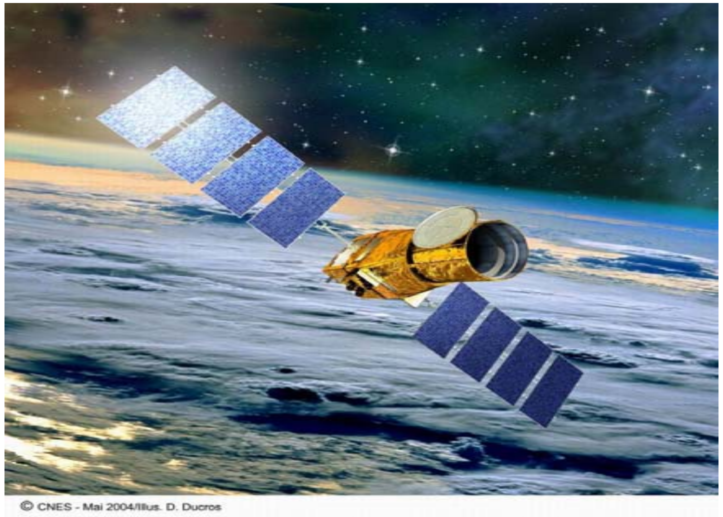
The compositions of ’s giant planets

Tristan Guillot, Mathieu Havel
OCA, Nice

Masahiro Ikoma
OCA, Nice & Tokyo Tech

Nicolas Iro
NASA/Goddard

François Fressin
CfA, Harvard

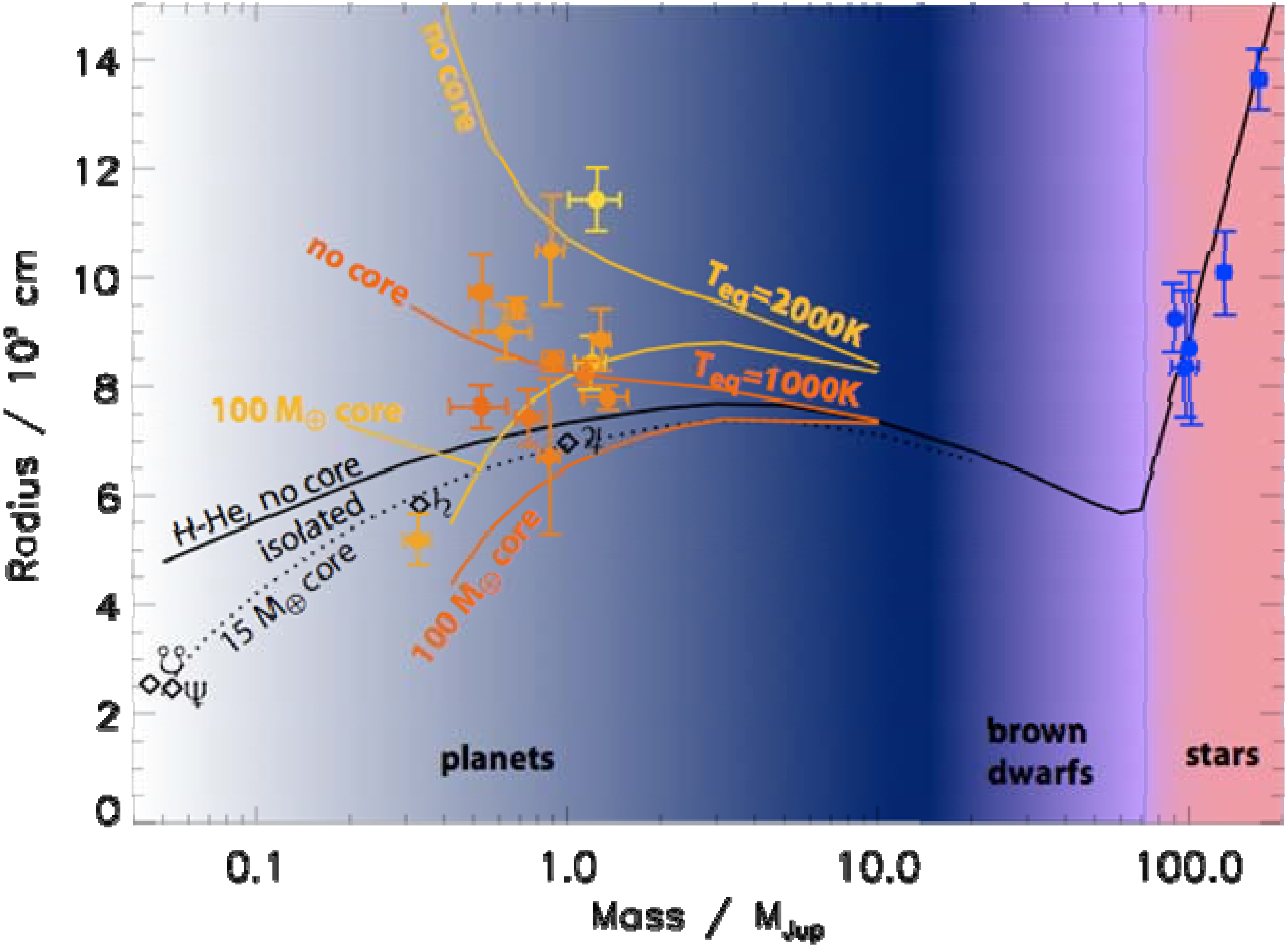


Mass-radius relation & models

The CoRoT planets: a family portrait

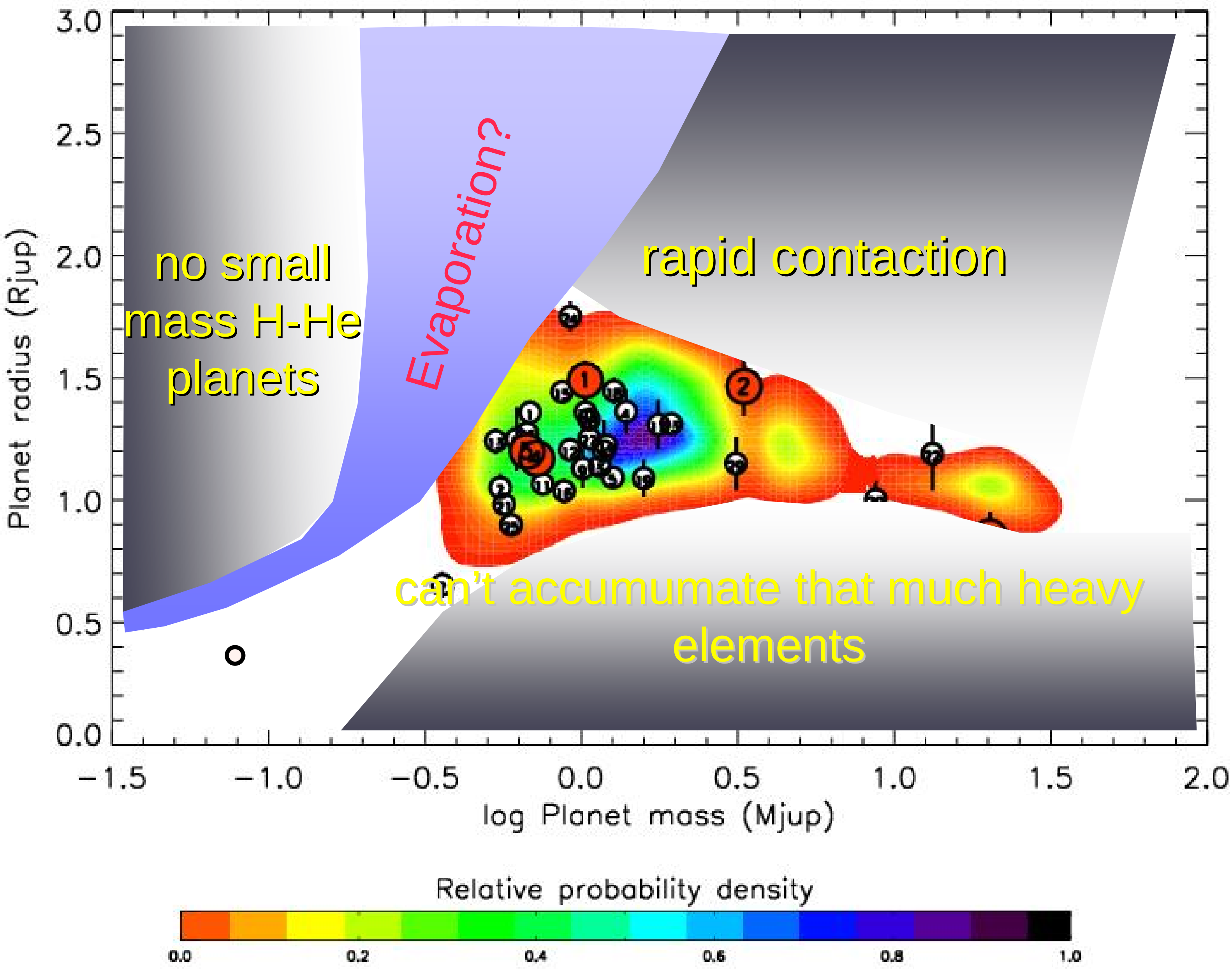
Confirmation of the star-planet metallicity correlation

