Transiting extrasolar planets at Leiden Observatory

Ignas Snellen

- ✧ Introduction
- ✧ Characterisation of exoplanet atmospheres
- ✧ Transit survey work
  - WTS (WFCAM/UKIRT Survey)
  - OmegaTranS (Omegacam/VLT Survey)
- ✧ An example case: OGLE2-TR-L9

Leiden Observatory, Leiden University

~25 faculty,
~40 postdocs,
~50 PhD students

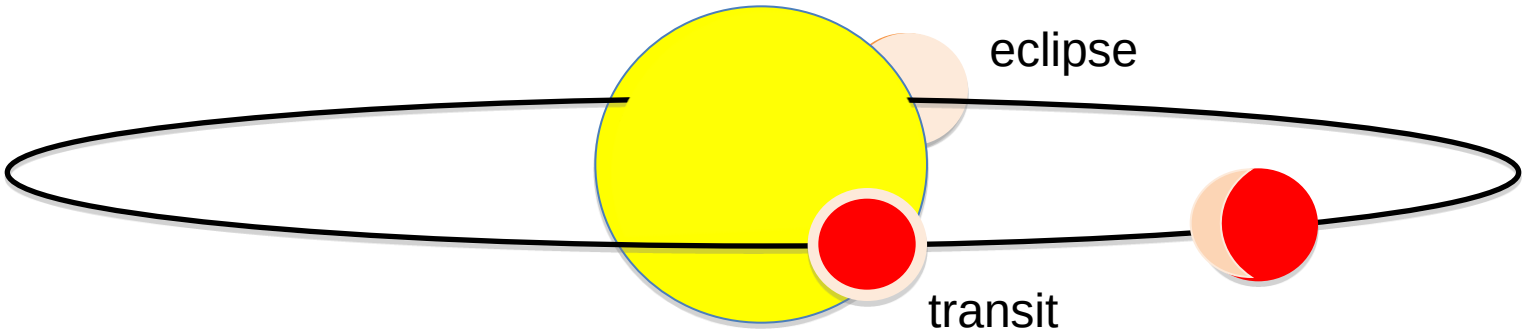
Exoplanet group:

PhD Students	Primary Subject
Ernst de Mooij	Sec. eclipses
Bas Nefs	WTS
??? [funded]	Omegatrans
Simon Albrecht	→ MIT Boston

Leiden Observatory, Leiden University

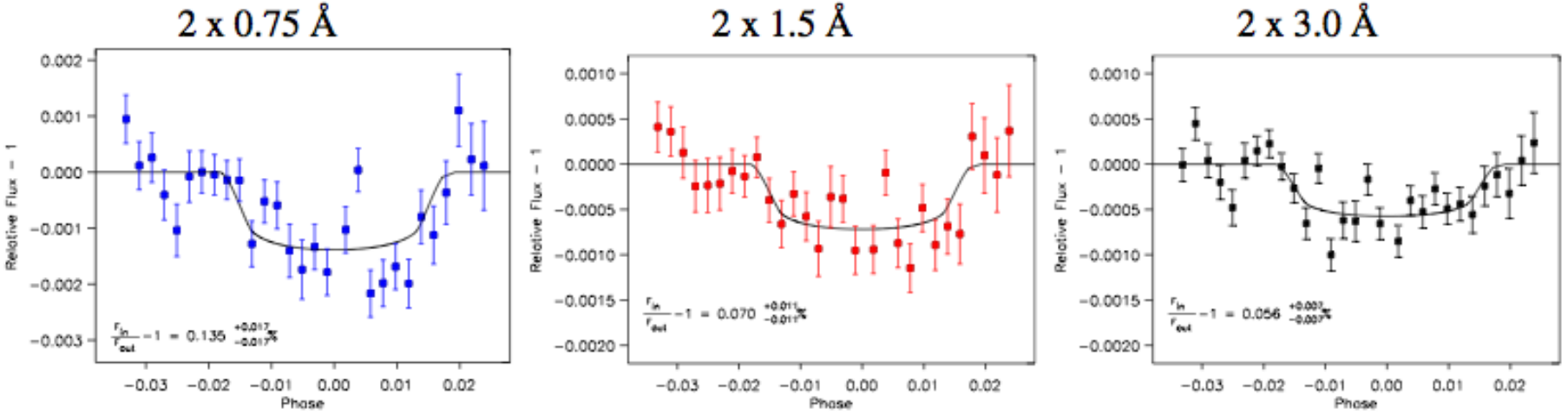
Access to telescopes	
4.2m William Herschel Telescope	La Palma
2.5m Isaac Newton Telescope	La Palma
European Southern Observatory	Chile

