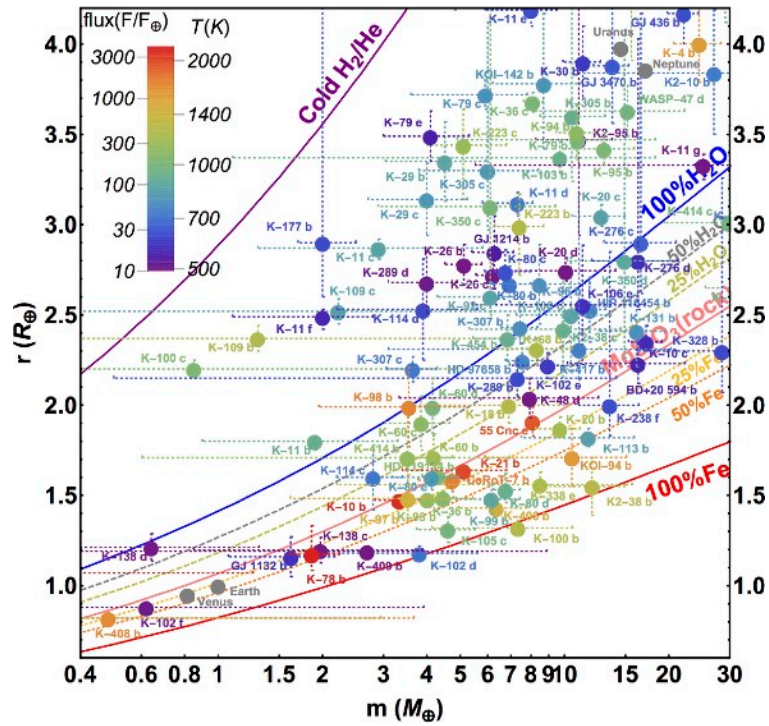
Exoplanet Working Group



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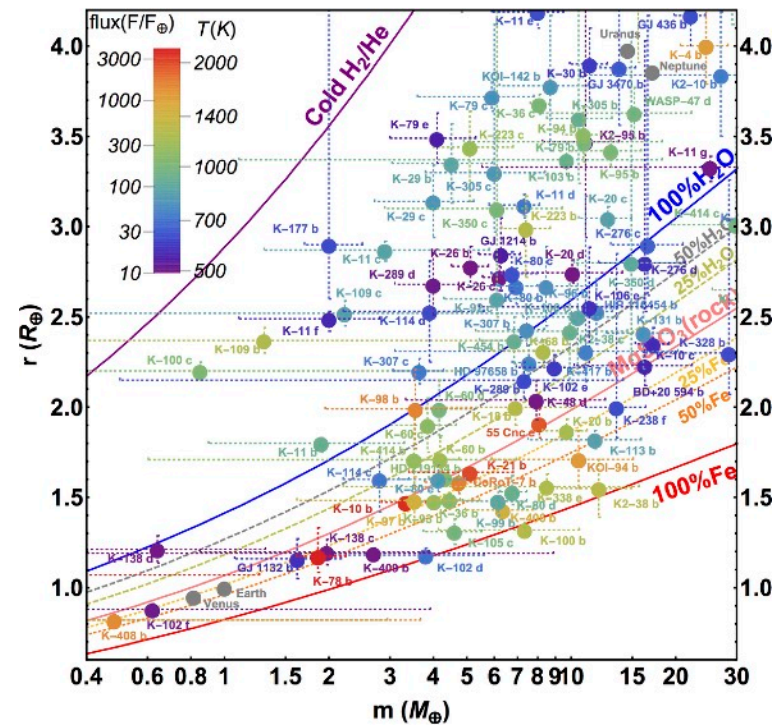
Scientific objectives

- Constraints on exoplanet characteristics
  - Direct measurements of radii
  - Constraining limb darkening
  - Improving stellar evolution models
- Other topics
  - What is the effect of spots/stellar activity?
  - What is effect of binarity

