The interesting case of HD41248

stellar activity, no planets?

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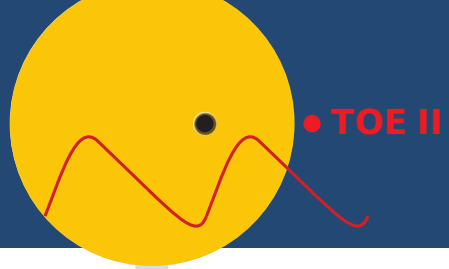
Astronomy & Astrophysics

The HARPS search for southern extra-solar planets⋆,⋆⋆,⋆⋆⋆

XXXV. The interesting case of HD 41248: stellar activity, no planets?

N. C. Santos[1,2], A. Mortier[1], J. P. Faria[1,2], X. Dumusque[3,4], V. Zh. Adibekyan[1], E. Delgado-Mena[1], P. Figueira[1], L. Benamati[1,2], I. Boisse[8], D. Cunha[1,2], J. Gomes da Silva[1,2], G. Lo Curto[5], C. Lovis[3], J. H. C. Martins[1,2], M. Mayor[3], C. Melo[5], M. Oshagh[1,2], F. Pepe[3], D. Queloz[3,9], A. Santerne[1], D. Ségransan[3], A. Sozzetti[7], S. G. Sousa[1,2,6], and S. Udry[3]

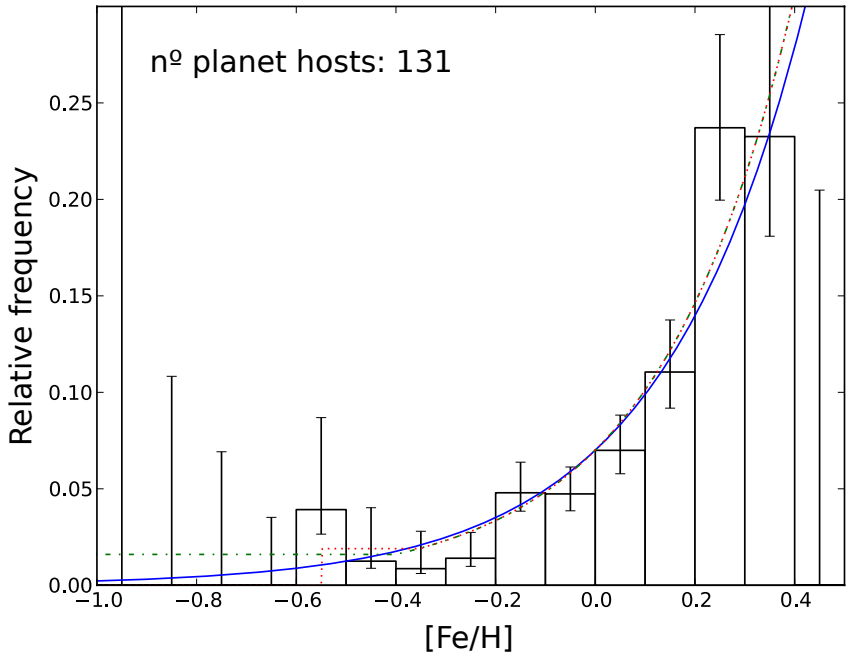
Planet-metallicity correlations



Metallicity is one of the most important ingredients in planet formation

Planet-metallicity correlations

Metallicity is one of the most important ingredients in planet formation



Mortier et al. (2013)

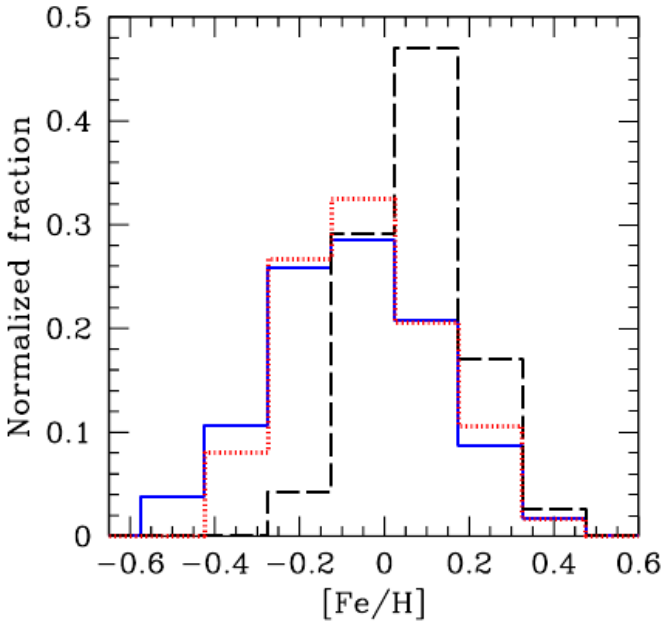
- Stars hosting giant planets are systematically metal-richer than non-hosts

