Near-IR Transmission Spectroscopy and Photometry of GJ1214b

Observing Planetary Systems II
Santiago de Chile, March 7, 2012

Our team

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Outline

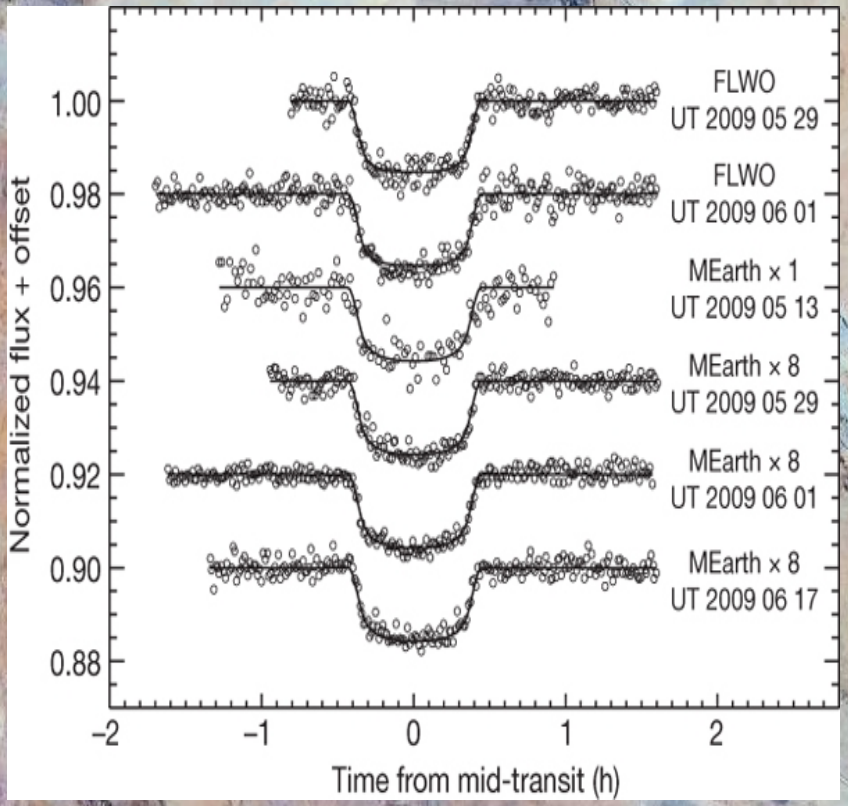
- Super-Earth Gj1214b
- Previous Work
- Oour Observations and Analysis
- Summary

Discovery of the GJ1214b

MEarth Project

Charbonneau et al., 2009, Nature 462, 891

Discovery of the GJ1214b



Host: M4.5V, V=14.7,
K=8.8, D=13 pc

P = 1.58 days

M = 0.02 (± 0.0027) Mj
= 6.55 Me

R = 0.245 (± 0.0054) Rj
= 2.7 Re

T_eq = 555 K

Mysterious atmosphere?

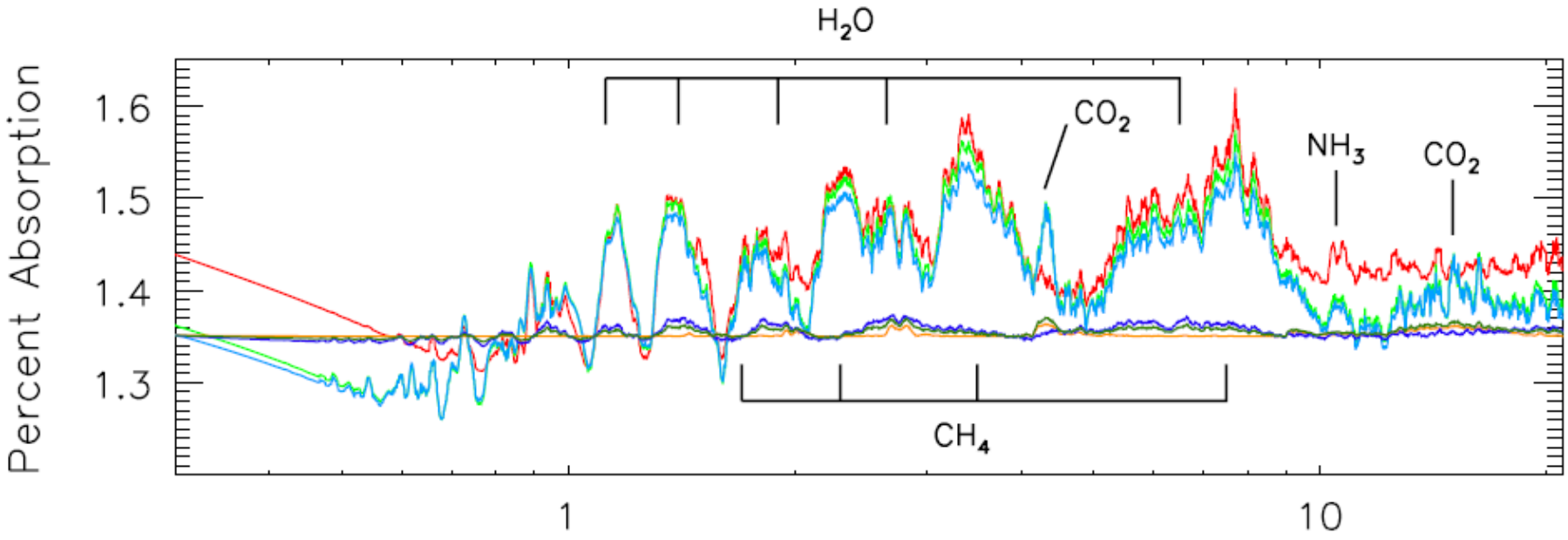
Charbonneau et al., 2009, Nature 462, 891