Characterisation of Hot Jupiter atmospheres

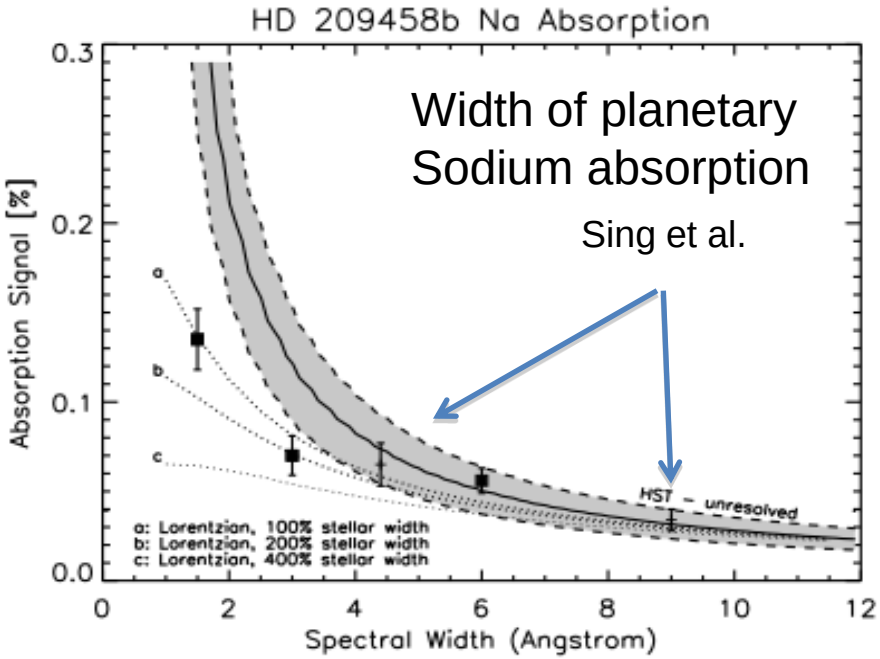


- ✧ Ground-based transmission spectroscopy
- ✧ Ground-based secondary eclipse photometry
- ✧ Optical light-curve of CoRoT-1b (*Nature* embargo)

Results on HD209458b



Snellen et al. 2008



Width of planetary Sodium absorption

Sing et al.

