MINERVA's Intrinsic Stability and First RV Results

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MINERVA

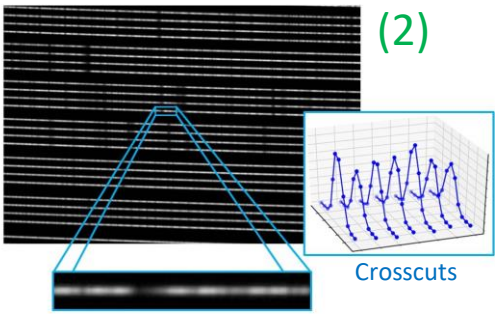
Precise RVs	High Cadence	Precise Photometry
Super Earths in habitable zones around nearest stars.	Dedicated Observatory	Transit photometry of Super Earths potentially in our RV target list.
Precision Goal: <1 m/s	Cadence: 60-80 spectra/night	Precision: < 1 mmag

Is the IP limiting our RV precision?

$$F_{\rm obs} = [F_{I_2}(\lambda(x)) \times F_\star(\lambda'(x))] * {\rm IP}(x)$$

Is IP characterization or IP stability the problem?

Find out by creating new IP in unique way, and have it fixed over time.



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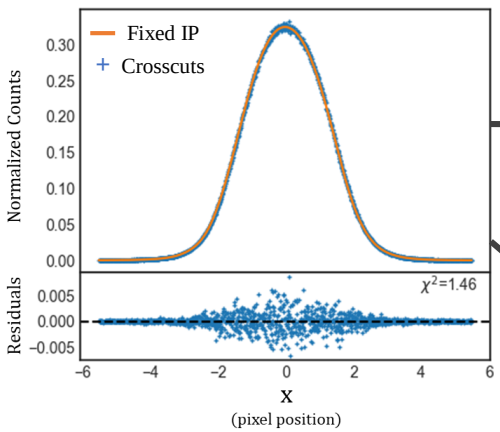
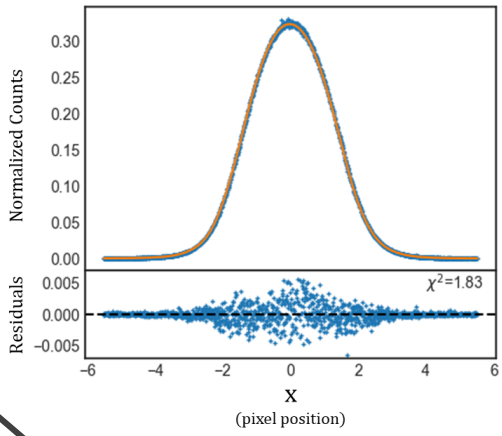


9 months later

15 months later

(4)



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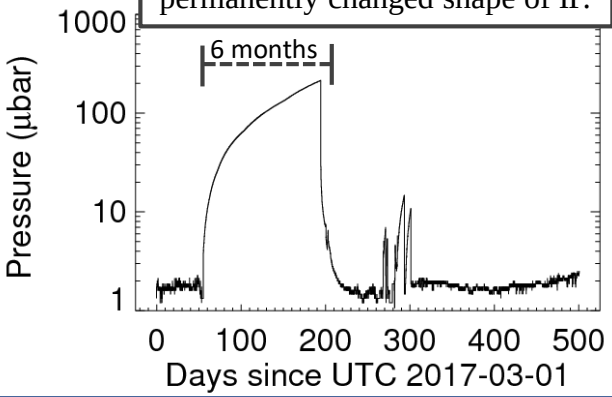
Horrible pressure instability permanently changed shape of IP.



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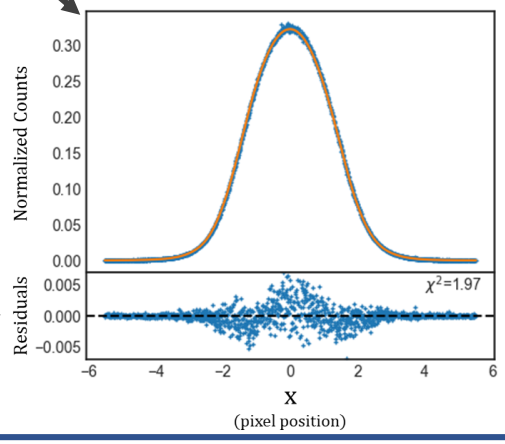

