Some interesting things to do with transits

Suzanne Aigrain

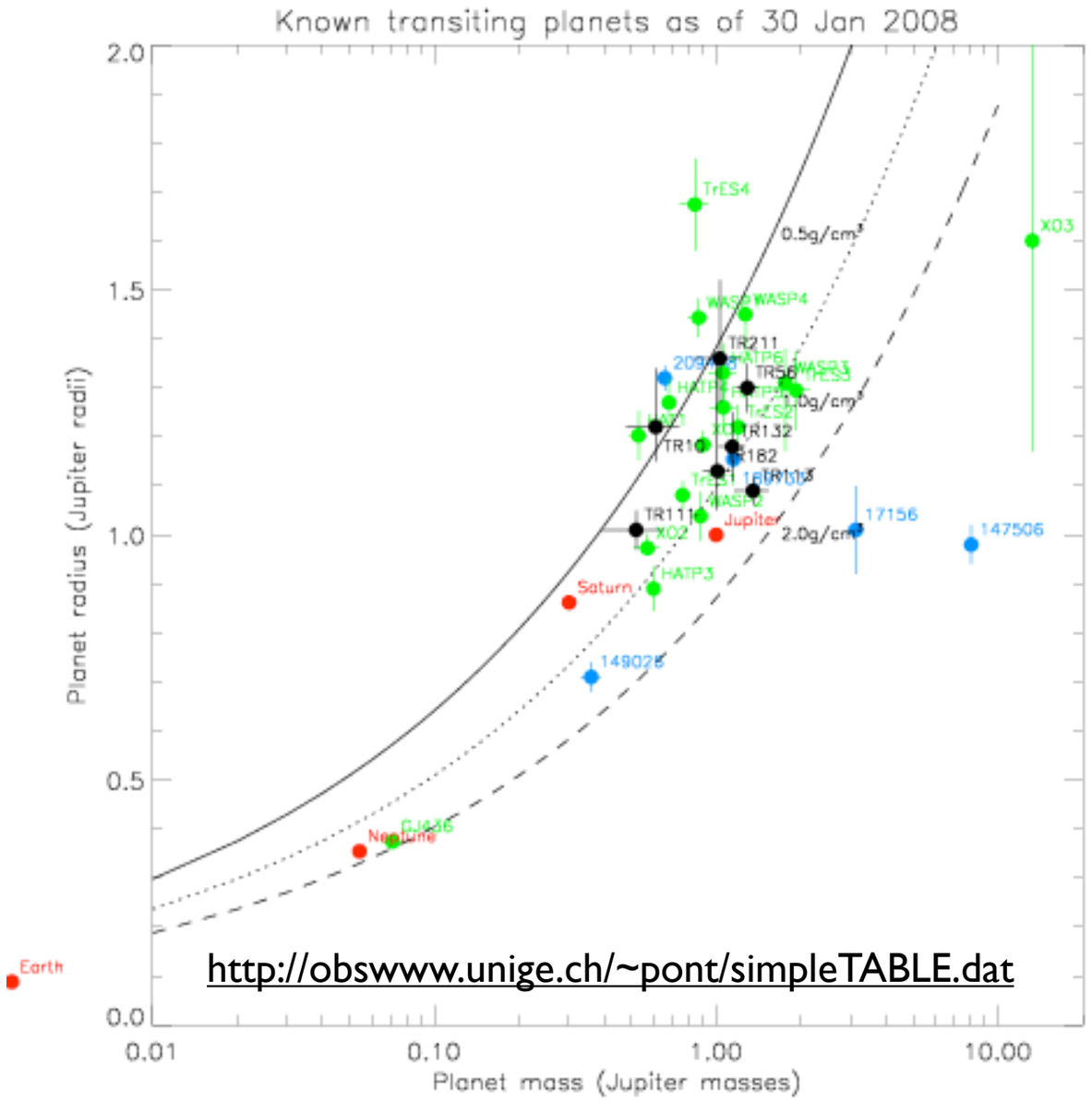
Exoplanets - 30/01/08

Off the cuff list

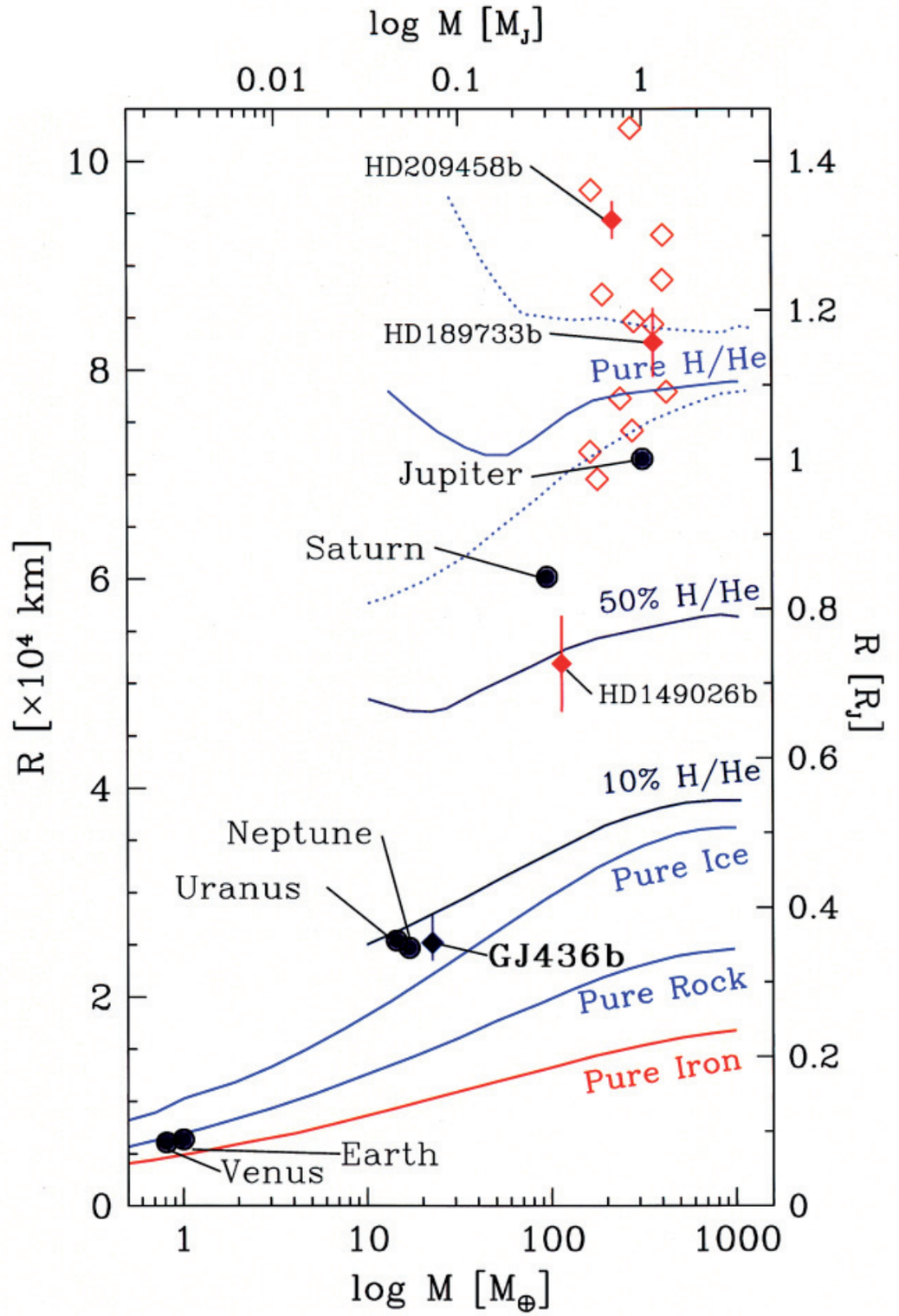
- True mass and radius
- Rossiter effect
- Detection of small planets
- Atmospheric studies
- Transit timing

True mass & radius

(very) inflated planets - additional heat source?
dense planets - core mass?
neptune-mass and smaller planets - composition? can we really tell?