M-R relations



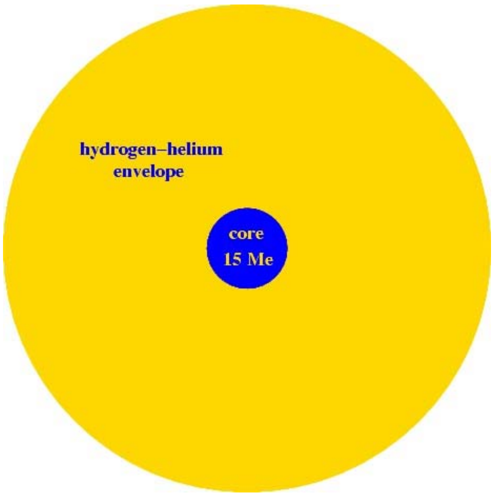
Guillot ARE&PS (2005)

M-R relations



Fressin et al. A&A (2009)

The model



- Assumes solar-composition envelope + central dense core
- EOS: SCVH 1995
- Opacities: Allard et al. (2001)
- Atmospheric boundary: Temperature at 10bars = f(Teq)
- Accounts for the difference between the measured transit radius (~1mbar) and the model radius (10bars)

$$\begin{aligned}
\frac{\partial P}{\partial r} &= -\rho g \\
\frac{\partial T}{\partial r} &= \frac{\partial P}{\partial r}\frac{T}{P}\nabla_T. \\
\frac{\partial m}{\partial r} &= 4\pi r^2 \rho. \\
\frac{\partial L}{\partial r} &= 4\pi r^2 \rho \left(\dot{\epsilon} - T\frac{\partial S}{\partial t}\right)
\end{aligned}$$

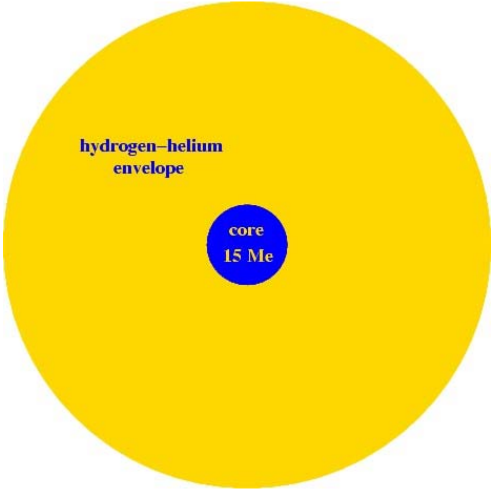
Explaining the “inflated” planets

- Problem: planets such as HD209458b are too large compared to conventional models

- Two classes of models account for these large radii:

  - Added tidal heat: Bodenheimer et al. 2001, Guillot & Showman 2002, Guillot et al. 2006, Baraffe et al 2008; see also Jackson et al. 2008, Levrard et al. 2009

  - Increased opacities: Guillot et al. 2006, Burrows et al. 2007



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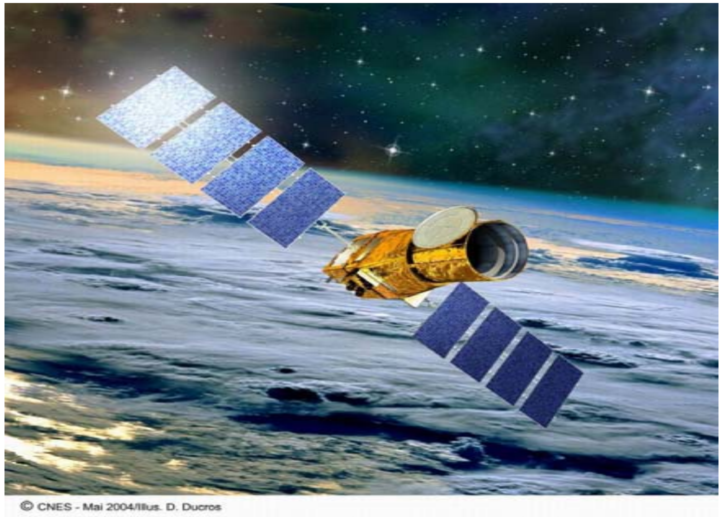