Atmosphere of GJ1214b

H/He atmosphere

H2O

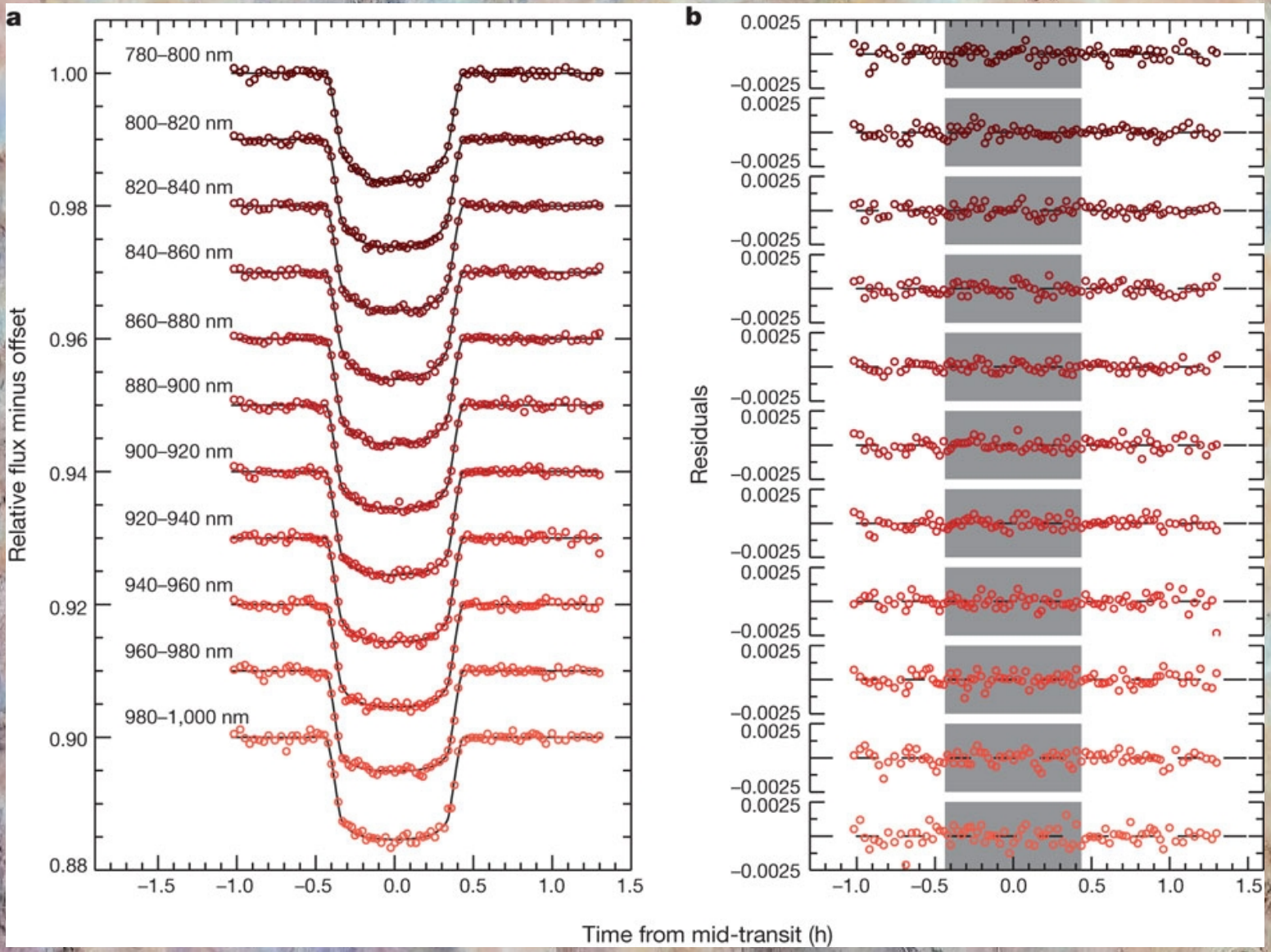
H/He/H2O



Miller-Ricci & Fortney, 2010, ApJ

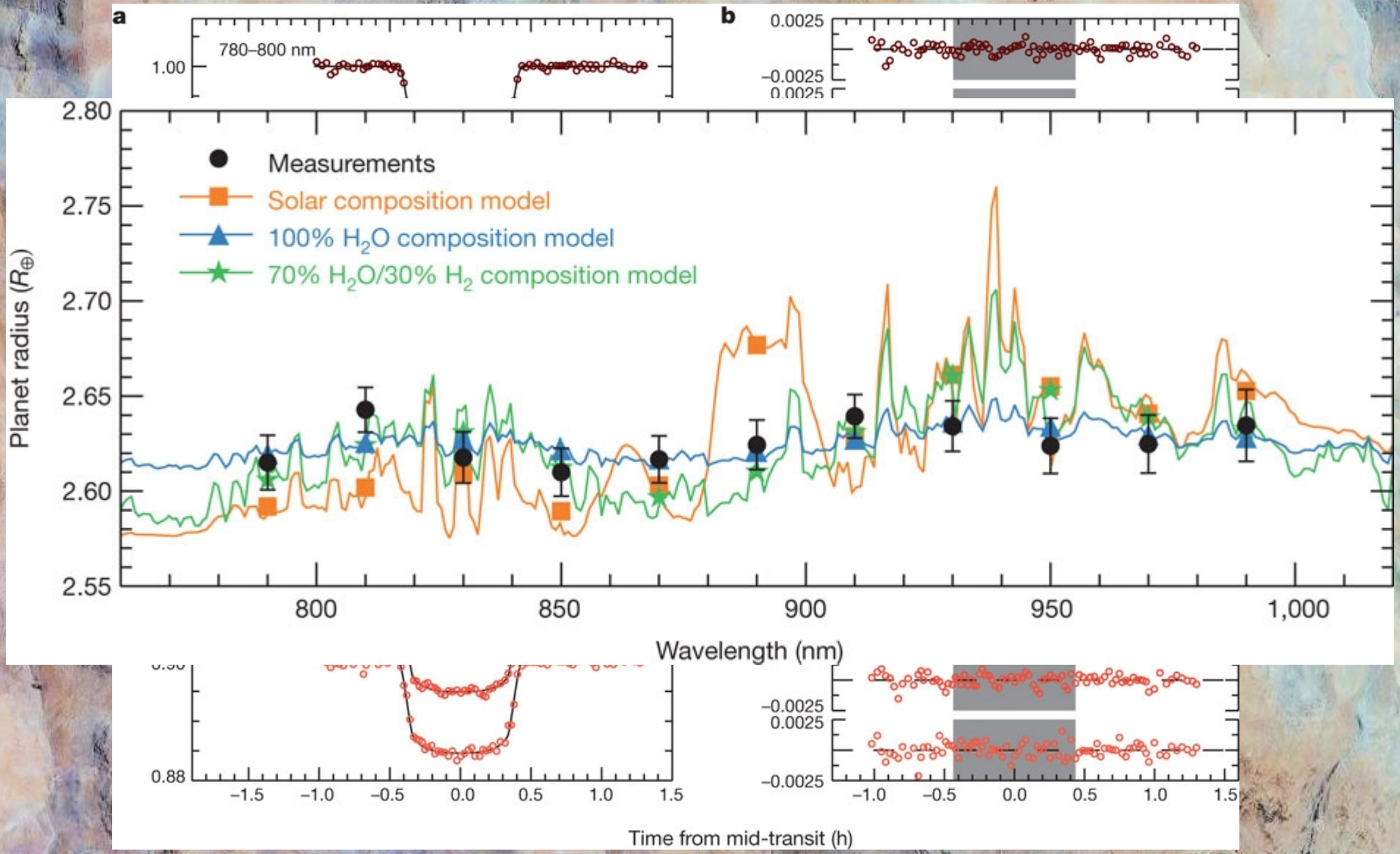
Previous Work

Previous Work