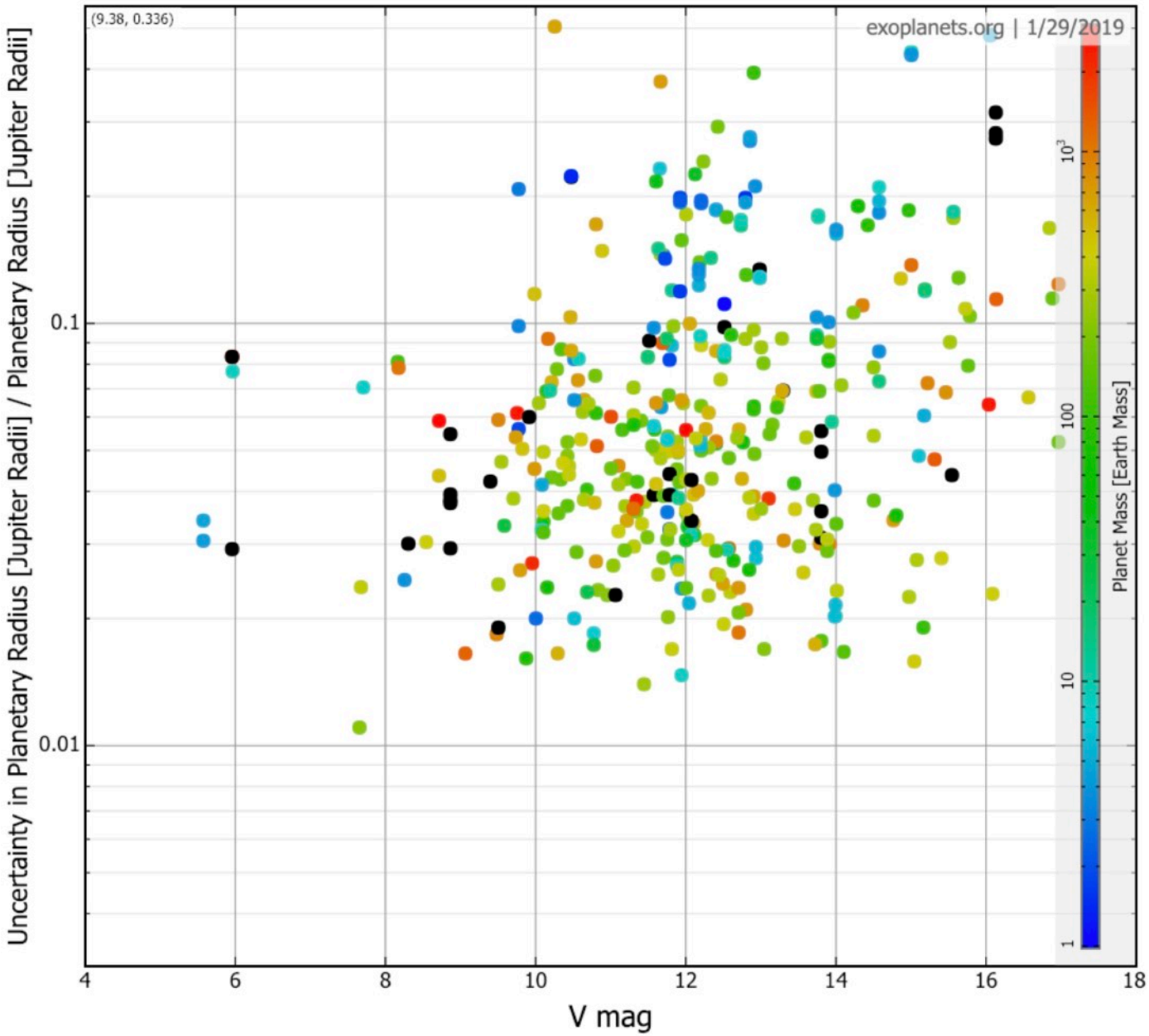
The need for direct radii measurements

- Constraining planetary compositions requires accurate stellar radii
  - Main limitation for planetary models
    - 2% radius accuracy is PLATO's goal for a G0V star with mV=10
    - Present accuracy: around 3% (but highly variable + systematics???)
  - We need independent measurements!