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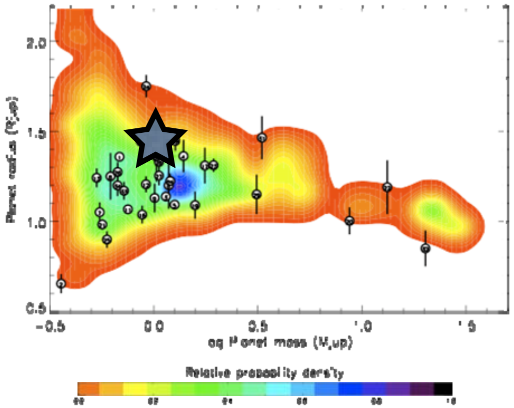
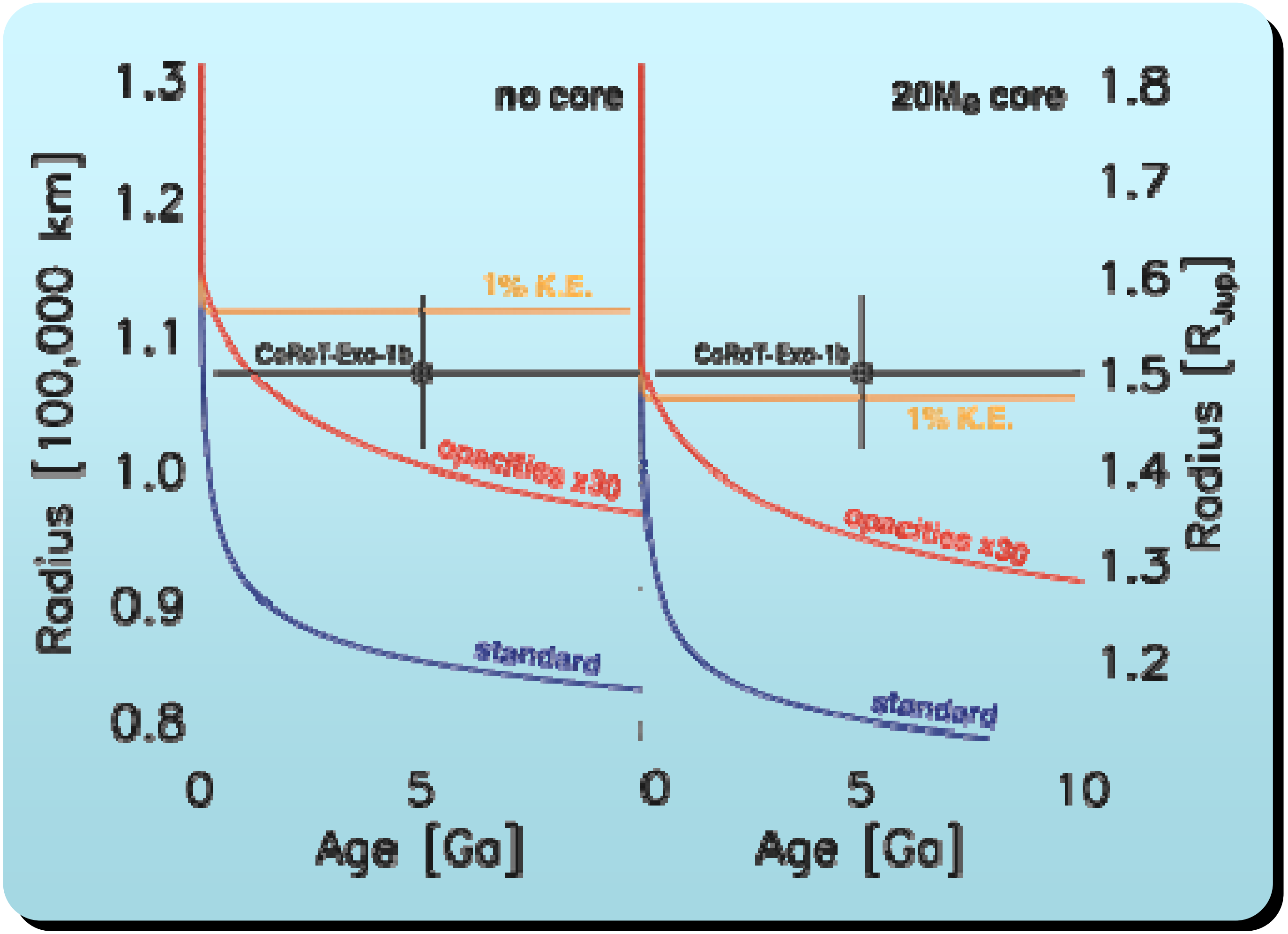
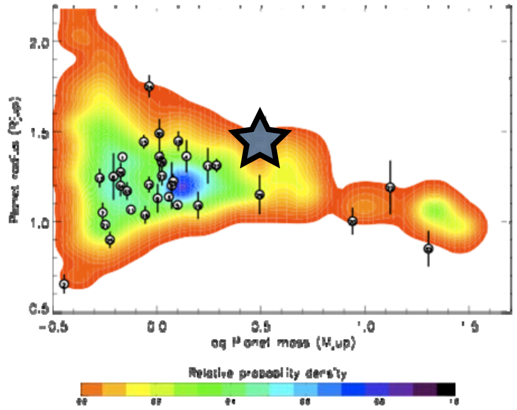


CoRoT-Exo-1b

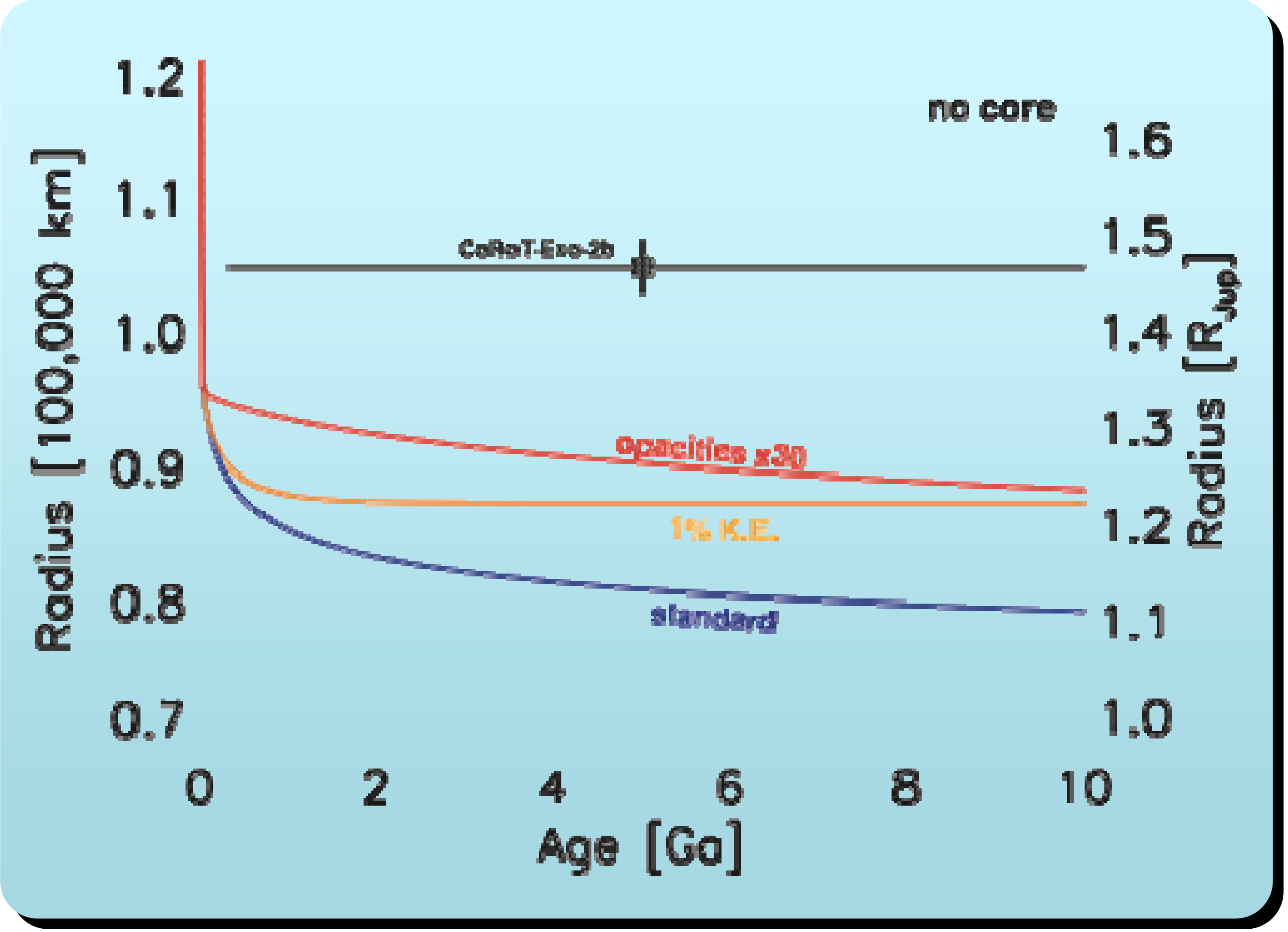
- CoRoT-Exo-1: the lowest [Fe/H] star with a transiting planet
- 1 Mjup, 1.5Rjup
- CoRoT-Exo-1b is an inflated planet with a small core, well explained by the increased opacities or tidal head models