  Gonzalez (1998); Santos et al. (2001, 2004b); Sousa et al. (2011b)

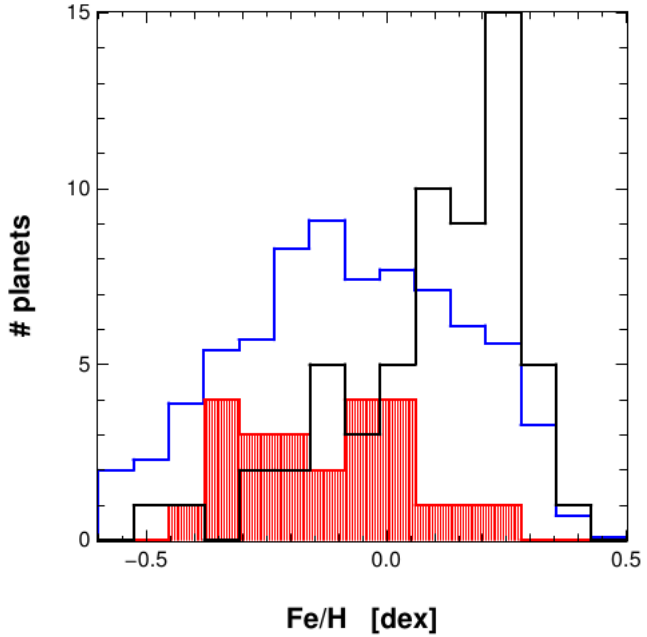
Planet-metallicity correlations

Metallicity is one of the most important ingredients in planet formation

formation models



observations



- No metallicity trend is observed for stars with lower mass planets

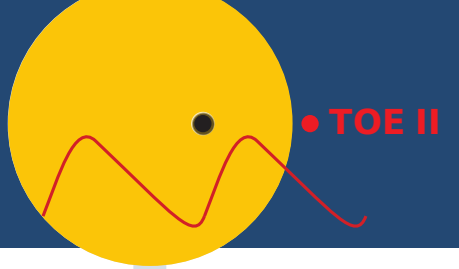
  Udry et al. (2006); Sousa et al. (2011); Mayor et al. (2011); Alibert et al. (2013)

Planet-metallicity correlations

Started an ESO Large Program to search for
Neptunes and super-Earths orbitting low-metallicity stars

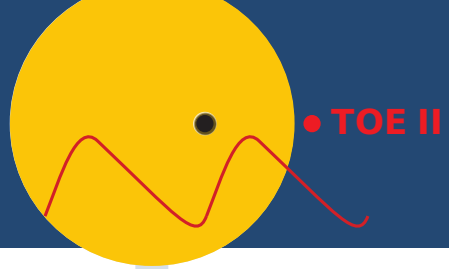
HD41248

HD41248



A metal-poor, solar-type star

Spectral type	G2V
m_v	8.82
$B - V$	0.62
Parallax [mas]	19.11 ± 0.71
Distance [pc]	52 ± 2
M_v	5.23
L [$L_\odot$]	0.70
$\log R'_{\rm HK}$	−4.90
$P_{\rm Rot}$ [days]	20 ± 3
$v \sin i$ [km s^{-1}]	1.0
$T_{\rm eff}$ [K]	5713 ± 21
$\log g$	4.49 ± 0.05
[Fe/H]	-0.37 ± 0.05
Mass [$M_\odot$]	0.94 ± 0.02
Radius [$R_\odot$]	0.92 ± 0.06



A metal-poor, solar-type star with a pair of resonant Super-Earths (?)

Two Super-Earths Orbiting the Solar Analogue HD41248 on the edge of a 7:5 Mean Motion Resonance[1]

J.S. Jenkins[1,2], M. Tuomi[2,3], R. Brasser[4], O. Ivanyuk[5], F. Murgas[6,7]

[1] *Departamento de Astronomia, Universidad de Chile, Camino el Observatorio 1515, Las Condes, Santiago, Chile, Casilla 36-D*

[2] *Center for Astrophysics, University of Hertfordshire, College Lane Campus, Hatfield, Hertfordshire, UK, AL10 9AB*

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[4] *Institute for Astronomy and Astrophysics, Academia Sinica, Taipei 10617, Taiwan*

[5] *Main Astronomical Observatory of National Academy of Sciences of Ukraine, 27 Zabolotnoho, Kyiv 127, 03680, Ukraine*

[6] *Instituto de Astrofísica de Canarias, Via Lactea, E38205, La Laguna, Tenerife, Spain*