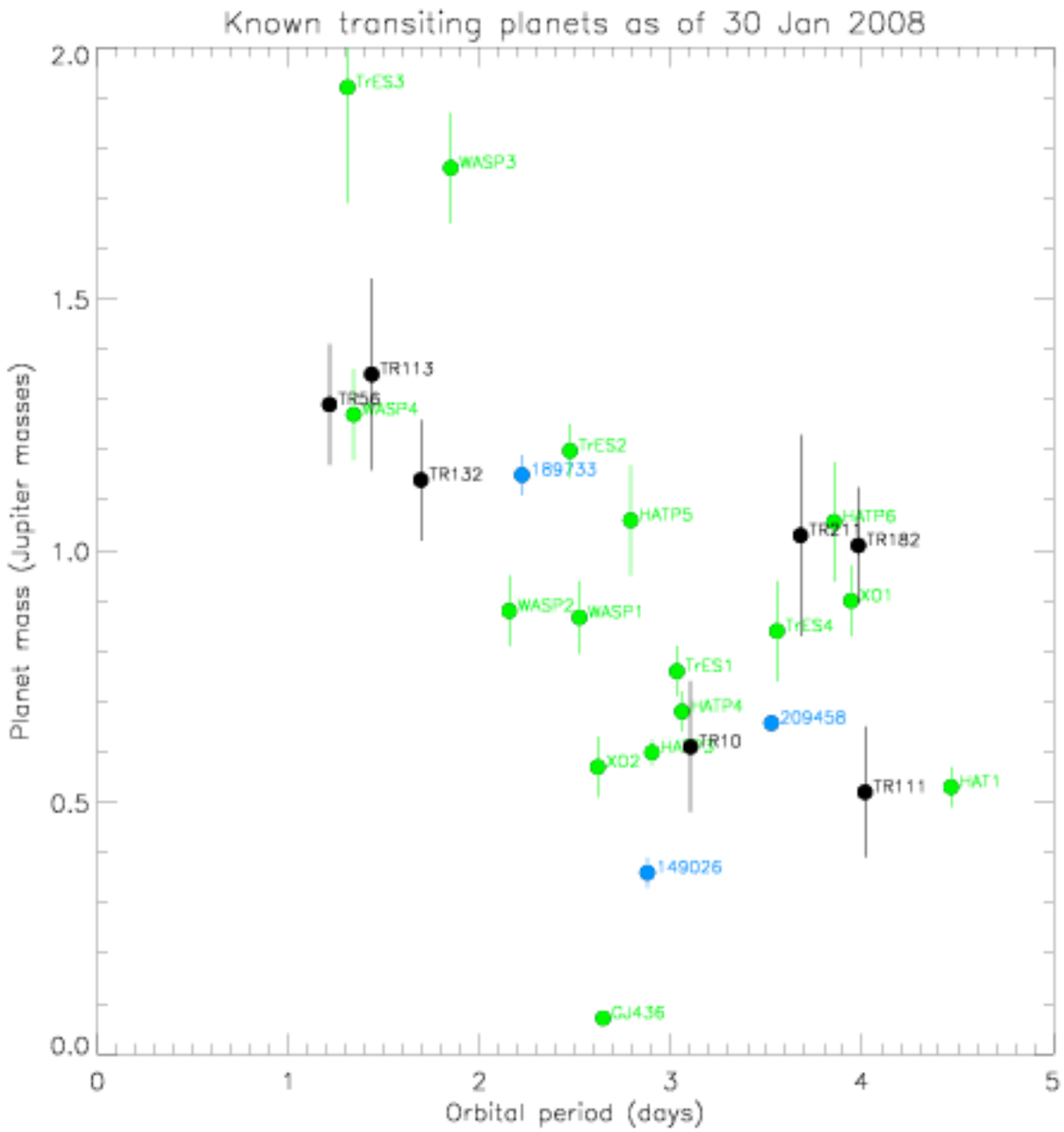
http://obswww.unige.ch/~pont/simpleTABLE.dat

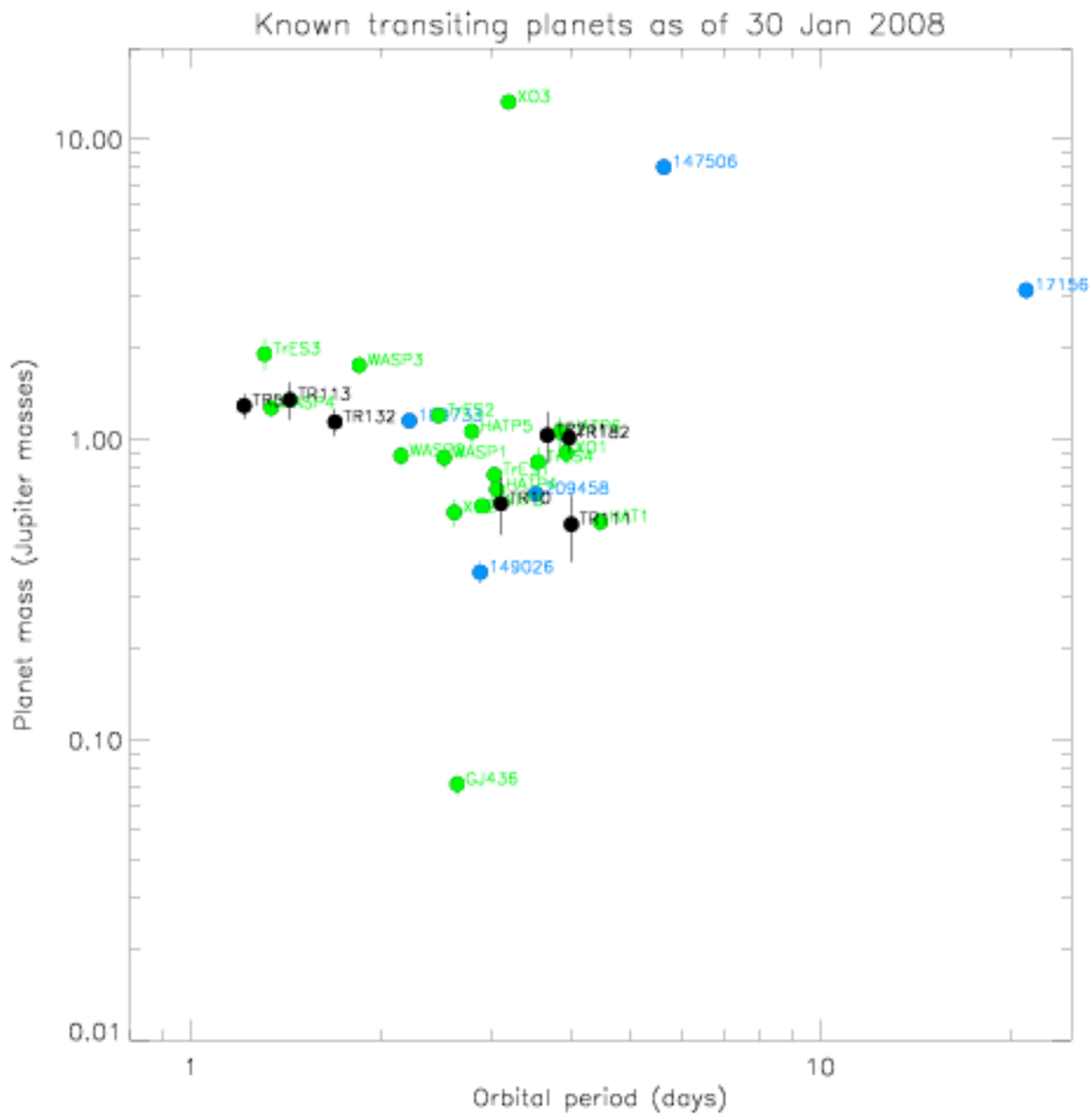


Gillon et al. (2007, A&A, 472, L13)

True mass & period

correlation pointed out first by Mazeh & Zucker (2005), looks less convincing today
3 clear classes of planets emerging on log-log plot: supermassive, normal giants, neptunes





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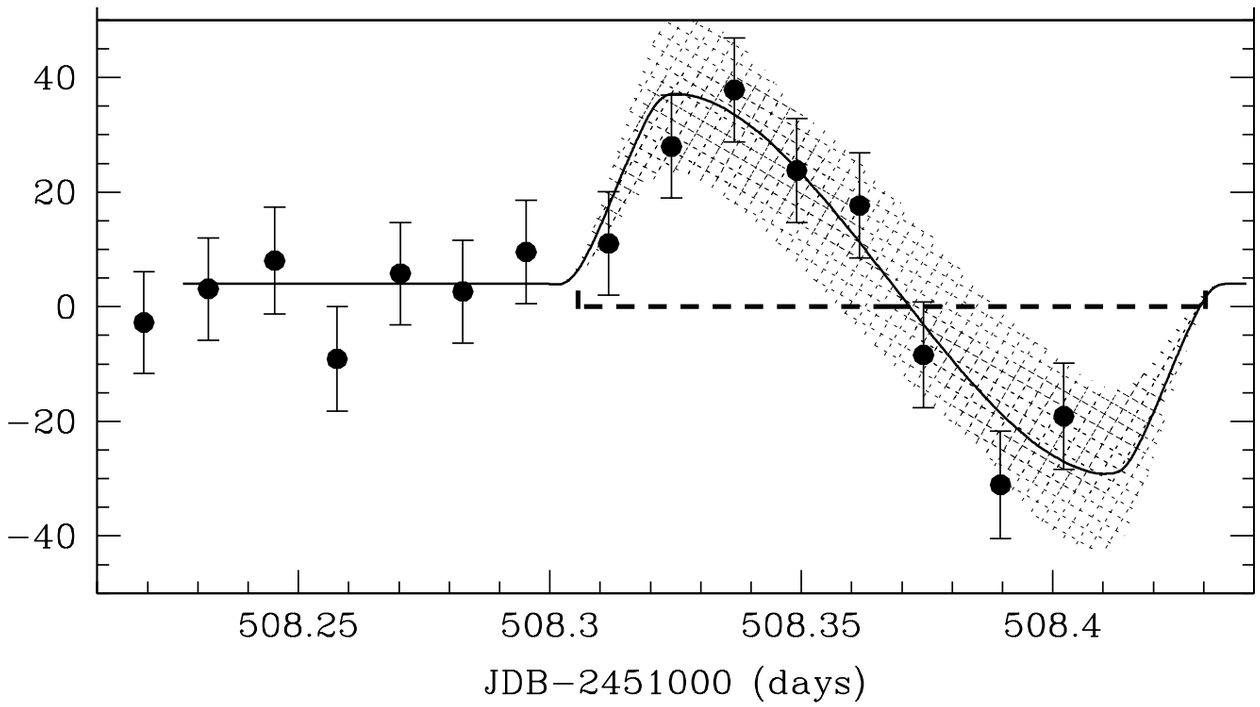
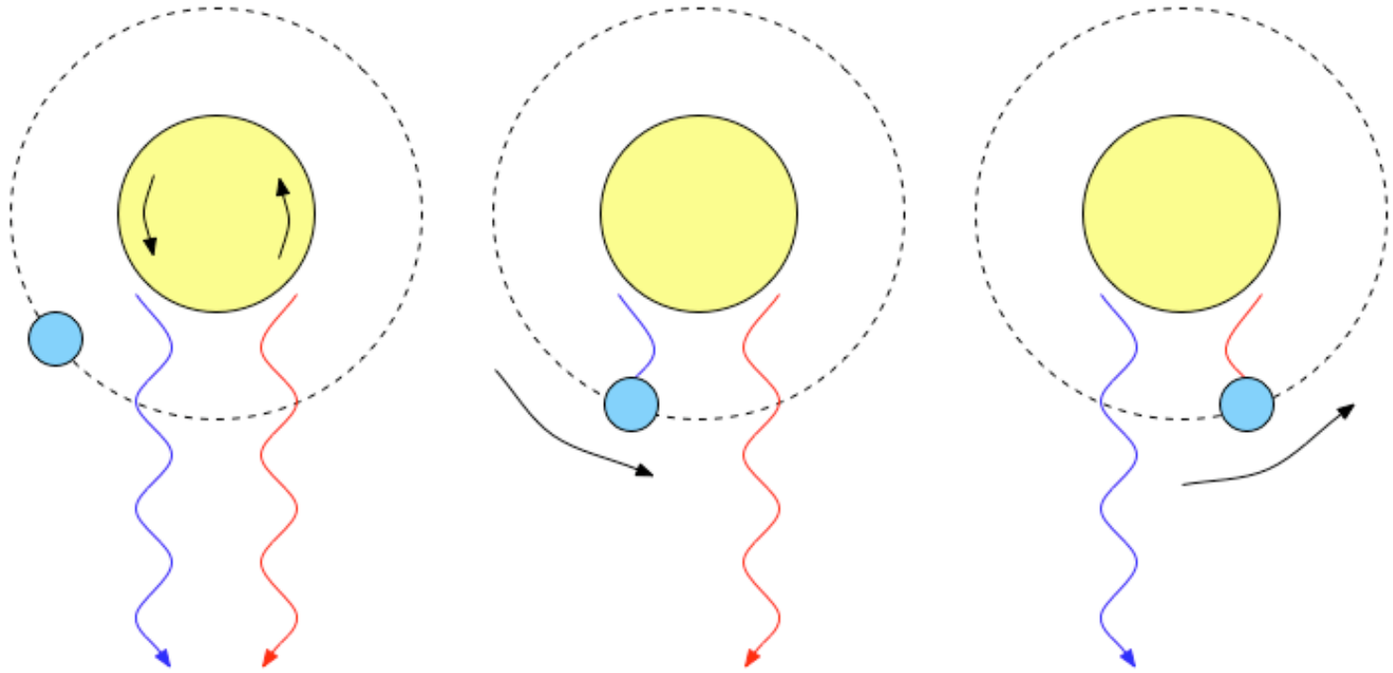
Rossiter effect

