

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

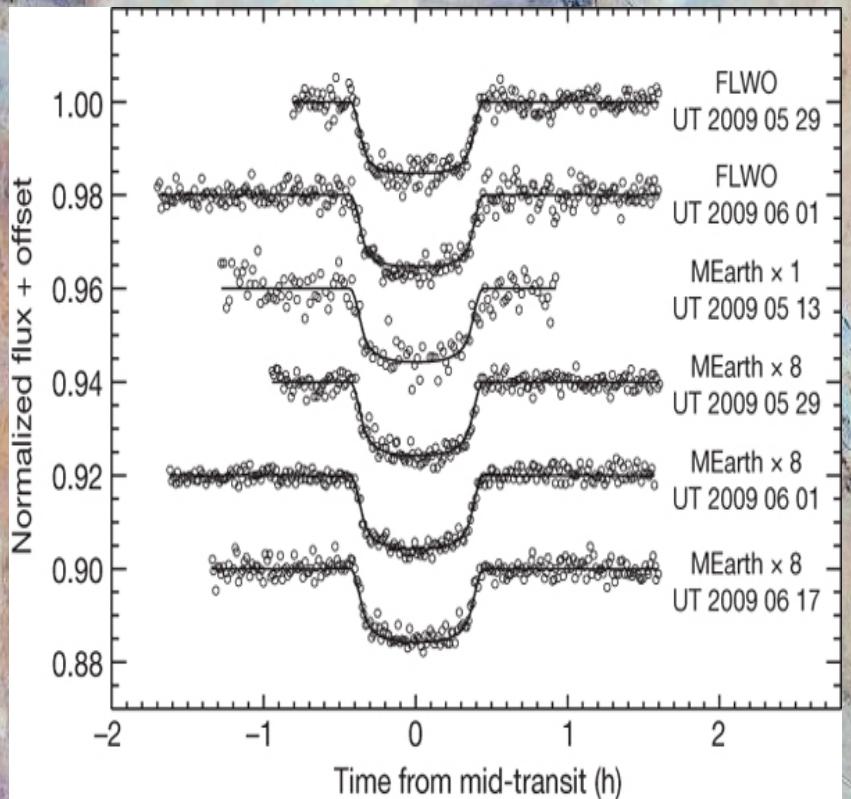
- Super-Earth Gj1214b
- Previous Work
- Our Observations and Analysis
- Summary

Discovery of the GJ1214b



MEarth
Project

Discovery of the GJ1214b



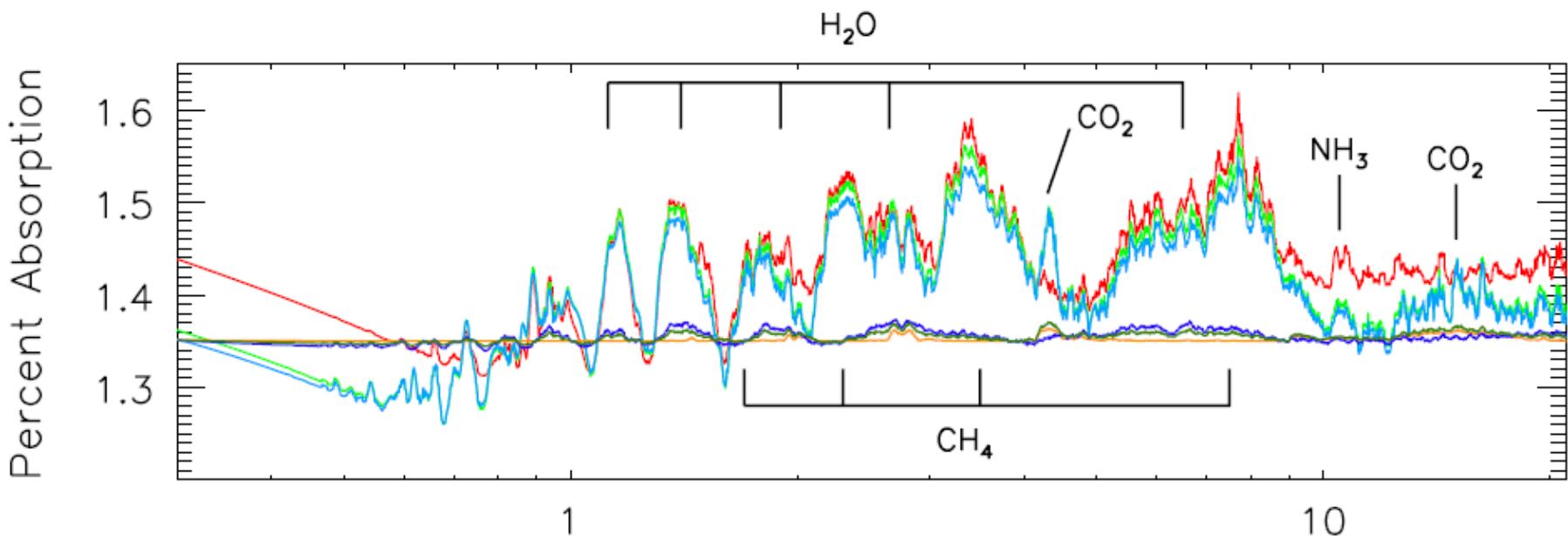
Host: M4.5V, V=14.7,
K=8.8, D=13 pc
 $P = 1.58$ days
 $M = 0.02 (\pm 0.0027) M_J$
= 6.55 Me
 $R = 0.245 (\pm 0.0054) R_J$
= 2.7 Re
 $T_{eq} = 555$ K
Mysterious atmosphere?

