Cool Dwarfs and Hot Giants
Atmosphere models across the substellar transition

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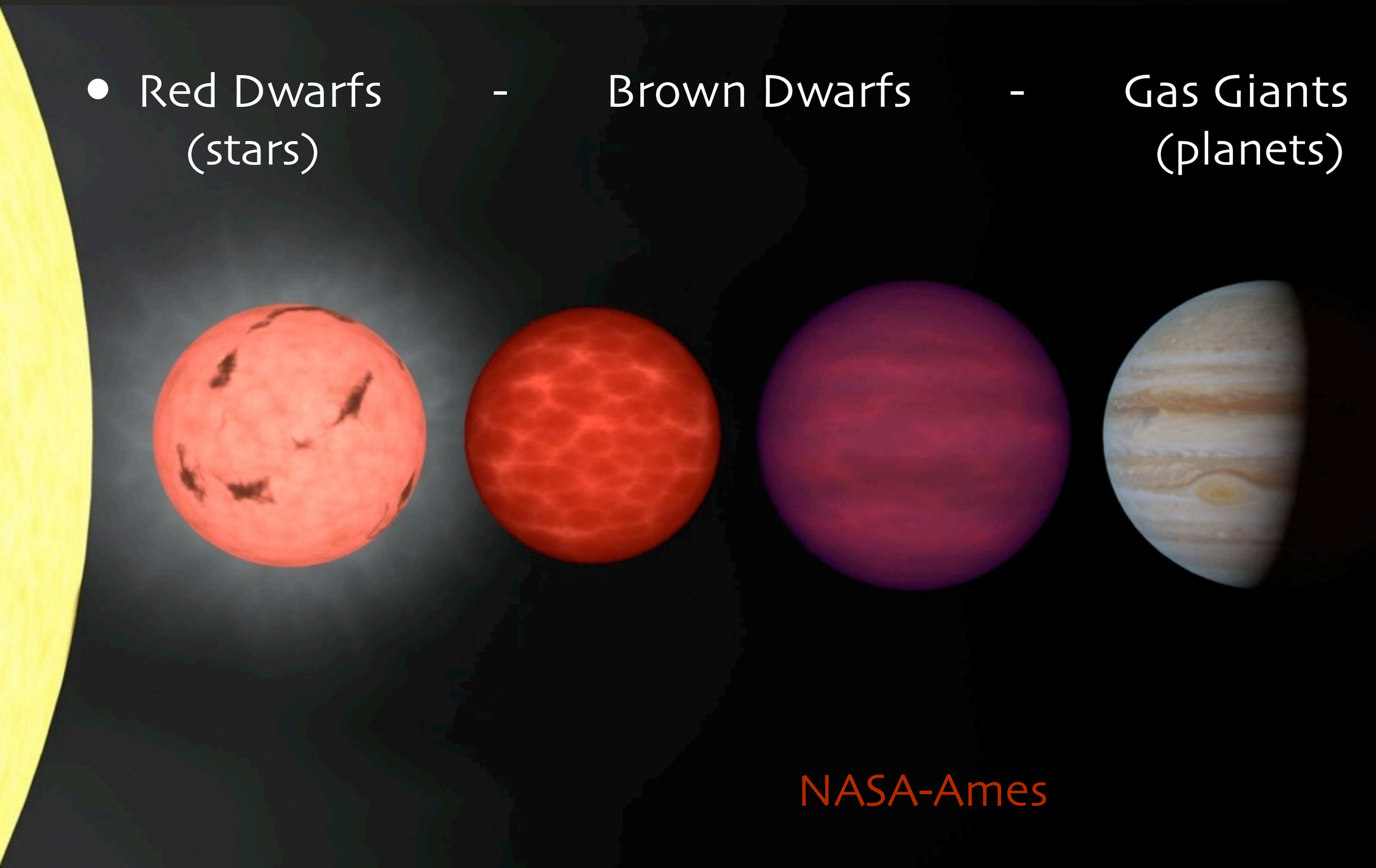
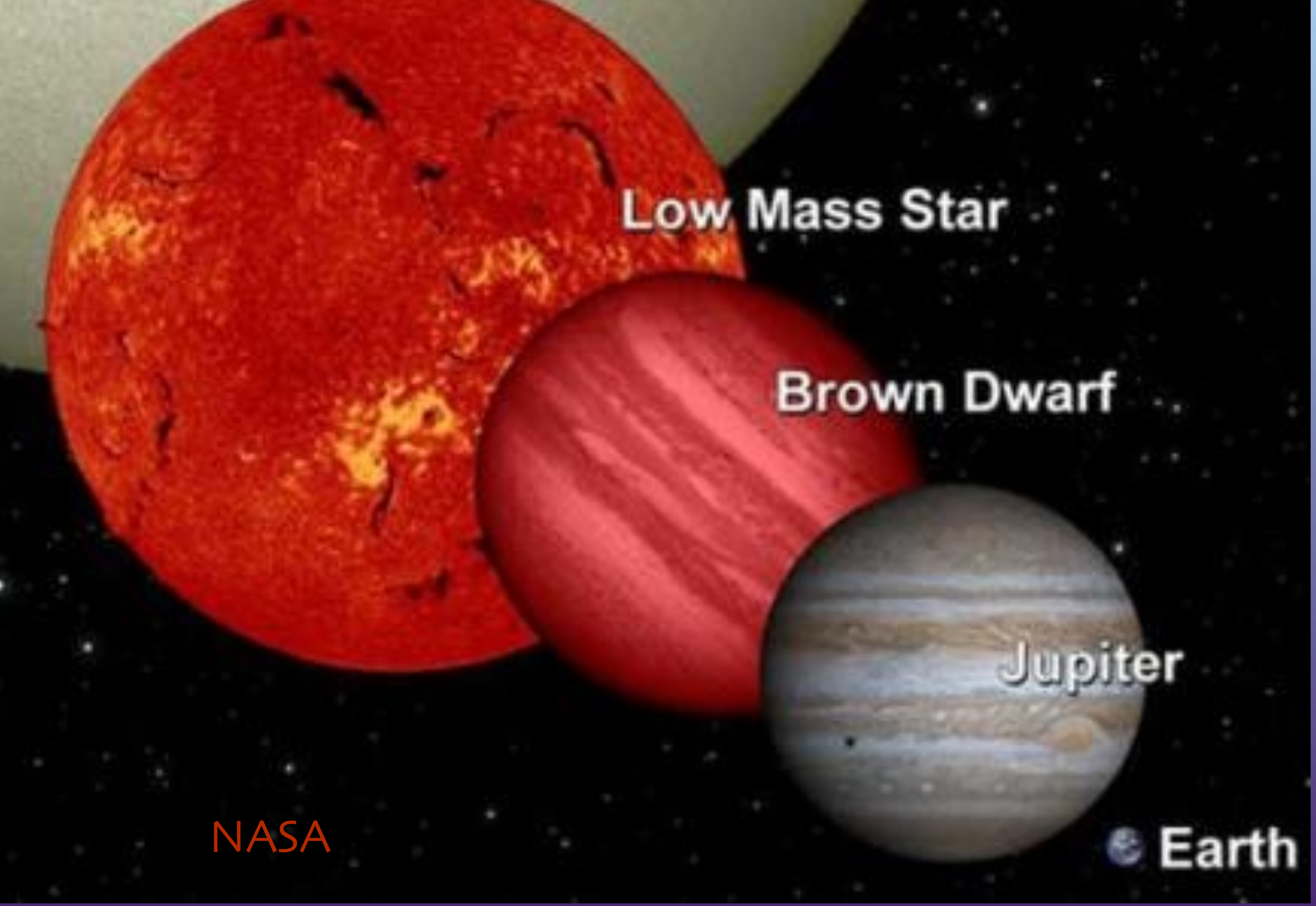
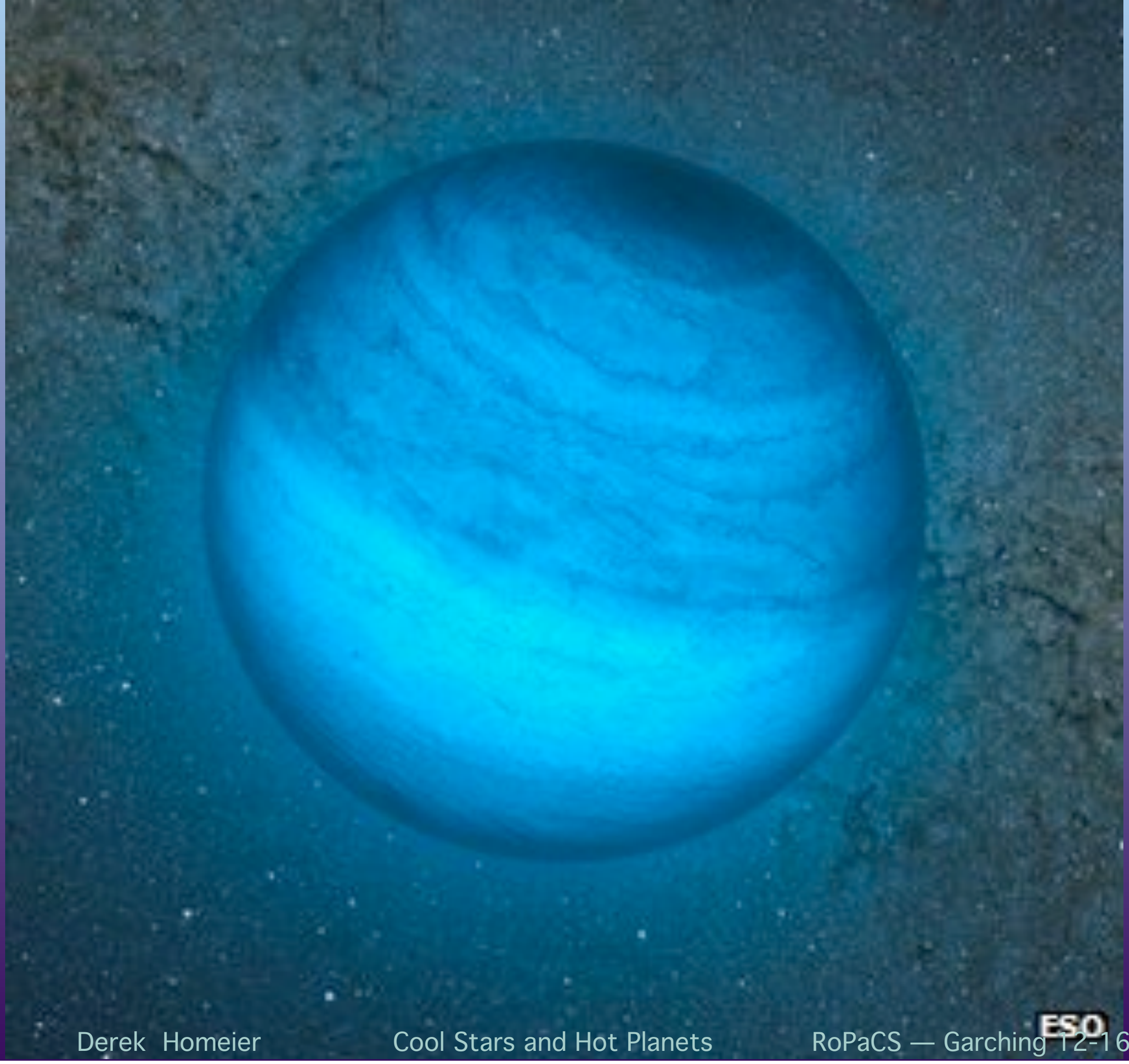
Ultracool Dwarves

