Transits Using Warm Spitzer

D. Deming (NASA's GSFC)

D. Charbonneau & H. Knutson (Harvard Univ.)

E. Agol & N. Cowan (Univ. Washington)

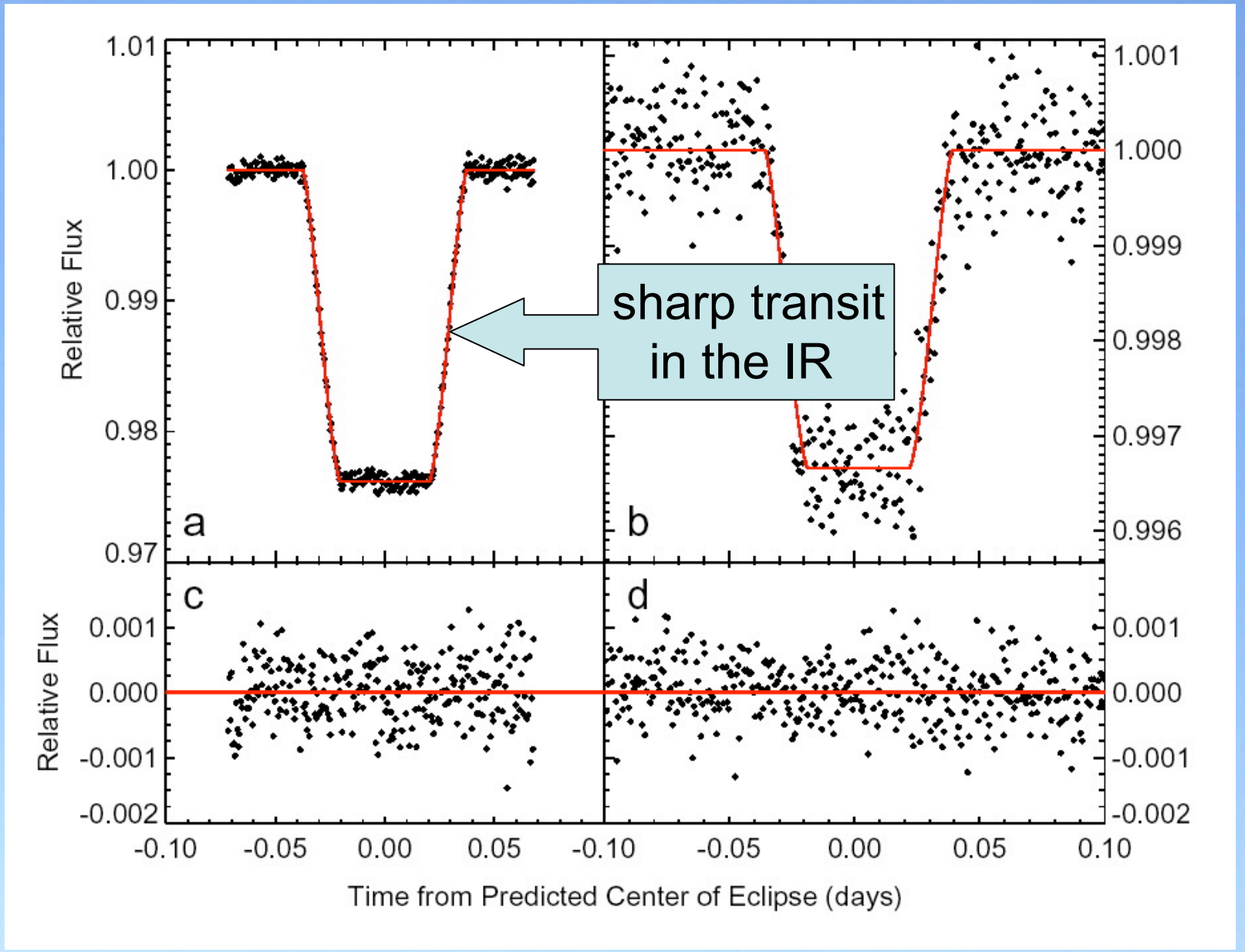
After ~ March 2009, Spitzer's cryogen will be gone then T~ 35K (radiatively cooled), full performance for 3.6 and 4.5 micron photometry, but nothing else