Queloz et al. (2000) - HD 209458b



Primarily sensitive to relative inclination of planet orbit and star rotational equatorial plane

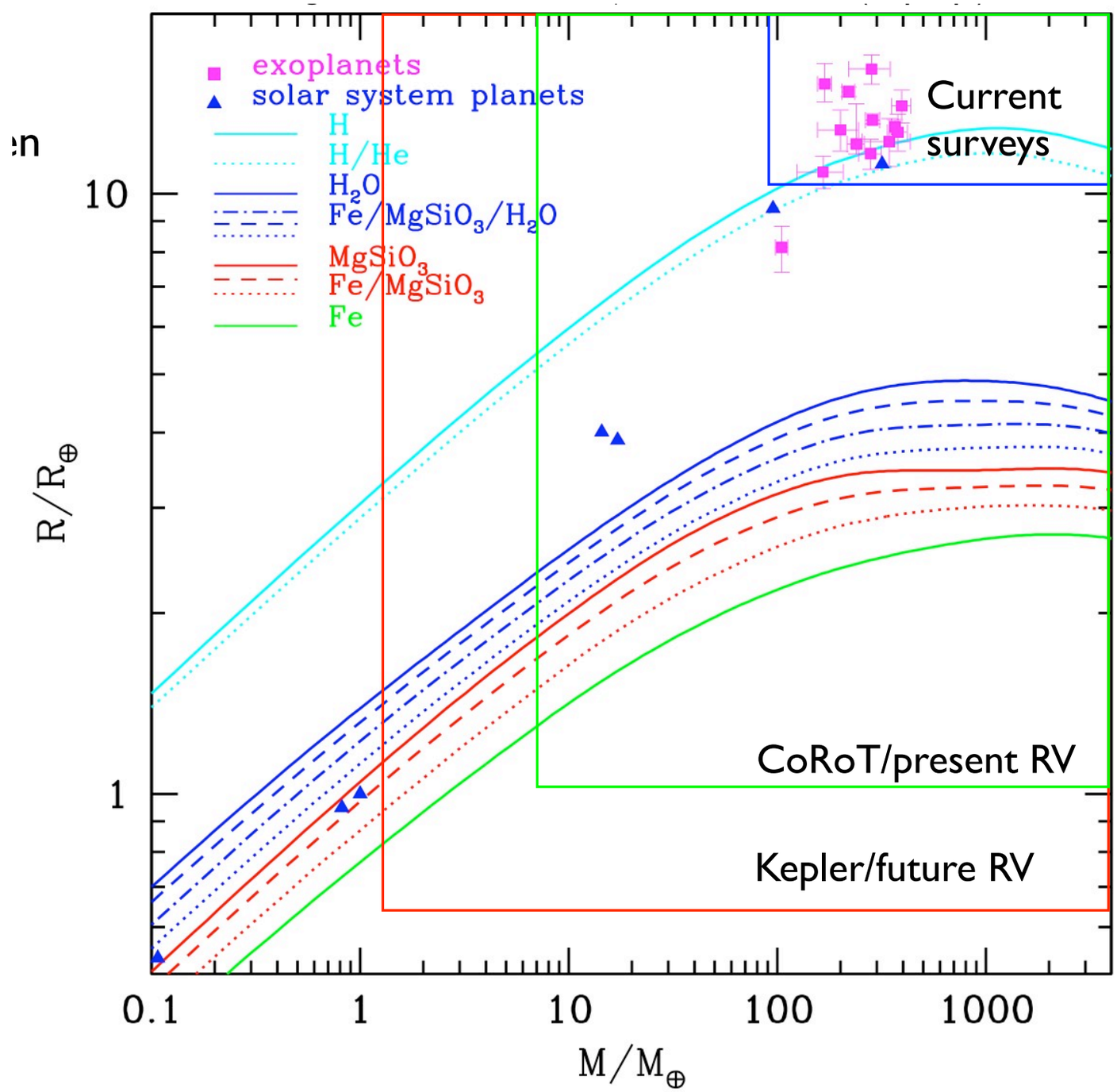
All measurements to date consistent with coplanarity



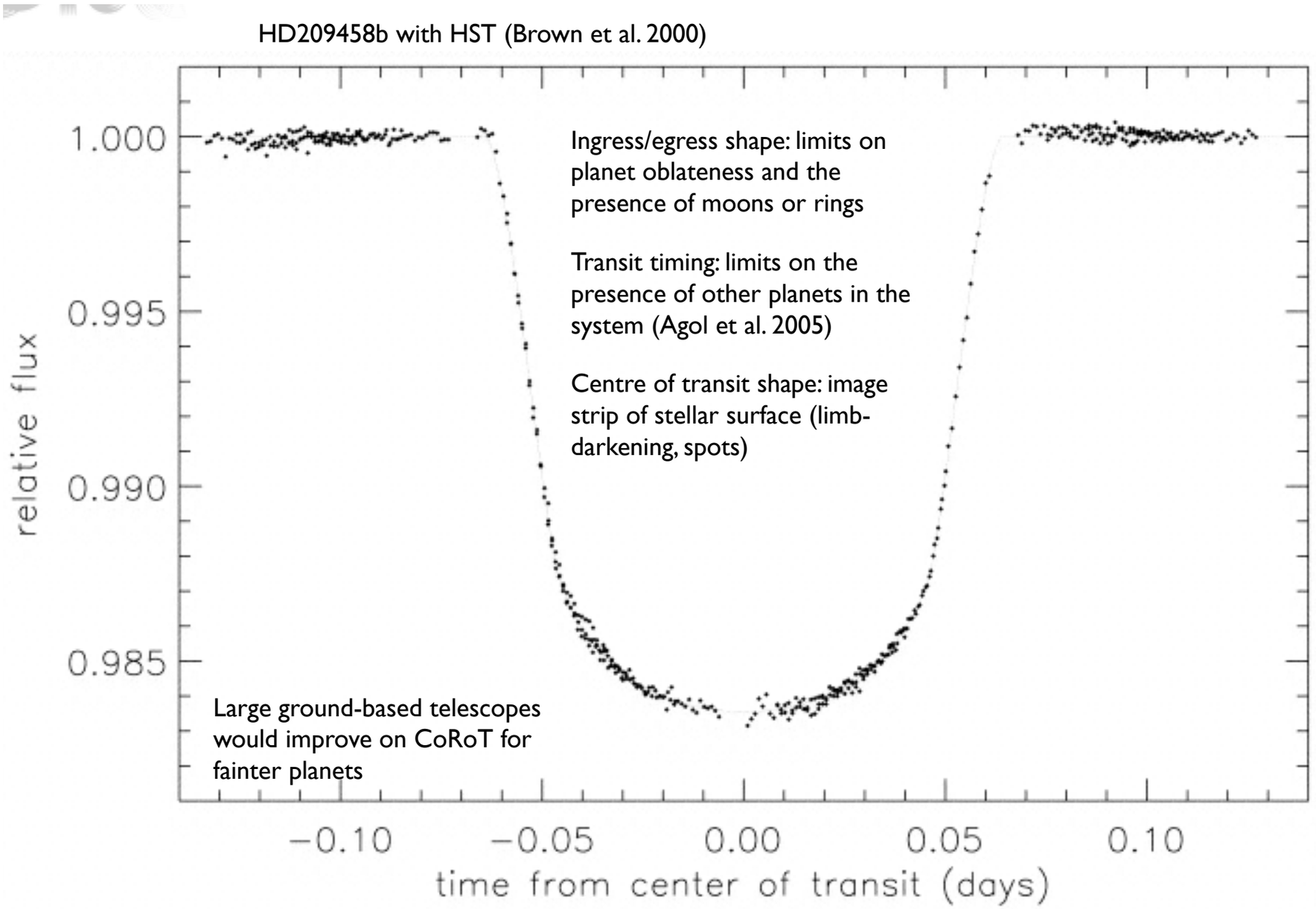
wikipedia

Small planets

Seager et al. (2007)