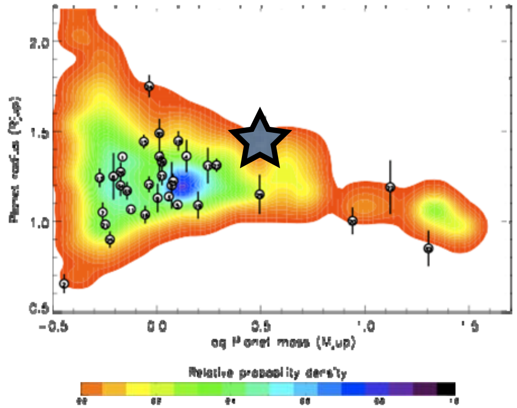




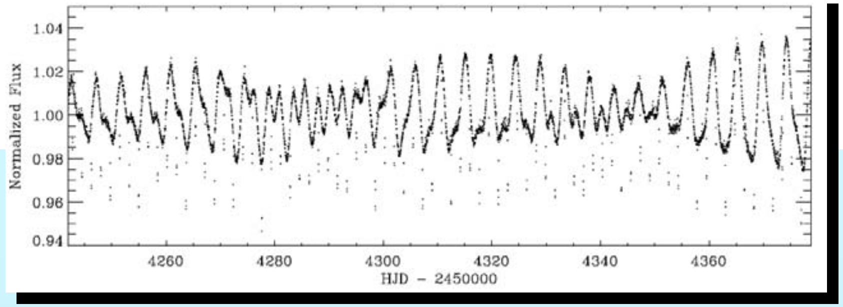
CoRoT-Exo-2b

- CoRoT-Exo-2: the most anomalously large planet
- 3.2 Mjup, 1.46Rjup
- CoRoT-Exo-2b's large size is not explained by any model!





CoRoT-Exo-2b



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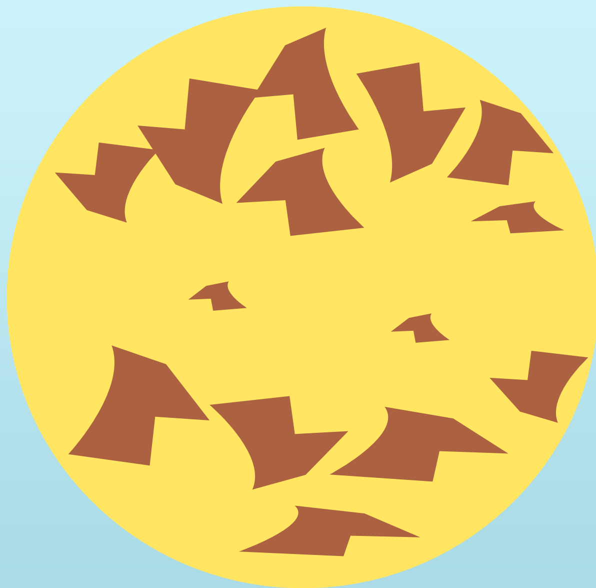
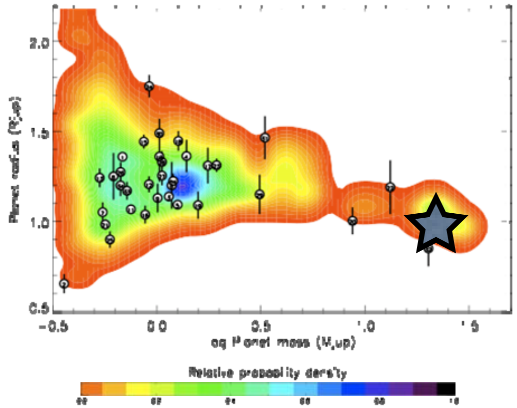
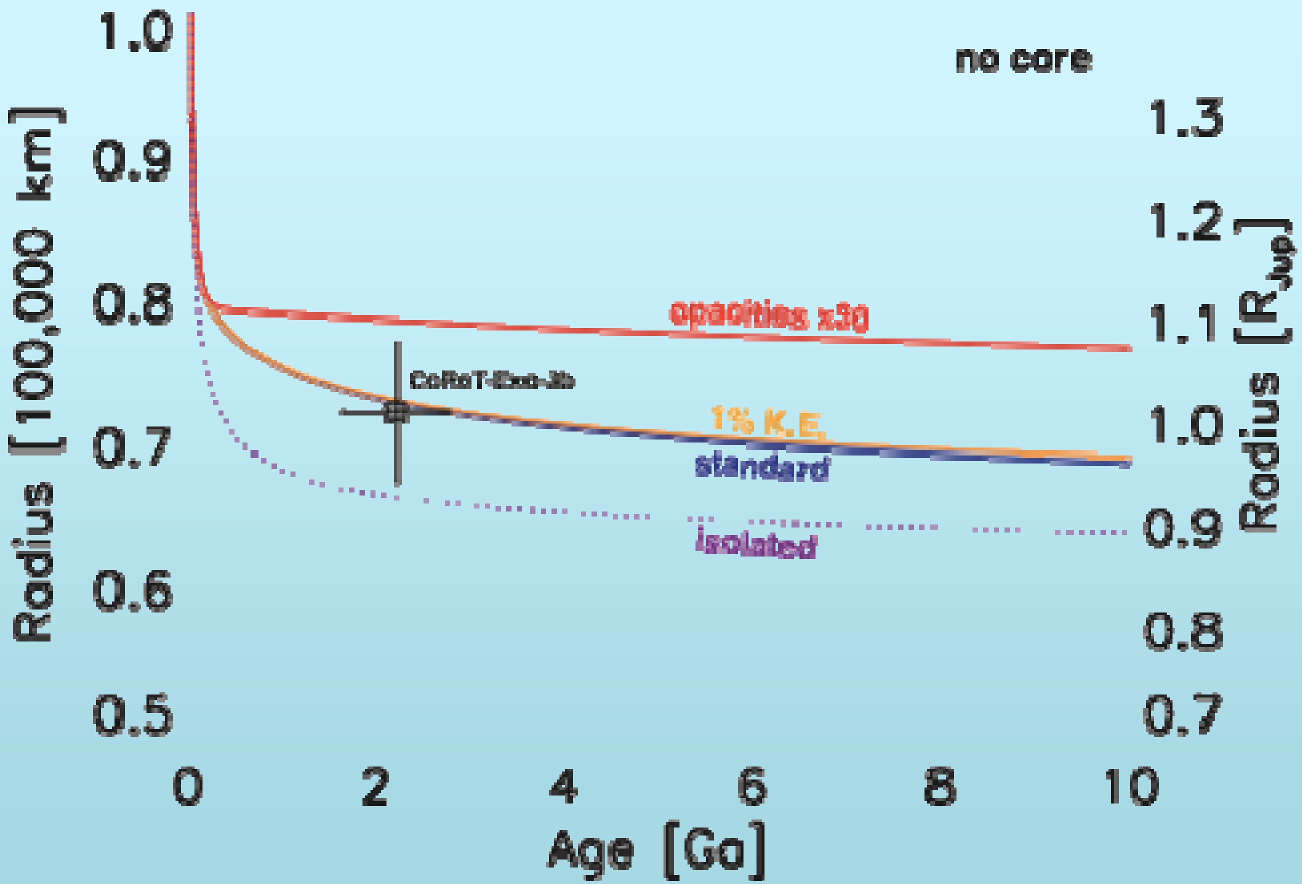


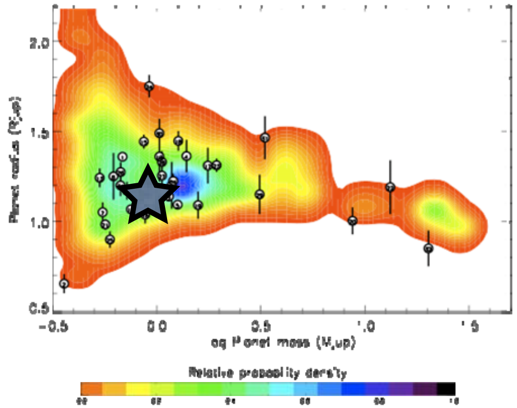
Overestimate of the planetary radius due to latitudinal brightness variations accross the stellar surface???