Can still do significant transit and eclipse science:

- **thermal emission and composition (water, CO)**
- **precise radii from transits**
  - **improved radii for giant planets**
  - **radii for close-in super-Earths**
- **direct transit searches for "hot Earths"**
- **transit timing to detect low mass non-transiting planets**

stable, precise, continuous photometry

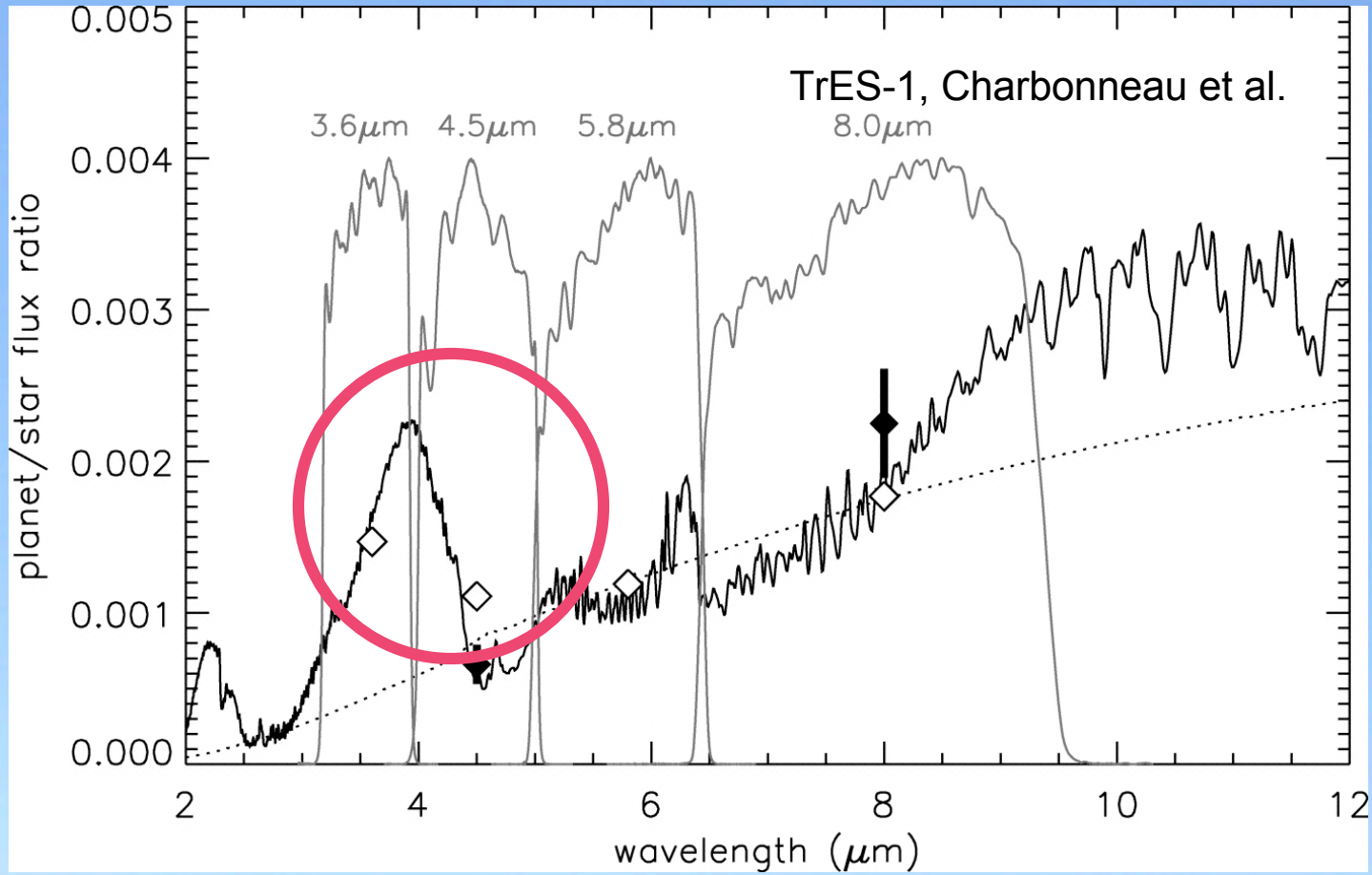
***significant* complement to Kepler**



Knutson et al. 2007 Nature (May 10)