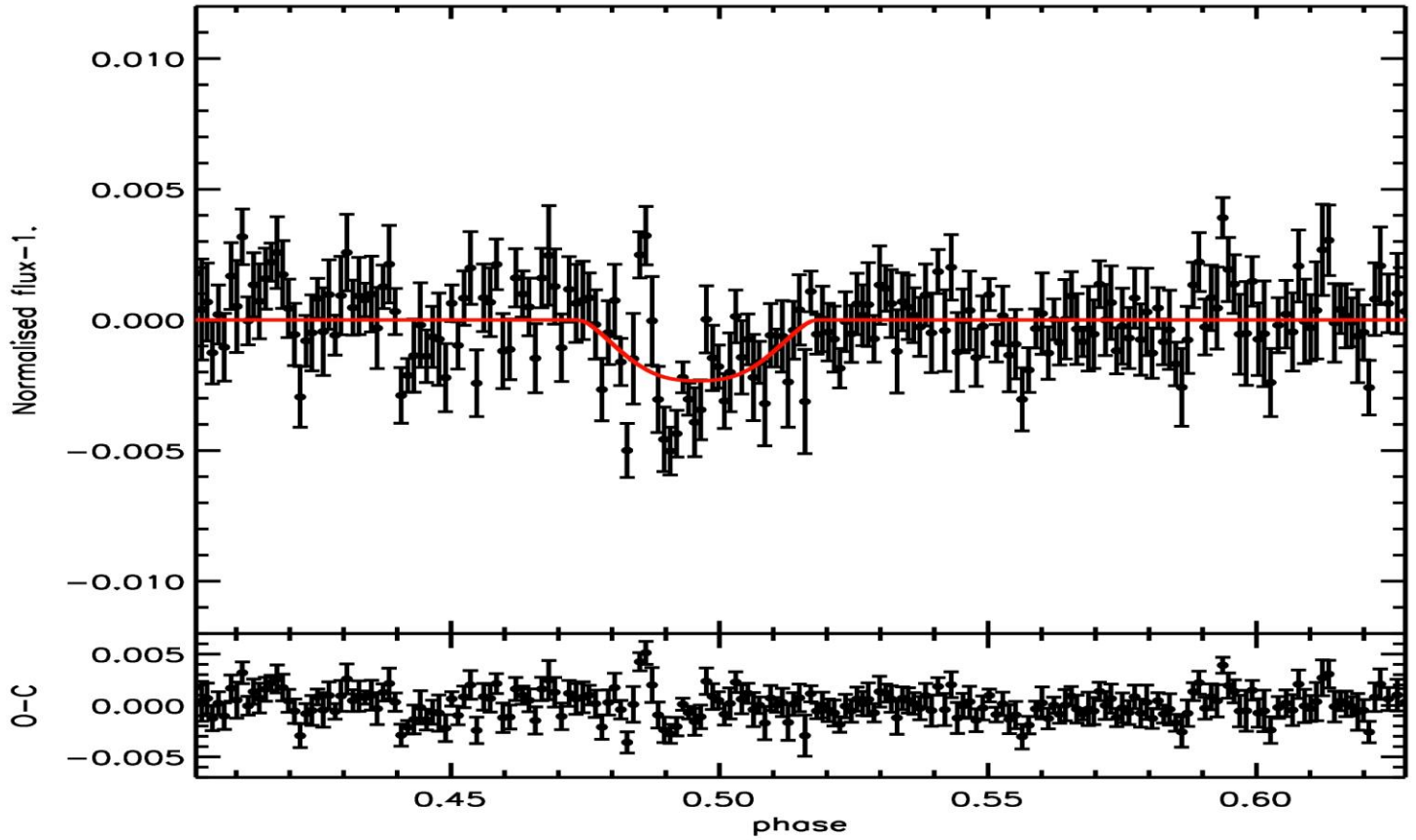
Next step: CRIRES VLT observations

Secondary eclipse photometry

✧ Challenging from the ground:

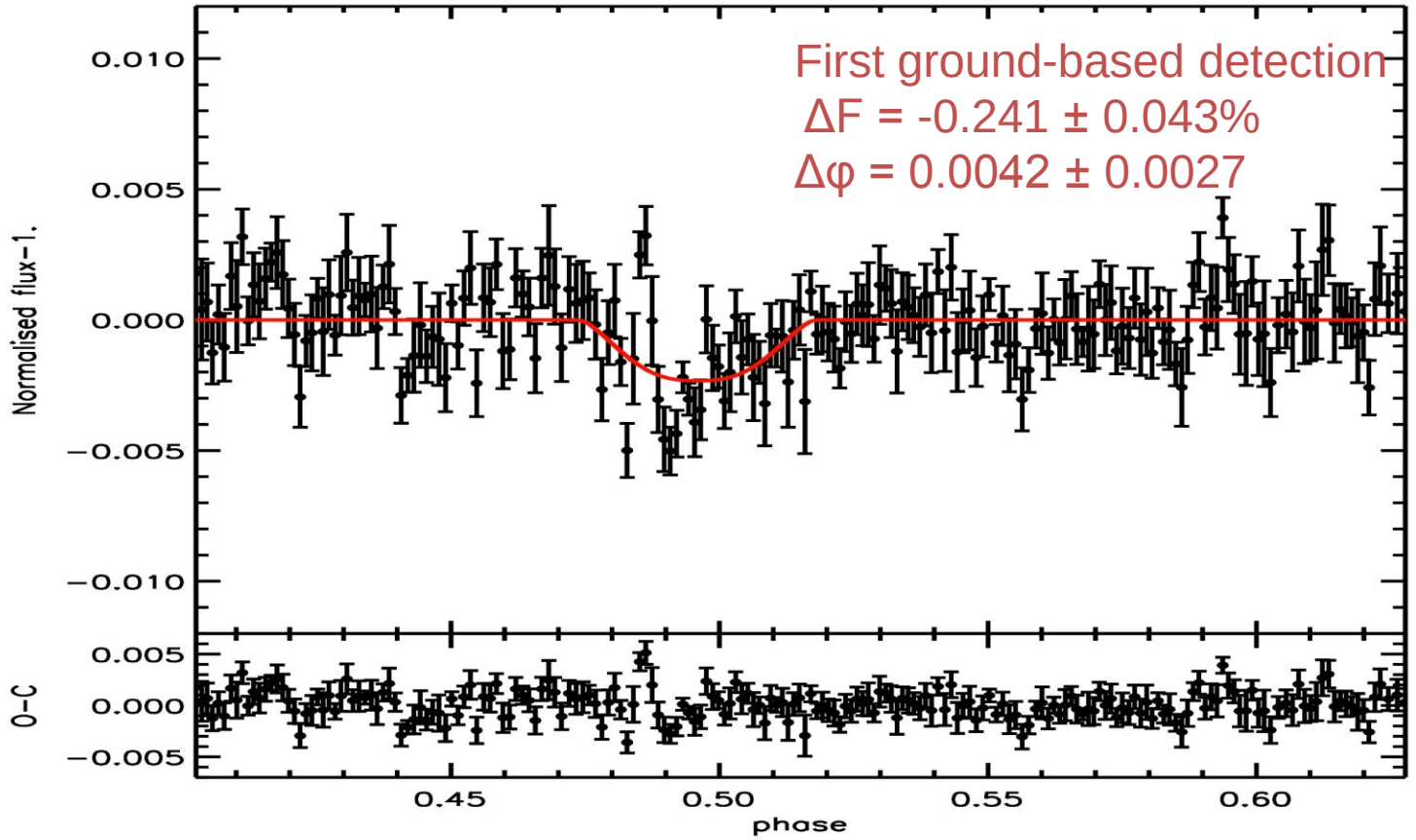
Snellen 2005 (HD209458b); Snellen & Covino (TrES-1).