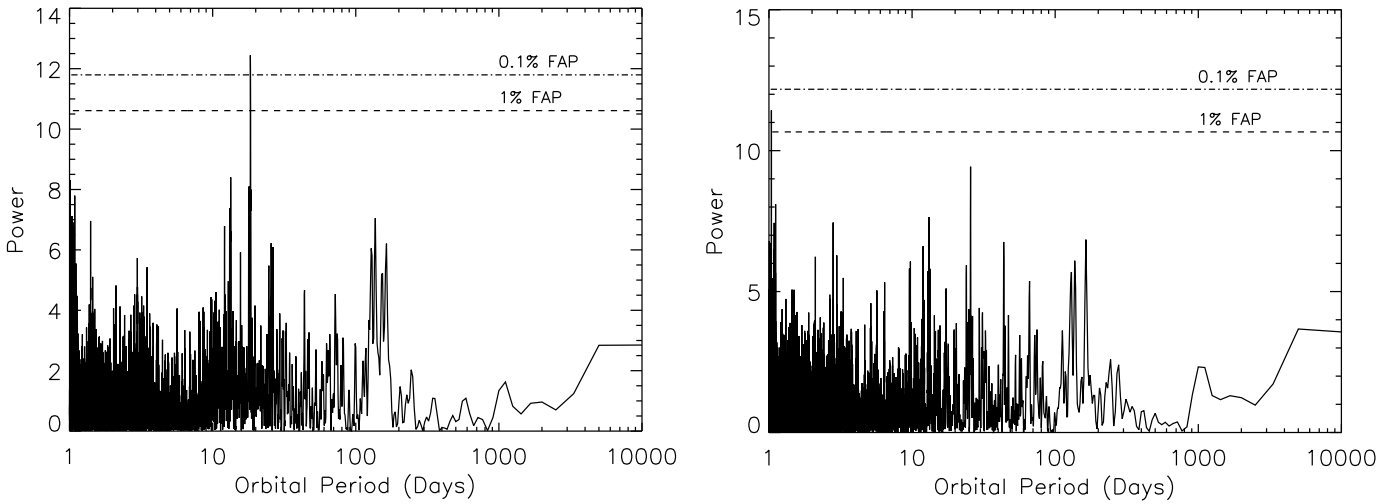
[7] *Departamento de Astrofísica, Universidad de La Laguna (ULL), E-38206 La Laguna, Tenerife, Spain*

ABSTRACT

The number of multi-planet systems known to be orbiting their host stars with orbital periods that place them in mean motion resonances is growing. For the most part, these systems are in first-order resonances and dynamical studies have focused their efforts towards understanding the origin and evolution of such dynamically resonant commensurabilities. We report here the discovery of two super-Earths that are close to a second-order dynamical resonance, orbiting the metal-poor ([Fe/H]=-0.43 dex) and inactive G2V star HD41248. We analysed 62 HARPS archival

HD41248

A metal-poor, solar-type star with a pair of resonant Super-Earths (?)



Jenkins et al. (2013)

HD41248

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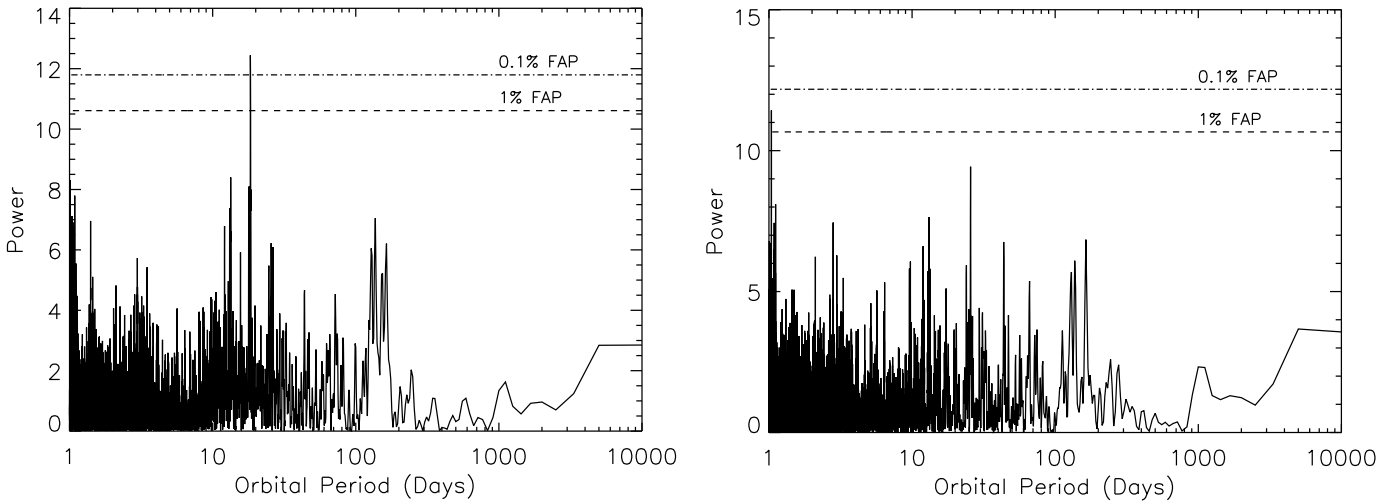

Jenkins et al. (2013)

- A peak at 18d is also seen in the BIS of the HARPS CCF
- Close to the estimated rotation period (too much?)