Ultraprecise light curves

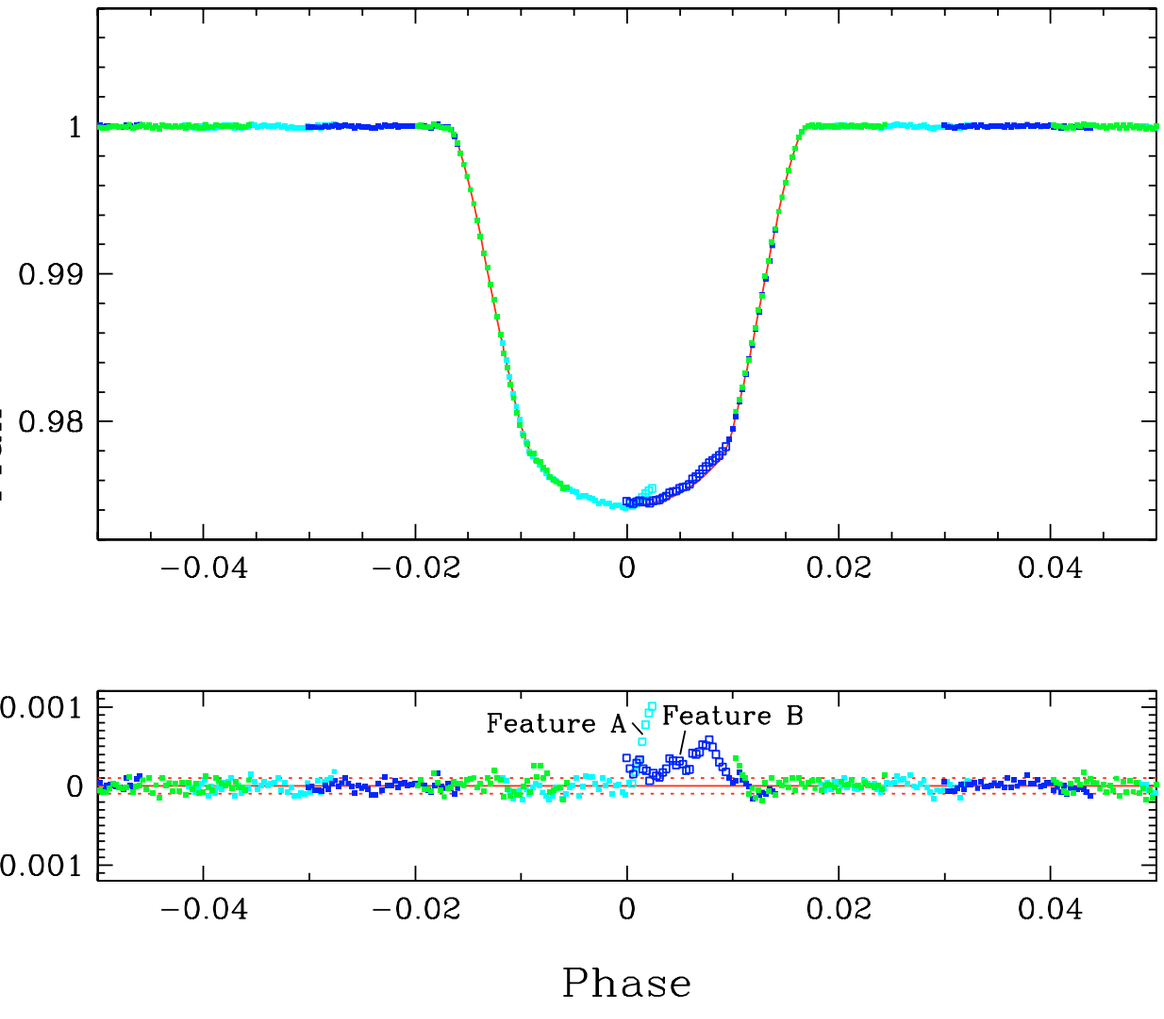


A&A 476, 1347–1355 (2007)
DOI: 10.1051/0004-6361:20078269

Astronomy & Astrophysics

Hubble Space Telescope time-series photometry of the planetary transit of HD 189733: no moon, no rings, starspots⋆

F. Pont[1], R. L. Gilliland[2], C. Moutou[3], D. Charbonneau[4], F. Bouchy[5], T. M. Brown[6], M. Mayor[1], D. Queloz[1], N. Santos[7], and S. Udry[1]



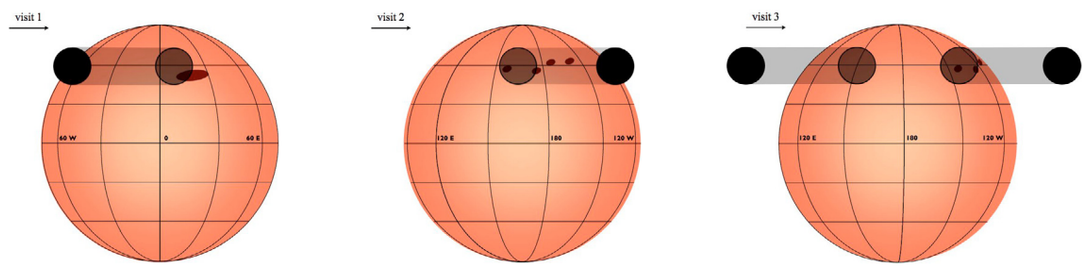
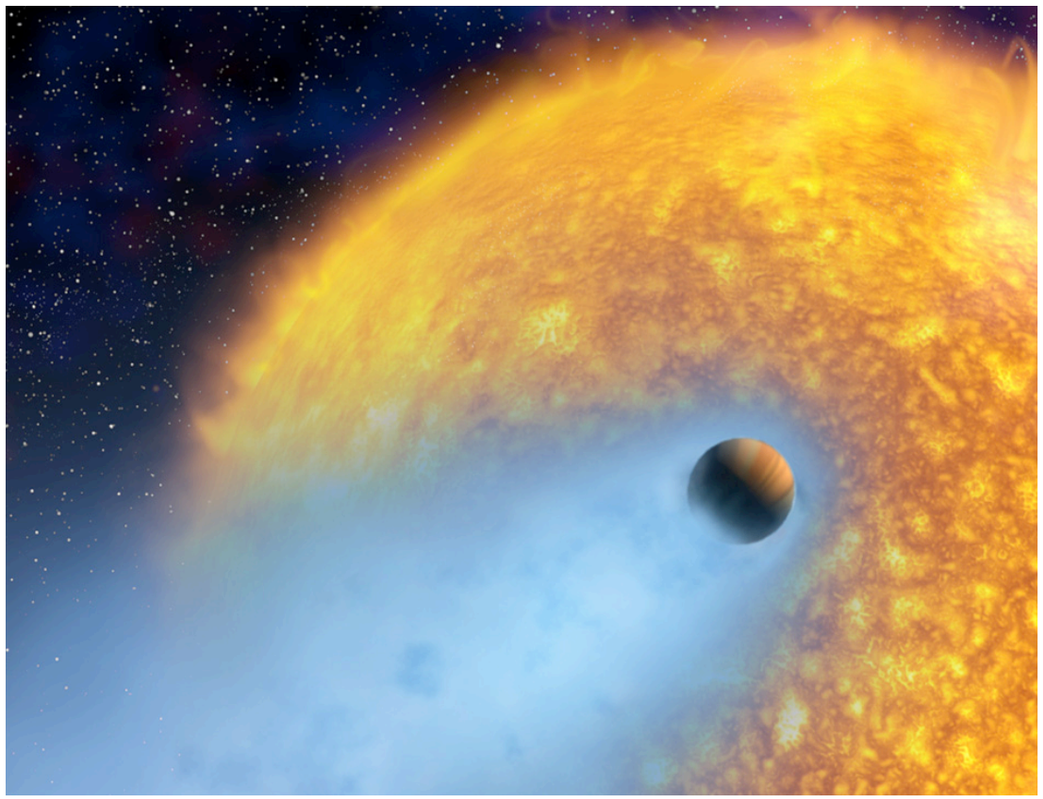


Fig. 6. Schematic configuration of the position of the star and planet during the three HST visits. Longitude and latitude lines are drawn on the star at 30 degrees intervals. Longitude zero is defined as the longitude pointing towards the Earth at the epoch of the first transit. The arrows indicate the direction of the stellar rotation and planet orbital motion. The path of the planet during the HST observations is shown for the three visits. Darker features on the star sketch the configuration for the spots affecting the HST lightcurve.