✧ First success: de Mooij & Snellen 2009: TrES-3b, 2.2 μm



Secondary eclipse photometry

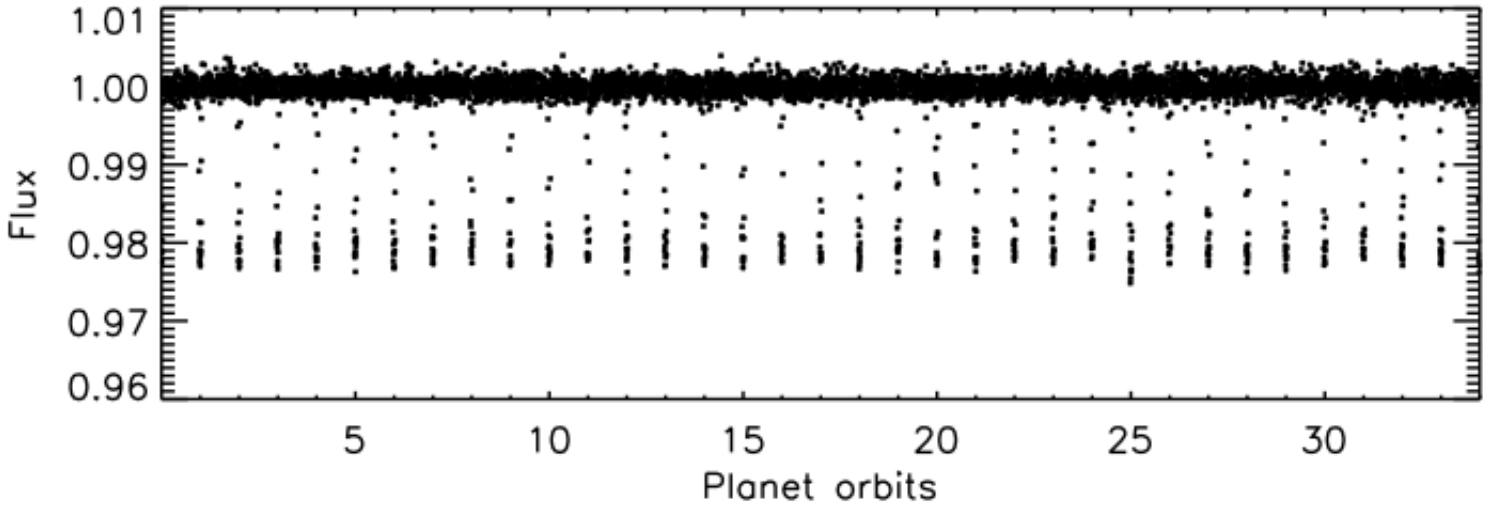
- ✧ Defocus telescope (minimize flat fielding errors, avoid high count levels)
- ✧ Randomize ditter positions (minimize ff problems)



CoRoT-1b: Optical light curve arXiv: 0904:1208

The changing phases of extrasolar planet CoRoT-1b
(Snellen, de Mooij, Albrecht; *Nature* embargo)