HD41248

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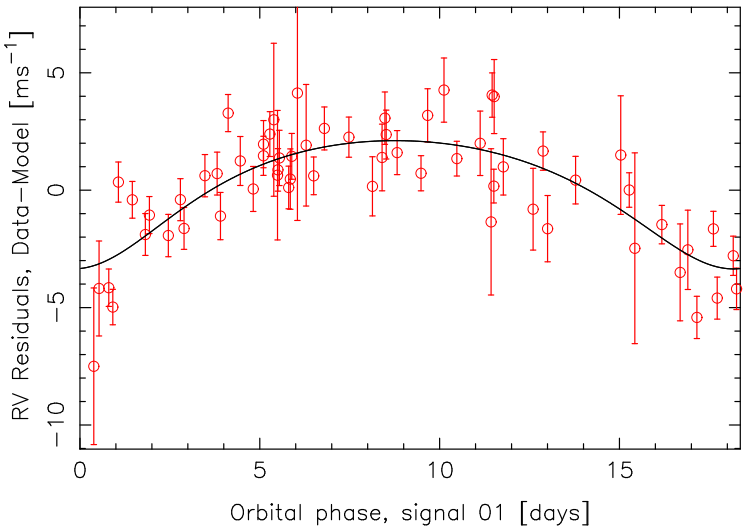
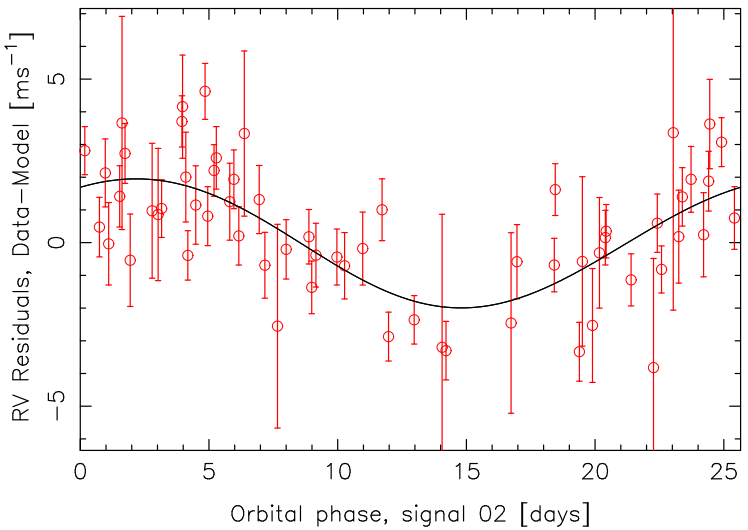




Jenkins et al. (2013)

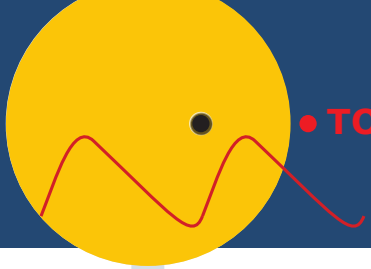
HD41248 b

P [d] = 18.357
e = 0.15
K = 2.93 ms^{-1}
a = 0.137 AU
$M_p \sin i$ = 12.3 $M_\oplus$