Transmission spectroscopy

Probes atmospheric transparency gradient near the **limb**

Vidal-Madjar et al. (2003, 2004) - evaporating exosphere



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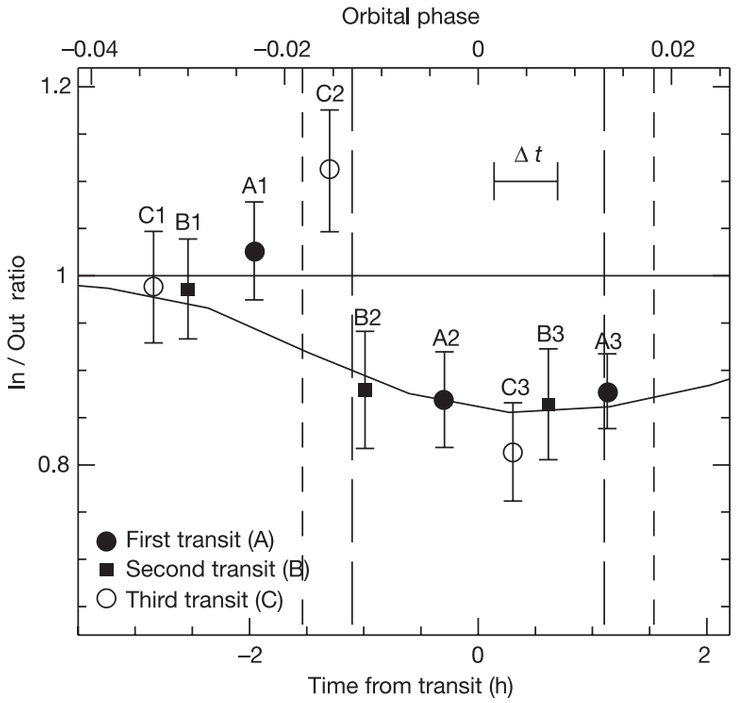

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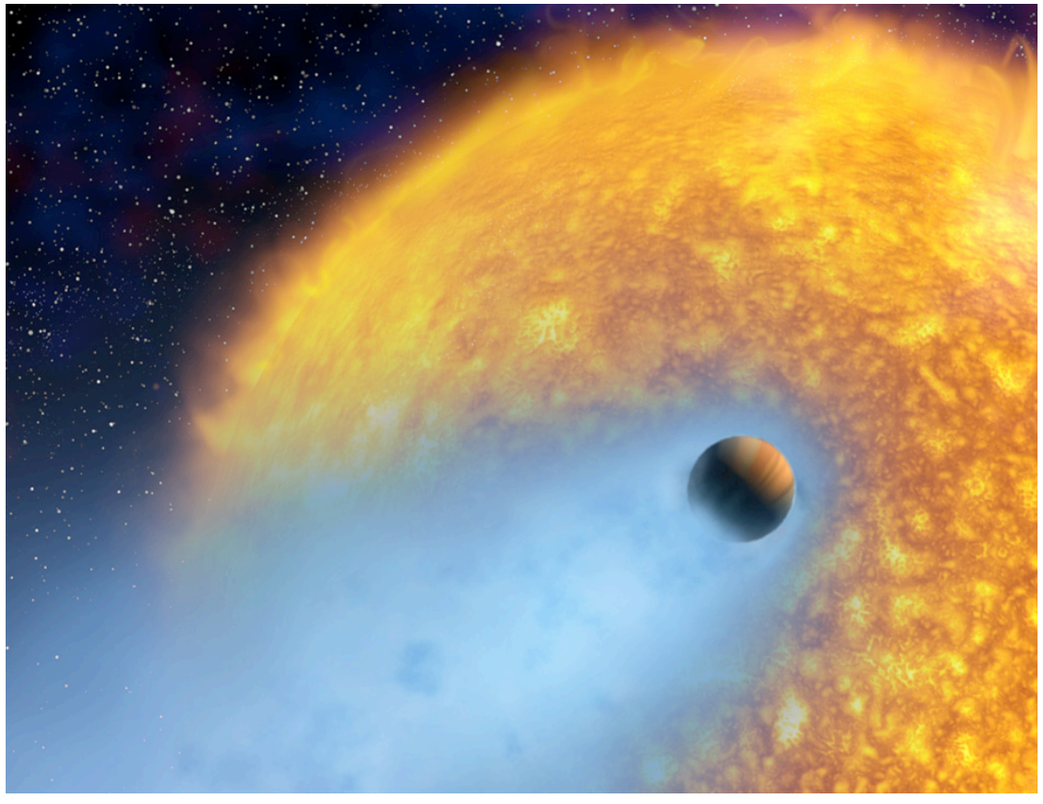

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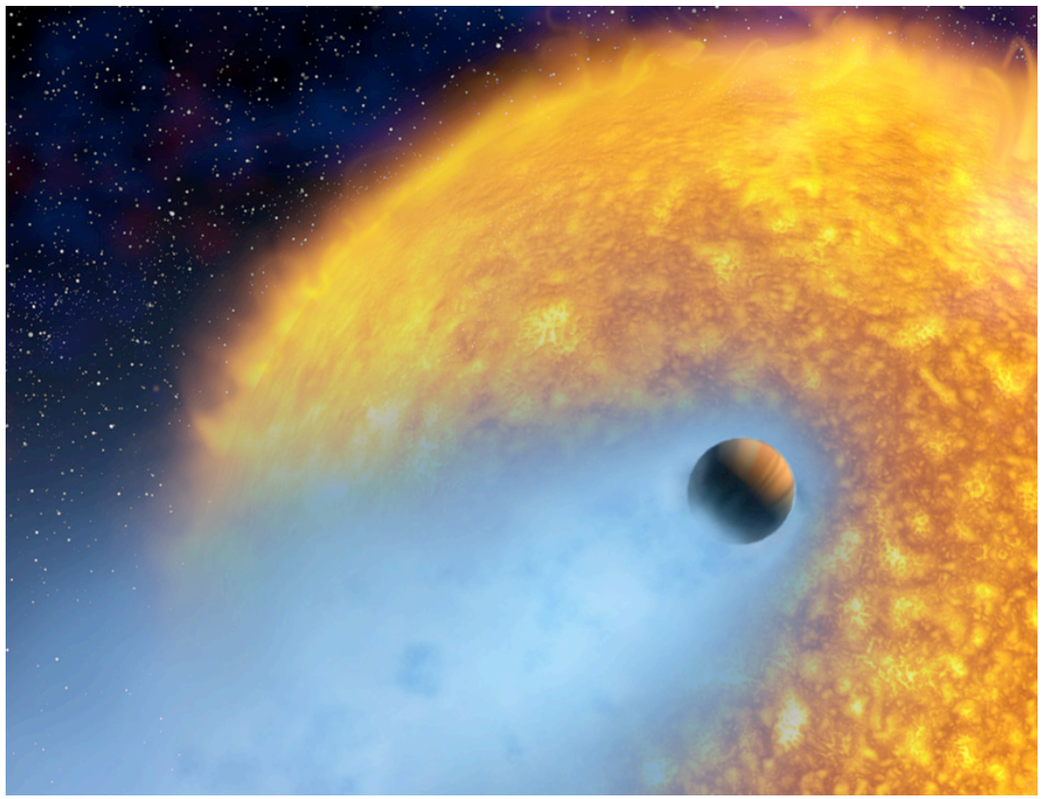

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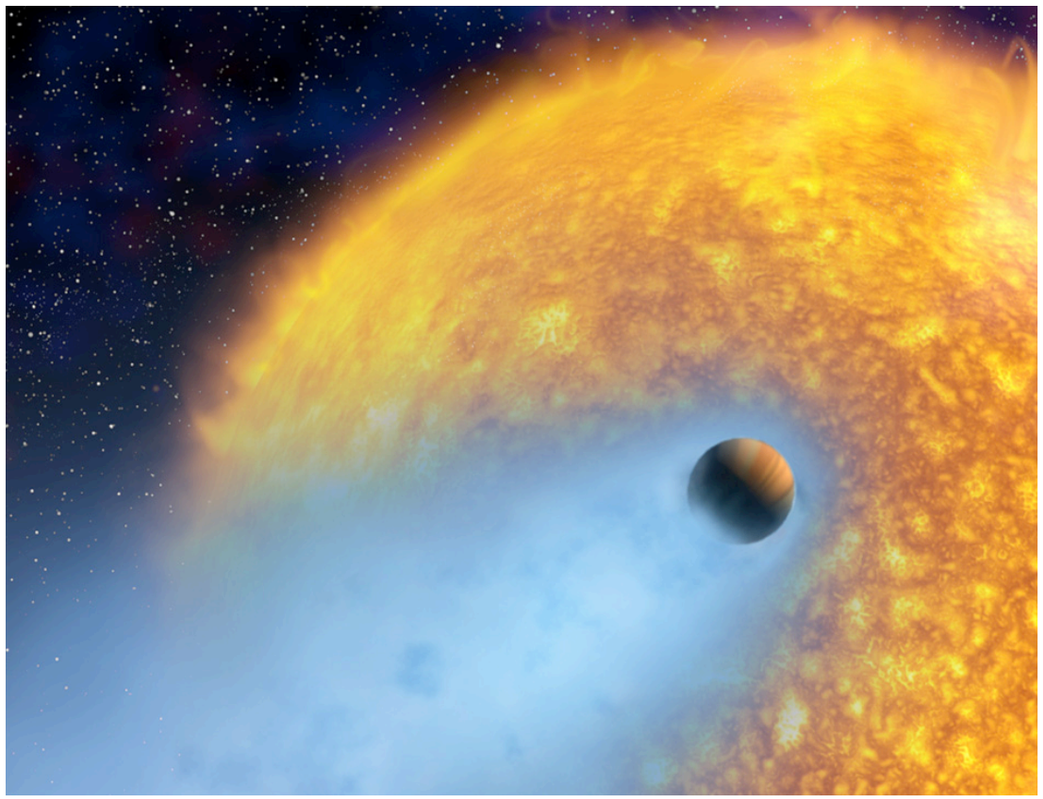