- Red Dwarfs (stars) - Brown Dwarfs - Gas Giants (planets)



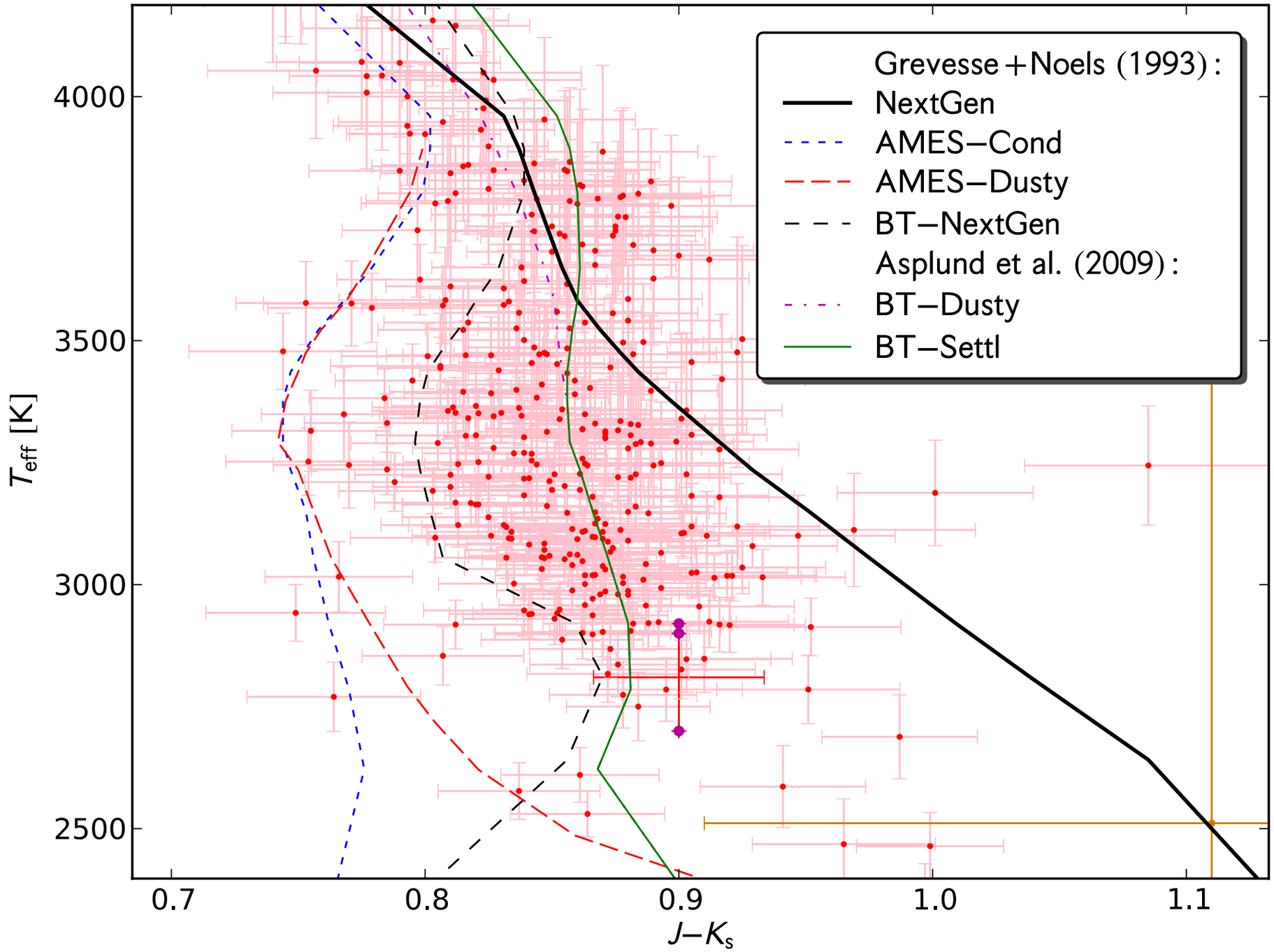


NASA

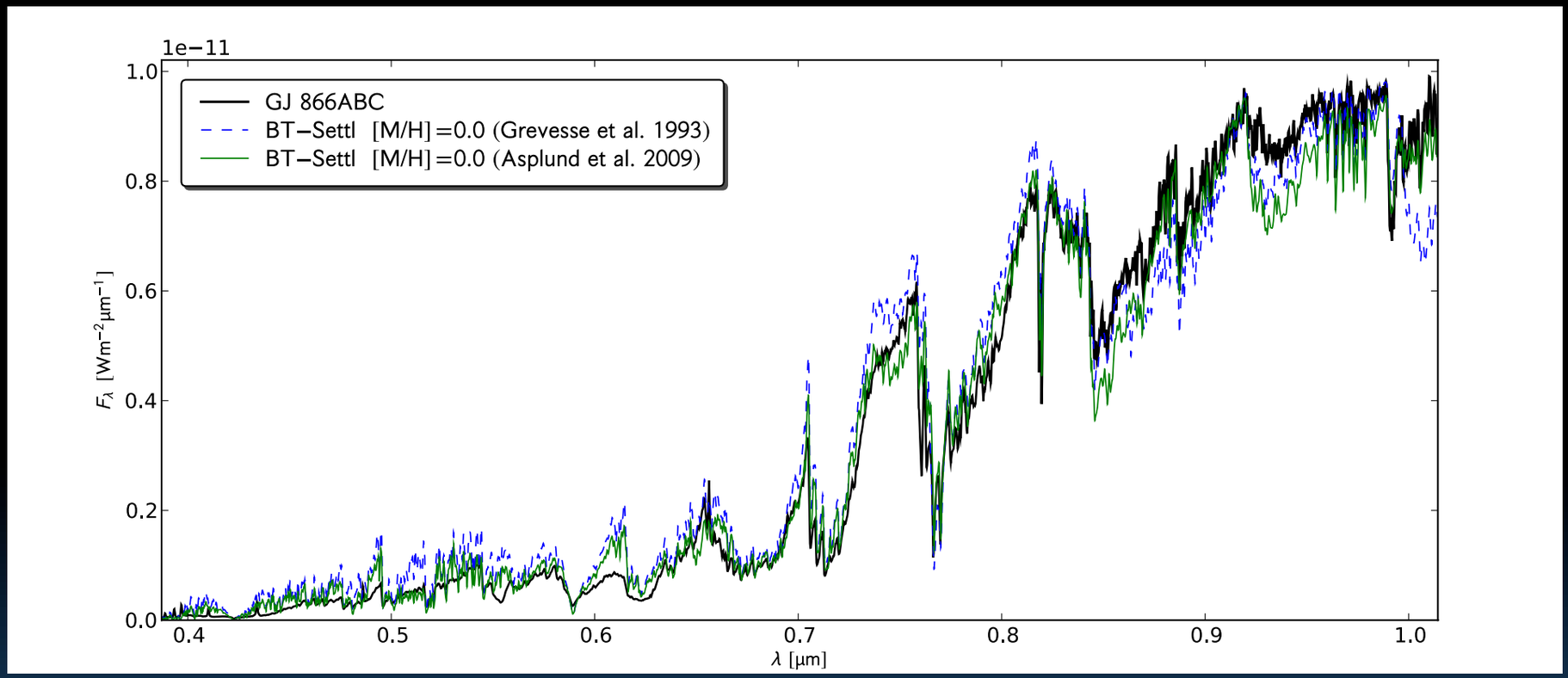