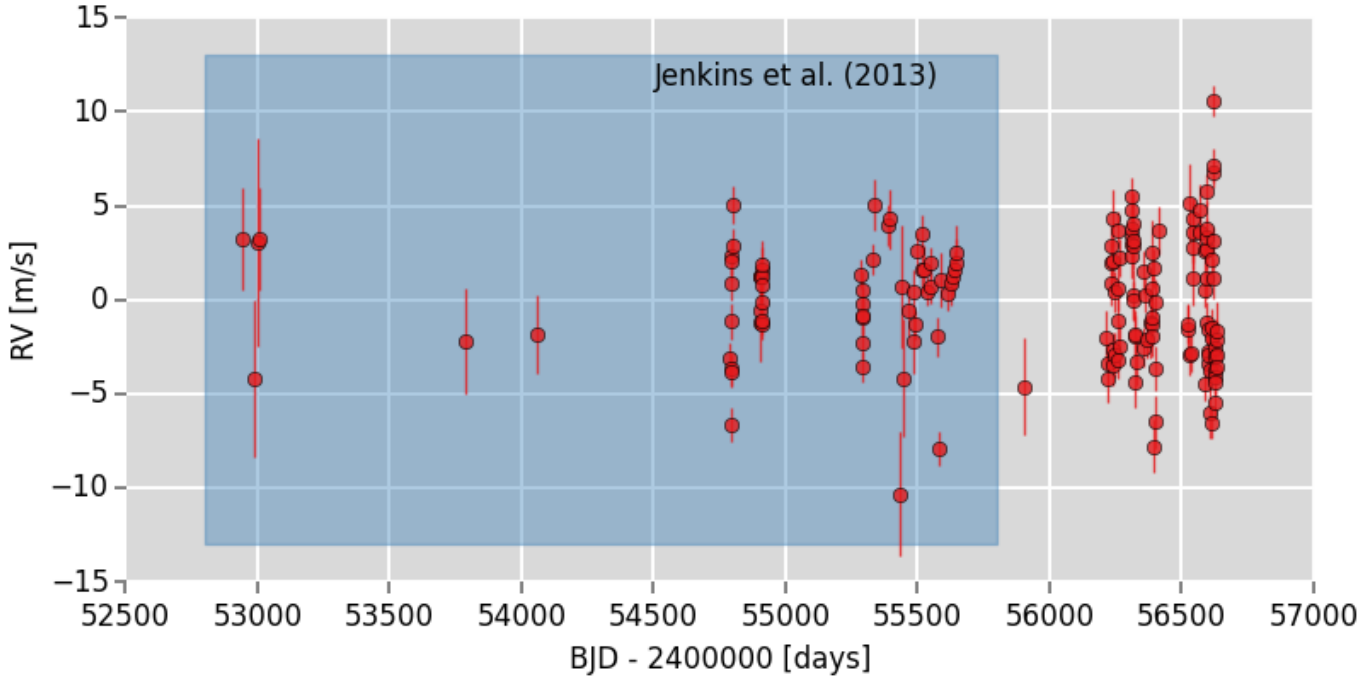
HD41248 c

P [d] = 25.648
e = 0.0
K = 1.84 ms^{-1}
a = 0.172 AU
$M_p \sin i$ = 8.6 $M_\oplus$

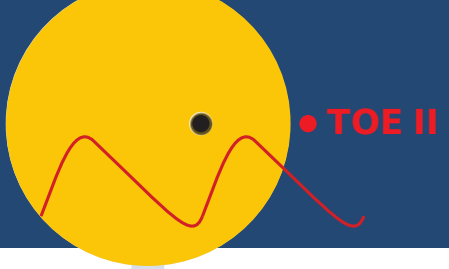
HD41248



A metal-poor, solar-type star
with a pair of resonant Super-Earths (?)
observed for more than 10 years with HARPS



HD41248



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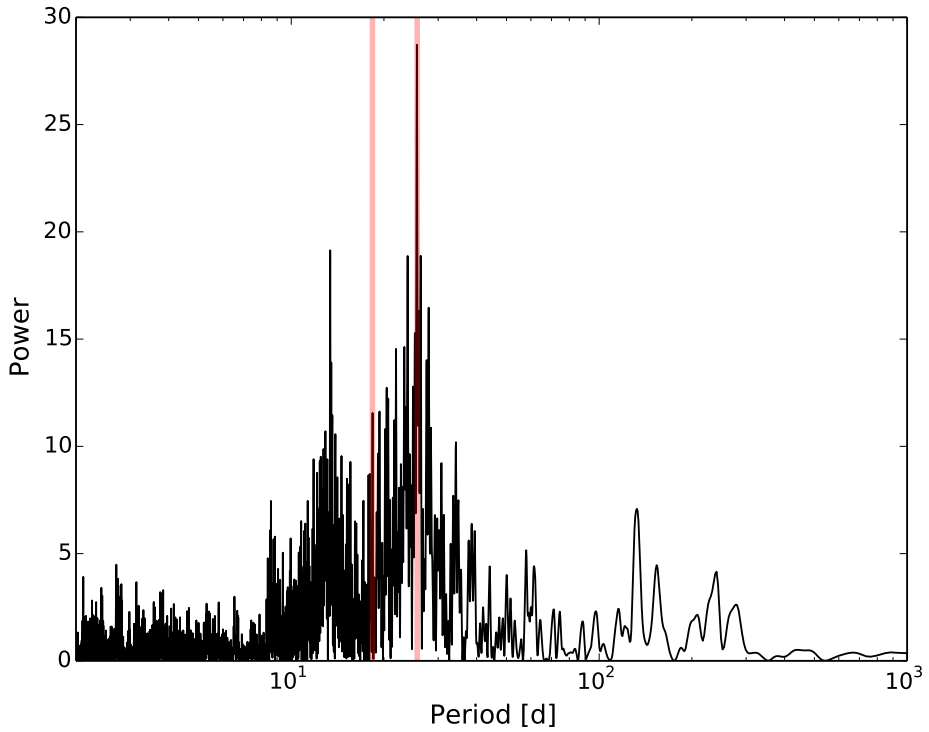