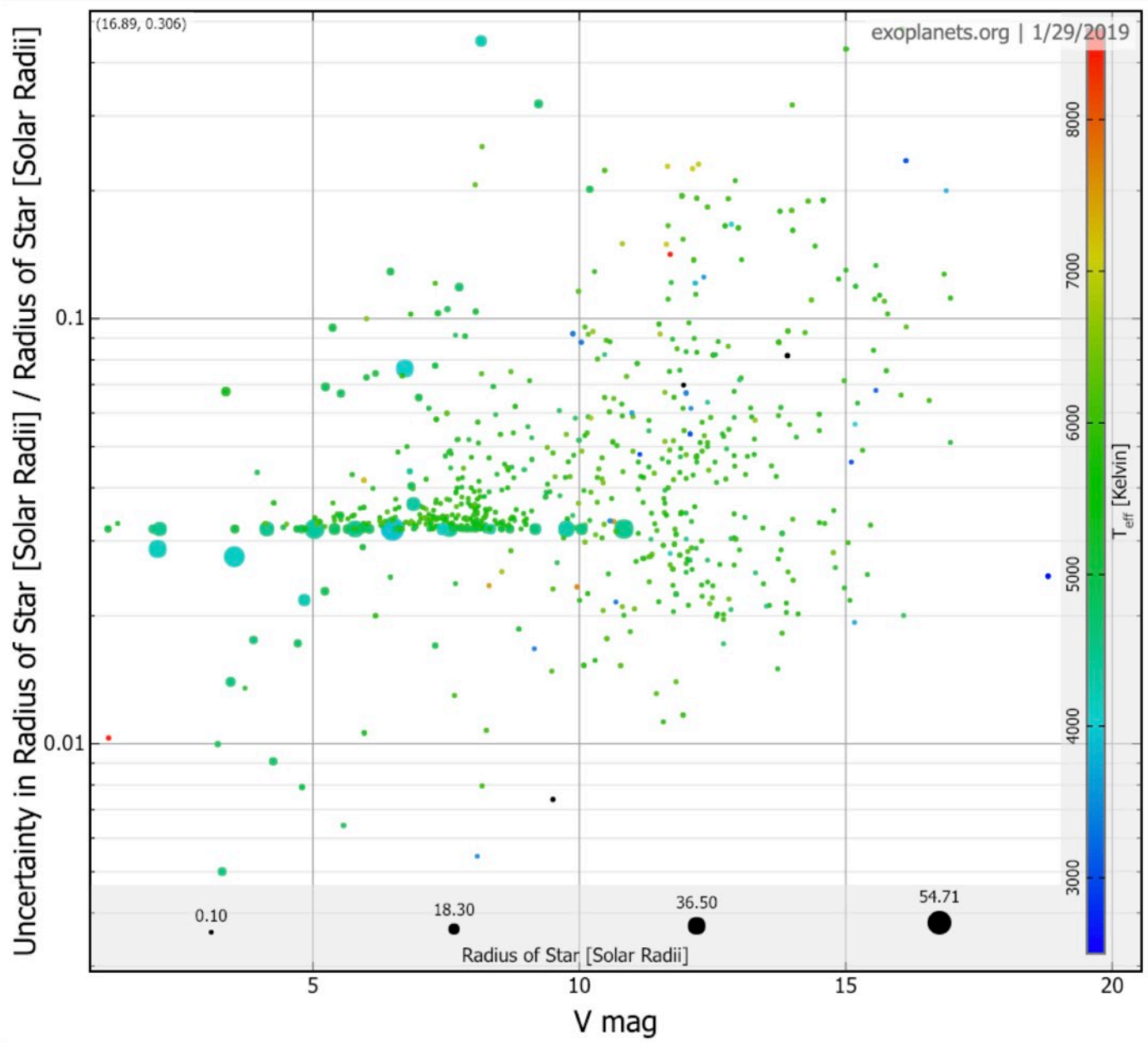


https://www.cfa.harvard.edu/~lzeng/planetmodels.html

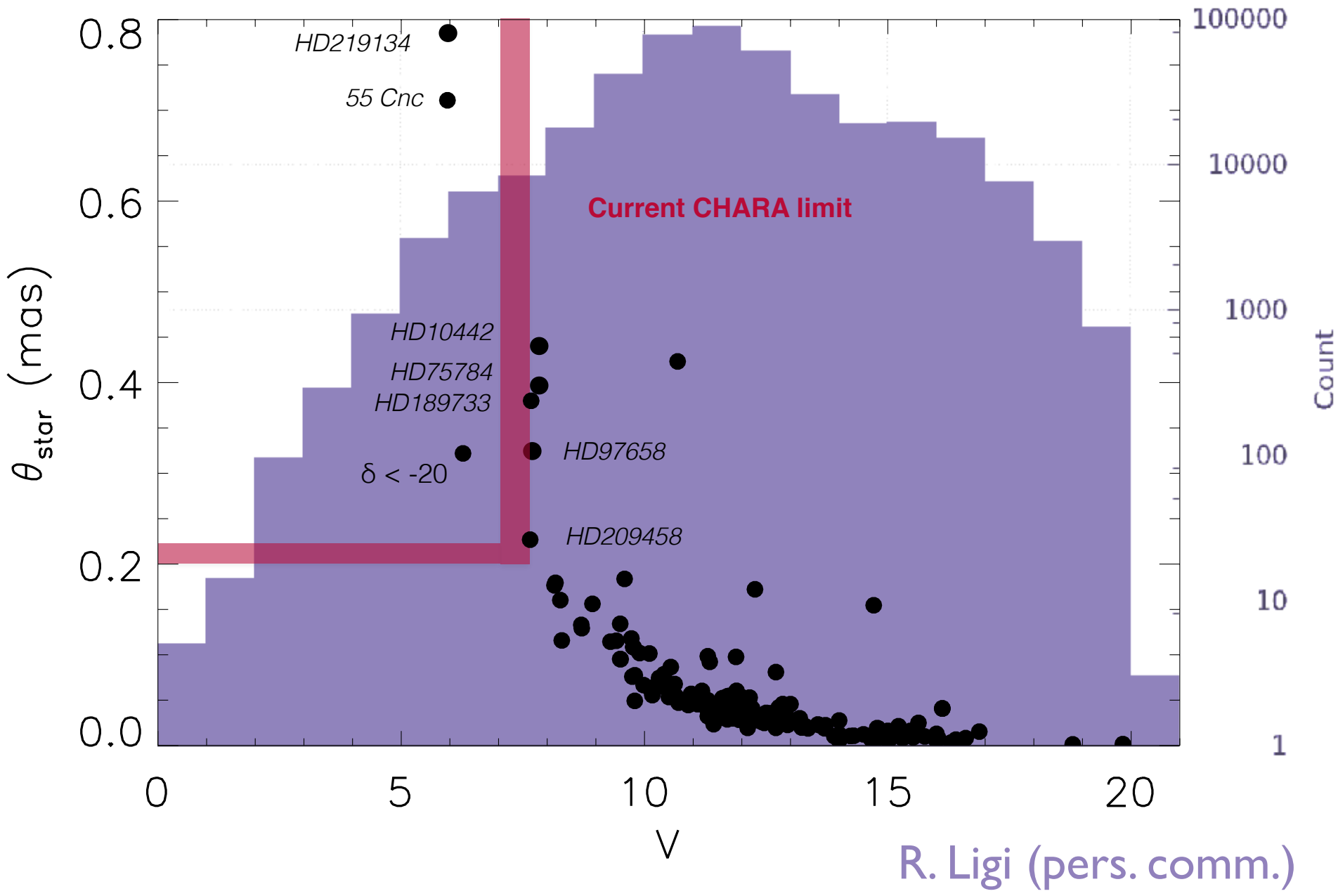
Uncertainty on planetary radii



Uncertainty on stellar radii



Angular sizes for transiting exoplanet hosts



R. Ligi (pers. comm.)

Limb darkening

- Limb-darkening is a crucial ingredient in exoplanet transit fitting.
- Exquisite transit fitting can allow (in some case) a measurement of the planetary shape