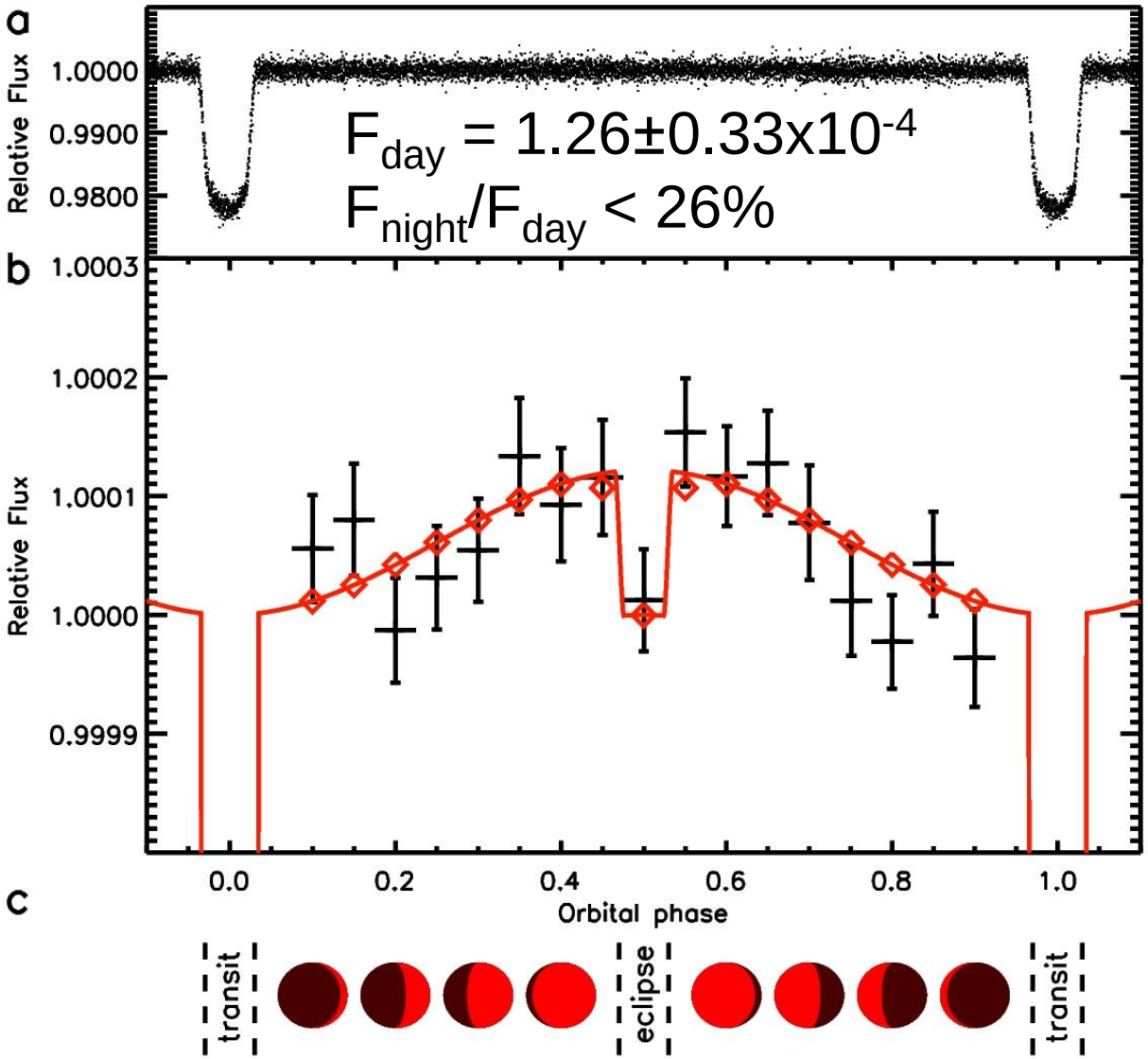
- ✧ Publicly available CoRoT data (red channel)
- ✧ 55 days of data – 36 planetary orbits
- ✧ Remove perturbations on time scales of
  - satellite orbital period (103 min)
  - 24 hour day.