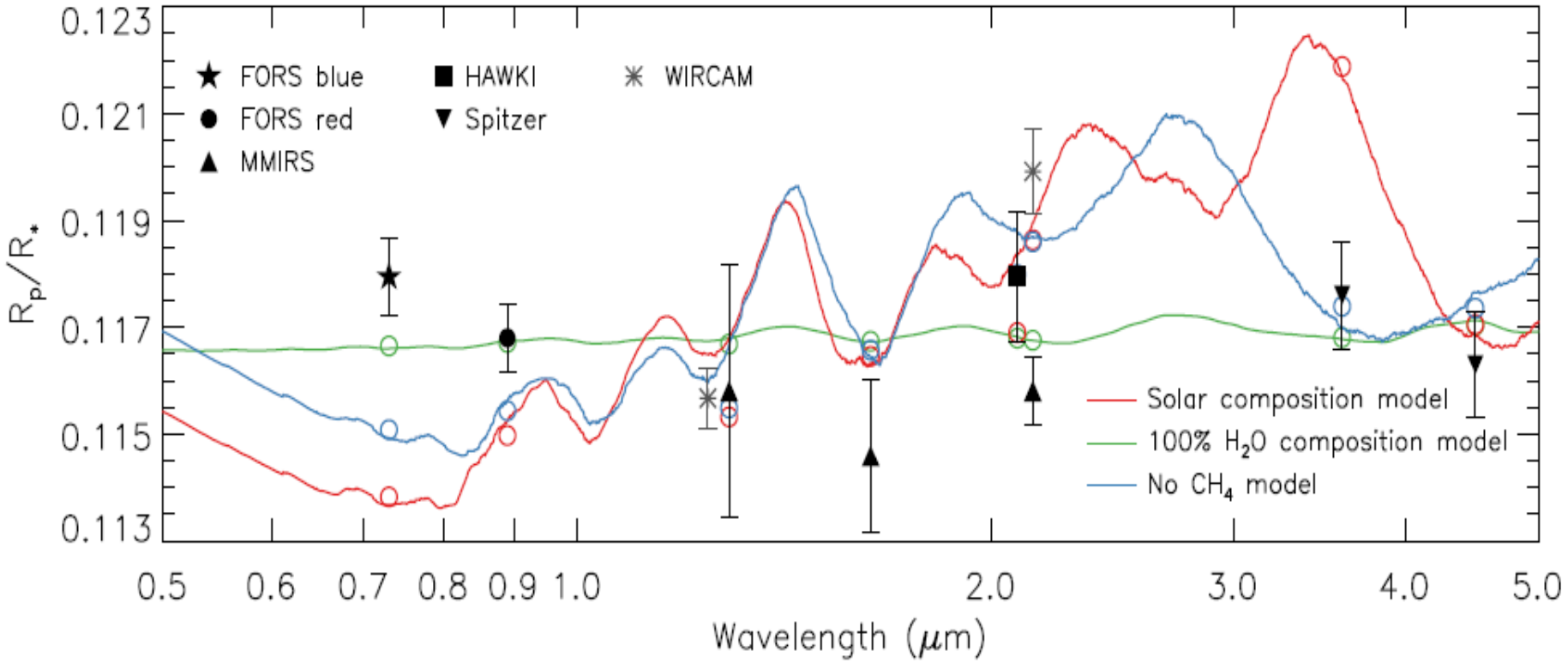
Bean et al. 2010, Nature

Previous Work



Bean et al. 2010, Nature

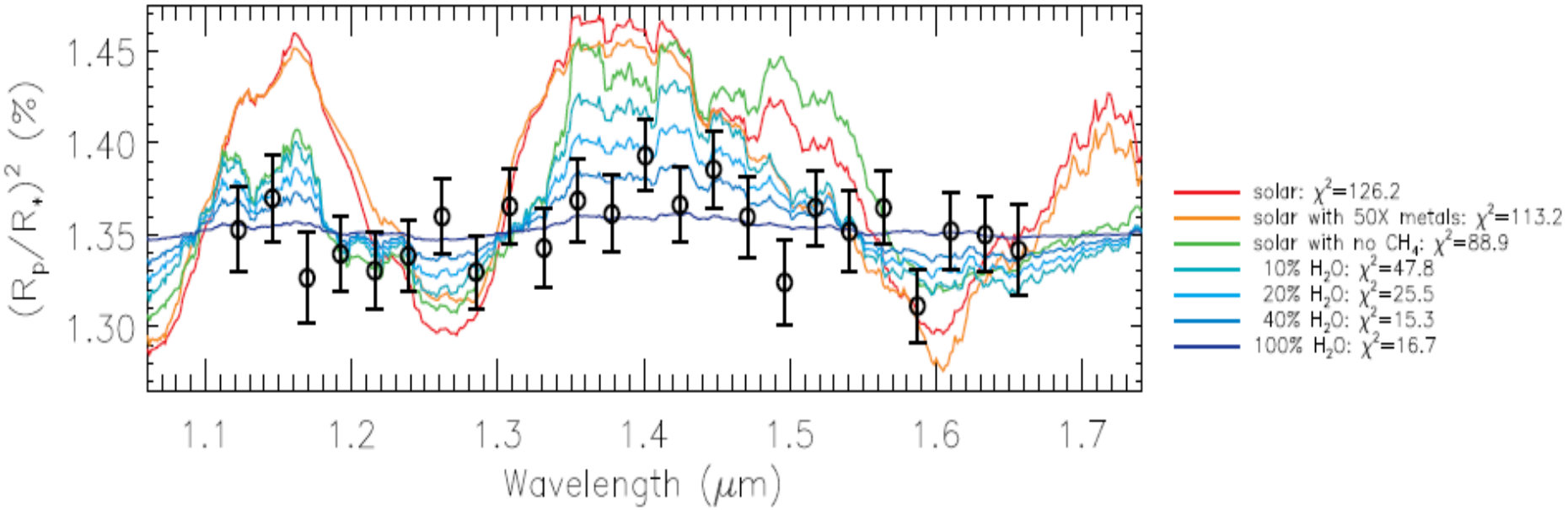
Previous Wrok



Bean, Desert, Kabath et al. 2011, ApJ

Previous Work

- Berta et al. 2012