  - => Constraint on the planetary core mass
- However
  - Determined empirically by transit light curve fitting (Kepler)
  - Difficult to obtain from Spica
    - Only at best 2 lobes will be observable with Spica.

Question: which precision is needed on LD to infer something valuable on planet shape?

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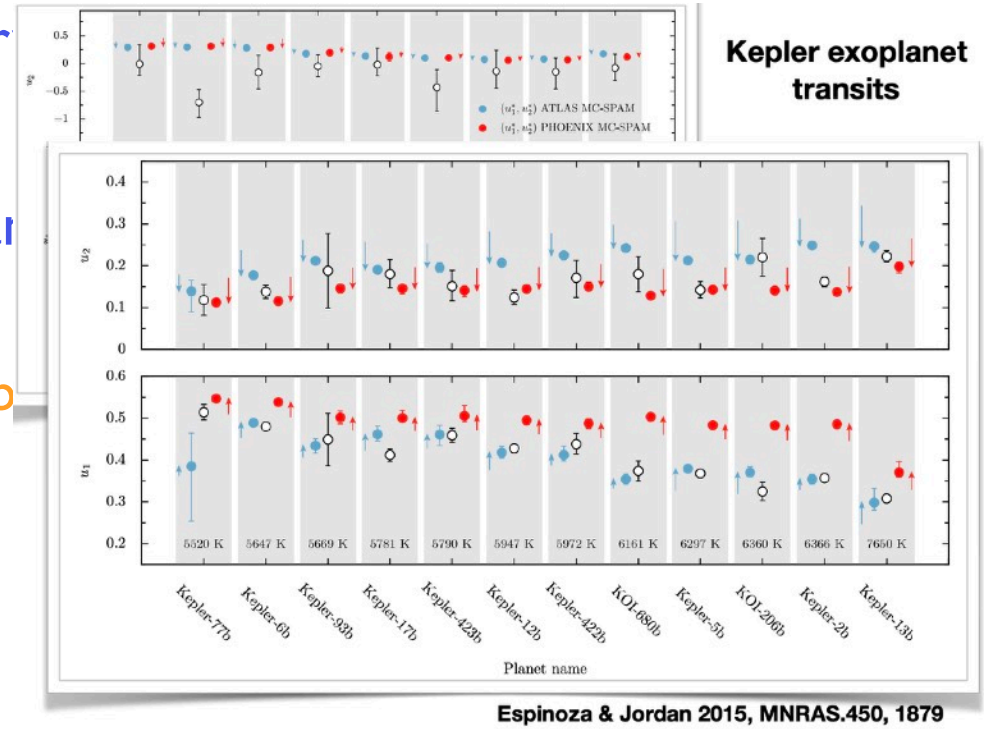


