Multi-wavelength transmission spectroscopy of the forerunner GJ1214b

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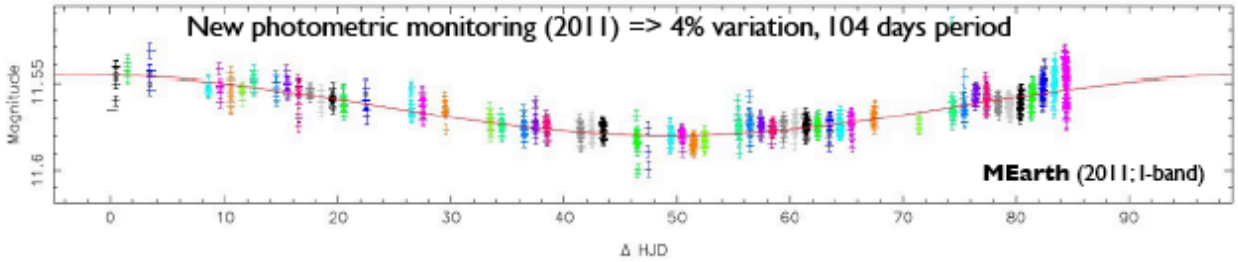
The bulk composition of Super-Earth planets cannot be uniquely determined using measurements of their mass and radius alone because of the inherent degeneracy between their interior and atmosphere in theoretical models. Breaking this degeneracy can be accomplished by obtaining knowledge of the planet's atmospheric composition.

We present observations to constrain the composition of the atmosphere of the transiting super-Earth GJ1214b. These observations are combination of ground- and space-based transmission spectra that together cover a broad wavelength domain, from the visible to the near-infrared.

Table 1 | System parameters for GJ 1214 — Charbonneau et al. (2009)

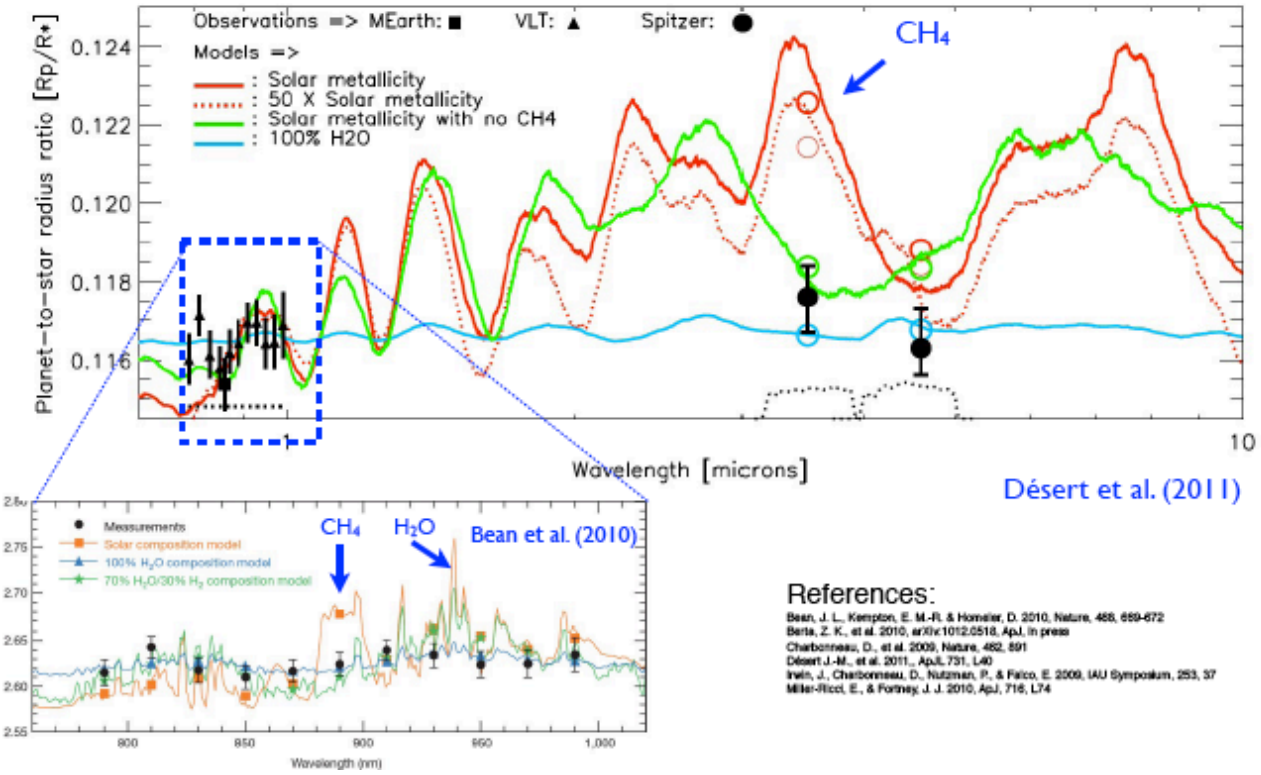
Parameter	Value
Orbital period, P (days)	1.5803925 ± 0.0000117
Stellar mass, M_s	0.157 ± 0.019$M_\odot$
Stellar radius, R_s	0.2110 ± 0.0076$R_\odot$
Stellar density, ρ_s (kg m^{-3})	23,900 ± 2,100
Log of stellar surface gravity (CGS units), log g_s	4.991 ± 0.029
Stellar effective temperature, $T_{\rm eff}$ (K)	3,026 ± 132
Planetary radius, R_p	2.678 ± 0.13$R_\oplus$
Planetary mass, M_p	6.55 ± 0.98$M_\oplus$
Planetary density, ρ_p (kg m^{-3})	1870 ± 400
Planetary surface acceleration under gravity, g_p (m s^{-2})	8.93 ± 1.3
Planetary equilibrium temperature, $T_{\rm eq}$ (K)	
Assuming a Bond albedo of 0	555
Assuming a Bond albedo of 0.75	393



Preliminary results: **2011 Photometric monitoring of GJ1214 with MEarth (I-band)** reveals variability caused by asymmetric distribution of starspots. The stellar rotation period is estimated at 104 days with a 4% peak-to-peak amplitude (=> transit depth variation of 0.1% at 1 microns). Rotation period increases by a factor of 2 and amplitude increases by a factor of 4 compared to Berta et al. (2010).

Observational evidence for a metal rich atmosphere on the super-Earth GJ1214b:

- Combining MEarth + VLT + Spitzer observations
- No spectral signature observed suggests small scale height (large mean molecular weight)
- **H-dominated atmospheric models excluded at 7-sigma level.**
- Observations consistent with atmospheric models containing more than 10% of water in volume.
- The flat spectrum over a large bandpass could be explained by the presence of clouds or/and hazes. However, non-equilibrium chemistry (e.g. condensation, photochemistry, etc...) is currently poorly constrained.



Désert et al. (2011)

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