Optical light curve

Nature embargo

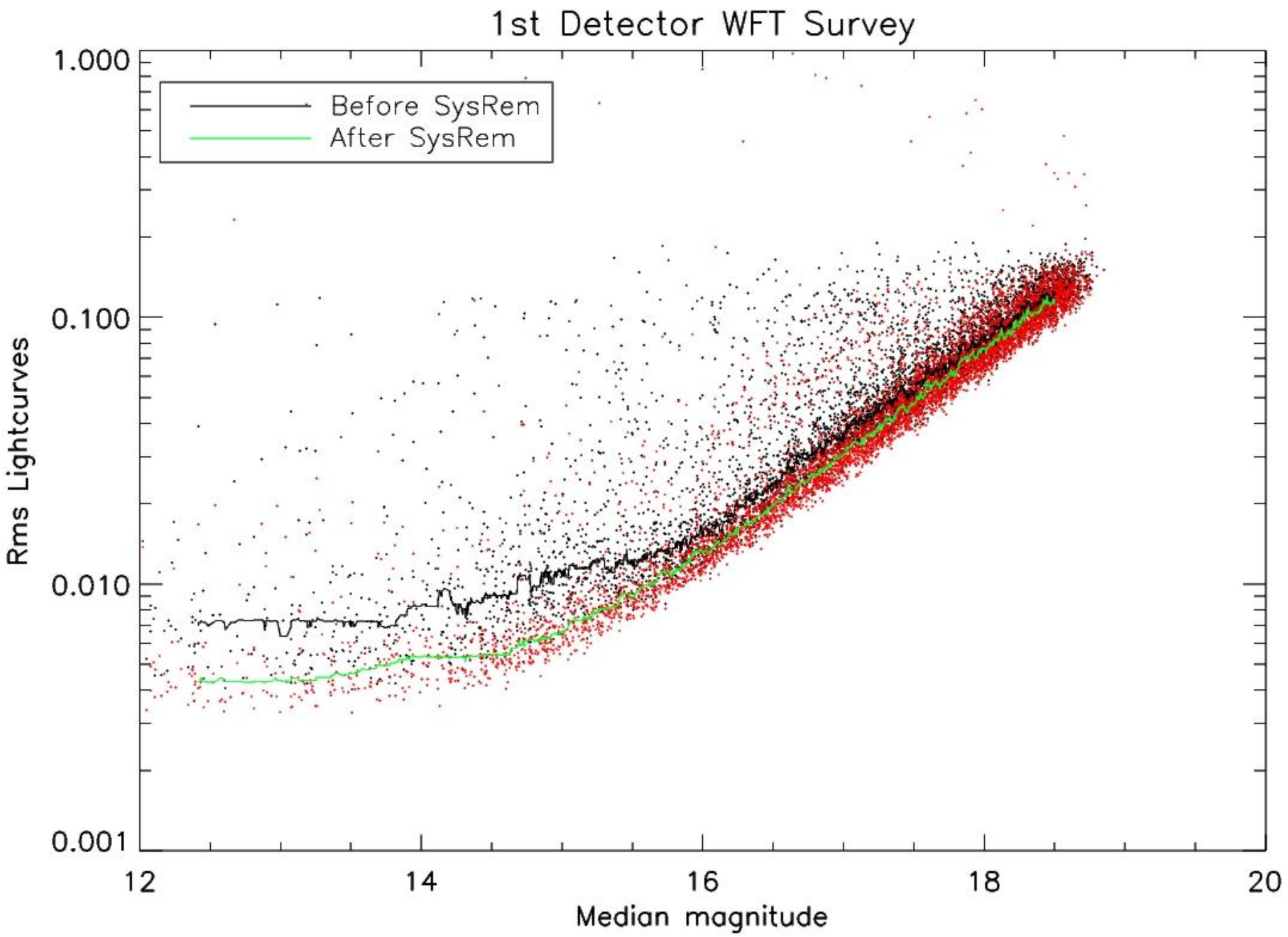
arXiv: 0904:1208



PhD student – Bas Befs

start April 1st 2009

- ✧ Analysis and follow-up of WTS survey
  - INT run July'09 : UBV photometry, transit follow-up of candidates] probably also Dec'09
  - analysis of light curves: sysrem, box-fitting, m-dwarfs


1st Detector WFT Survey
Before SysRem
After SysRem
1.000
0.100
0.010
0.001
Rms Lightcurves
12
14
16
18
20
Median magnitude