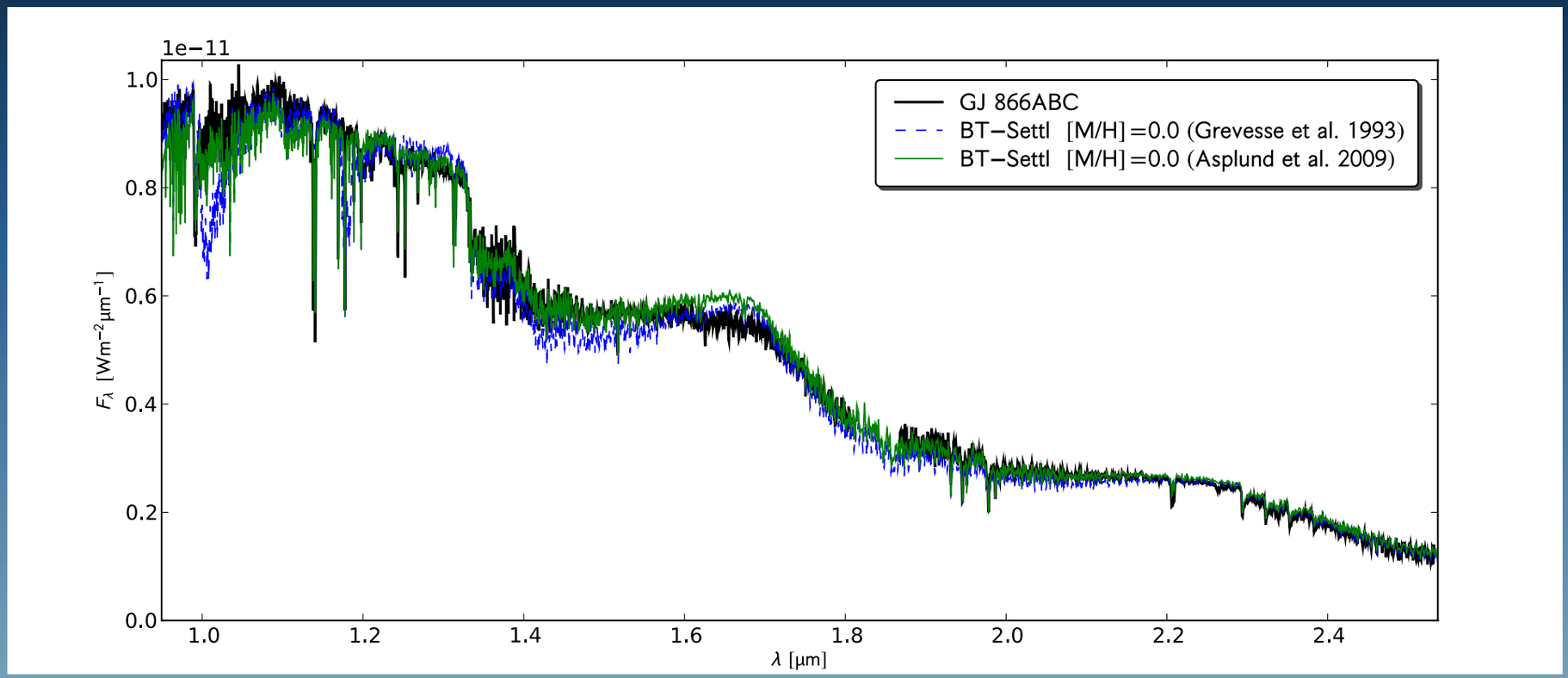
Delorme et al. 2012 (see also M.-E. Naud, this volume)

Allard, Homeier & Freytag (Philosophy Trans. A 2011)