- Peak at 25d is now dominant
- No sign of a strong 18d period

HD41248

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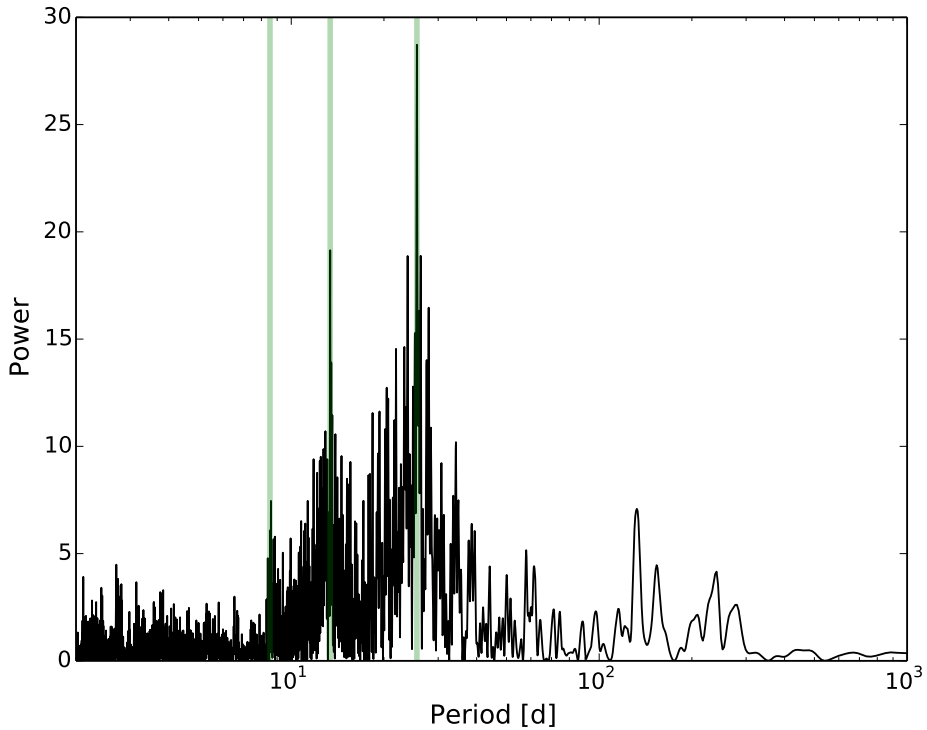
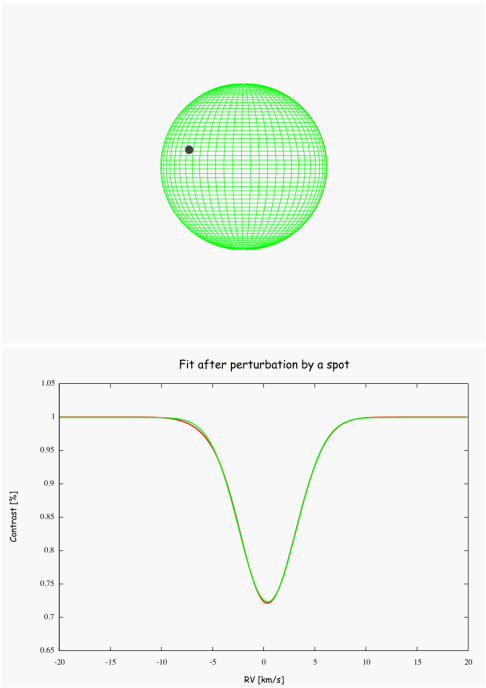


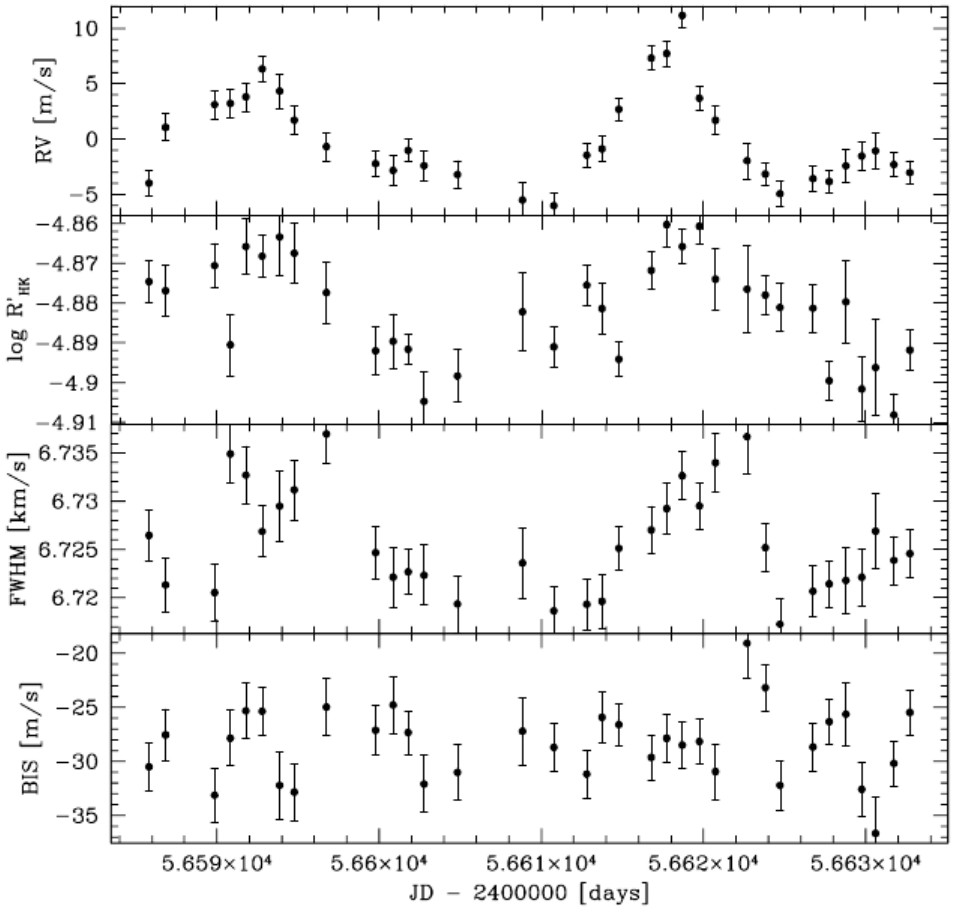
- If 25d is the rotation period of the star
  peaks at P_{rot}, $P_{rot}/2$ and $P_{rot}/3 \longrightarrow$ presence of a spot