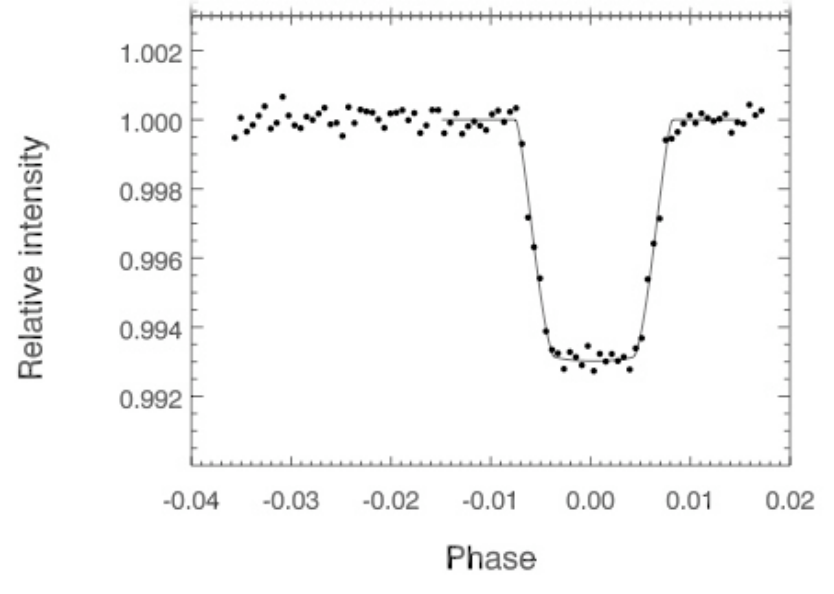
3.6 & 4.5 μm secondary eclipses using Warm Spitzer

Can in principle measure water & CO absorption,
if ground observers can measure thermal continuum



Large programs will be possible on Warm Spitzer: so, how many transiting systems by 2009?

- **Currently there are 16 with V < 13**
- **Expect ~ 20 by early 2008**
- **A transiting "hot Neptune" recently announced**
- **Discovery rate is accelerating**