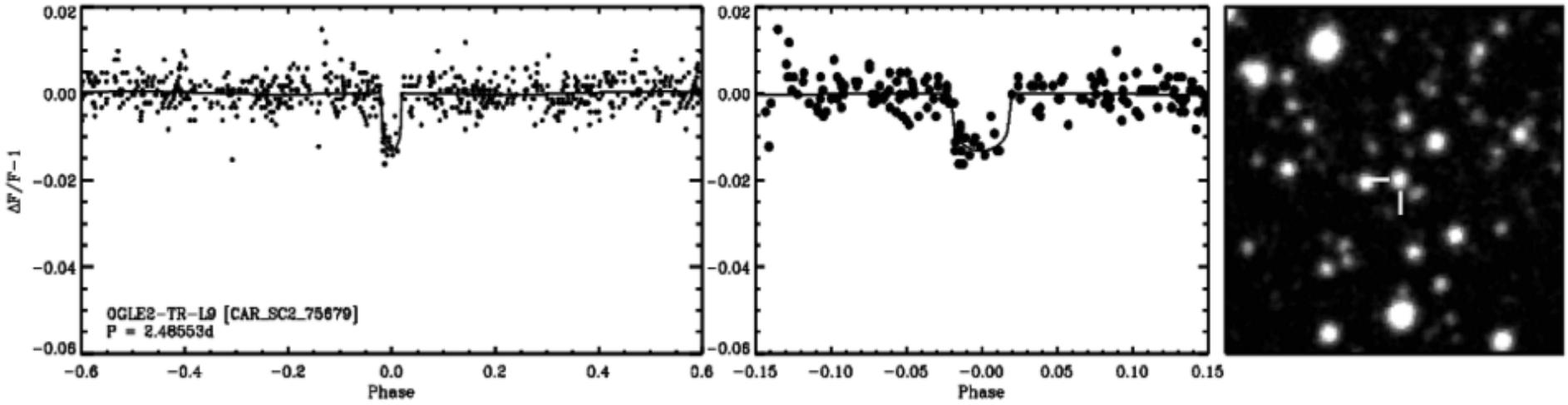
New PhD student → Omegatrans

- Survey starts early 2010(??)
- German/Dutch/Italian collaboration
- 25 days of GO observing time (per year)
- Process of field selection

The case of OGLE2-TR-L9:

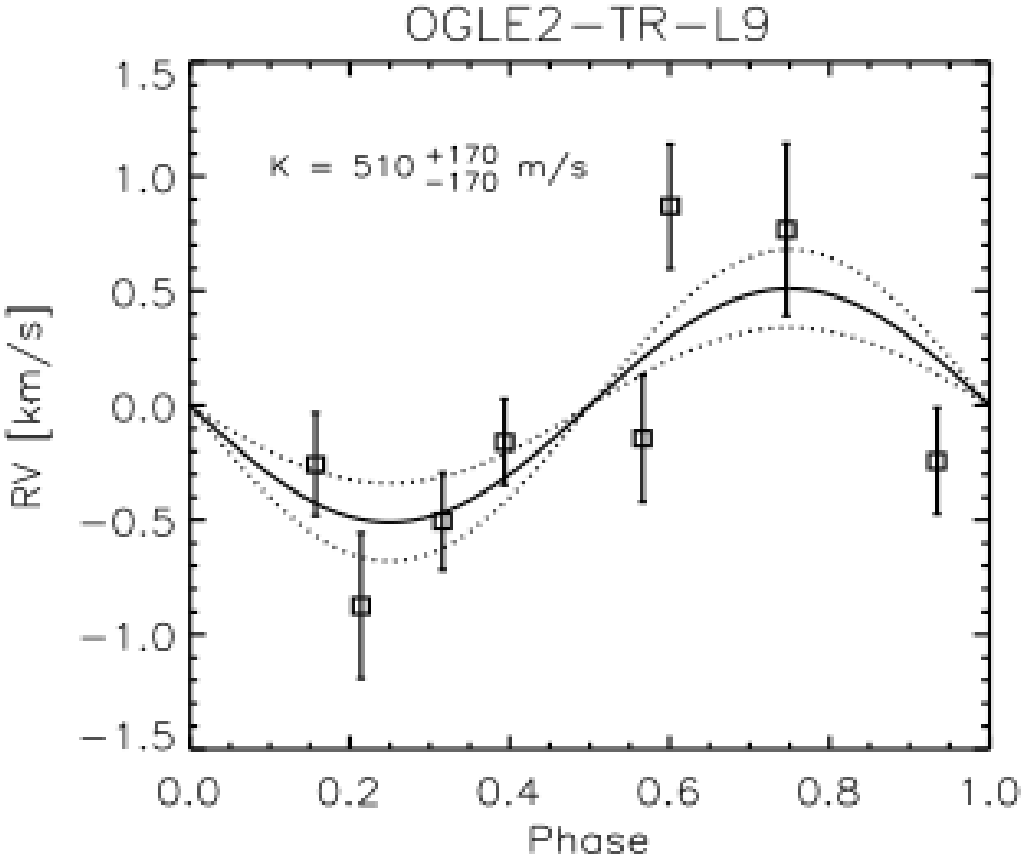
The first transiting exoplanet found around a hot and fast rotating F3 star

