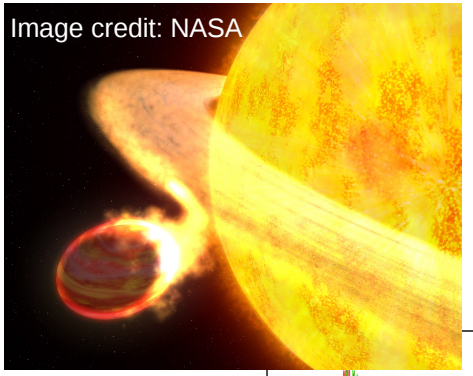
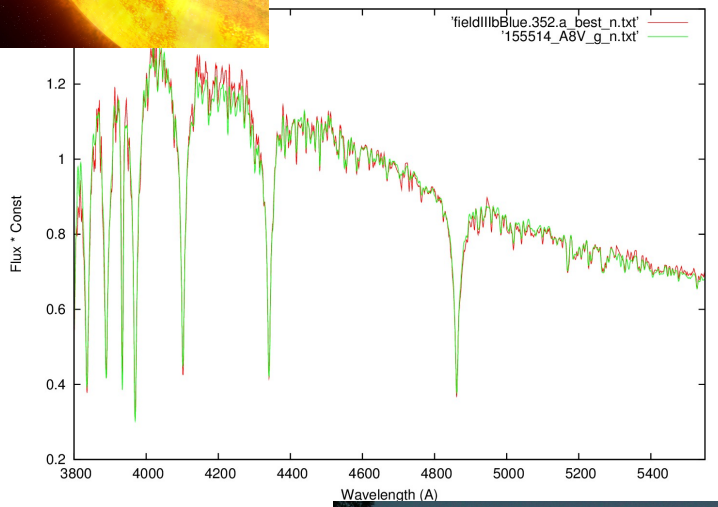
Transiting planets of intermediate-mass stars

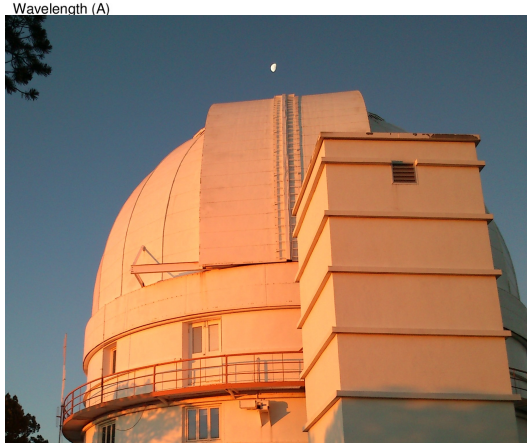
Daniel Sebastian + the CoRoT team
11.CoRoT Week, La Laguna, Tenerife, Spain

Outline



- motivation
- preparatory work
- observations
- preliminary results





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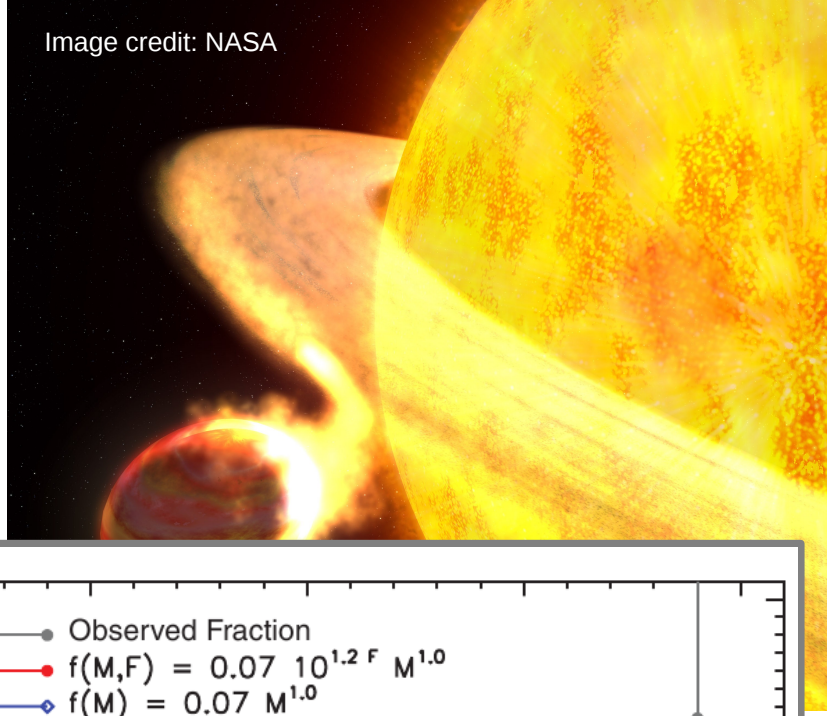
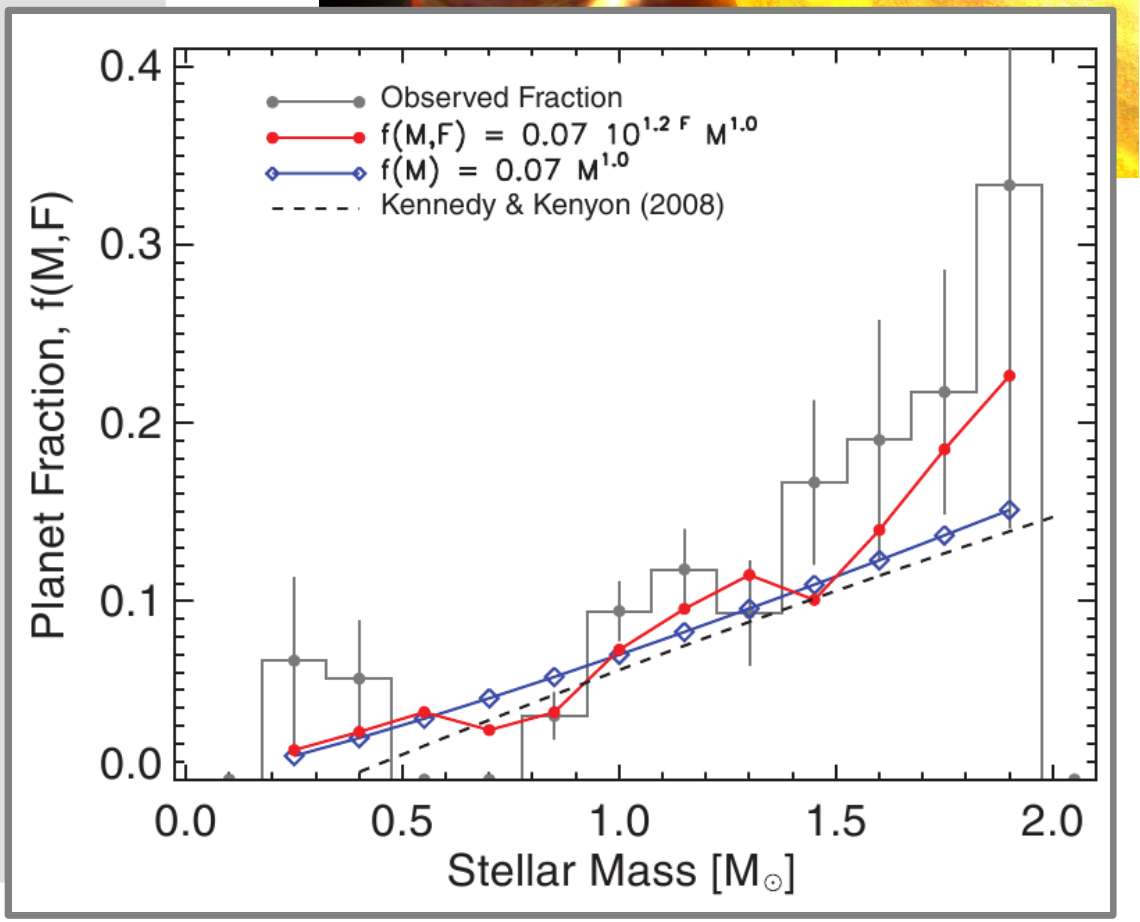
Motivation