Our Observations

Our observations

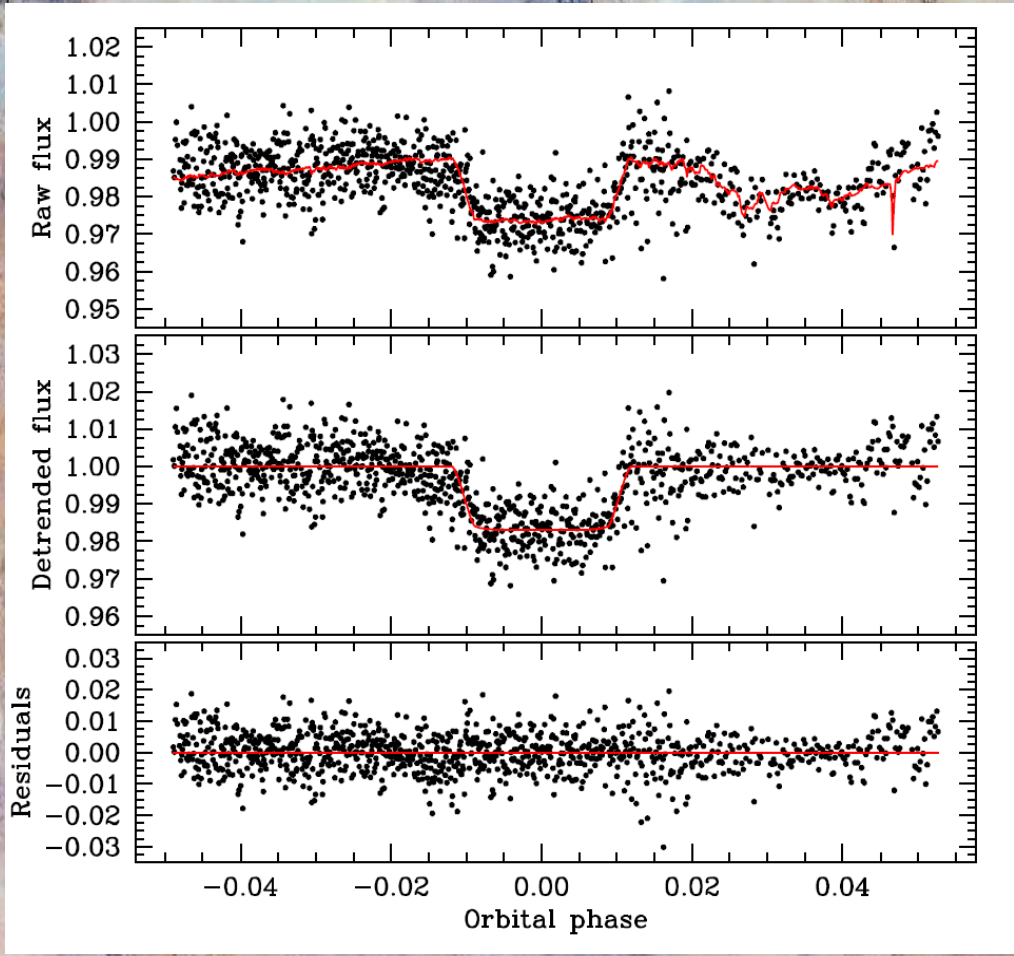
- SOFI @ NTT on La Silla: 3n
- OSIRIS+SOA @ SOAR on Cerro Pachon: 1+1n

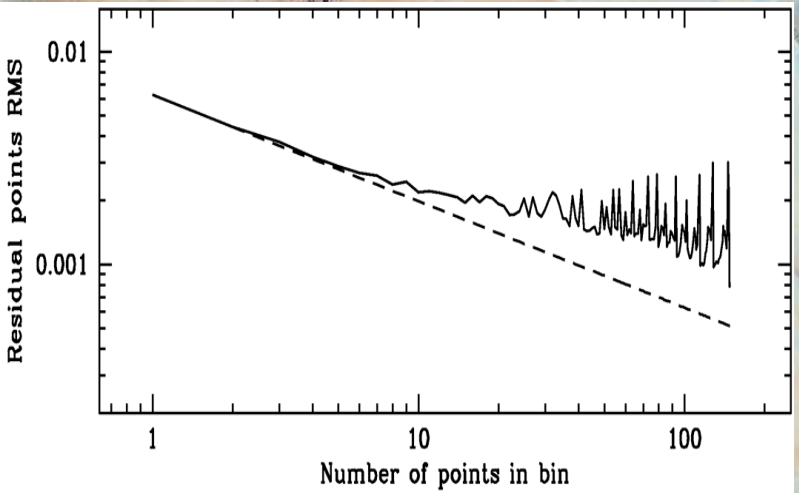
Both telescopes are 4-m class!!!