CoRoT-Exo-3b

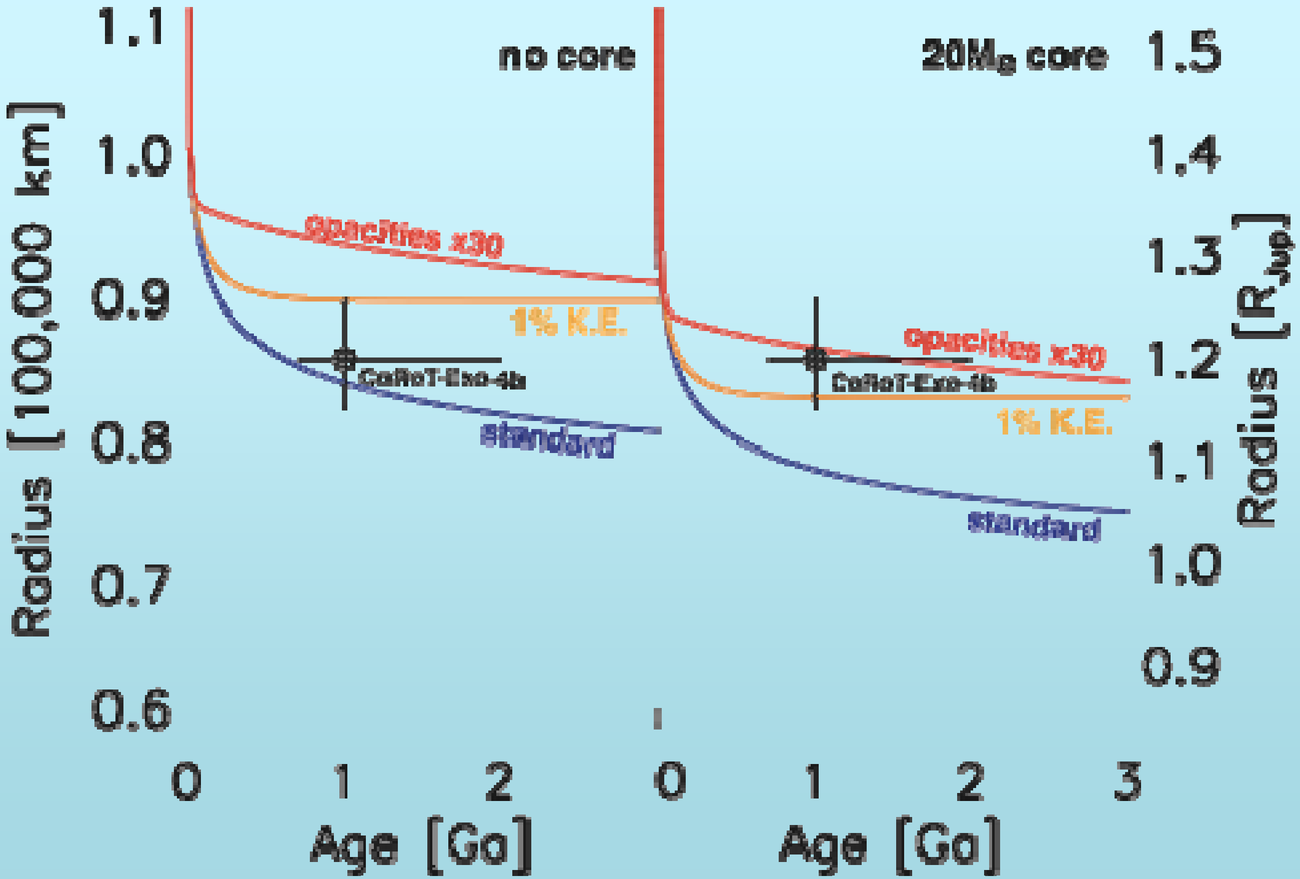
- CoRoT-Exo-3b: the most massive transiting brown dwarf
- 22 Mjup, 1.0Rjup
- => favors the tidal heat model