Question:

"How does the frequency of planets change With the mass of the host-star?“

Current status:
Frequency of massive planets seems to increase
(Johnson et al. 2010)



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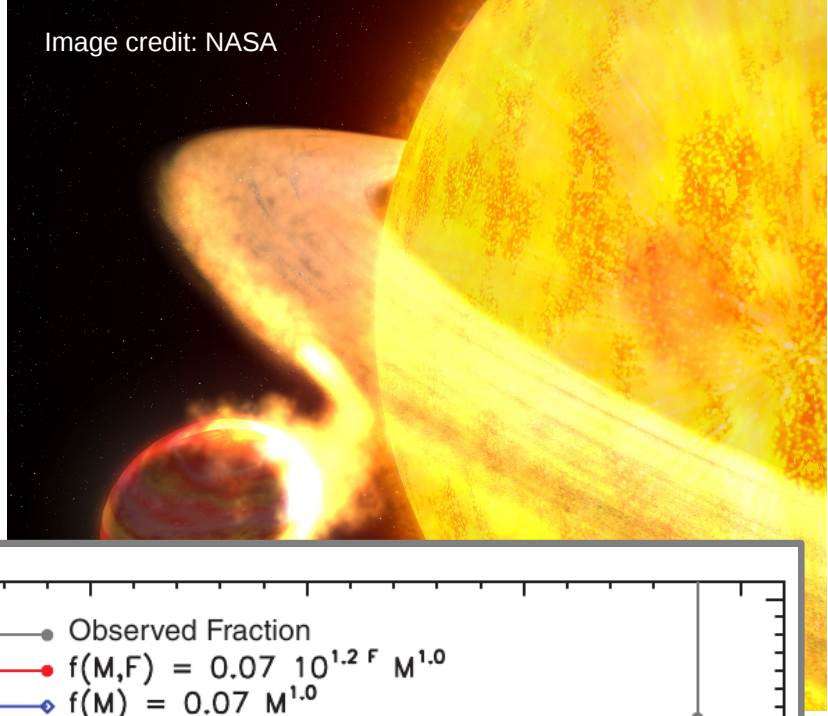