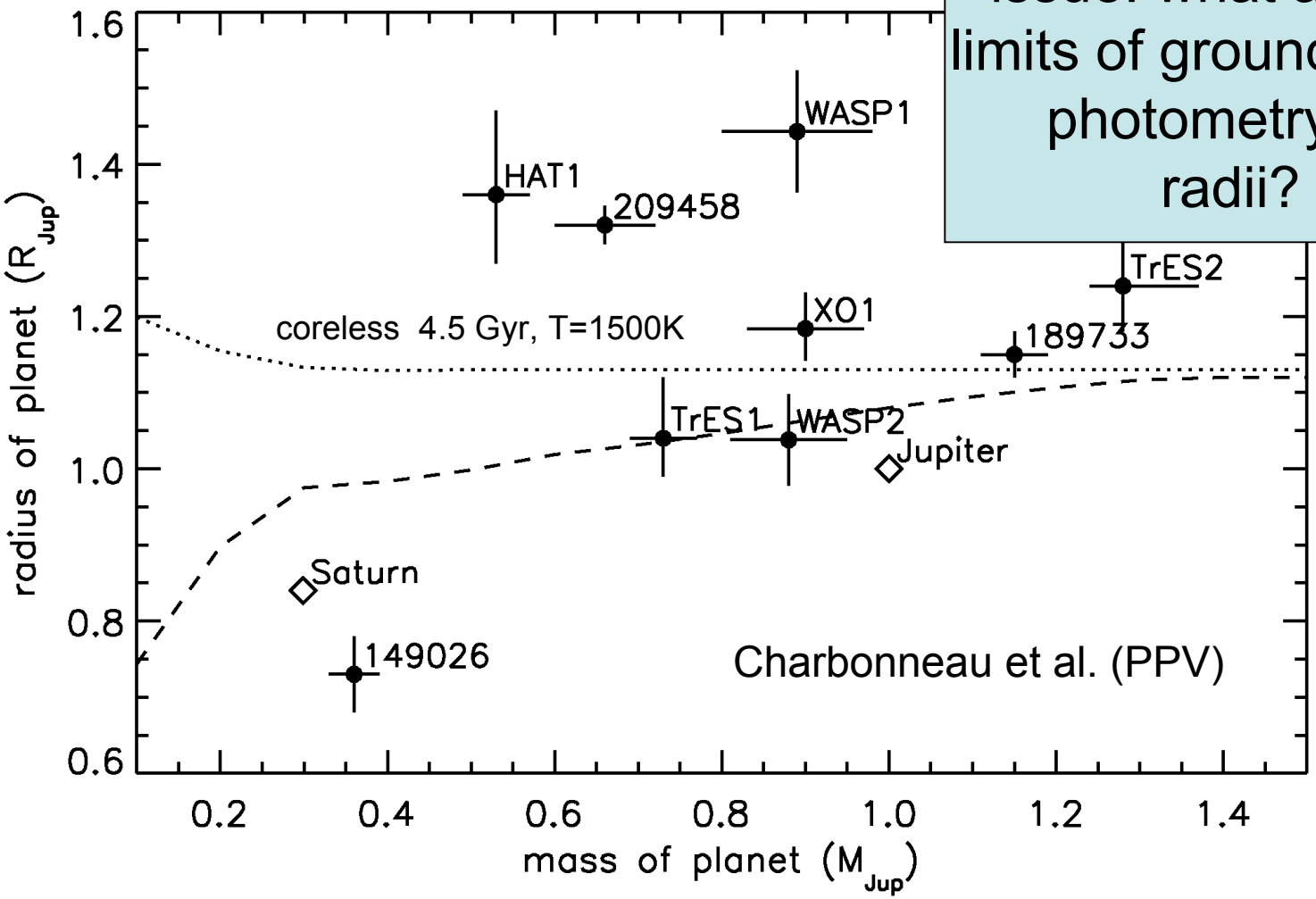


Spitzer transit of GJ 436b
Deming et al. astro-ph /0707.2778

Arguably by 2009:

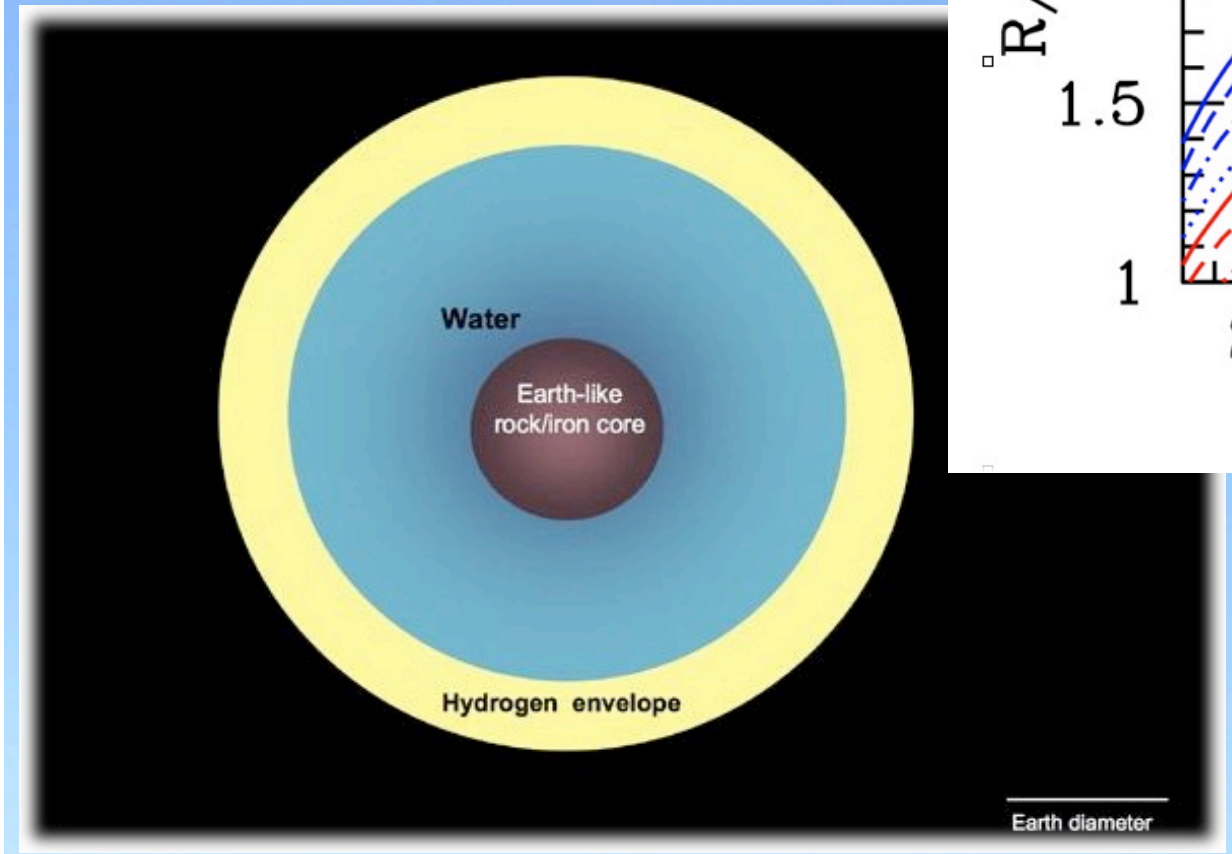
- **–100 transiting hot Jupiters**
- **–10 hot Neptunes**

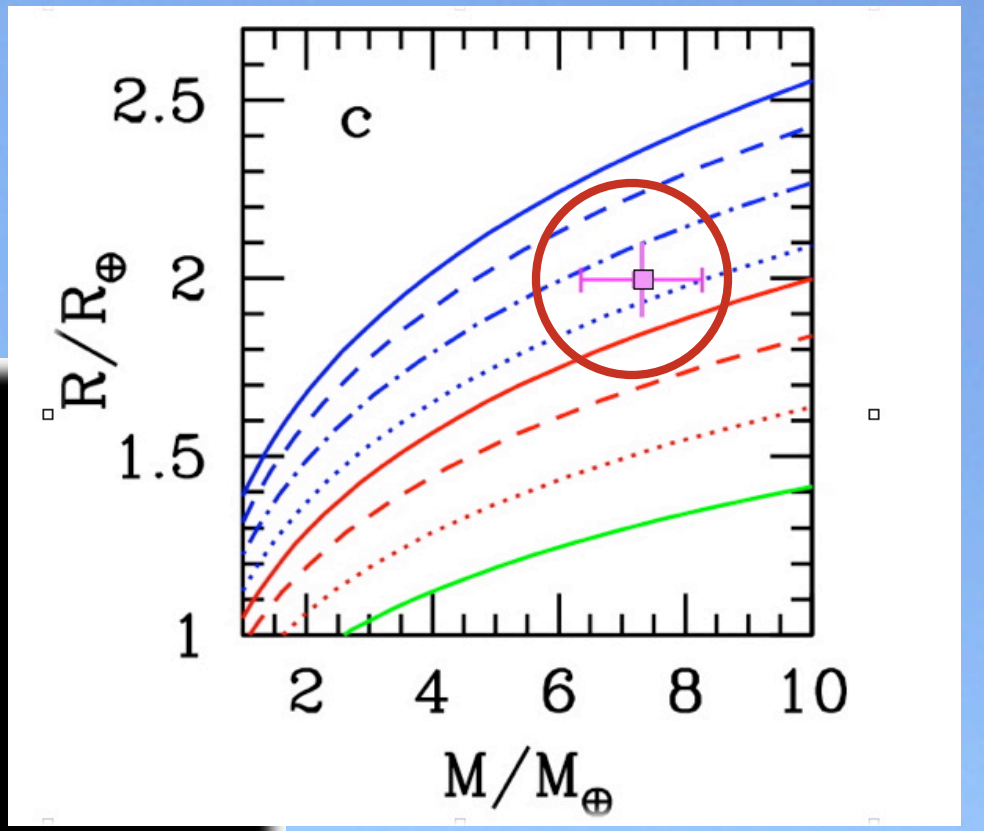
Transit radius precision depends on precise photometry - Spitzer provides both precise photometry, and absence of stellar limb darkening