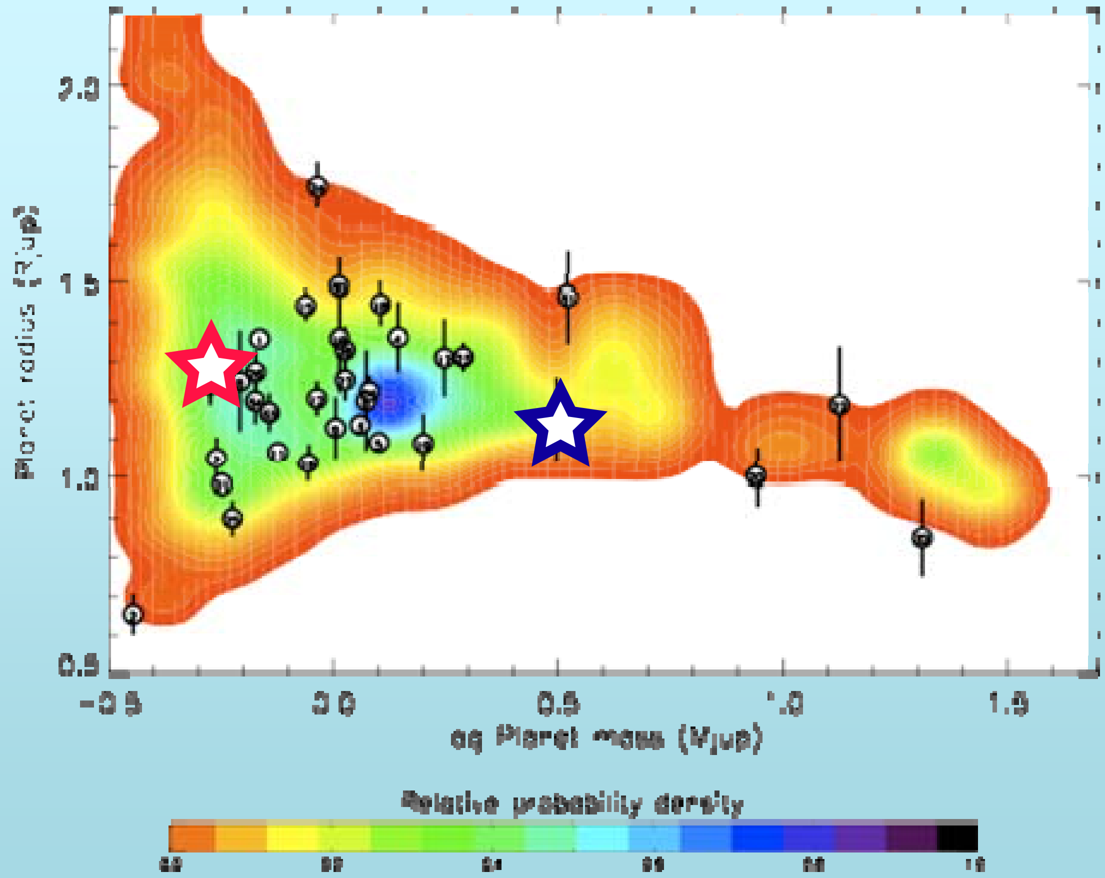
CoRoT-Exo-4b

- CoRoT-Exo-4b: a small planet with a small core
- 0.72 Mjup, 1.19Rjup

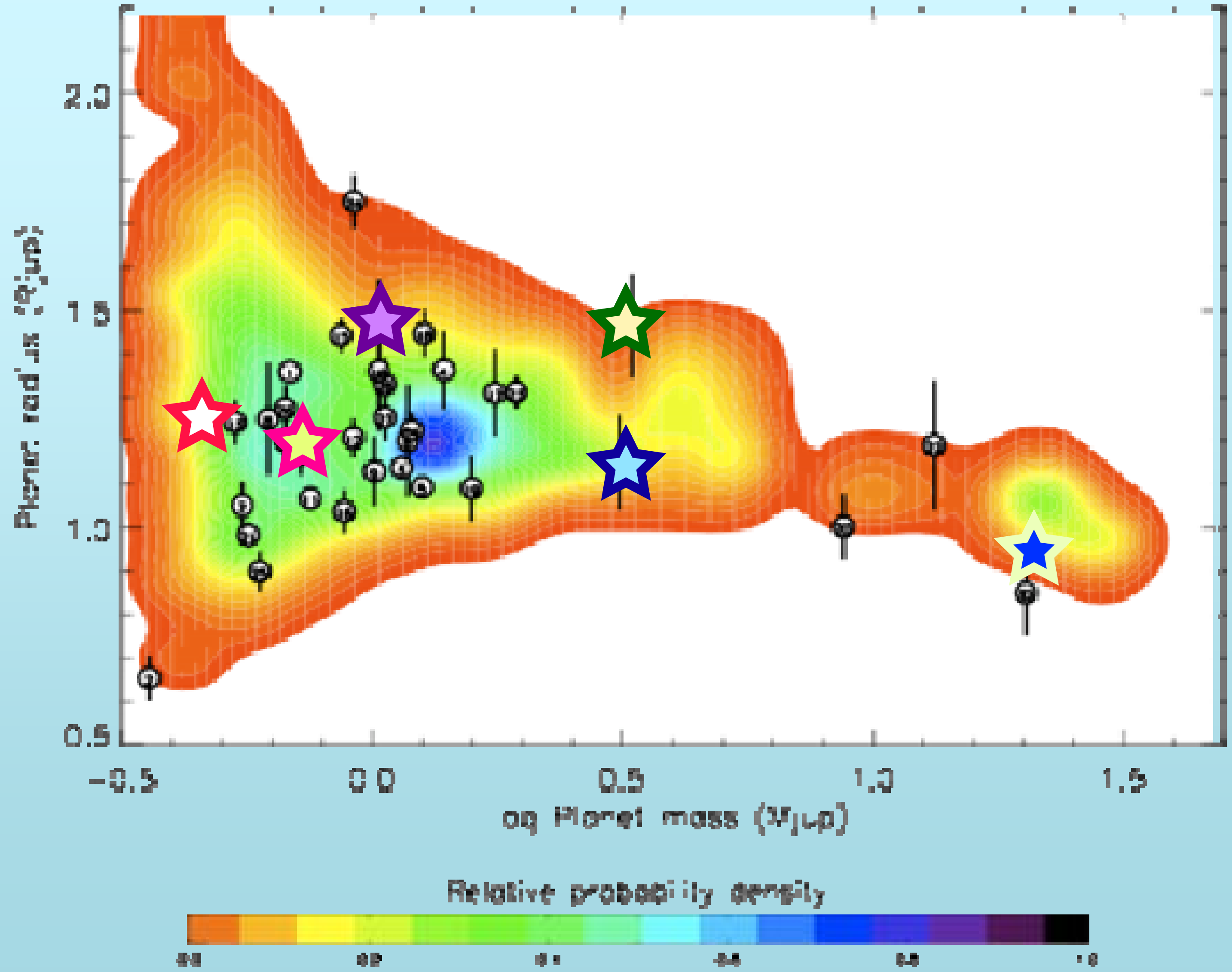


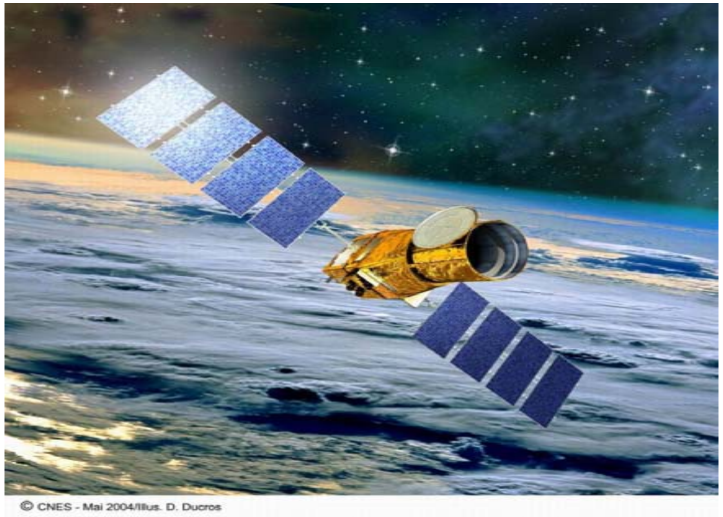
CoRoT-Exo-5b & 6b

- CoRoT-Exo-5b: 0.46 Mjup, 1.28Rjup, P=4 days
- CoRoT-Exo-6b: 3.3 Mjup, 1.15Rjup, P=8.9 days