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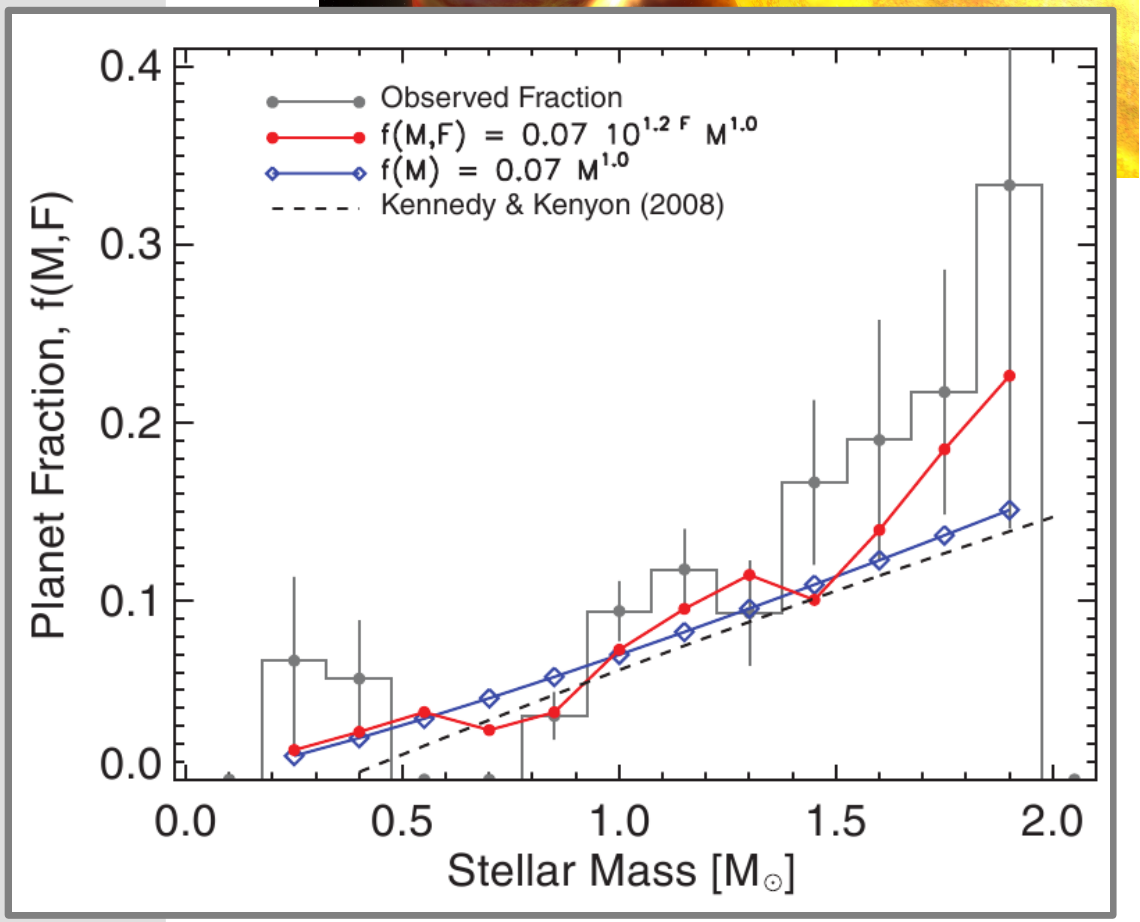
- Inhomogenious data set (giant-stars,main sequence stars)
- Only planets with a > 0.5 AU

→ **This means, we simply do not know if intermediate-mass stars have close-in planets or not.**



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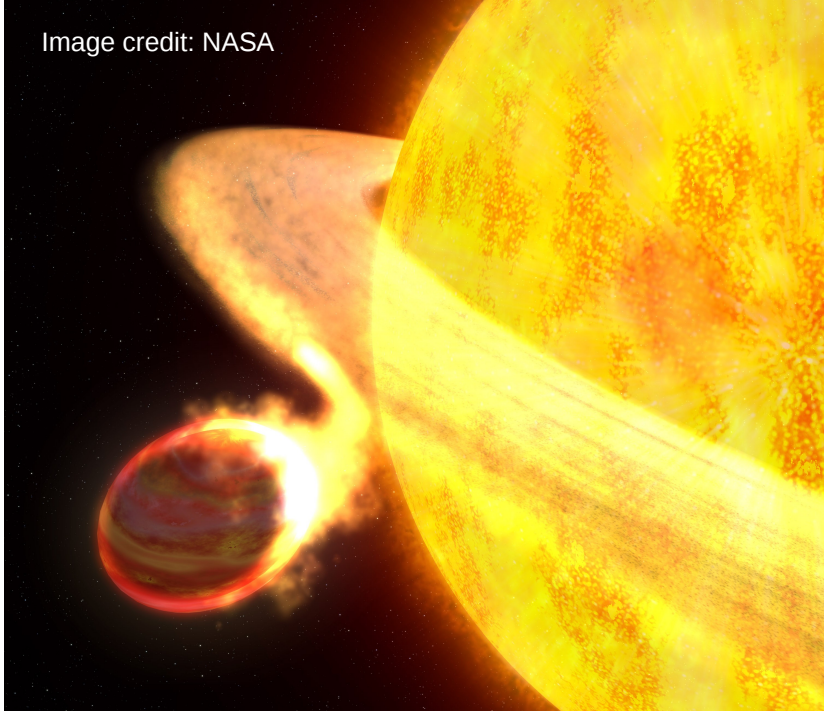


Hot Jupiters are quite “common“ for solar-like stars

Key question

What is the frequency of “Hot Jupiters“ orbiting 1.3 … 2 M⊙ stars?

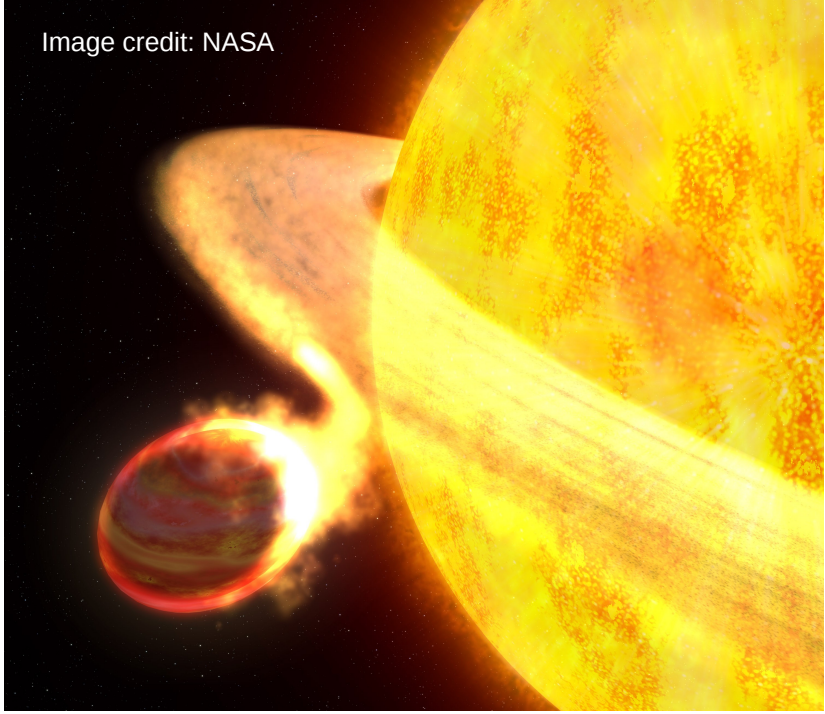
two possibilities:

- there are as many “Hot Jupiters“ formed as predicted by observations
  (they are engulfed by there host-star while RGB-phase)

  or:

- frequency is small and “Hot Jupiters“ are rare
  (WASP33b is orbiting within 0.5 AU around an A5 star)

Motivation



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two

Empirical answer:

- Homogeneous survey for planets orbiting A-type main-sequence stars

ervations

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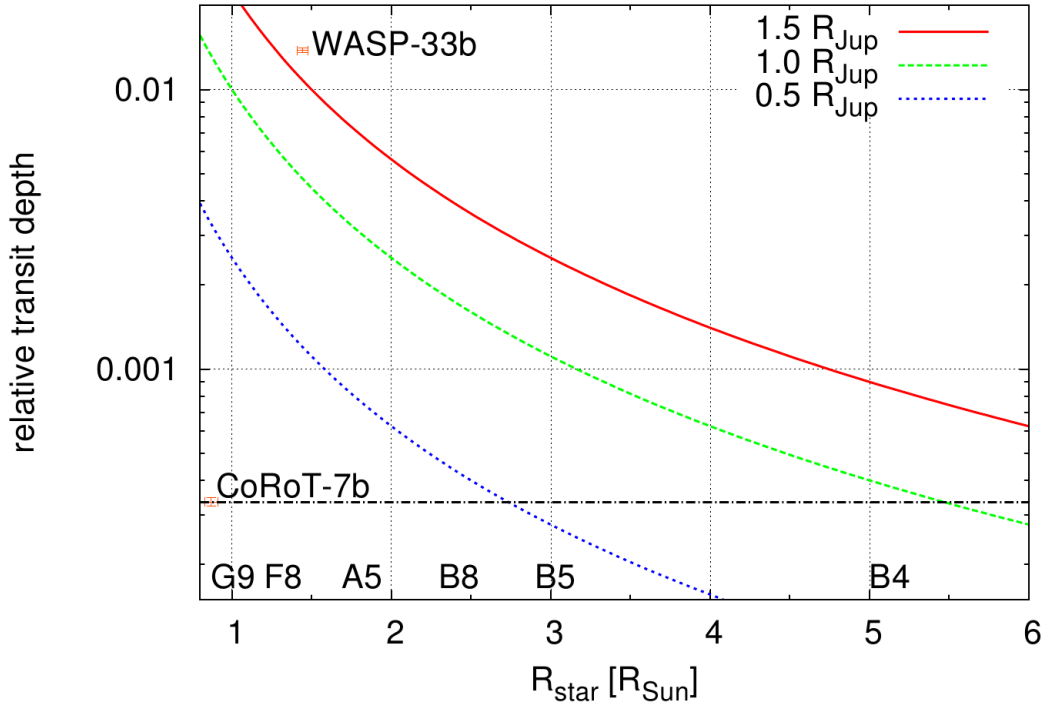
Feasible with CoRoT?

B- and A-type stars have large radii:



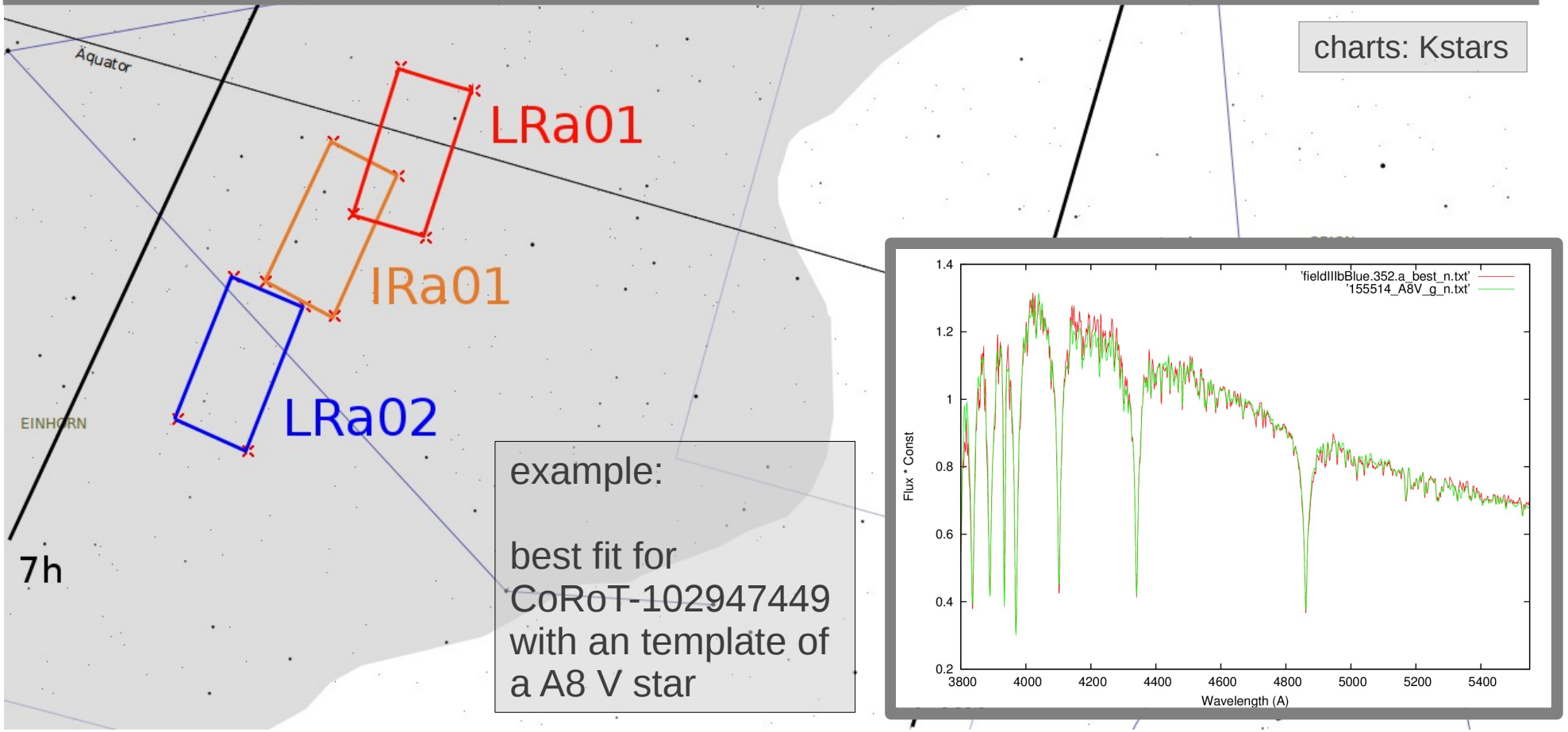
- with CoRoT were no such planets detected yet
- accuracy --> it would be possible to detect jupiter-like planets up to spectral type B4