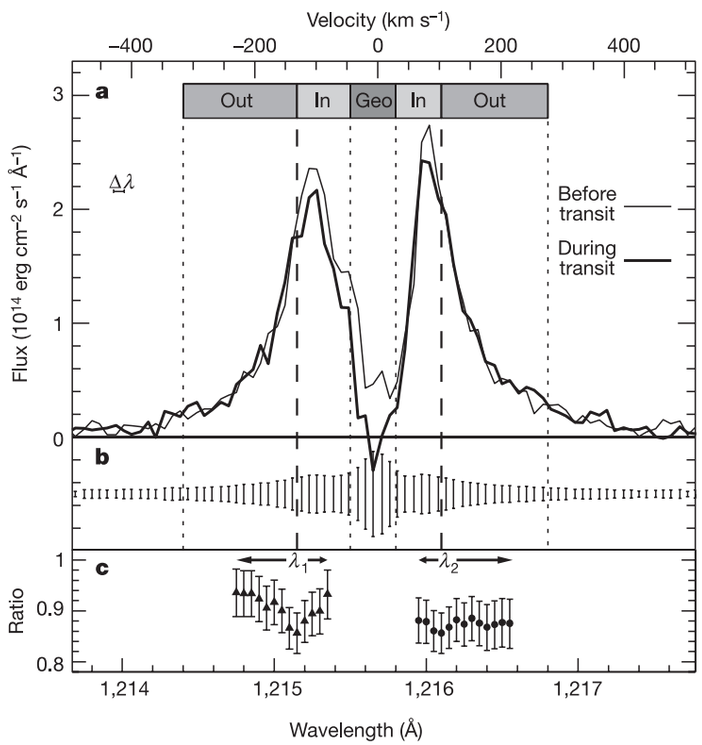

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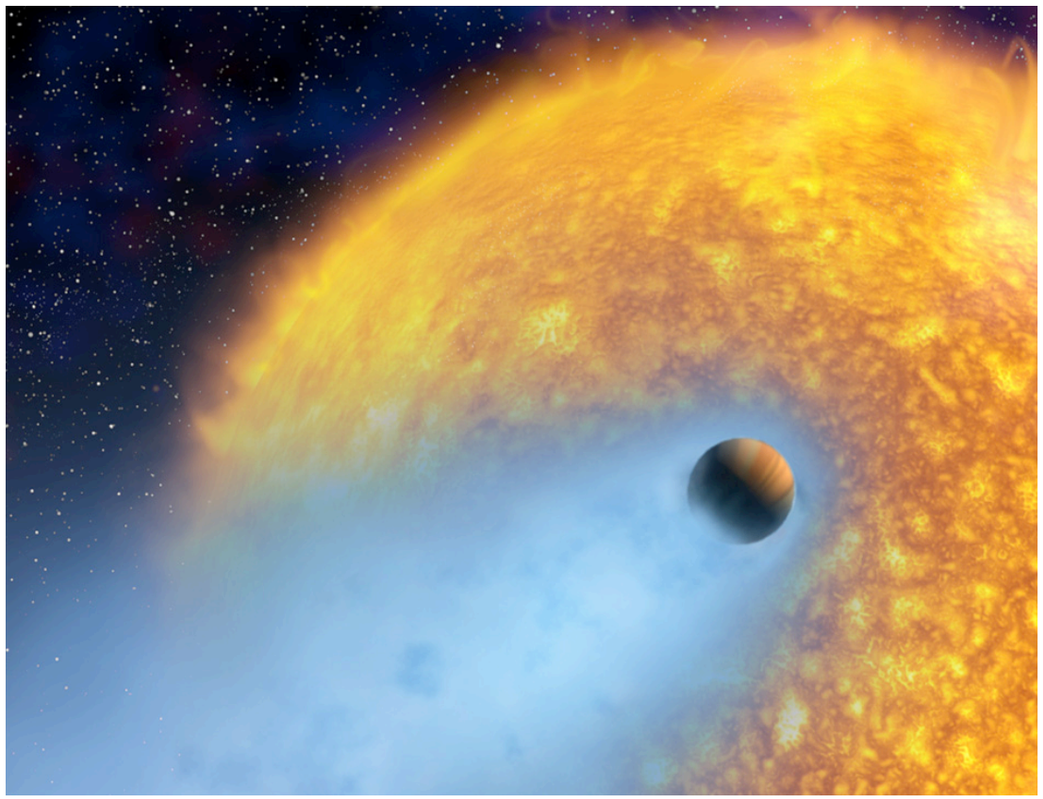

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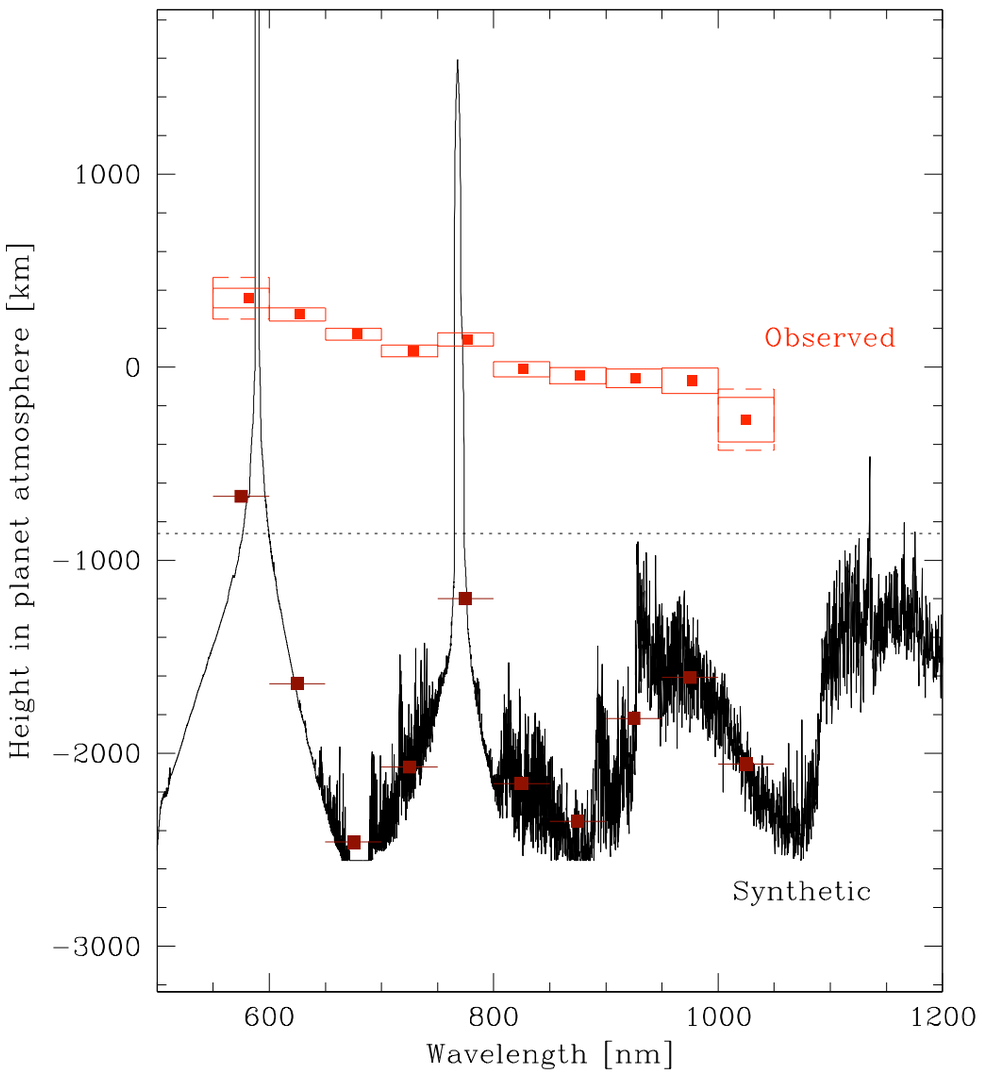
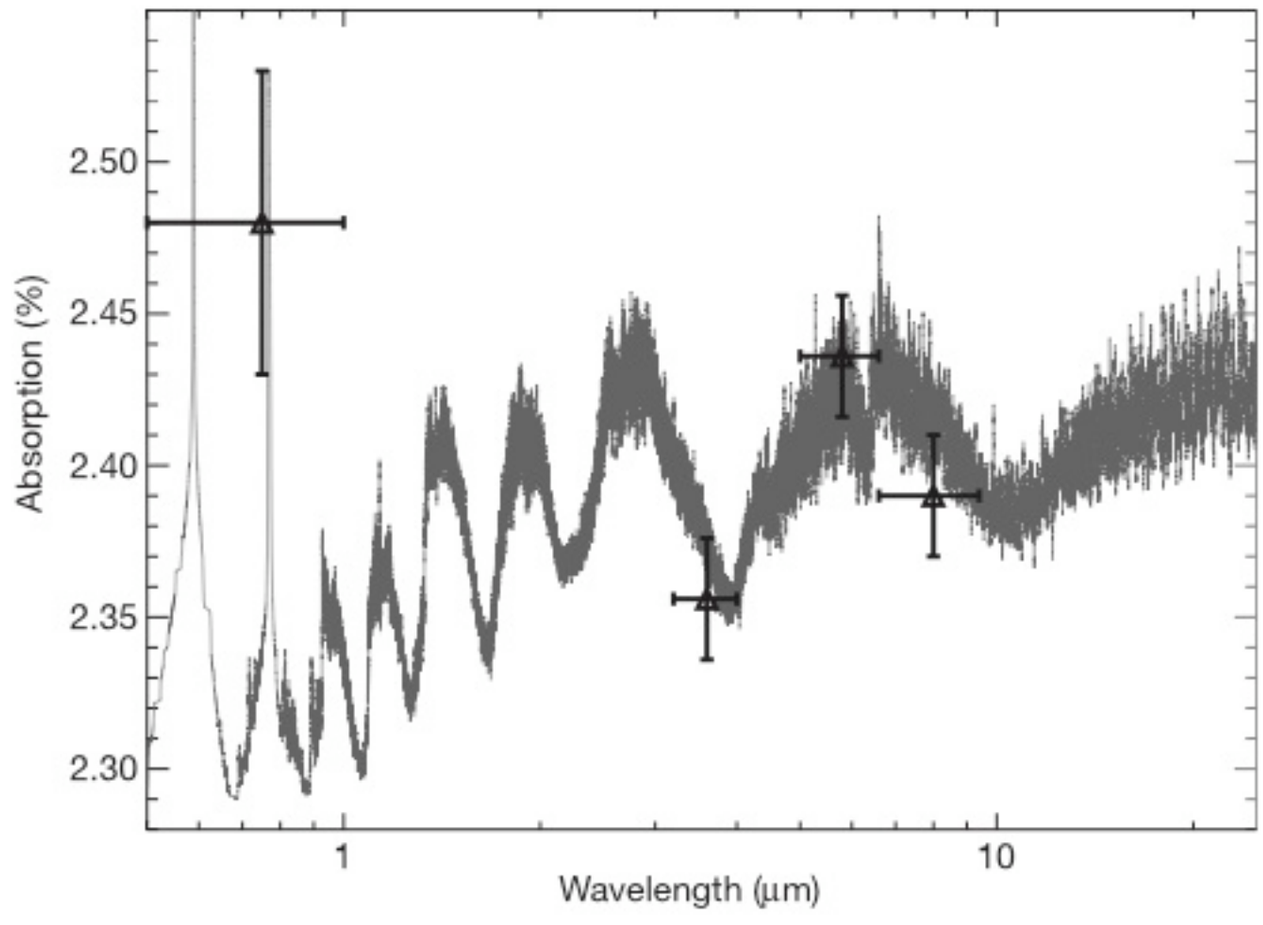
Pont et al. (in press) - optical: ~1 micron haze