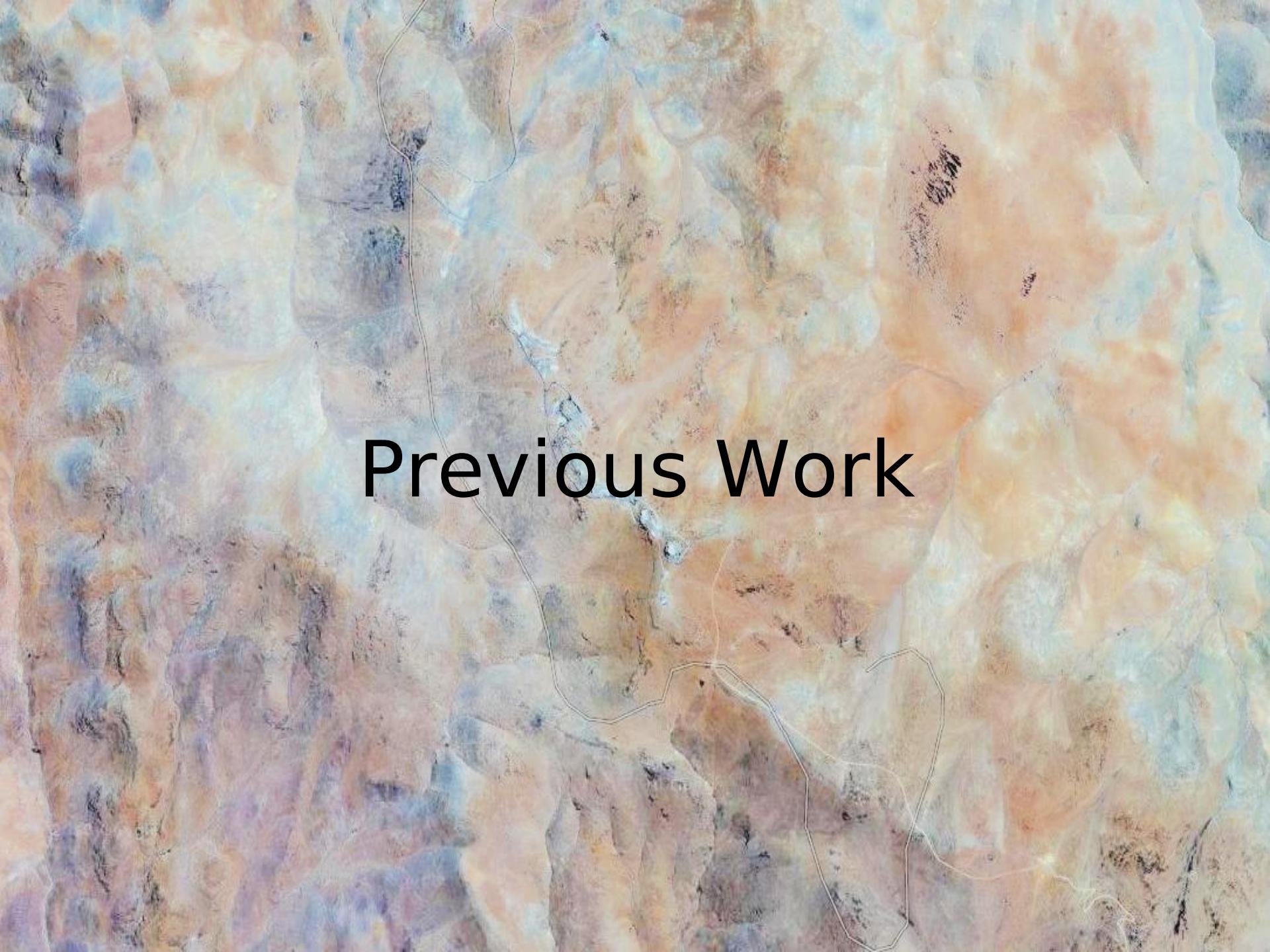
Atmosphere of GJ1214b

H/He atmosphere

H₂O

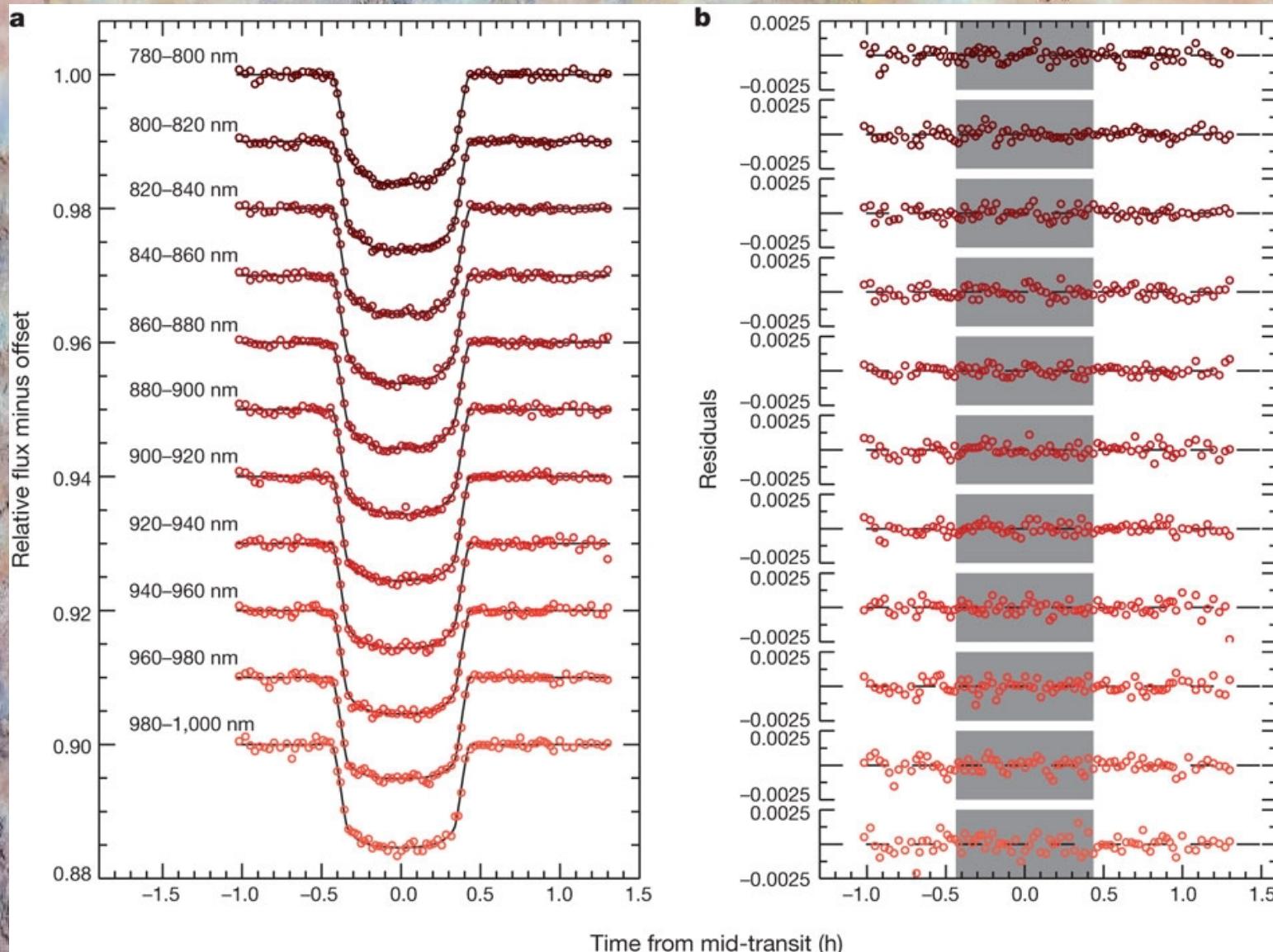
H/He/H₂O



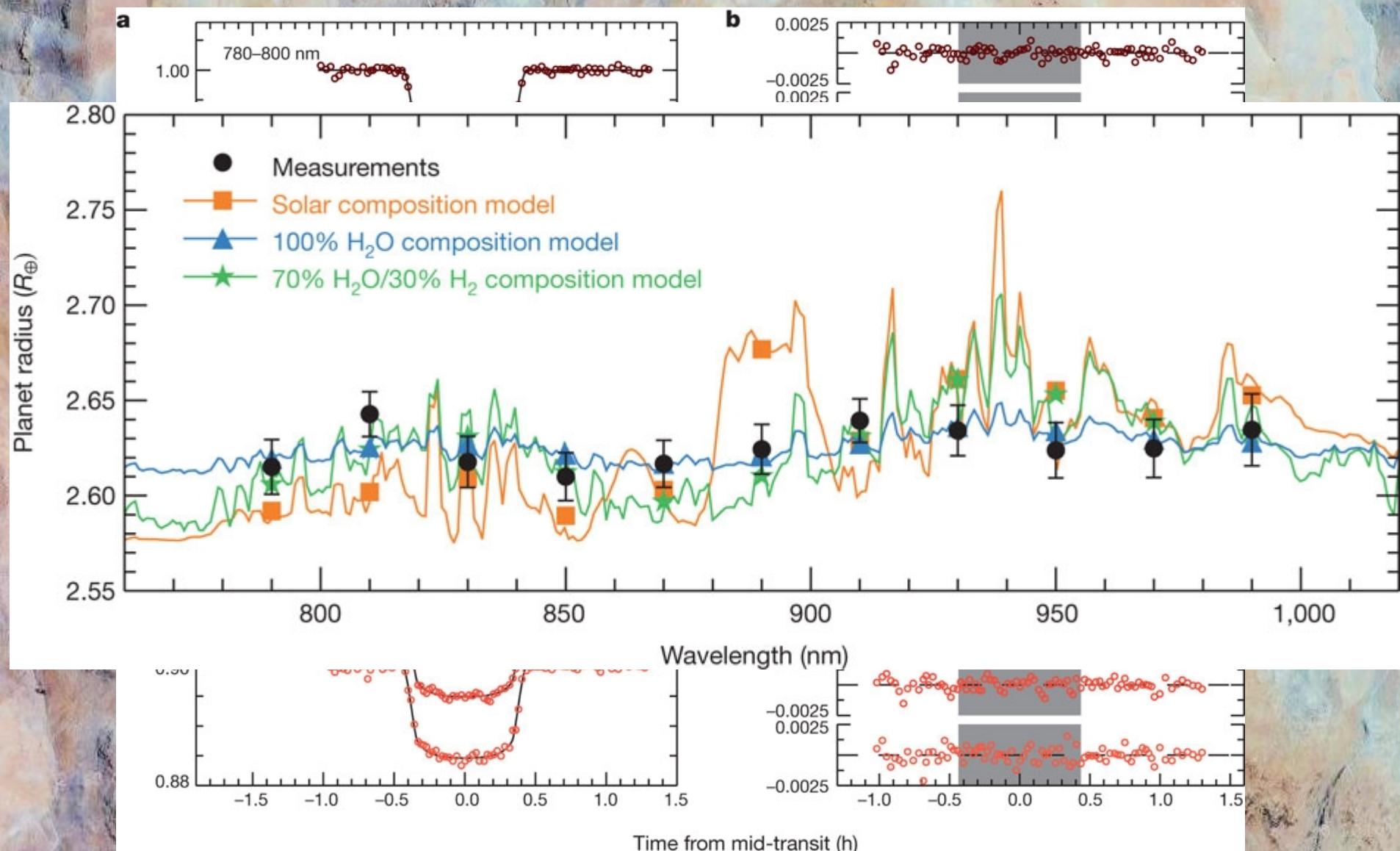
The background image is a high-resolution aerial photograph of a desert or semi-arid region. The terrain is characterized by a rich palette of earthy tones, ranging from deep reds and browns to lighter yellows and tans. Sparse, dark green vegetation is scattered across the landscape, particularly along the edges of dry riverbeds and in small, isolated patches. A network of thin, light-colored lines, likely representing roads or survey boundaries, cuts through the terrain. One prominent road follows a winding path from the top left towards the center. Another set of lines forms a roughly rectangular shape in the lower right quadrant. The overall texture is rugged and uneven, with numerous small hills and depressions visible.