Boisse et al. (2011)

HD41248



credit: Pedro Figueira



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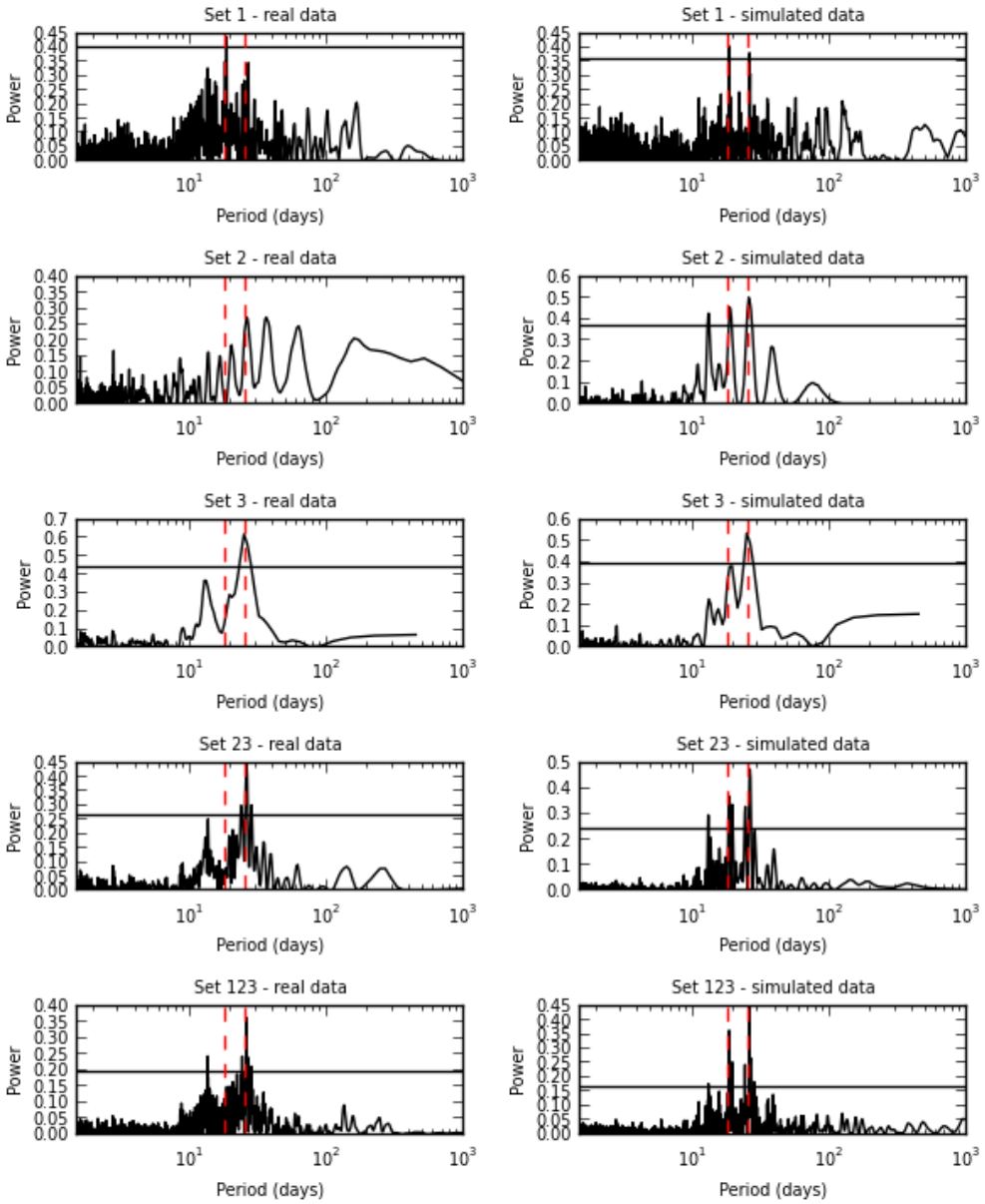
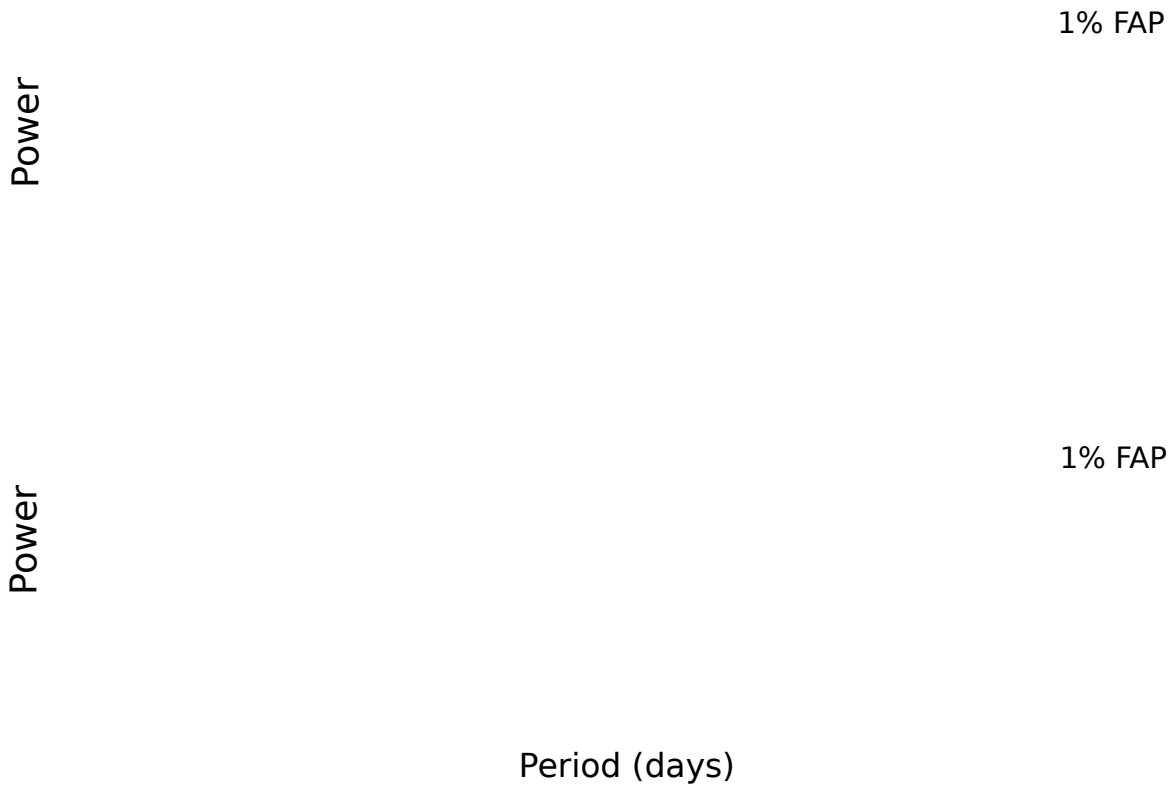