issue: what are the limits of ground-based photometry for radii?

Warm Spitzer can measure radii of super-Earths, and "Ocean Planets"

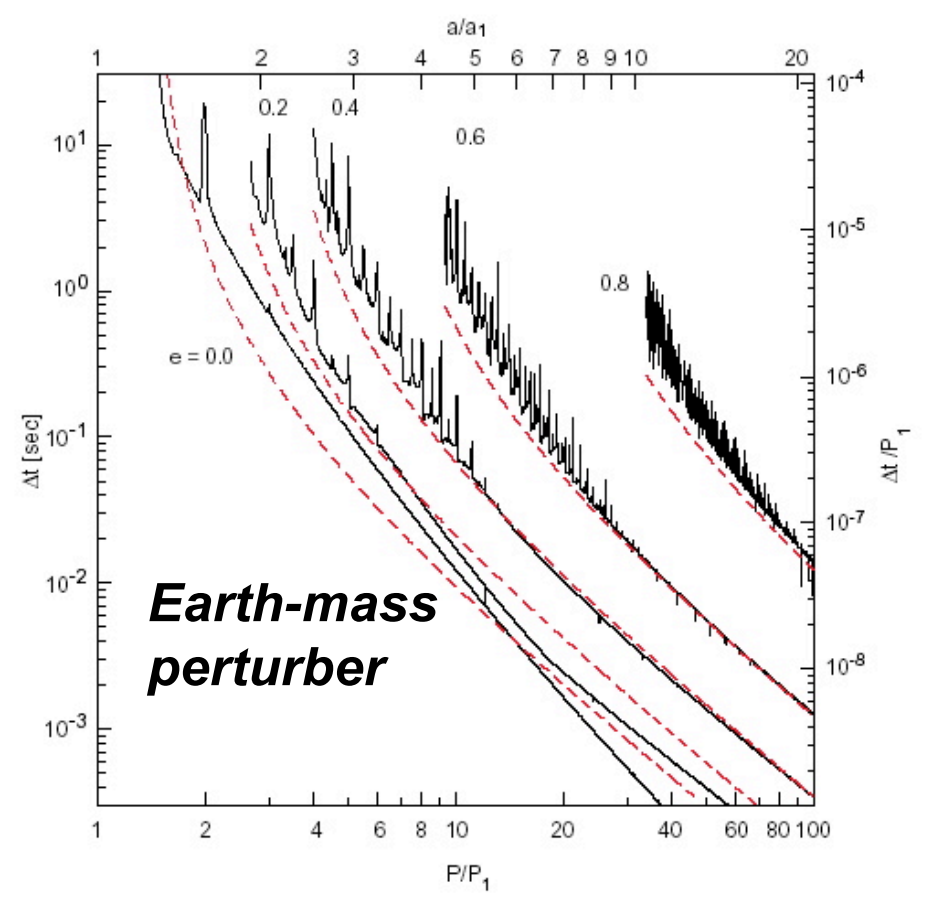




GJ876d

Warm Spitzer will be sensitive to close-in super-Earths in systems already known to contain a hot Jupiter:

- **via direct transit searches**
- **via transit timing perturbations**



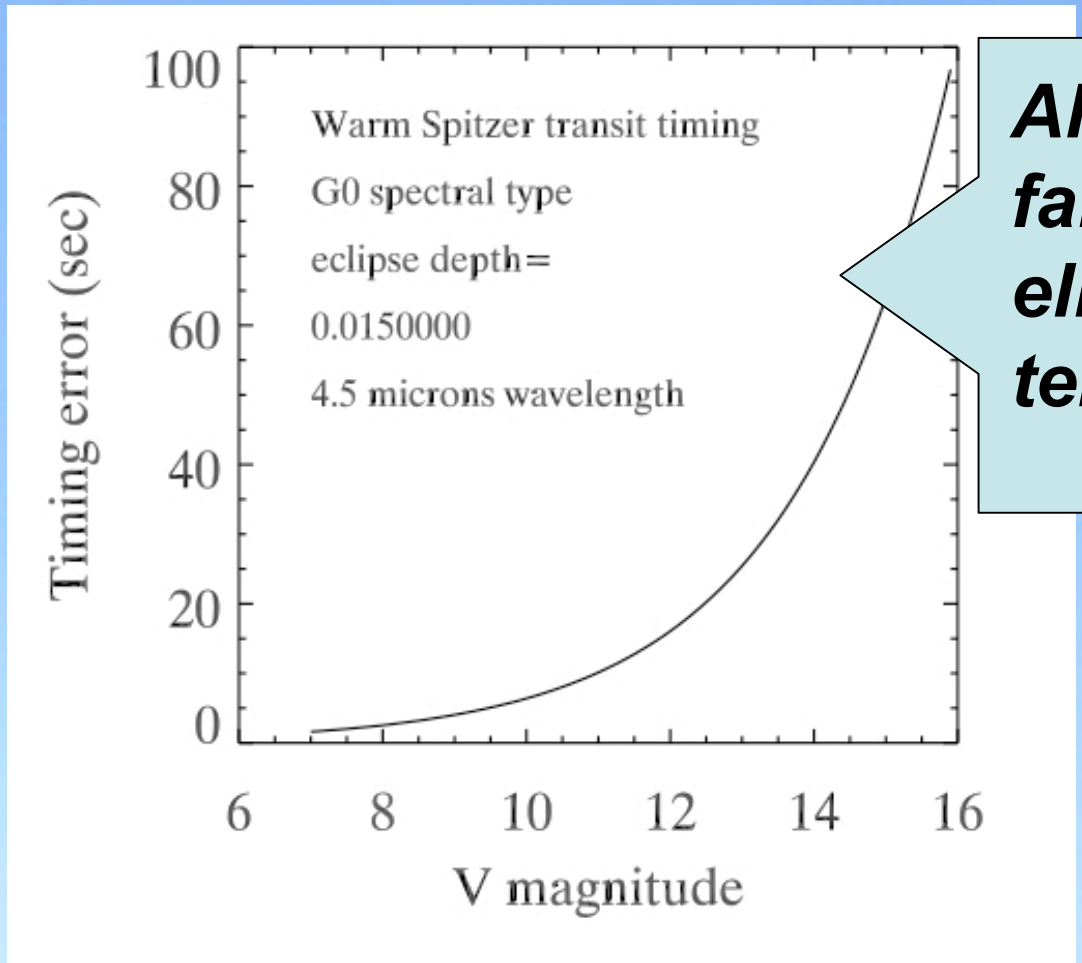
both techniques benefit from resonances

Holman & Murray 2005
Science 307, 1288

Warm Spitzer complements Kepler

- transit timing

- less sensitive to stellar activity



Also, false-positive elimination for terrestrial transits (?)

Conclusions

Warm Spitzer will still be at the cutting edge of exoplanet science, especially for:

secondary eclipses at 3.6 & 4.5 microns

transits of small planets orbiting M-dwarfs

transit timing in the Kepler field