Previous Work

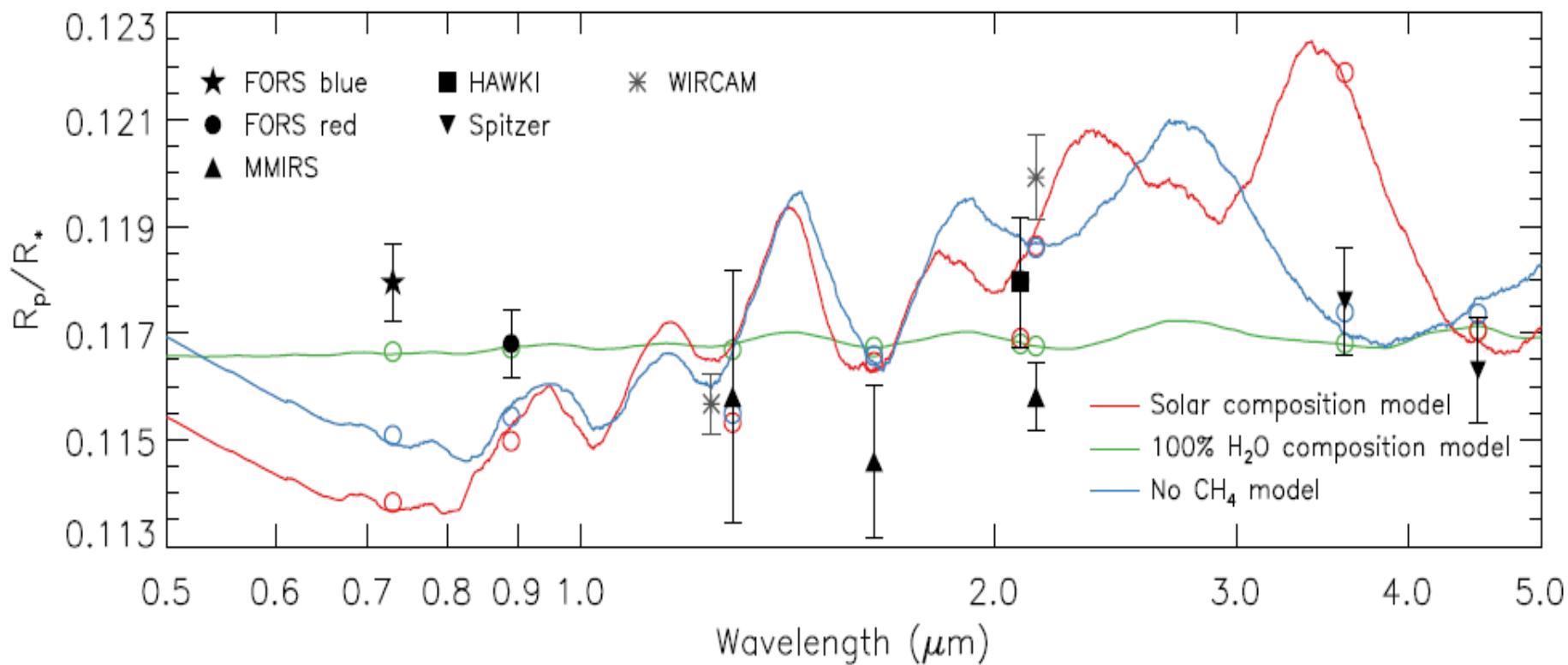
Previous Work



Previous Work



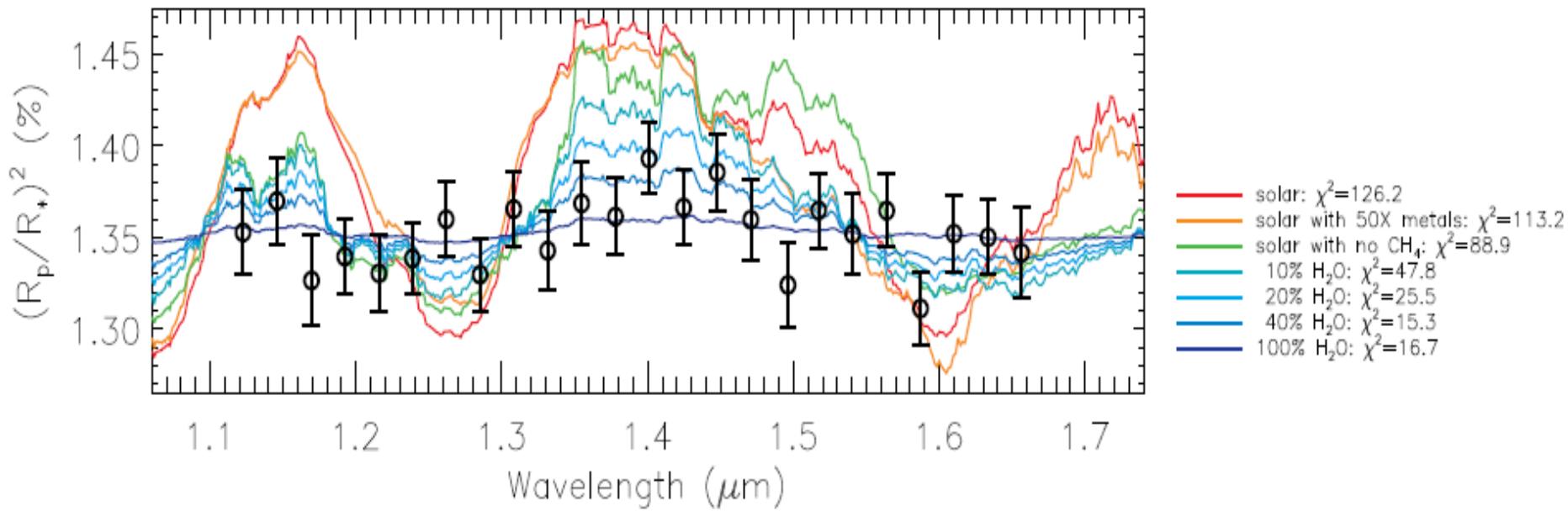
Previous Work



Bean, Desert, Kabath et al. 2011, ApJ

Previous Work

- Berta et al. 2012



The background image is a satellite or aerial photograph of a desert region. The terrain is characterized by reddish-brown, textured ground. Several dry, light-colored riverbeds or washes cut through the landscape. A single, thin, dark line, likely a road, winds its way across the center of the image. In the lower right quadrant, there is a more concentrated area of darker vegetation or possibly a small oasis.

Our Observations

Our observations

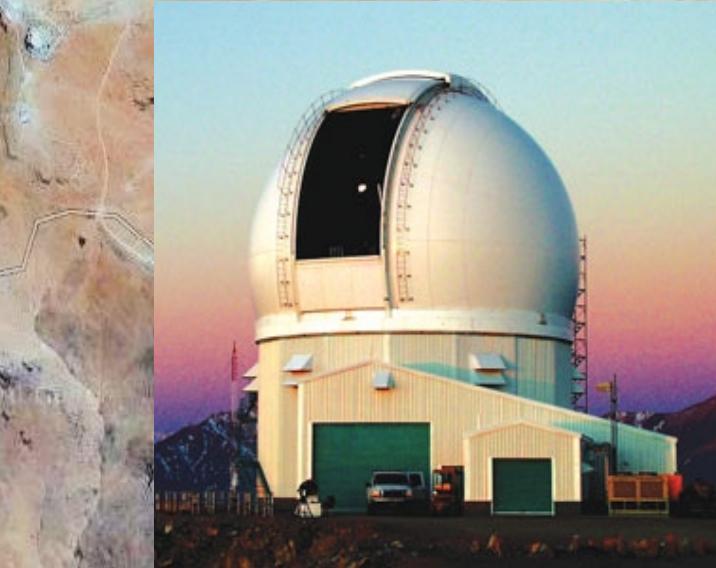
- SOFI @ NTT on La Silla: 3n
- OSIRIS+SOA @ SOAR on Cerro Pachon: 1+1n

Both telescopes are 4-m class!!!