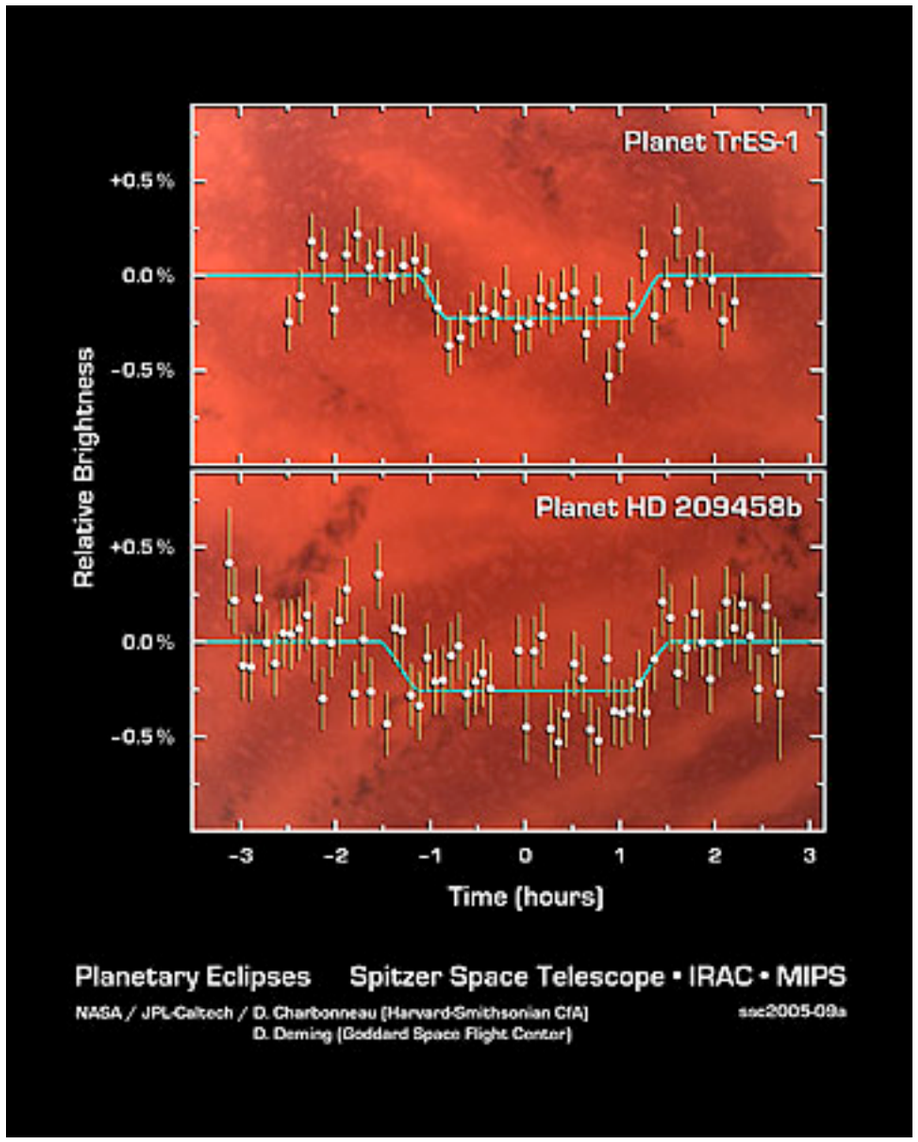


Tinetti et al (2008) - IR: H2O? (controversial)



Secondary eclipses

Probes thermal (IR) or reflected (optical) emission from top of atmosphere

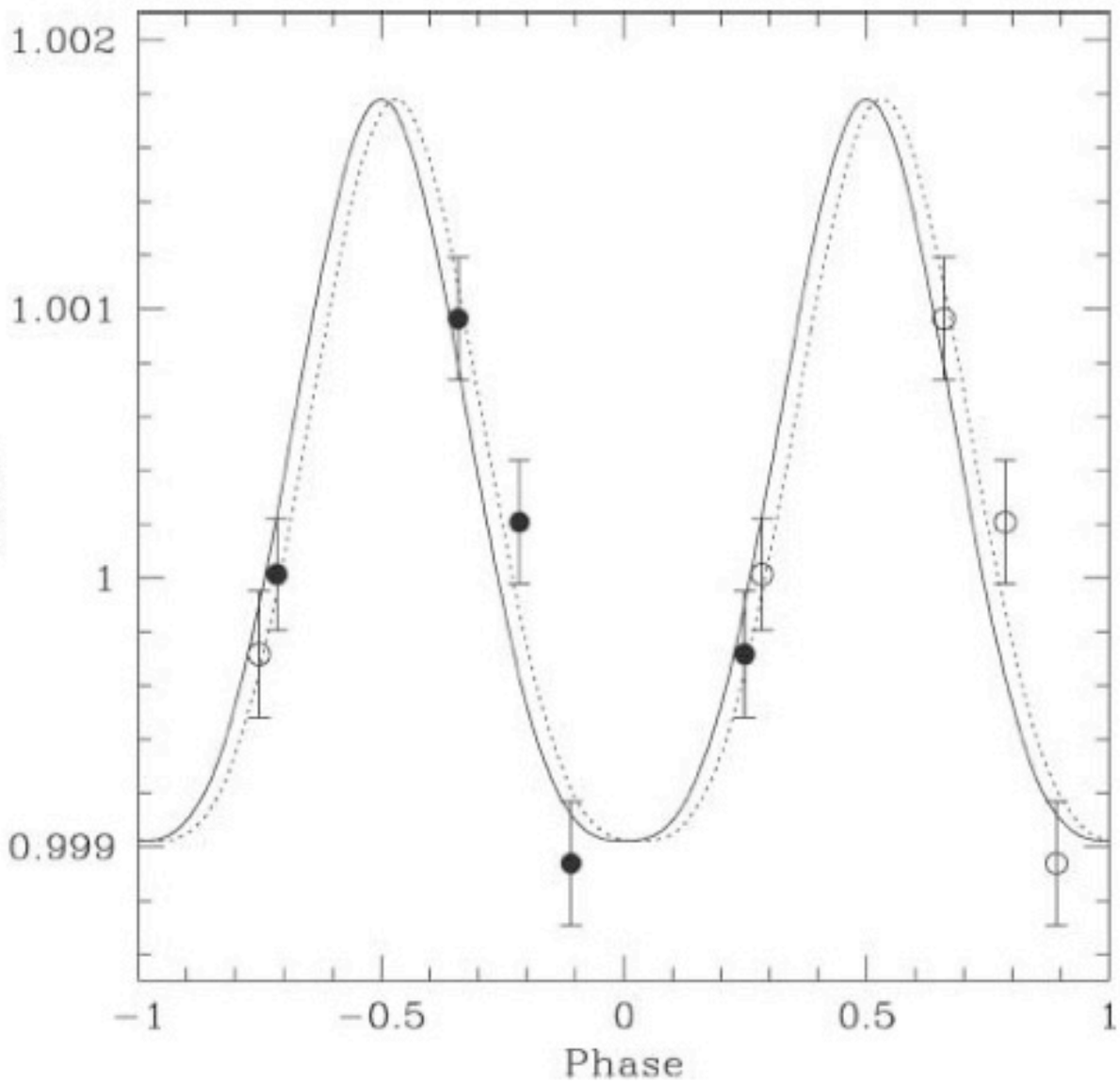


Charbonneau et al. (2005), Deming et al (2005), many more since
-> Hot planets are really hot (1000-2000K)

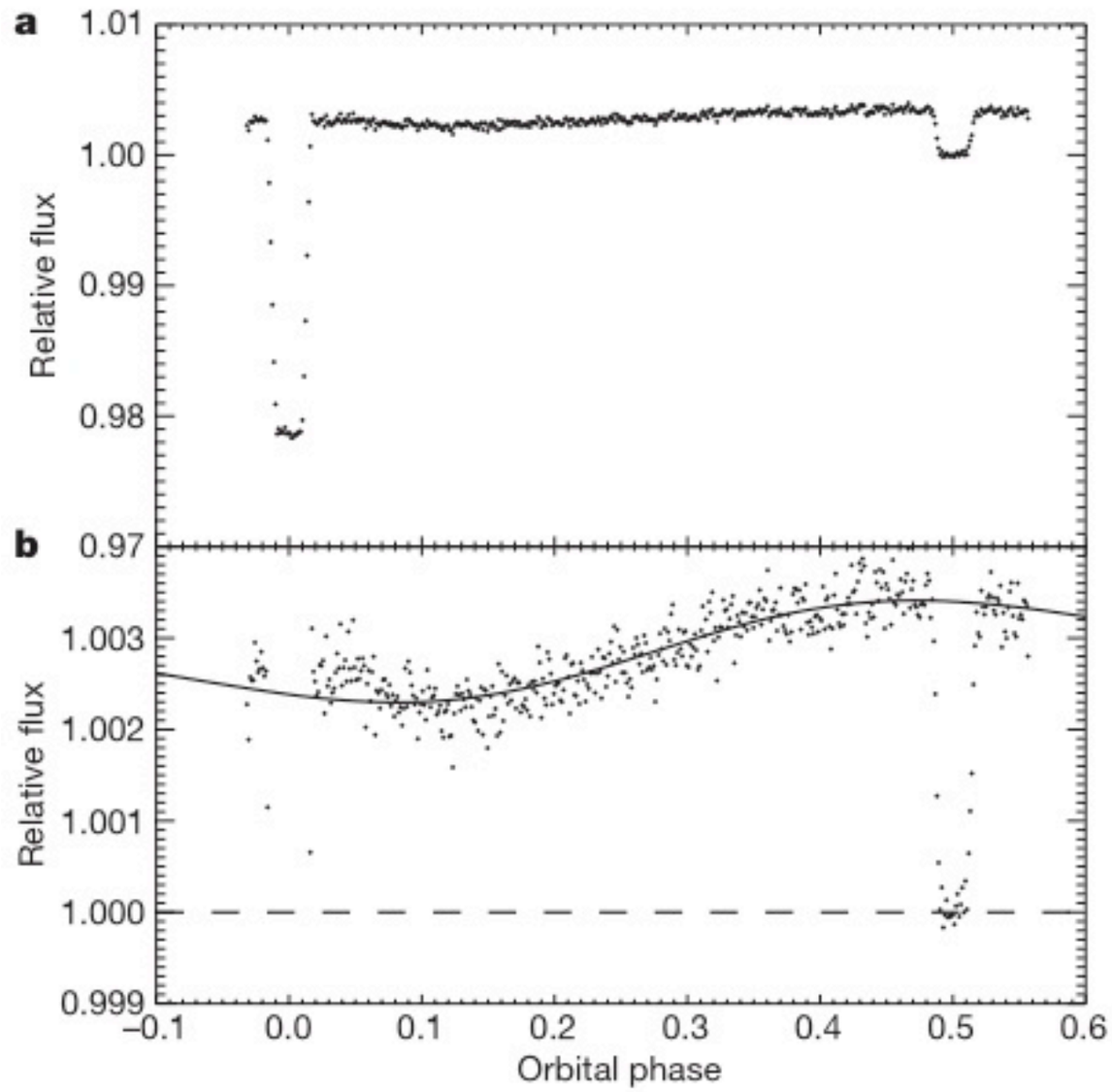
Optical non-detections (MOST satellite)
-> Hot Jupiters are really dark
but ... watch this space: CoRoT may change this