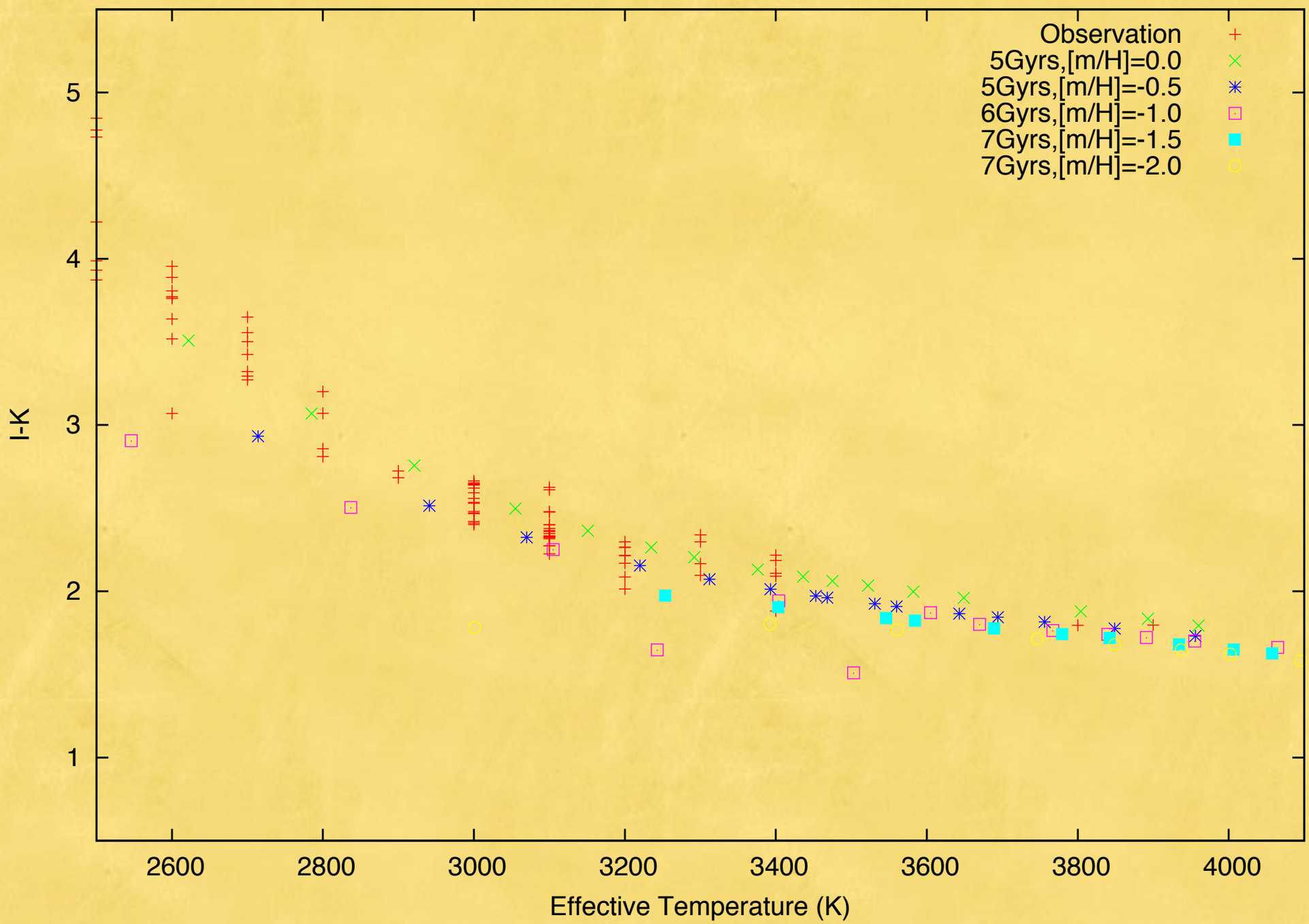
Estimated Teff for M dwarfs by Casagrande et al. (2008) and brown dwarfs by Golimowski et al. (2004) and Vrba et al. (2004) are compared to the NextGen isochrones for 5 Gyrs using various generations of model atmospheres: NextGen (black thick line), the limiting case AMES-Cond/Dusty cases by Allard et al. (2001) (dotted and dashed lines), the current BT-Settl models using the Asplund et al. (2009) solar abundances (full line). The Gl866 system is highlighted by darker colors and shown with its relatively large photometric error bars at *J-Ks* = 0.9.





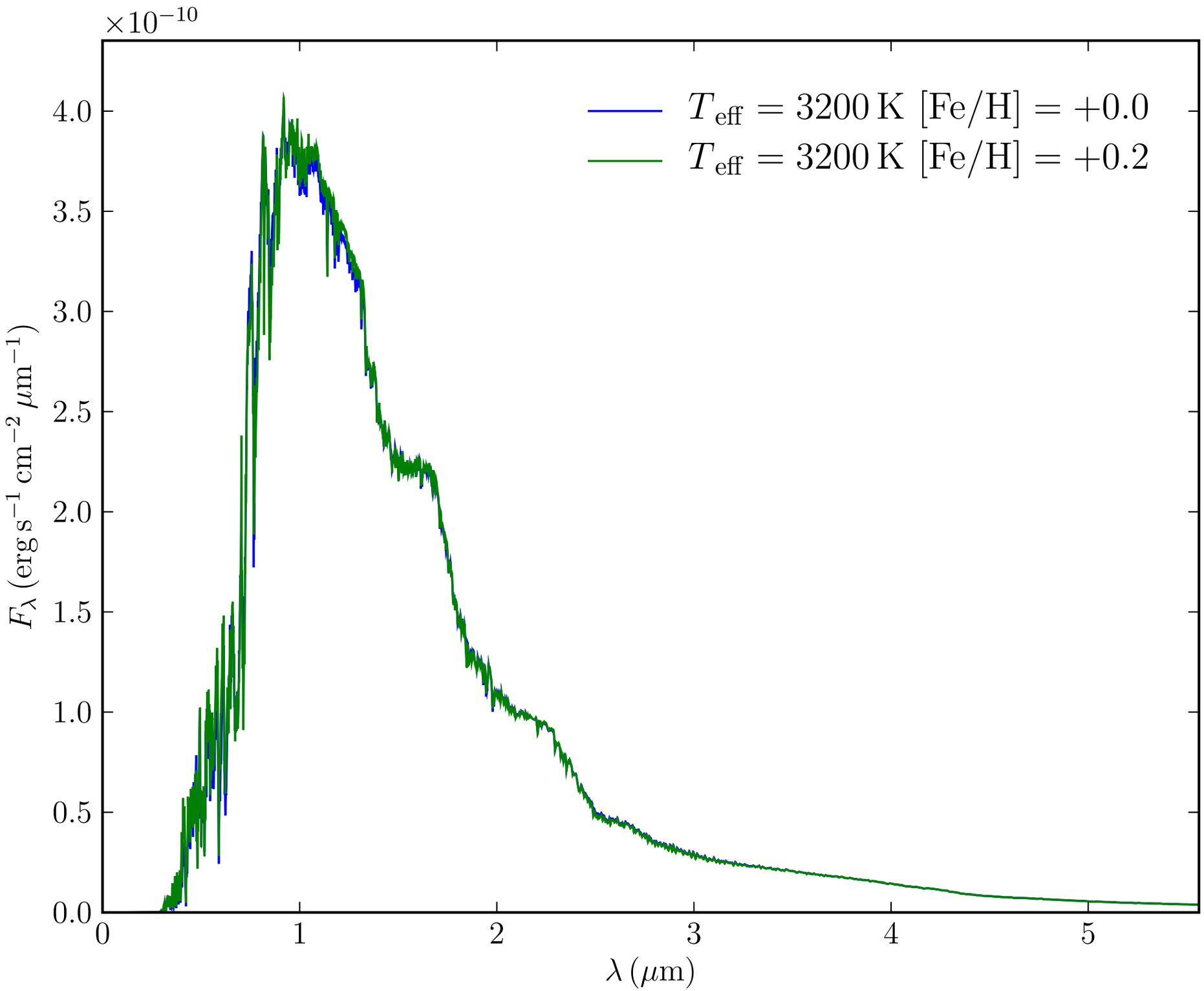
Allard, Homeier & Freytag (2011, Philosophy Trans. A)