The 18d "planet" should be detected

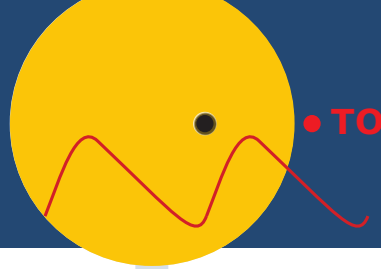
It is not an effect of the time sampling

HD41248



- After removing activity signal there are no significant peaks left
- A Bayesian analysis does not detect the planet at 18d

Conclusions



- The 25d period is almost exactly reproduced in the log R'_{HK} and the *FWHM* of the HARPS CCF
- The 18d period is not successfully recovered in the new data
- We propose the observed signals may be caused by different active regions in a star presenting strong differential rotation

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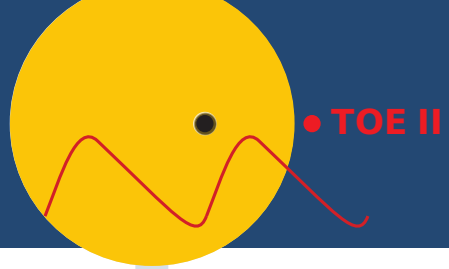

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- The 18d period is not successfully recovered in the new data
- We propose the observed signals may be caused by different active regions in a star presenting strong differential rotation
- Bayesian $\neq$ always correct! It all depends on your model

Thank you