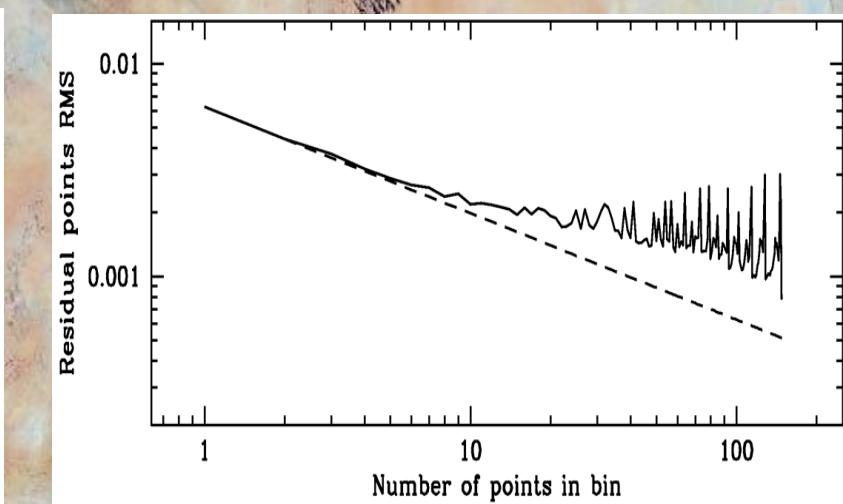
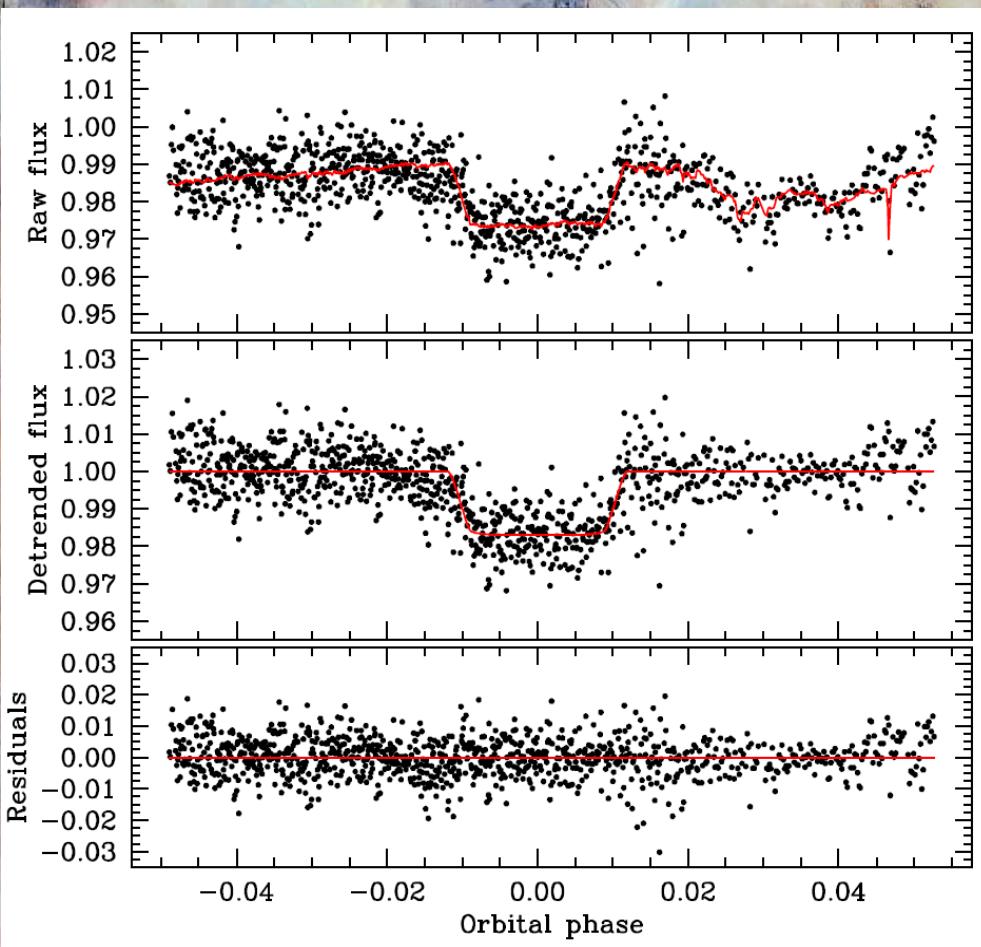
NTT