Optical/NIR photometry



Rajpurohit et al. 2012

GJ 1214, Super-Earth Host



Revised metallicity, radius, T_{eff} from Anglade et al. 2012 (see also B. Rojas-Ayala, this volume)

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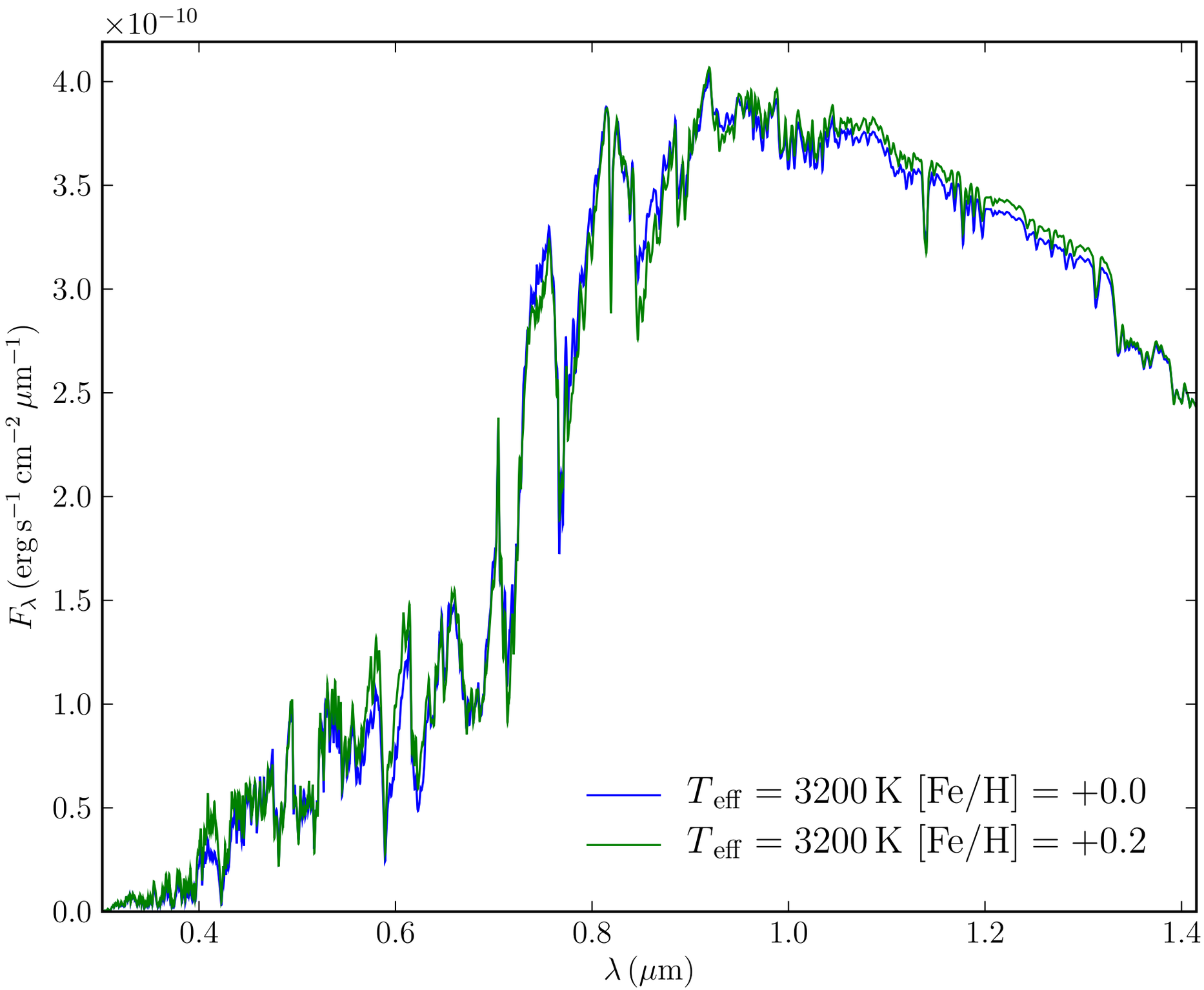
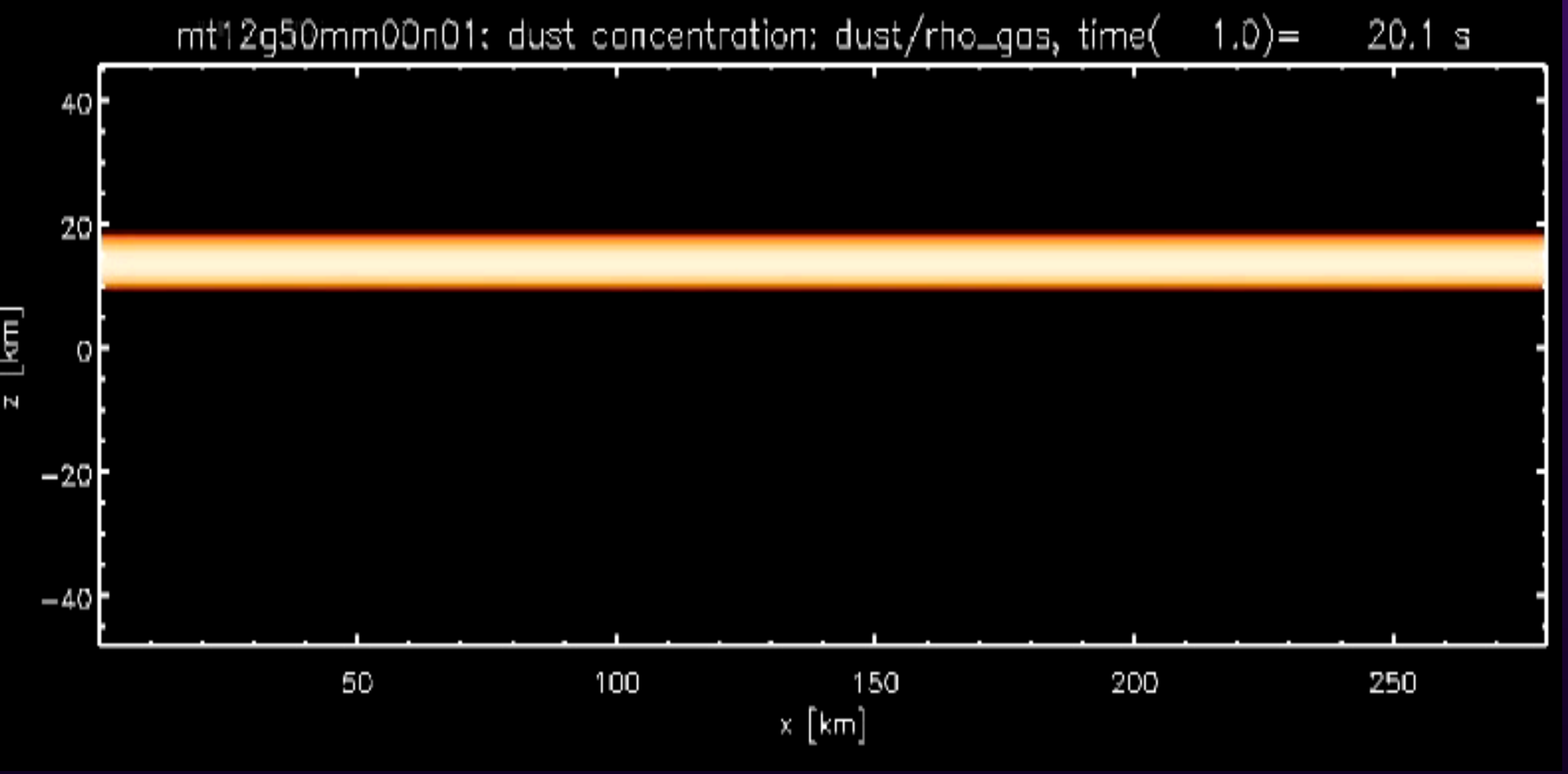


