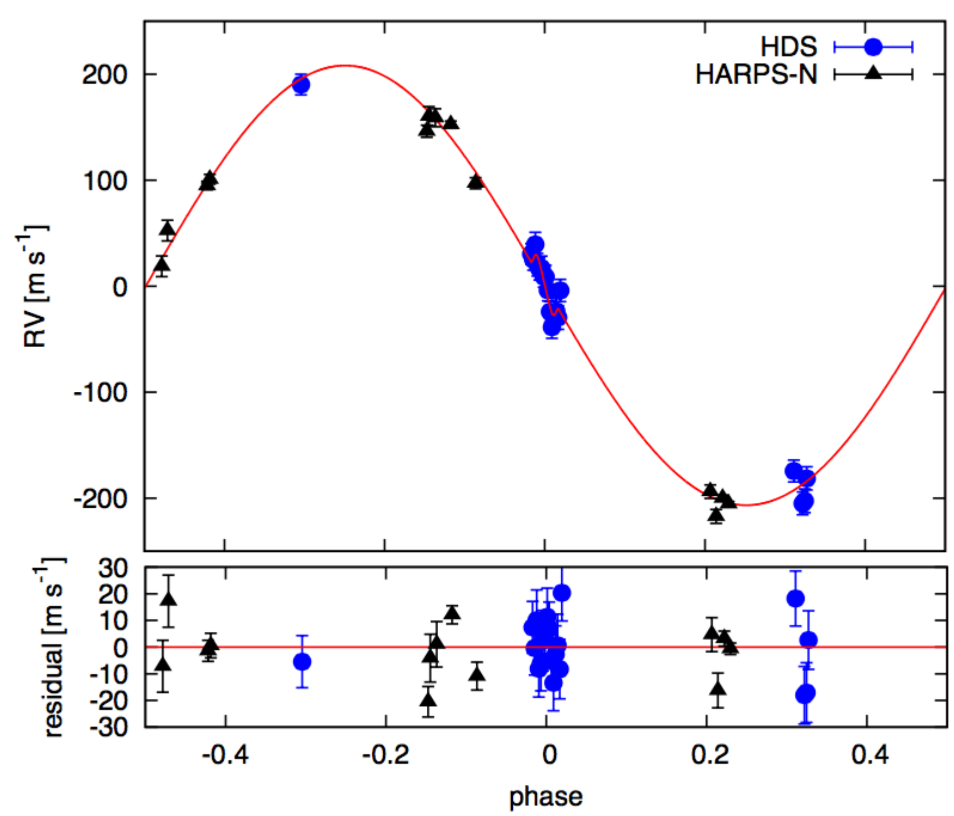
K2-ESPRINT



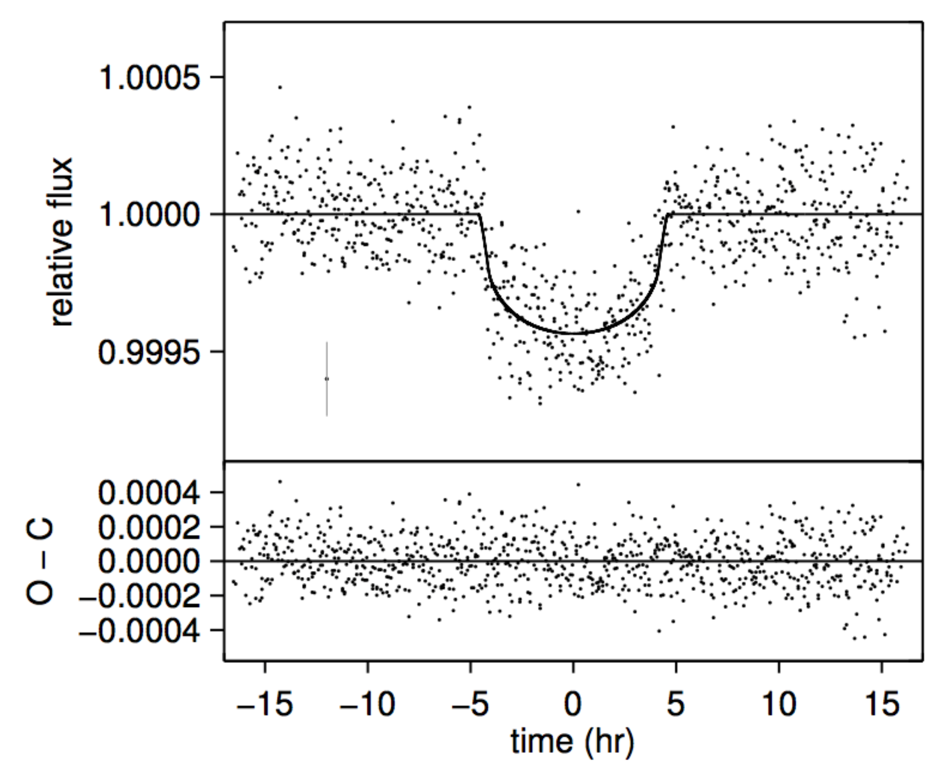
A disintegrating rocky planet K2-22b



Low obliquity of WASP-47b revealed