SOAR



Ks-band Near-IR Imaging

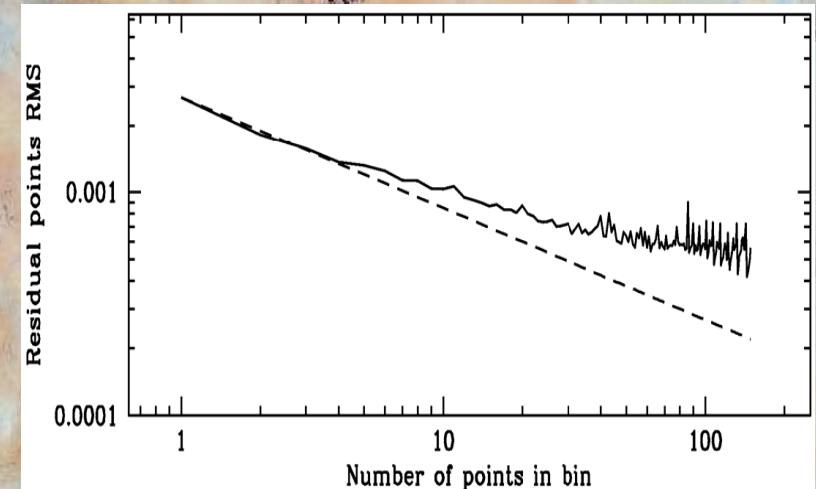
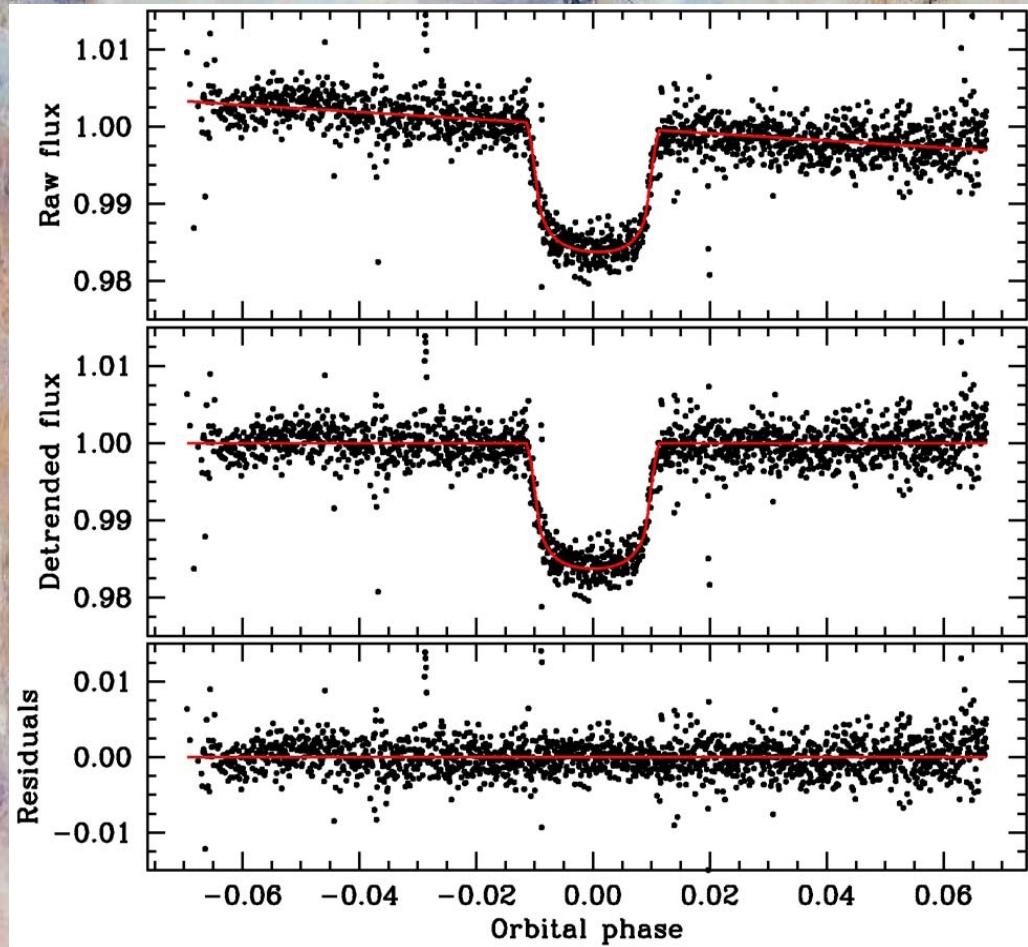


$$Rp/Rs = 0.118101
(+0.002562/-0.002766)$$

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



$$R_p/R_s = 0.117151 \\ (+0.001182/-0.001173)$$

NIR Transmission Spectroscopy

Instrument: [SofI@NTT](#):

- Coverage: 1.5 – 2.3 micron.
- Low-res red grism ($R \sim 900$).
- Slits: 0.6, 1.0, 2.0 arcsec.
- 3 transits: 17.05.2011,
13.06.2011, 9.08.2011

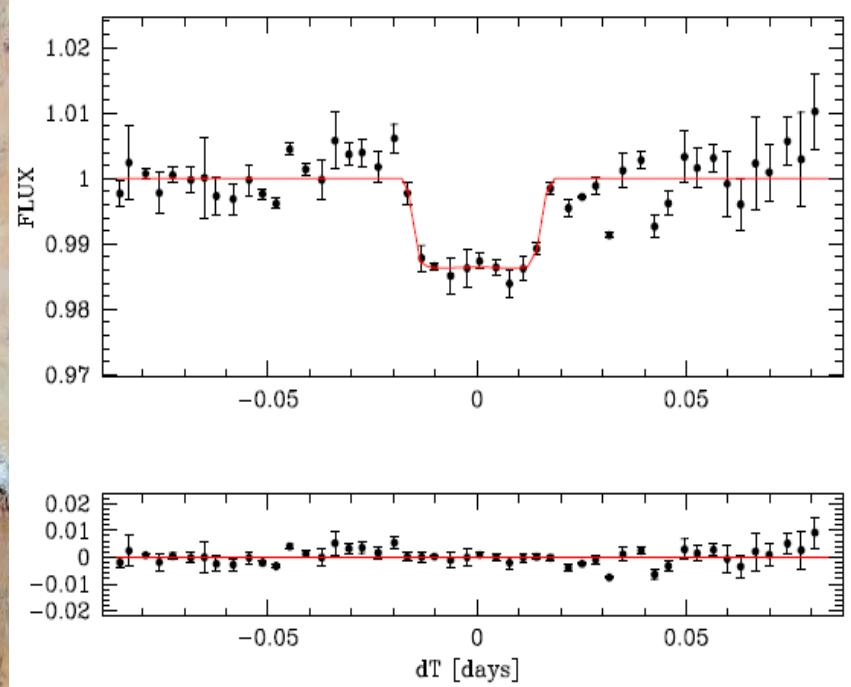
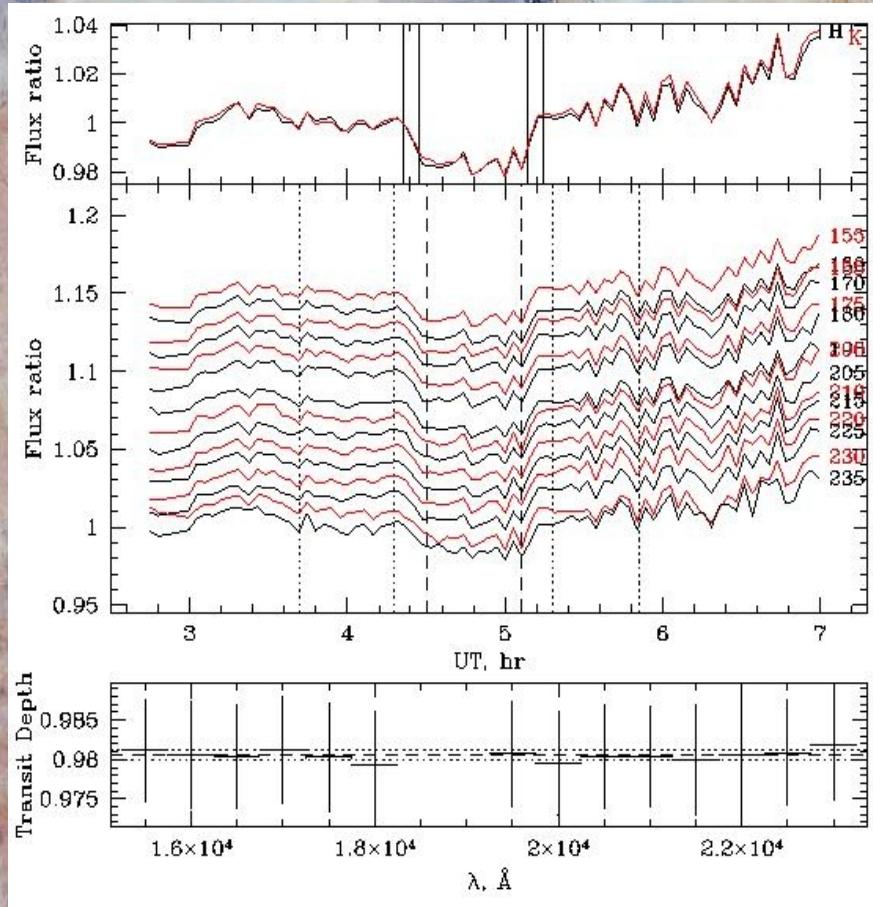
GJ1214: J=9.75, H=9.09,
Ks=8.78.