Preparatory work

Identification of spectra in IRa01, LRa01 and LRa02

More than 11,000 classified stars (Sebastian et al. 2012, Guenther et al. 2012)

→ **15.9%** of the CoRoT-targets are early-type stars.



Preparatory work

Seaching or Candidates:

- Sample of more than 2000 classified intermediate-mass stars
- Several stars were classified using the low-res spectrograph at TLS
- Additionally: add other CoRoT-fields by using photometric spectral types provided by the EXODAT- database (Deleuil et al. 2009)

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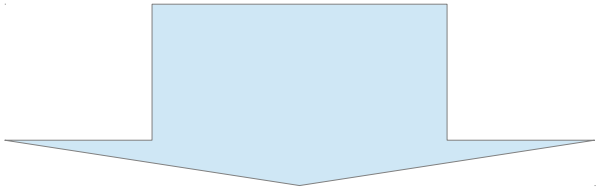
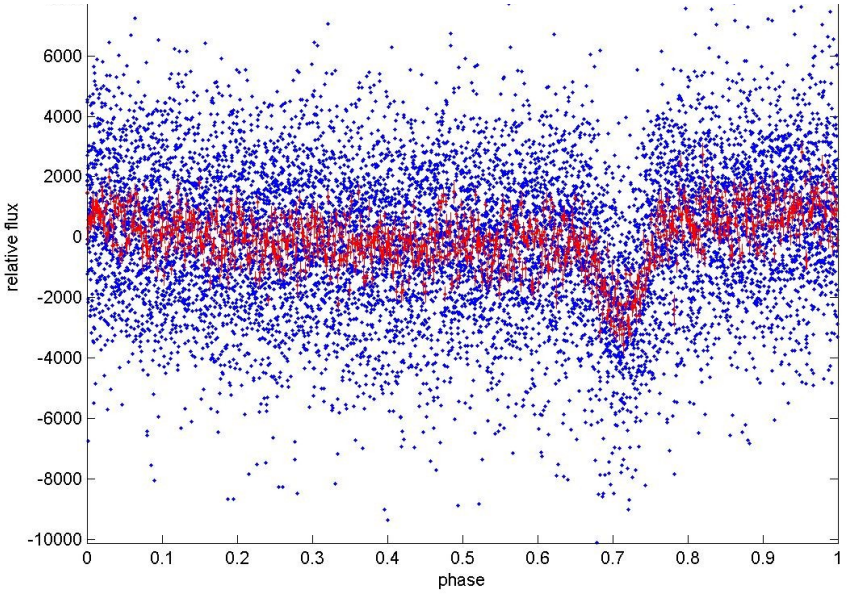


Used filter algorithm developed by Grziwa S. et al. to search for transits manually



Preparatory work

Feasibility study:

RV-measurements of early-type stars are not easy

- high vsini (~100km/s)
- less spectral features than solar-type stars

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Requirements to detect close-in planets? ($P \lesssim 4d$)

Example:

a planet with 2 M_{Jup} in 4 day orbit would show 200m/s RV- variations

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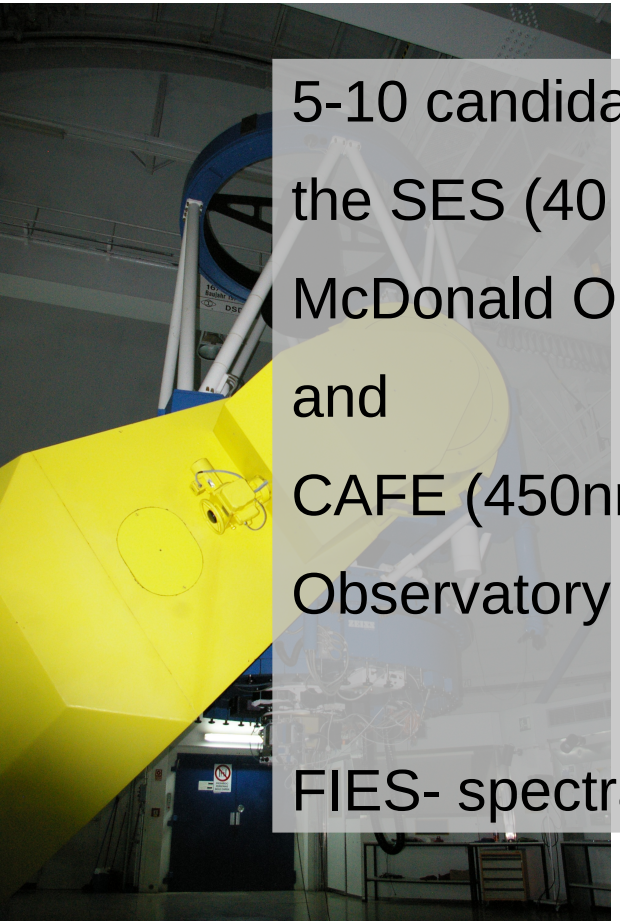
Requirements to detect close-in planets? ($P \lesssim 4d$)