NTT

SOAR

Ks-band Near-IR Imaging



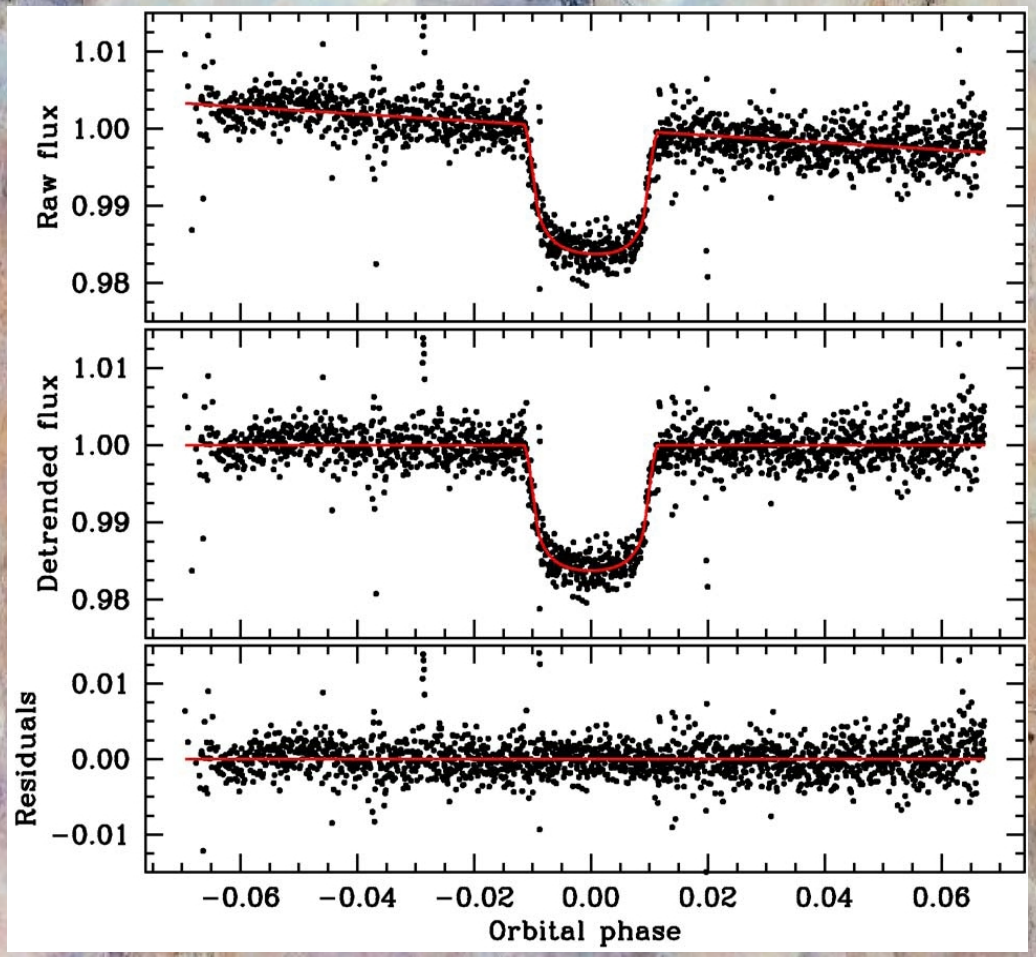


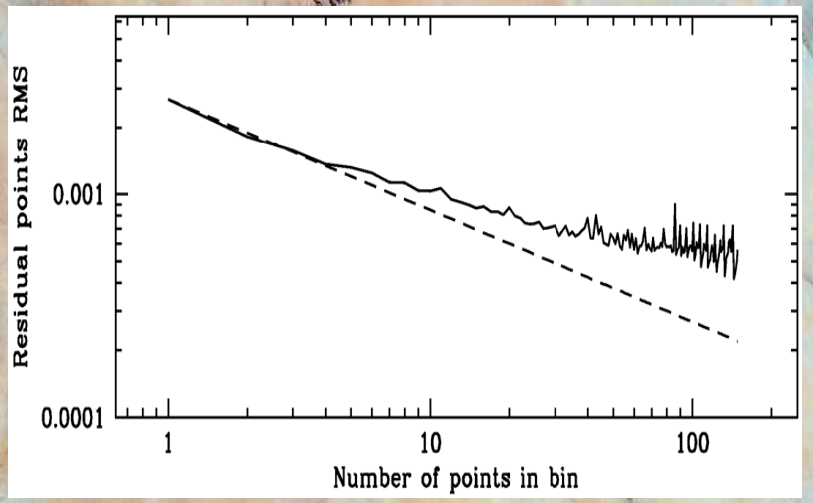
Rp/Rs = 0.118101
(+0.002562/-0.002766)

Caceres et al. 2012, in prep.

MCMC code by M. Gillon and C. Caceres
(e.g. Gillon et al. 2012; Caceres et al. 2011)

I_BESSEL Optical Imaging



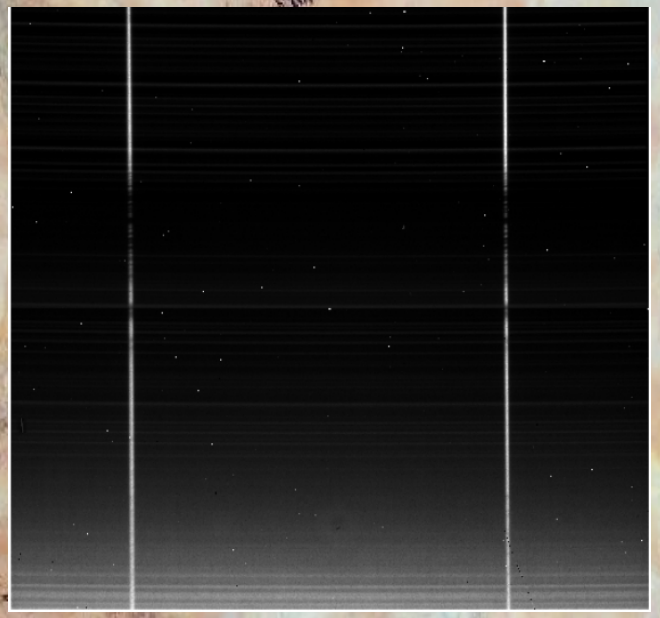


Rp/Rs = 0.117151
(+0.001182/-0.001173)

Hoyer et al. 2012, in prep.