Reference star: J=9.71, H=8.98,
K=8.83.

Separation: 3.06 arcmin



NIR Transmission Spectroscopy



RMS = 0.008

NIR Transmission Spectroscopy

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

- 1.7 micron (1000 Ang spectral bin):

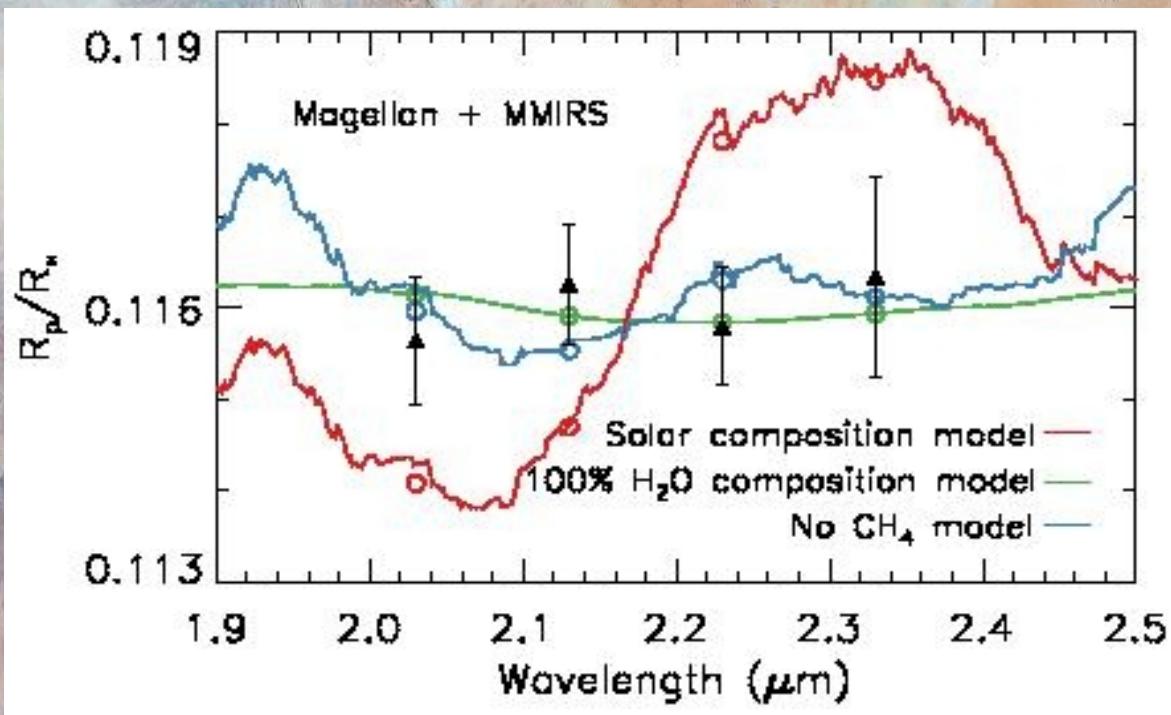
$$Rp/Rs = 0.1154885 (+0.0081278/-0.0094224)$$

- 1.6 micron (1000 Ang spectral bin):