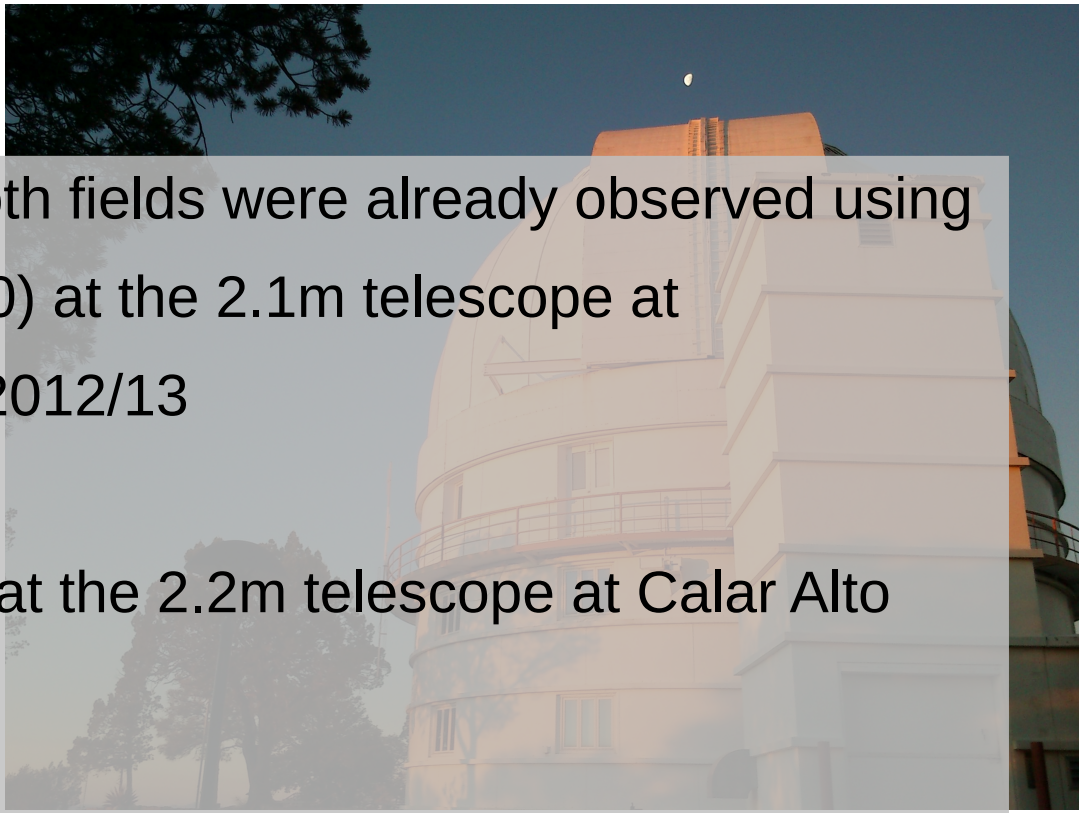
Example:

a planet with 2 M_{Jup} in 4 day orbit would show 200m/s RV- variations
11 M_{jup} in same orbit would show 1km/s variations!

→ All we need is an accuracy of 200 m/s.

Observations





5-10 candidates each in both fields were already observed using the SES (40 nm, R = 60000) at the 2.1m telescope at McDonald Observatory in 2012/13

and

CAFE (450nm, R= 60000) at the 2.2m telescope at Calar Alto Observatory in 2012.