CoRoT's family portrait





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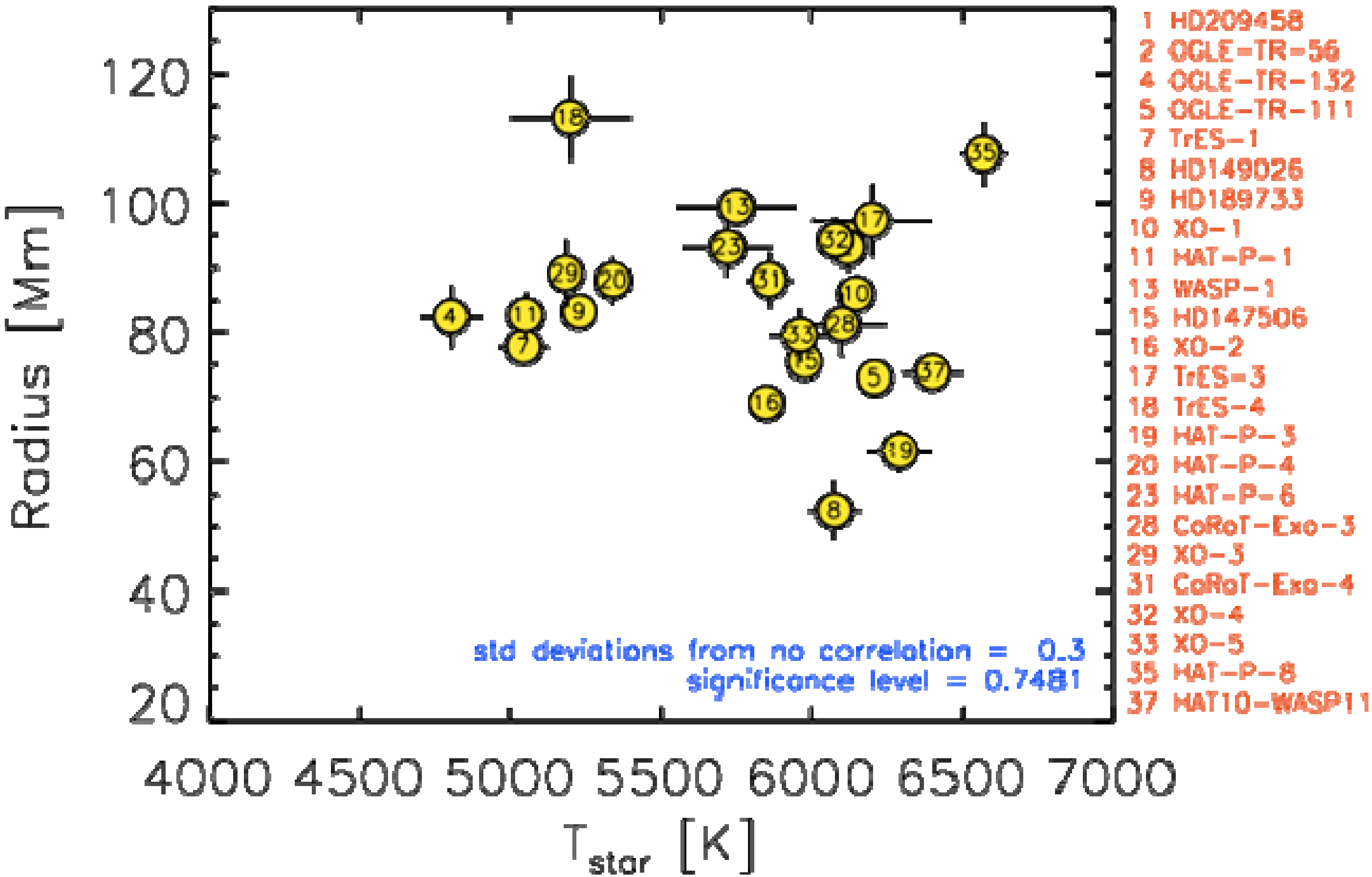
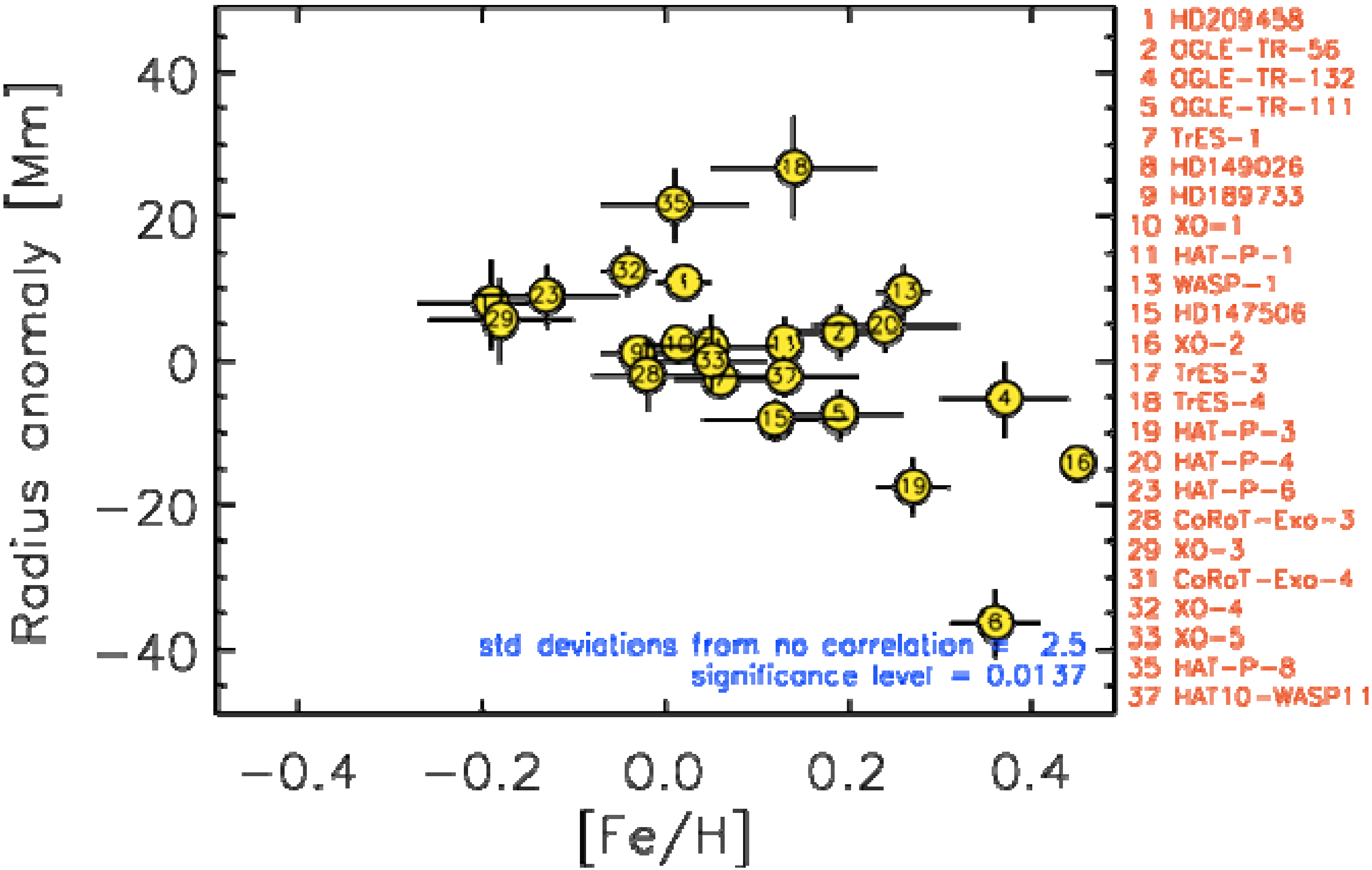
Planetary radius vs. T_{star}