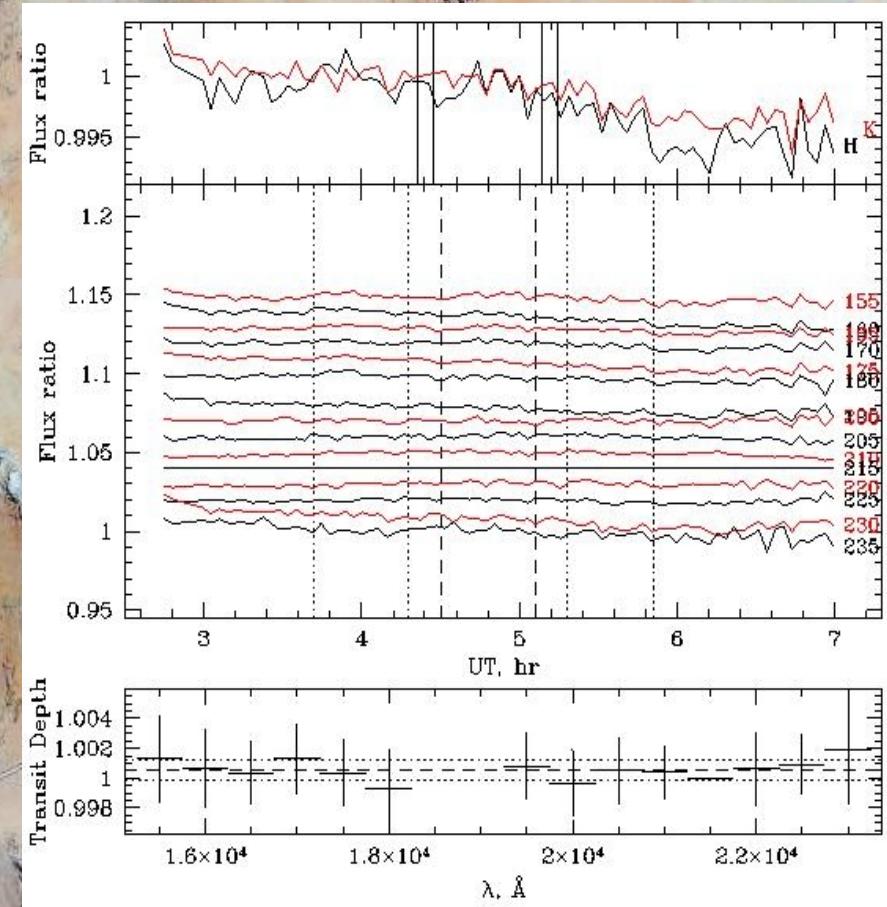
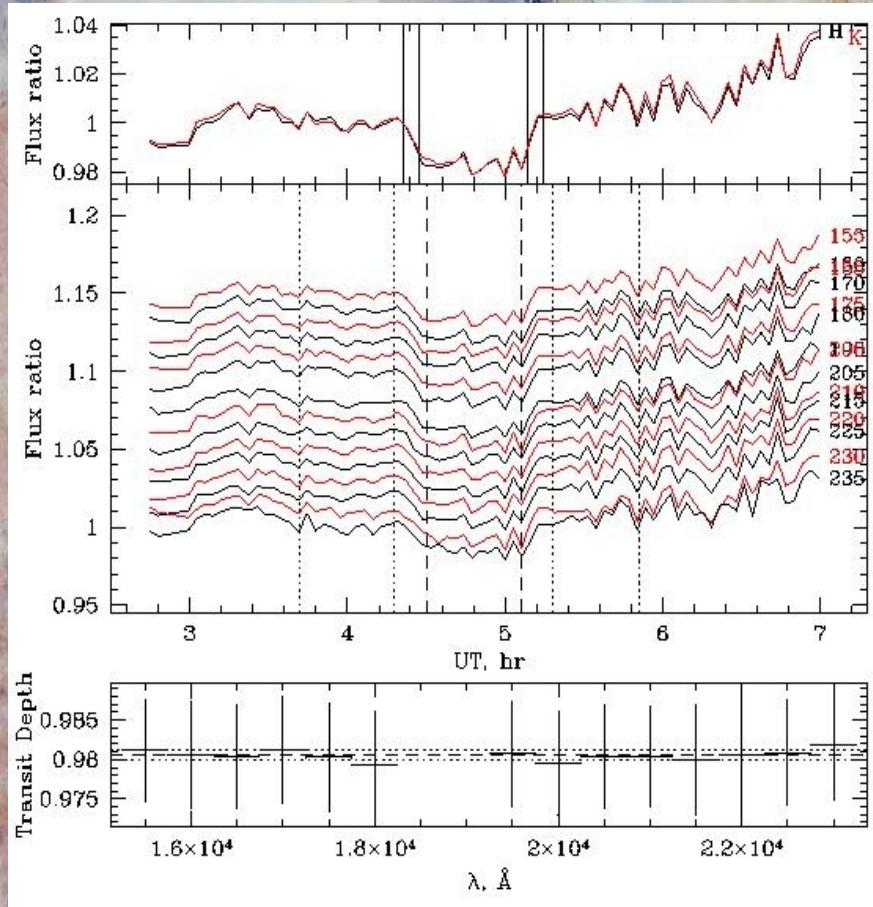
$$Rp/Rs = 0.1149844 (+0.0070462/-0.0098685)$$

NIR Transmission Spectroscopy

Can we improve?

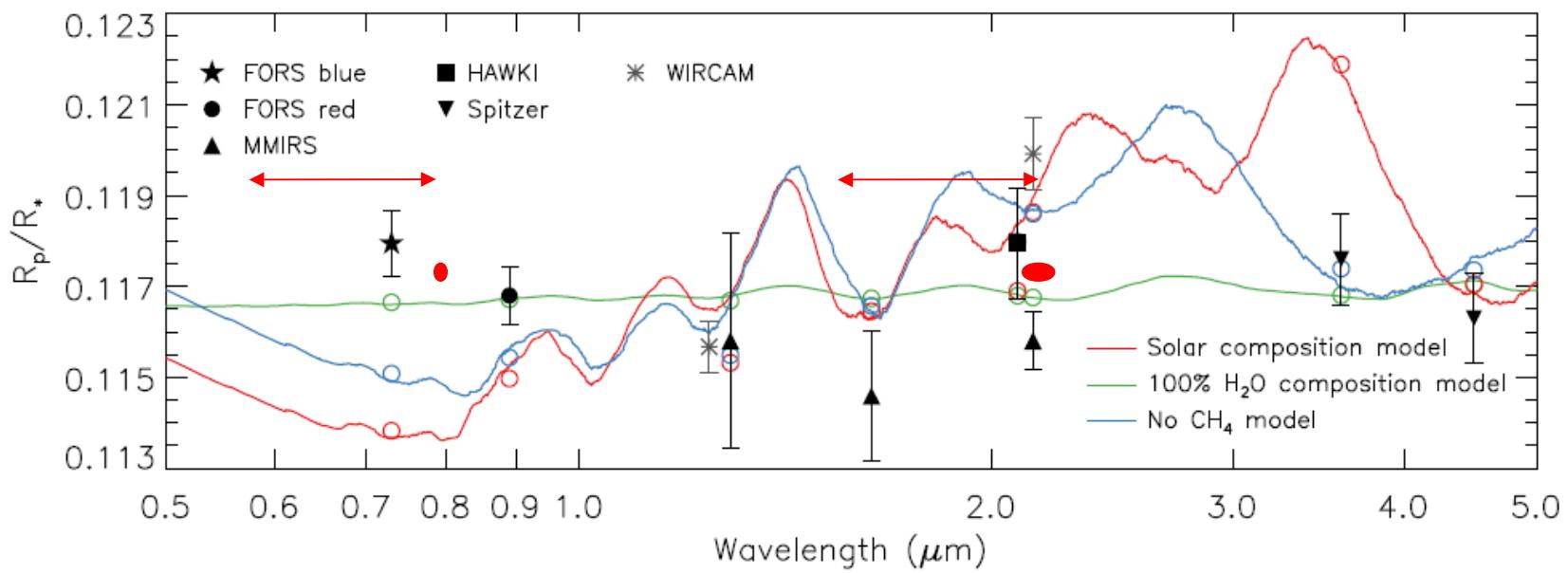


NIR Transmission Spectroscopy



RMS = 0.0037

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.