NIR Transmission Spectroscopy

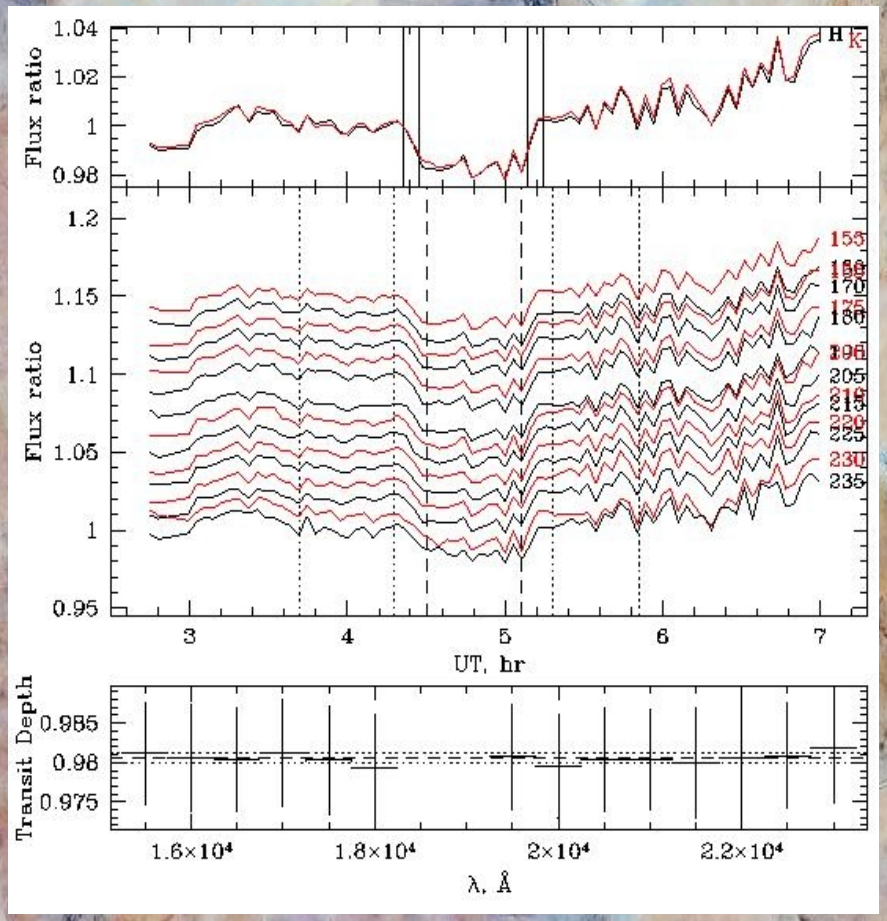
Instrument: SofI@NTT:
- Coverage: 1.5 – 2.3 micron.
- Low-res red grism (R~900).
- Slits: 0.6, 1.0, 2.0 arcsec.
- 3 transits: 17.05.2011, 13.06.2011, 9.08.2011

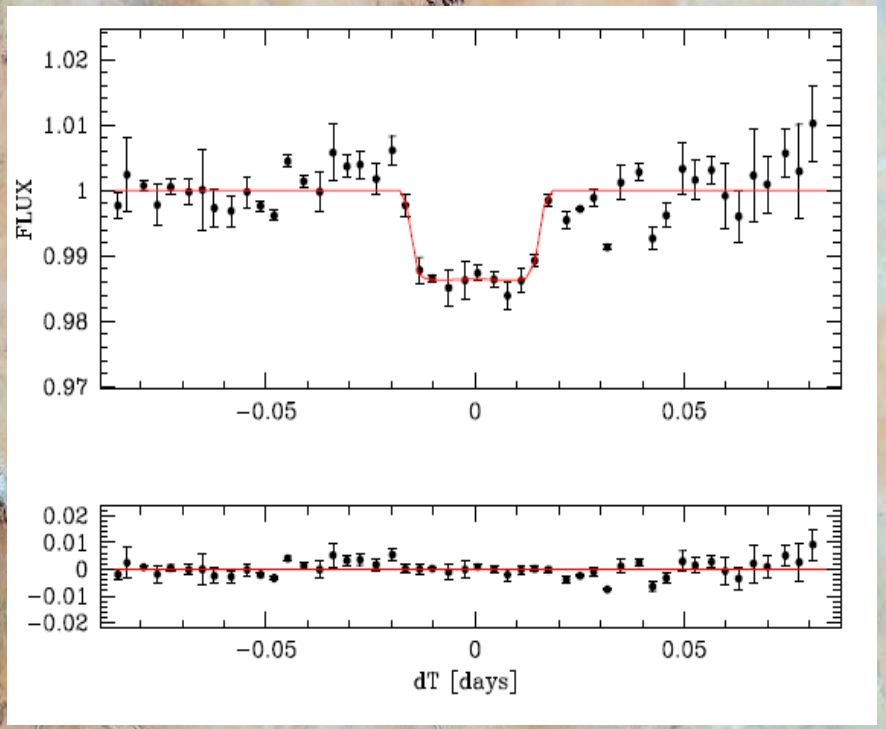


GJ1214: J=9.75, H=9.09, Ks=8.78.
Reference star: J=9.71, H=8.98, K=8.83.
Separation: 3.06 arcmin

Kabath et al. 2012, in prep.