RV Standard Star: HD 122064

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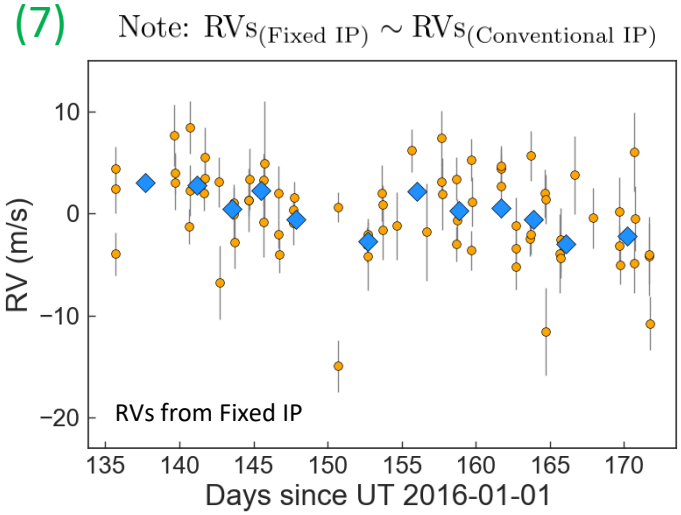
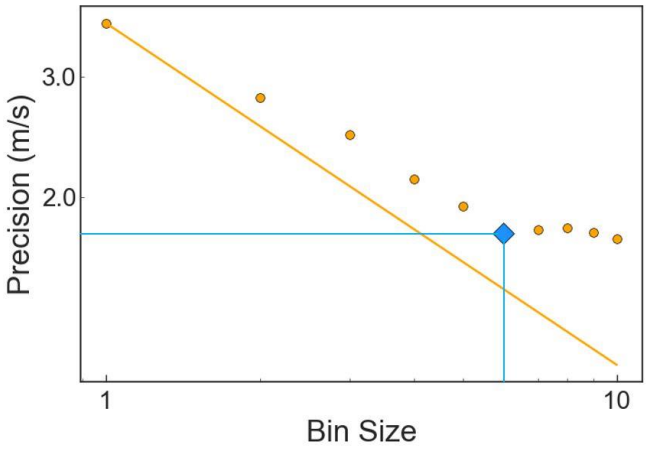


Precision: **1.8 m/s** (8)



Hot Jupiter Confirmation: 51 Peg b

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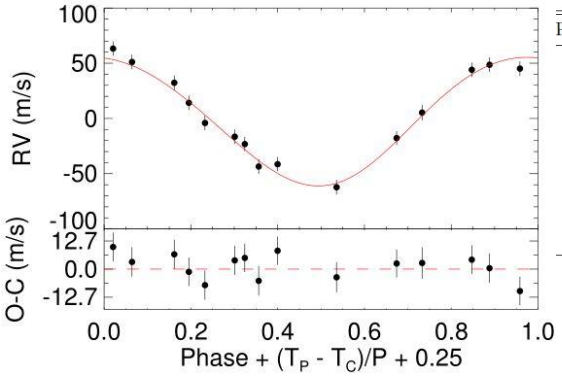

Test Case: 51 Peg b

Parameter	Description	MINERVA/EXOFASTv2	Reference (Butler, 2006)	$\Delta\sigma$
P	Period (days)	$4.236^{+0.028}_{-0.025}$	4.230785 ± 0.000036	0.209
e	Eccentricity	$0.051^{+0.062}_{-0.036}$	0.013 ± 0.12	0.303
K	RV semi-amplitude (m/s)	$57.6^{+3.6}_{-3.7}$	55.94 ± 0.69	0.441
$M_p \sin i$	Minimum mass (M_J)	$0.484^{+0.036}_{-0.037}$	0.472 ± 0.039	0.223

Accurate to within 1σ. Yay!

Doppler Tomography with MINERVA

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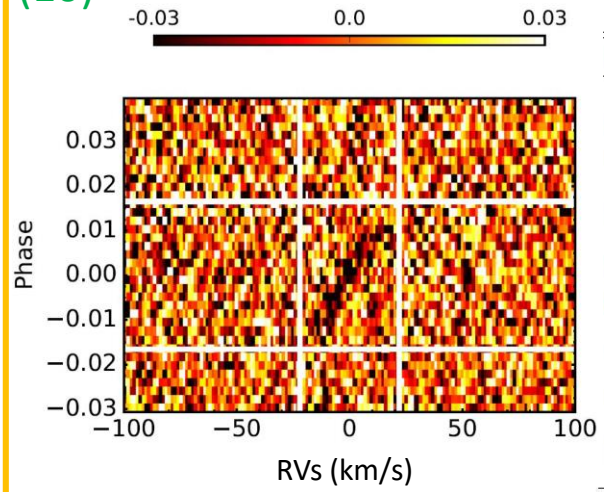

(Credit: George Zhou)

Preliminary KELT-24 Properties
(from RVs, Transits, & Doppler Tomography)

Parameter	Description	Value
Stellar Parameters:		
V	V-magnitude	8.3
$v \sin i_*$ ...	Projected rotational velocity (m/s)	$20{,}209^{+69}_{-490}$
Planetary Parameters:		
P	Period (days)	$5.5514951^{+0.0000056}_{-0.0000060}$
e	Eccentricity	$0.047^{+0.023}_{-0.030}$
λ	Projected spin-orbit alignment (Degrees)	$2.8^{+4.6}_{-2.8}$
M_p	Mass (M_J)	5.06 ± 0.24