FIES- spectra were also obtained in 2013

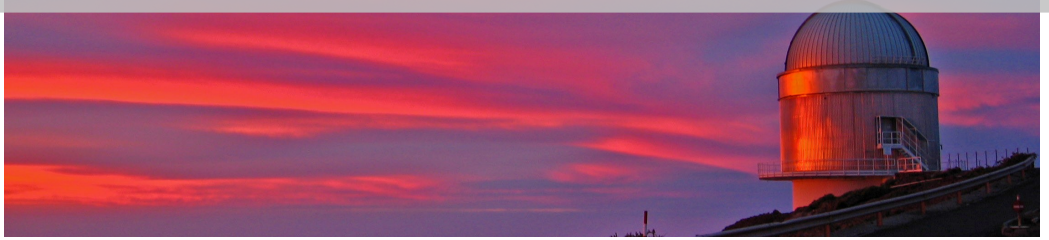


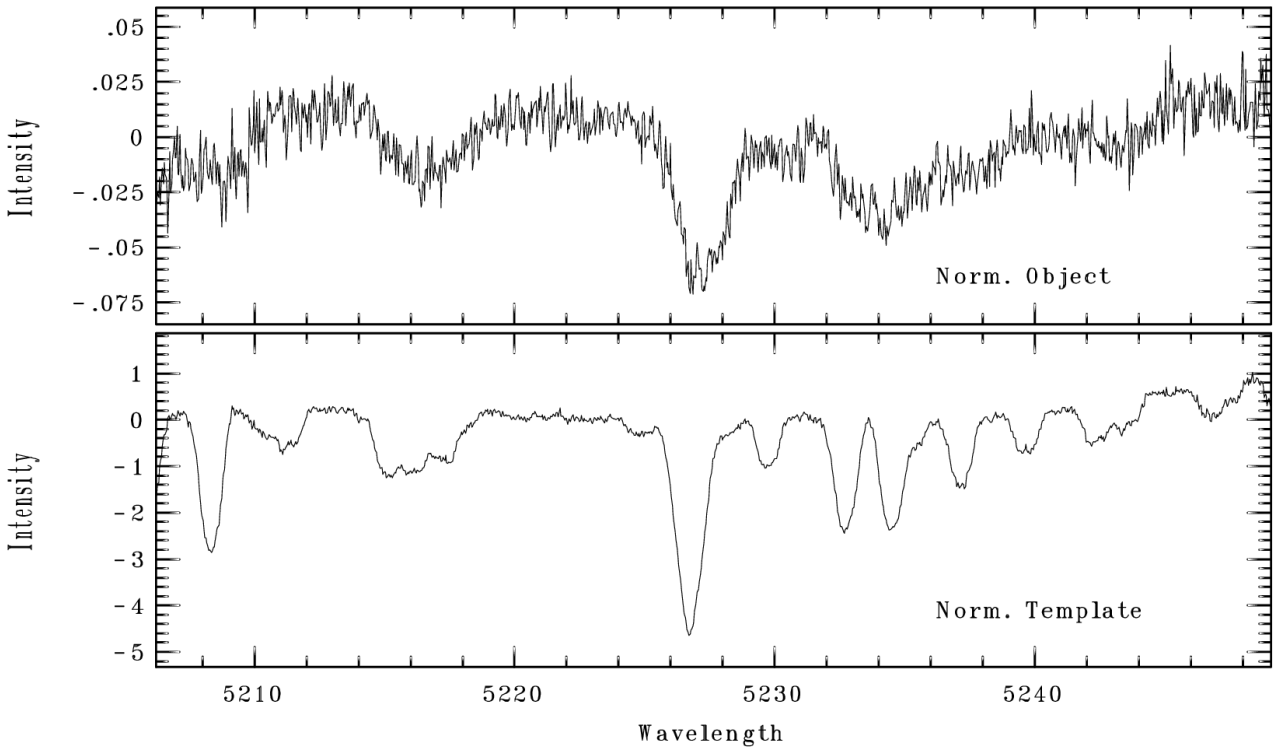
Image credit:
Jyri Näränen

Observations

Example:

CAFE spectrum
of an A-type star:

cross corelation with
template of similar
spectral type



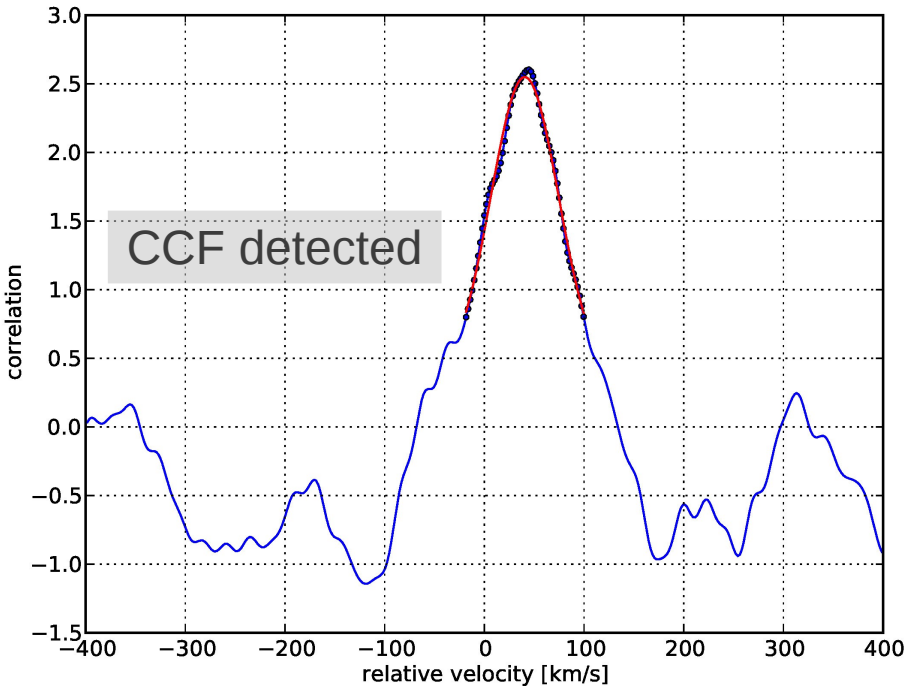
Observations

Example:

CAFE spectrum
of an A-type star:

cross corelation

and sum CCF up for all orders:

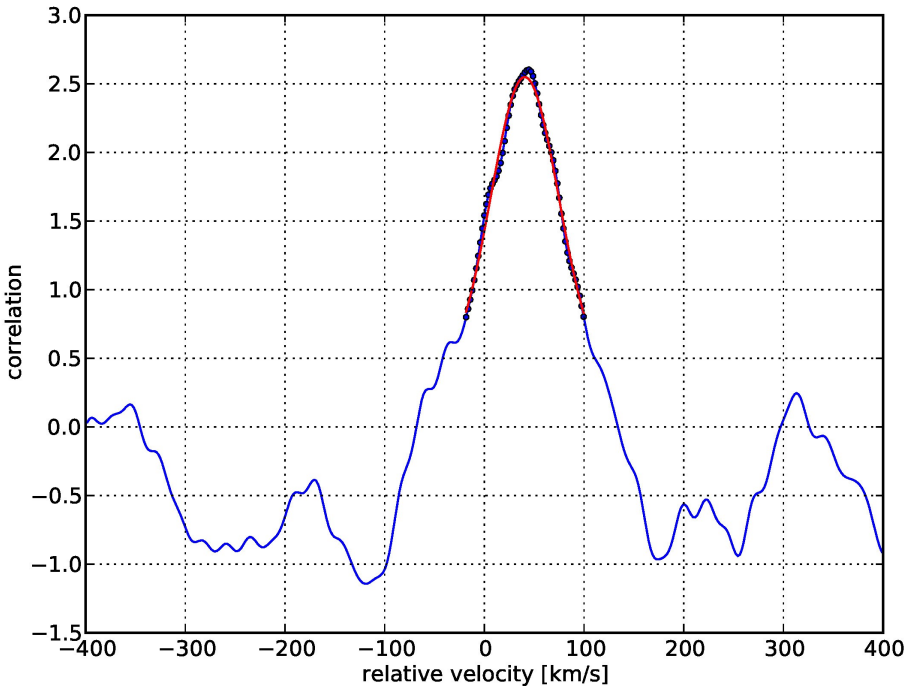


Observations

Example:

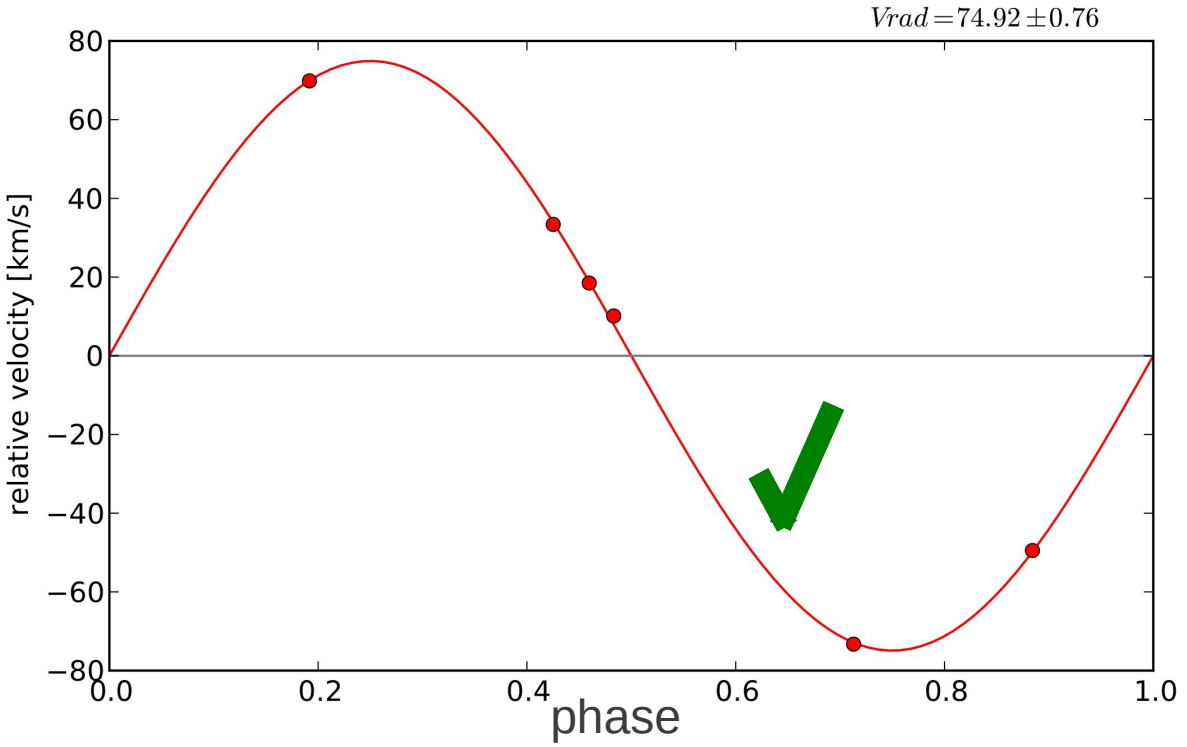
CAFE spectrum
of an A-type star:

Get Errors down to 200m/s
depending on wavelength
coverage and S/R



Results I

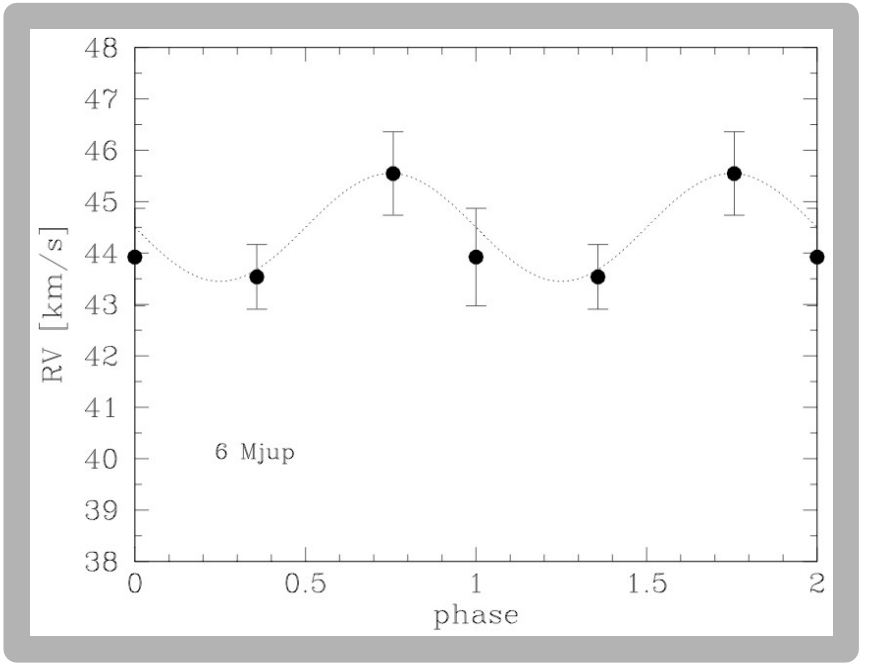
- Example for a binary that was found in the survey



Results II

- McDo:
  For several targets we got upper limits, and detected binaries
  (wavelength coverage to small to detect planets)

- CAFE:
  planet detection is possible
  but more data is needed.



Example candidate:
Note: Not a FIT, but upper limits!

Conclusions

- dedicated survey for close-in massive planets orbiting early-type stars
- Sensitivity of CoRoT allows to detect Hot Jupiters obiting early-type stars
- We have > 10 candidates for close-in planets of intermediate-mass stars
- feasibility study showed that it's possible to measure the mass even for early-type stars
- several binaries detected that mimic planet like transit signals
- we obtained upper limits of a few Mjup from McDo
- More observations with CAFE needed to determine the masses.

Thank you for your attention!