NIR Transmission Spectroscopy





RMS = 0.008

Kabath et al. 2012, in prep.

NIR Transmission Spectroscopy

Some numbers from the LC fitting for the first two nights with better data:

- 1.7 micron (1000 Ang spectral bin):

  Rp/Rs = 0.1154885 (+0.0081278/-0.0094224)

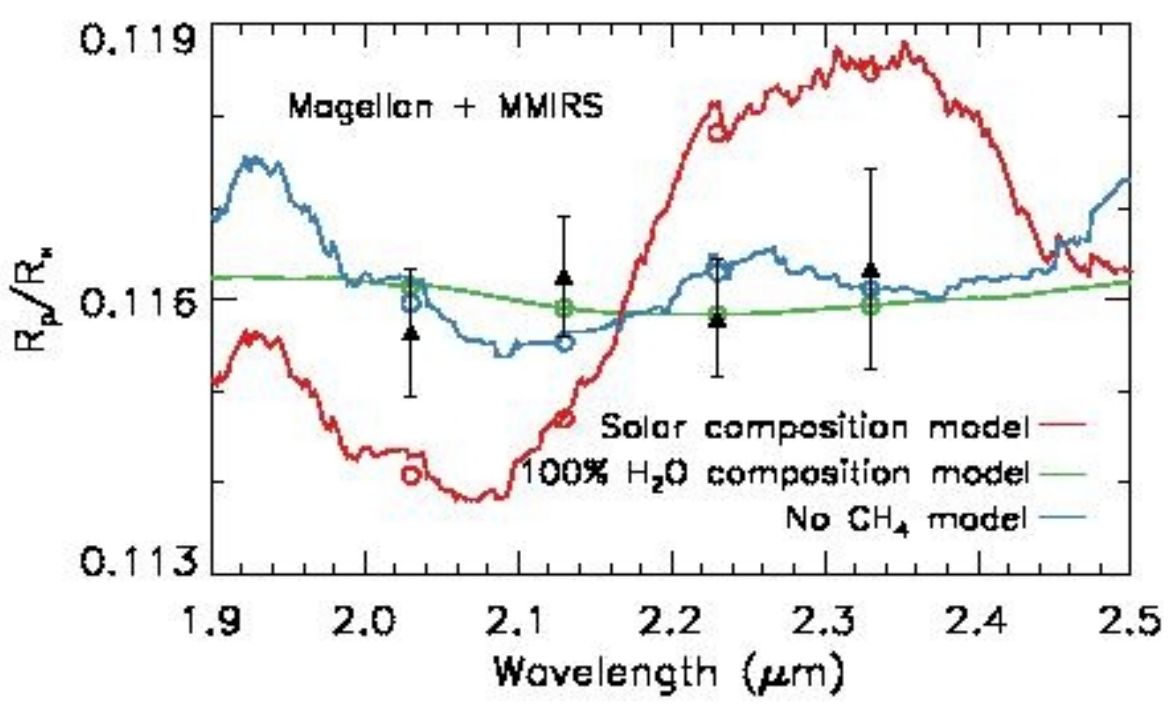
- 1.6 micron (1000 Ang spectral bin):

  Rp/Rs = 0.1149844 (+0.0070462/-0.0098685)

Kabath et al. 2012, in prep.