- ✧ Bachelor student project aimed to develop detrending and search algorithms for transiting planets
- ✧ They found a very promising candidate in one of the old OGLE2 fields (microlensing fields): m_I=14.0



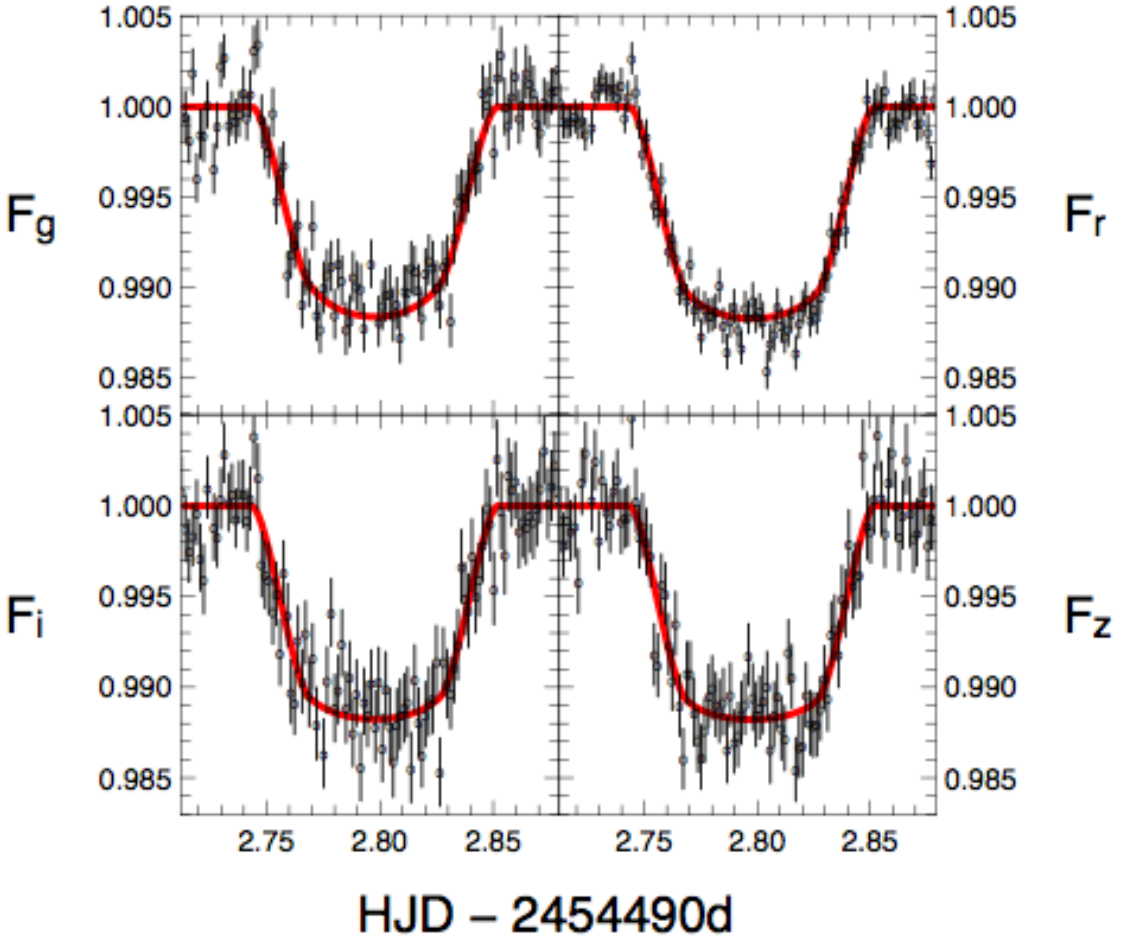
The case of OGLE2-TR-L9:

- ✧ Follow-up with UVES (Flames) @ VLT
  Rapidly-rotating (vsini=39 km/s) F3 star - T=6930 K
  3-sigma detection of the RV-wobble → M_p=4.5±1.5



The case of OGLE2-TR-L9:

✧ Can we rule out a blend? → yes, from multicolor photometry with GROND @ ESO2.2m (Johannes)



The case of OGLE2-TR-L9:

- ✧ Excellent agreement between colors → If blended eclipsing binary → primary must have the same colour (temperature as the I=14 star)
- ✧ Transit shape (→ mean stellar density) and spectral classification in excellent agreement → if blends – both stars should be F3 type.
- ✧ <u>Assume a large fraction of the light is from unrelated F star, the mean stellar density to fit the transit is too high for the eclipsed star to be F.</u>