by Rossiter-McLaughlin effect

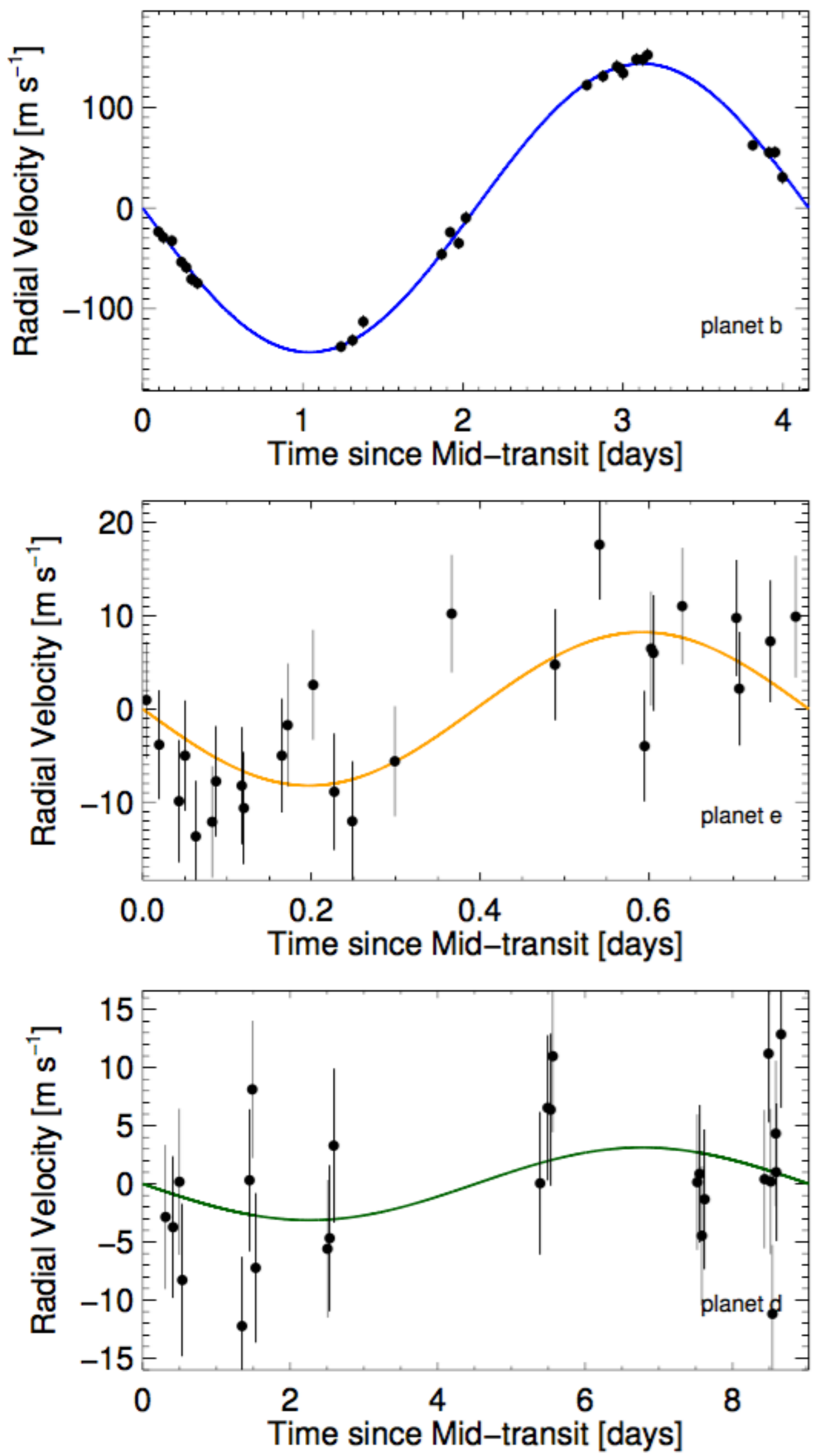


K2-34b: A hot jupiter on a prograde orbit

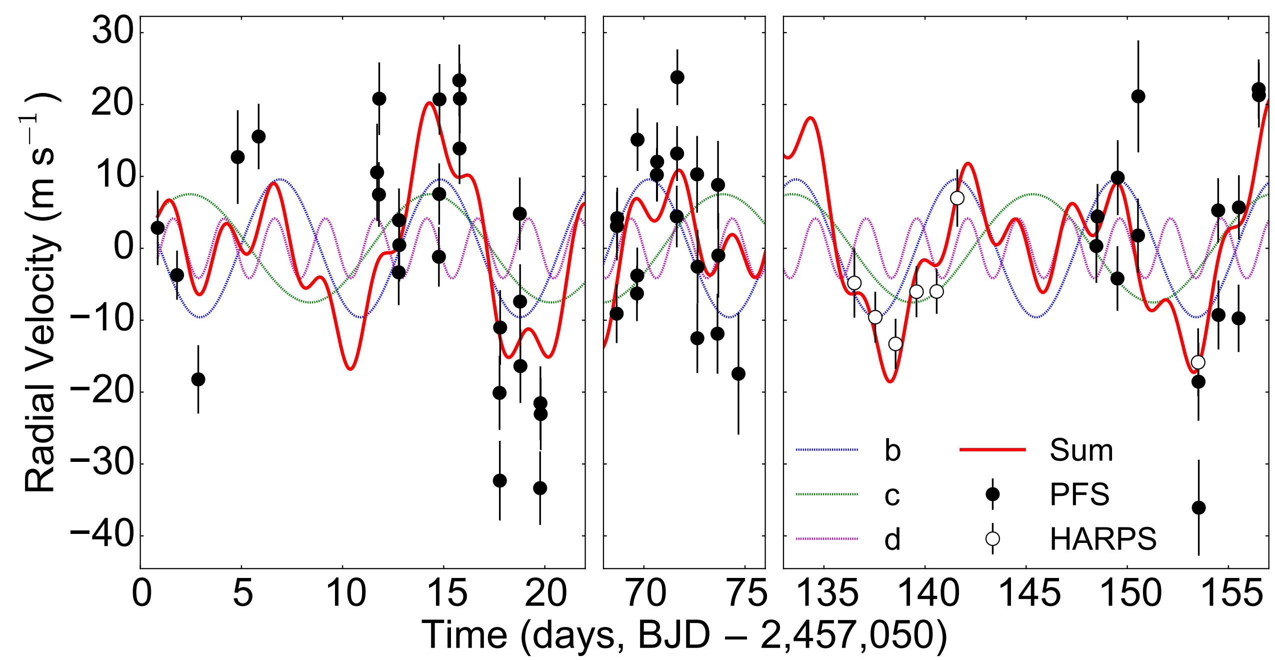


K2-39b: A short-period giant planet around a sub-giant star

RV Follow-up with PFS/Magellan



Folded RV of WASP-47 b, d, e



K2-19: mass measurements using both RV and TTV