Phase curves

Harrington et al (2006) - mu And
strong day-night contrast



Knutson et al (2006) - HD 189733
weak day night contrast, phase offset



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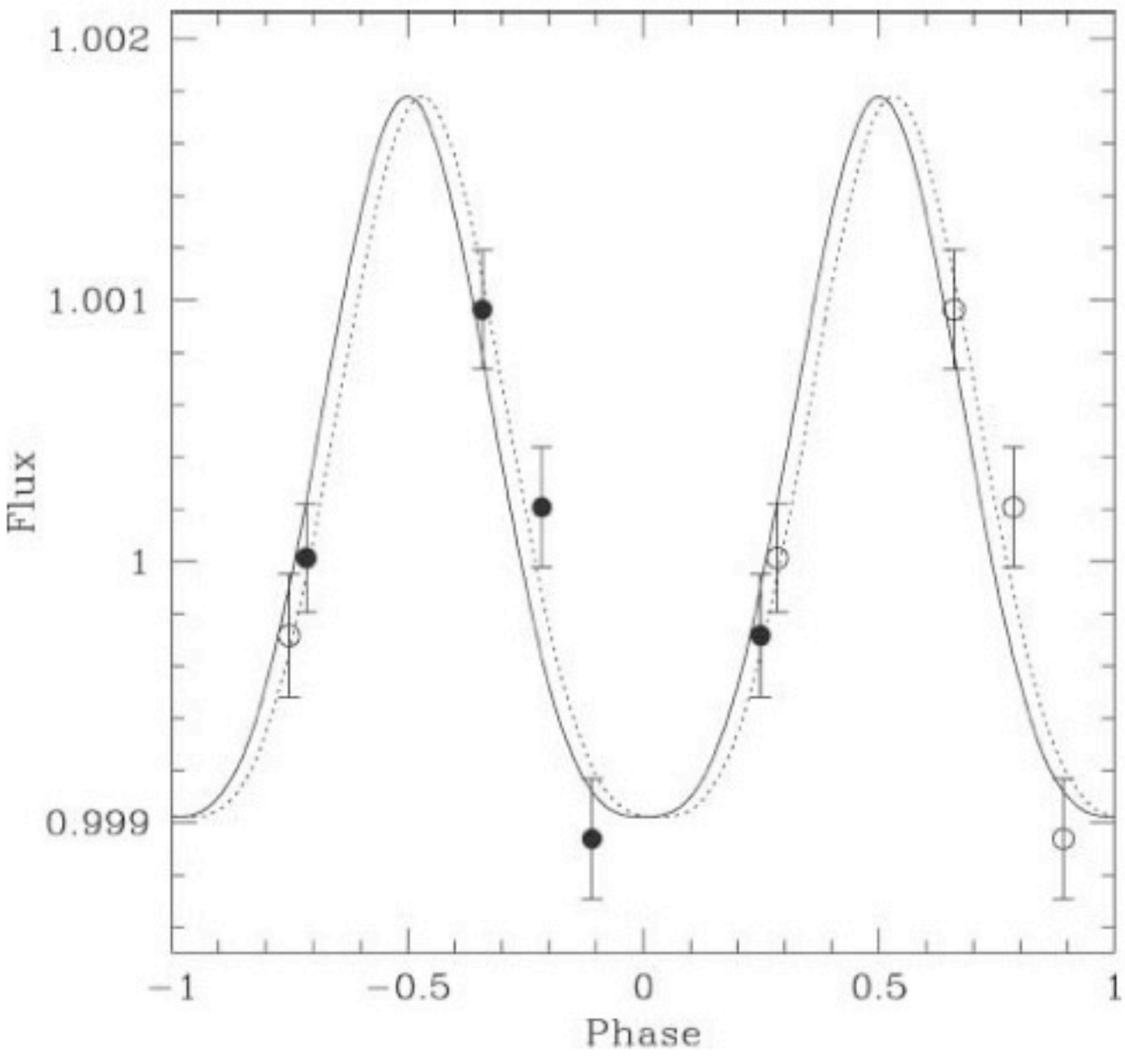

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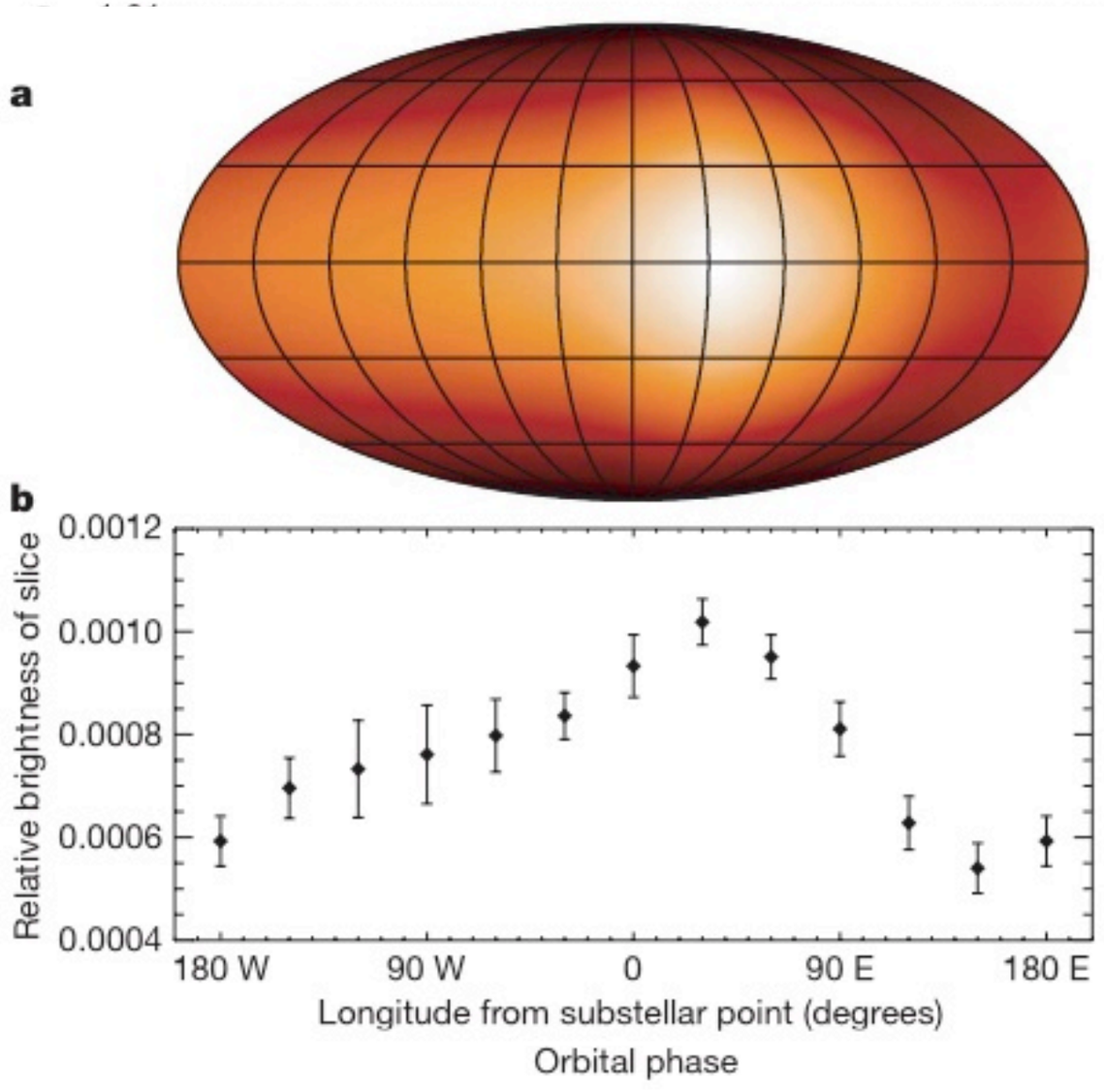

Transit timing

Additional planets in system dynamically perturb the planet's orbit

CoRoT-exo-2b observed over 78 transits with 32s sampling...

... watch this space