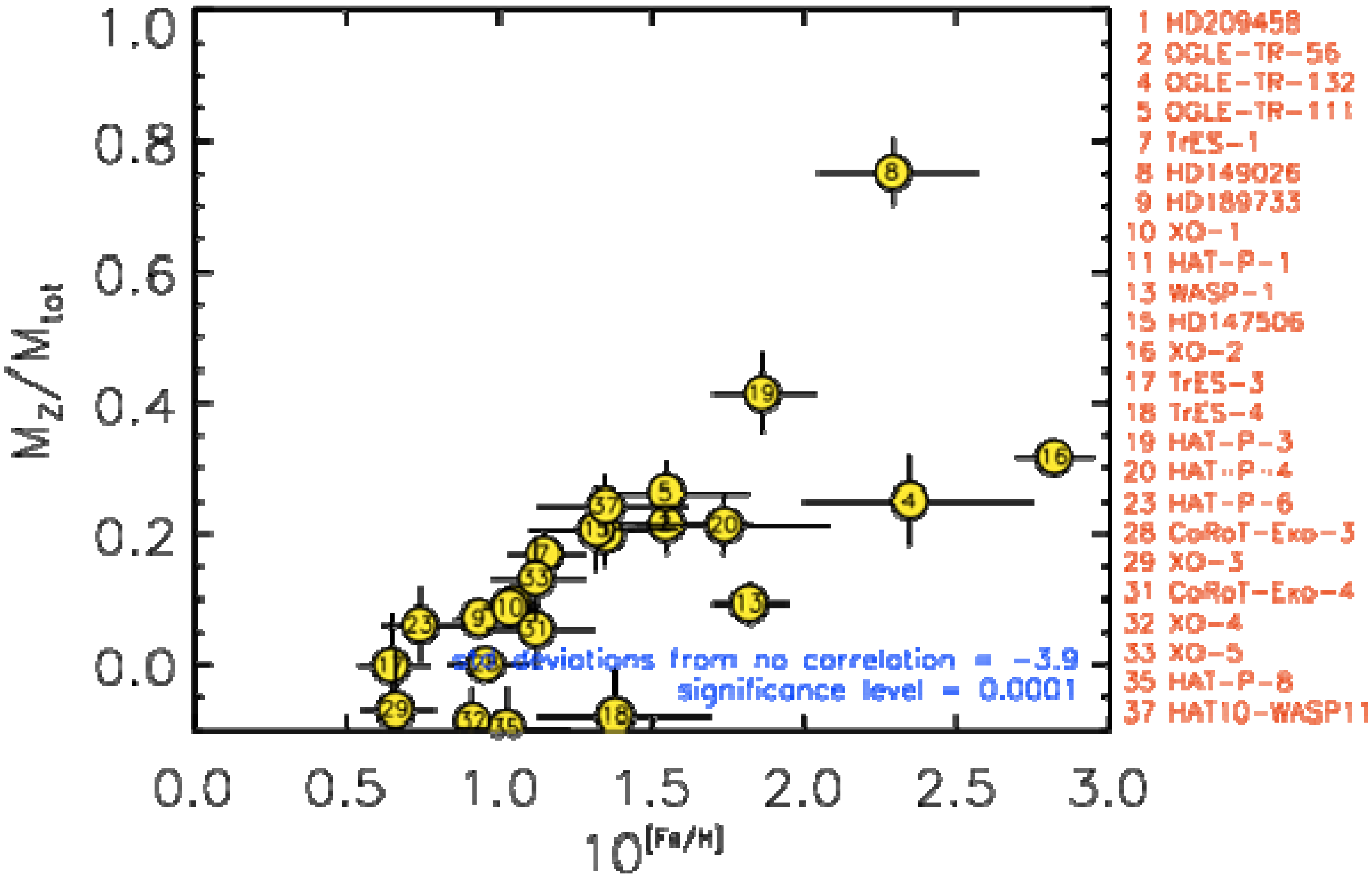
Radius anomaly vs. [Fe/H]

Radius anomaly= difference between observed radius and modelled radius with a standard evolution model



M_Z/M_{tot} vs. [Fe/H]

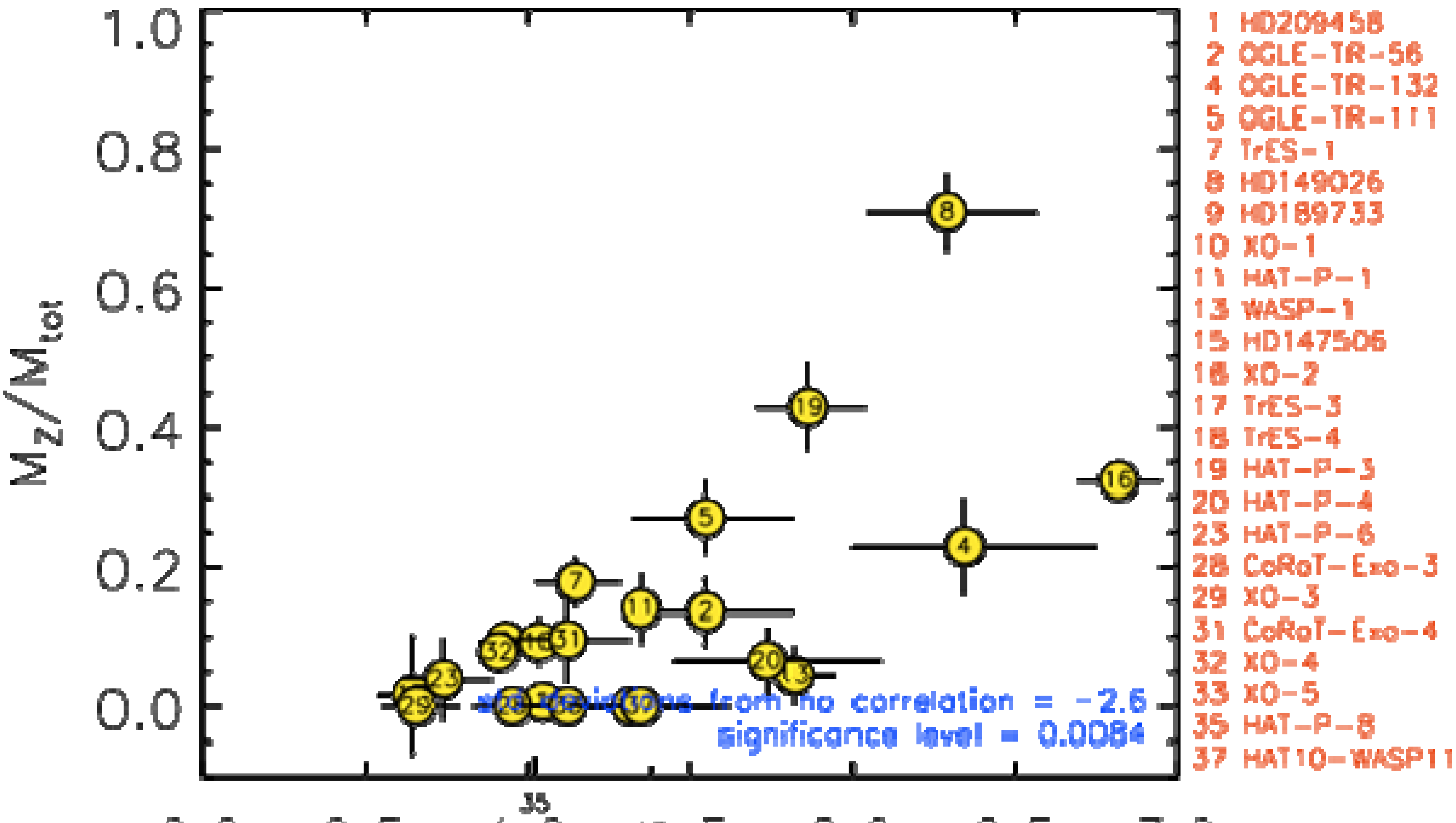
K.E. model (1% of incoming flux added at center)



Guillot et al. A&A (2006); Guillot Physica Scripta (2008)

M_Z/M_{tot} vs. [Fe/H]

d opacities model



Conclusions

CoRoT has discovered several giant planets that are crucial to understand the formation of planetary systems

- Around a metal-poor star, a brown dwarf, an active star
- CoRoT-Exo-2b has a radius that is unexplained by all present models

Exoplanetology: some statistics!

- Large masses in heavy elements in some giant planets
- Significant correlation between planetary Mz & stellar [Fe/H]
- To be explained by formation models

CoRoT needs to observe more fields & to reobserve selected fields

- To discover new intriguing planets (especially around bright stars)
- To discover smaller mass planets that are harder to detect