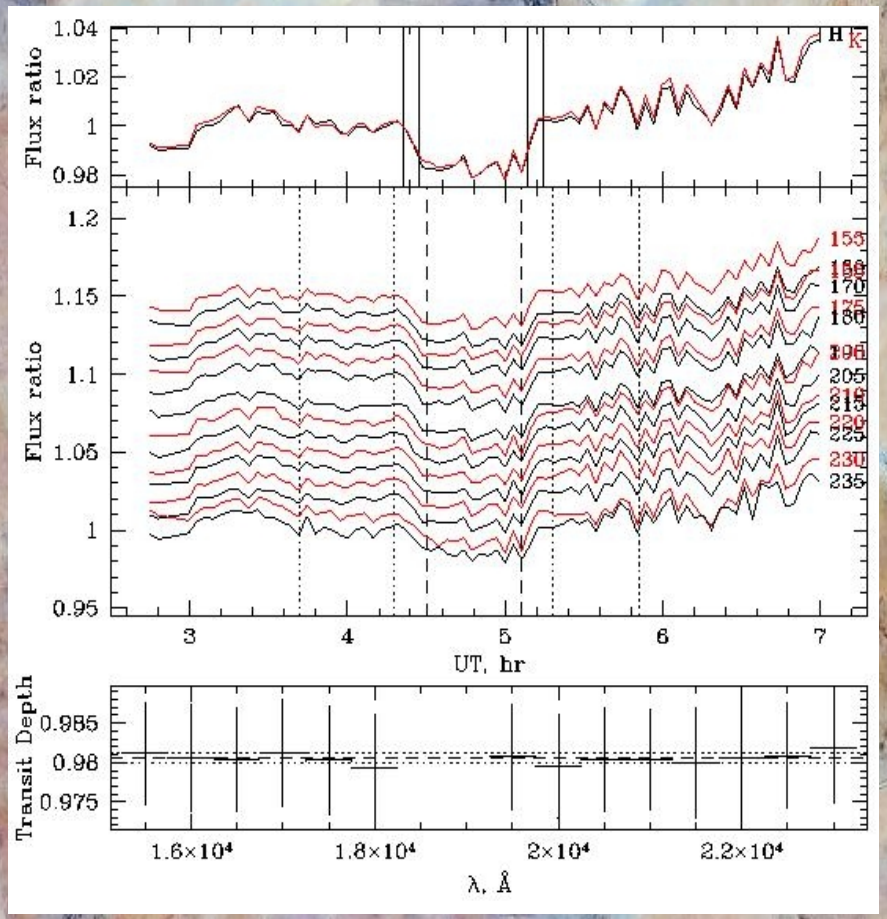
NIR Transmission Spectroscopy

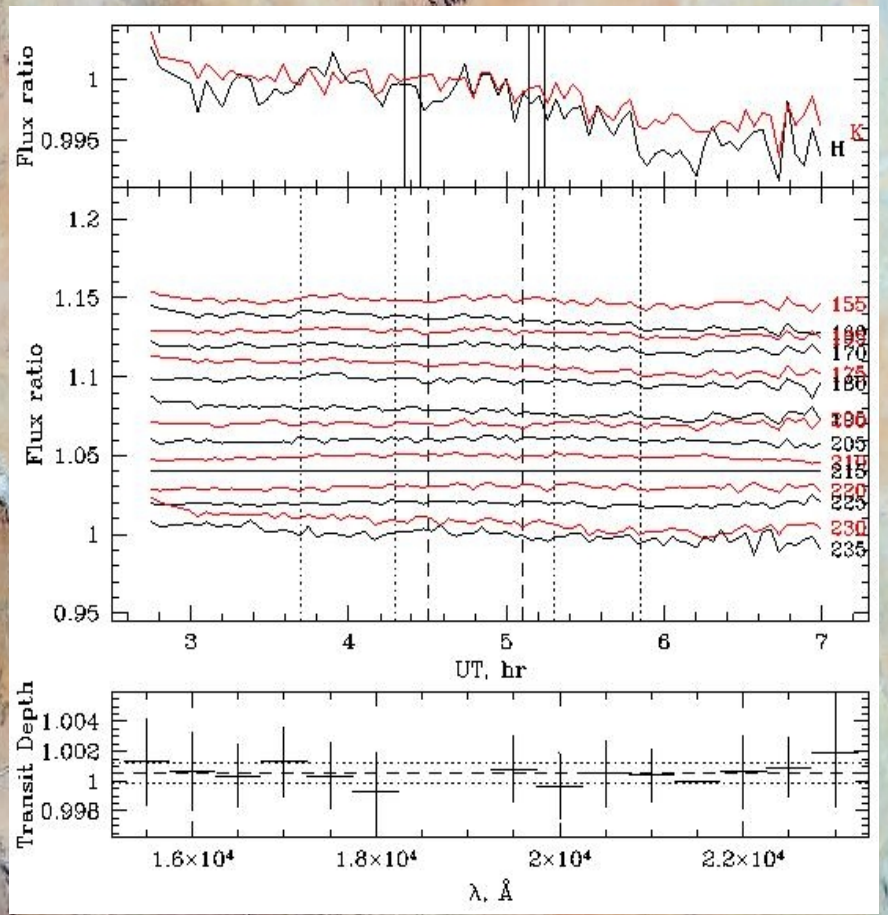
Can we improve?



Bean et al. 2011, Fig. 9.

NIR Transmission Spectroscopy

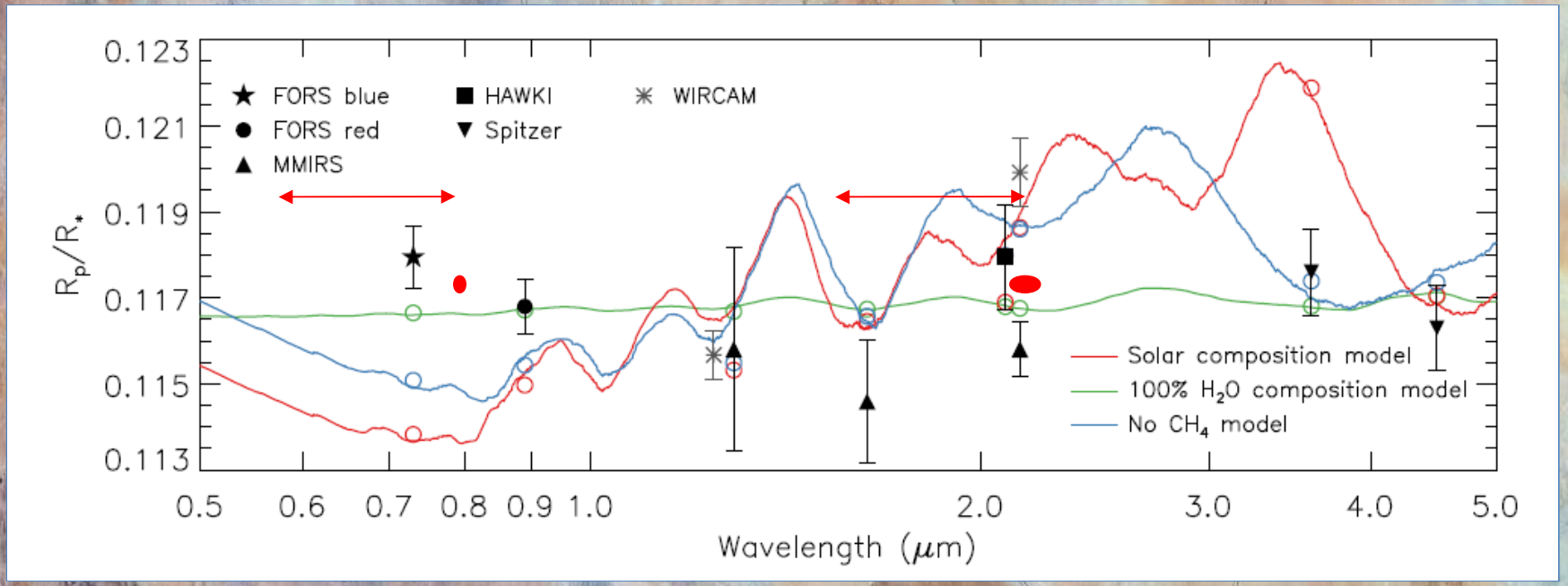




RMS = 0.0037

Kabath et al. 2012, in prep.

Current status compared with available observations



Bean, Desert, Kabath et al. 2011, accepted to ApJ: FORS2 and MMIRS (black stars, black solid dots, black triangles)

Hoyer et al. (2012), Caceres et al. (2012): SOI and OSIRIS (red solid dots)

Summary

- Our data favoring the flat spectrum, providing an independent confirmation of the work of Ben et al. and others
- Further observations are needed, i.e. KMOS
- We demonstrate potential utility of moderate (4m) class telescopes for these studies.