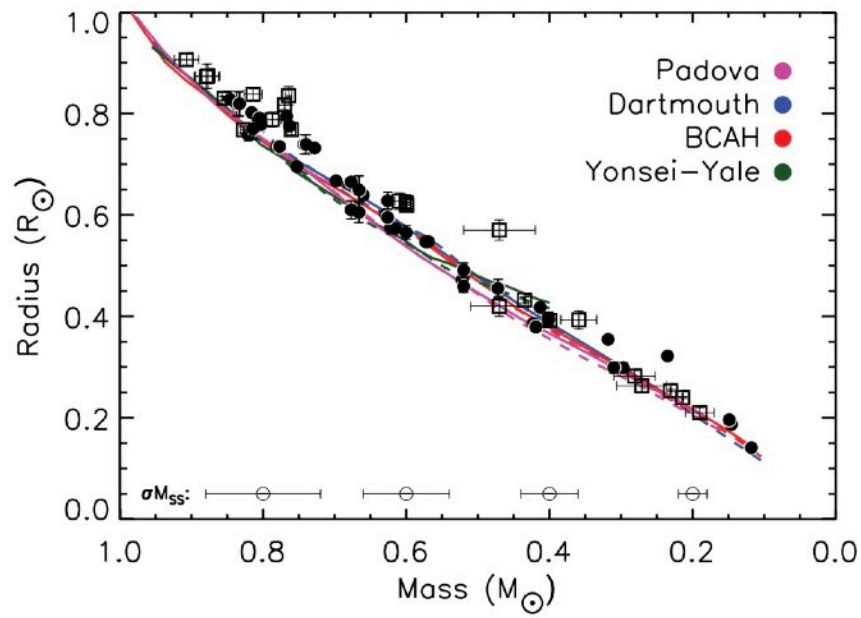
Espinoza & Jordan 2015, MNRAS.450, 1879

Question: which precision is needed on LD to infer something valuable on planet shape?

Improving stellar evolution models

- M dwarfs
  - Discrepant radii between observations and stellar evolution models
  - Crucial in general for exoplanet because of searches for small-size transiting planets

Question: How many M dwarfs are accessible to Spica?



Boyajian et al. (2012)

see also Rabus et al. (2018)

Improving stellar evolution models

- Young stars
  - Degeneracies in the HR diagrams
  - PMS and young stellar evolution is more uncertain
    - Very sensitive to the atmospheric model used

Question: How many young (<1Gyr) bright stars are accessible to Spica?

Possibility: young moving groups? (e.g. Beta Pic moving group: 23Myr)

Effect of spots/stellar activity?

- Link with radii…
  - Appears difficult to do for exoplanet host stars

The Sun at 10pc is 0.76mas in diameter. (? The Sun is 0.93% AU in diameter -> 0.93 mas ?)
Observation of spots has to be based on the displacement of the photocenter (for smaller angular diameters). Star has to be large enough and have large spots (or groups of spots).
Ok on a case-by-case basis. We would need to know in advance whether a target is interesting.
Note that spectropolarimetry would be easier but requires that the star is a fast rotator.

Binarity?

- Binarity may play a role in rare cases:
  - If 2 stars are aligned and have the same effective temperature they may not be seen in high resolution imaging and in spectroscopy.
    - This may affect inferred planetary parameters…
    - Explanation for anomalous planets?
  - GAIA is able to probe for 400mas (DR2) and should be able to go to 100mas (DR3)

Question: Until which magnitude can we probe for companions? Spatial resolution?

Monotransits?

- Some mono transits (due to planets on long orbits) are usually not studied
  - However a constraint on the orbital period can be inferred from the transit duration and shape - if the stellar properties are well known.
  - Getting the stellar radius (& limb darkening) could help.

To be studied/quantified

The 1000 targets

- About 200 stars with exoplanets (not necessarily transiting) are presently accessible with Spica
  - This number will grow.
  - However, it is not clear that non-transiting planets are interesting
- M dwarfs
  - Important for evolution models (discrepant ones)
  - Even when not an exoplanet host
- Young stars
  - Especially those with known ages (e.g. in moving groups…)