Revised metallicity, radius, T_{eff} from Anglade et al. 2012 (see also B. Rojas-Ayala, this volume)

Transit Parameters Inferred from the Combined White Light Curve

Parameter	No LD Prior	LD Prior[a]
t_{14} (days)	0.03624 ± 0.00013	0.03620 ± 0.00012
$R_\star$ ($R_\odot$)	$0.2014^{+0.0038}_{-0.0025}$	$0.201^{+0.004}_{-0.003}$
$a/R_\star$	$15.30^{+0.19}_{-0.29}$	$15.31^{+0.21}_{-0.29}$
i (°)	89.3 ± 0.4	$89.3^{+0.4}_{-0.3}$
b	$0.18^{+0.09}_{-0.11}$	$0.19^{+0.08}_{-0.11}$
$R_p/R_\star$[b]	$0.1158^{+0.0007}_{-0.0006}$	0.1160 ± 0.0005
$c/3 + d/5$	0.096 ± 0.008	0.095 ± 0.007
$c/5 - d/3$	$-0.52^{+0.22}_{-0.14}$	-0.433 ± 0.032
Predicted rms	337 ppm	337 ppm
Achieved rms	373 ppm	376 ppm
s	1.12 ± 0.07	1.12 ± 0.07

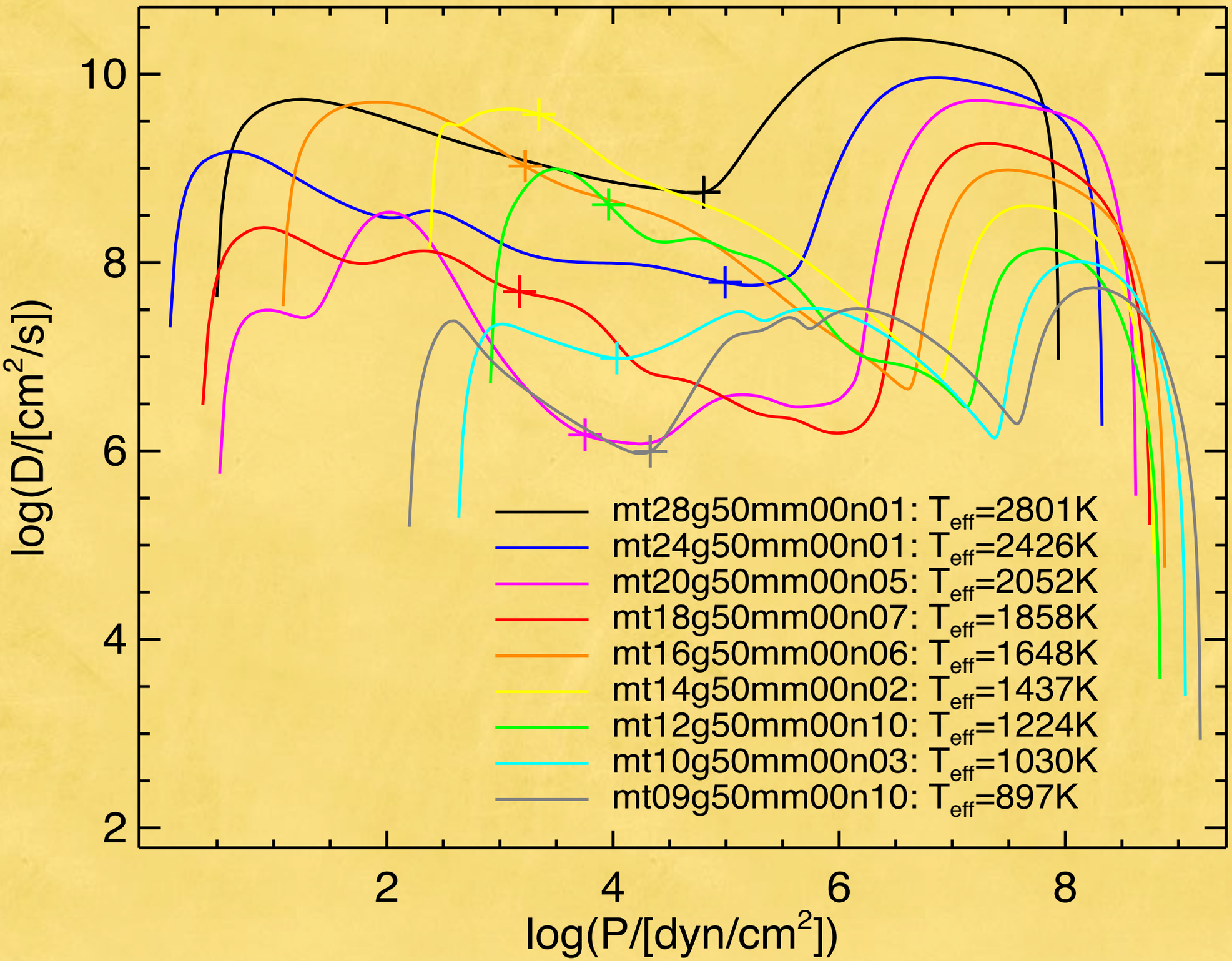
Notes.
[a] The Gaussian limb-darkening priors of $(c/3 + d/5) = 0.0892 \pm 0.018$ and $c/5 - d/3 = -0.4306 \pm 0.032$ were derived from PHOENIX stellar atmospheres, as described in the text.



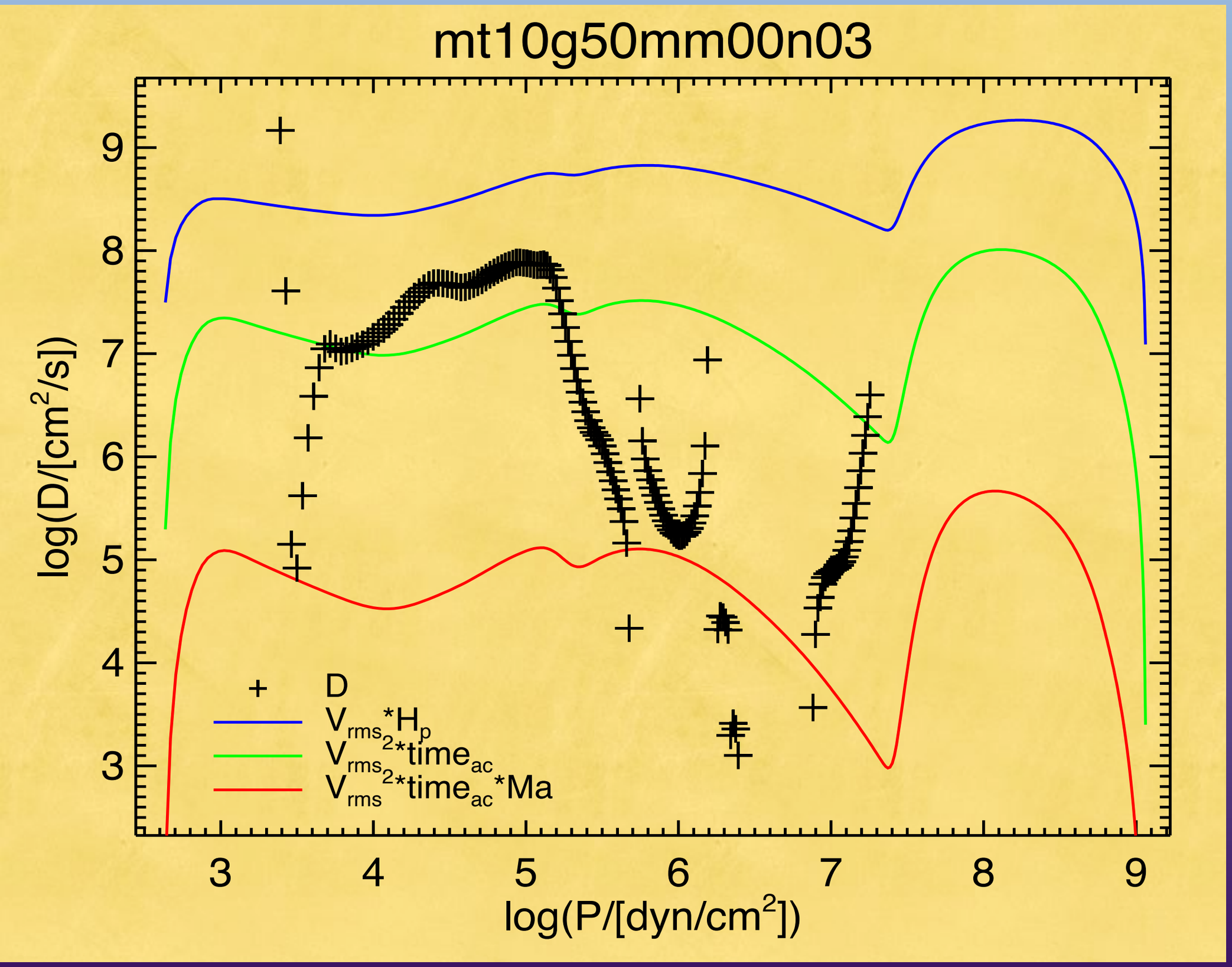
CO5BOLD 2D-Hydrodynamic Simulation of L/T dwarf atmosphere (1200 K) with Forsterite cloud model

B. Freytag et al. 2010

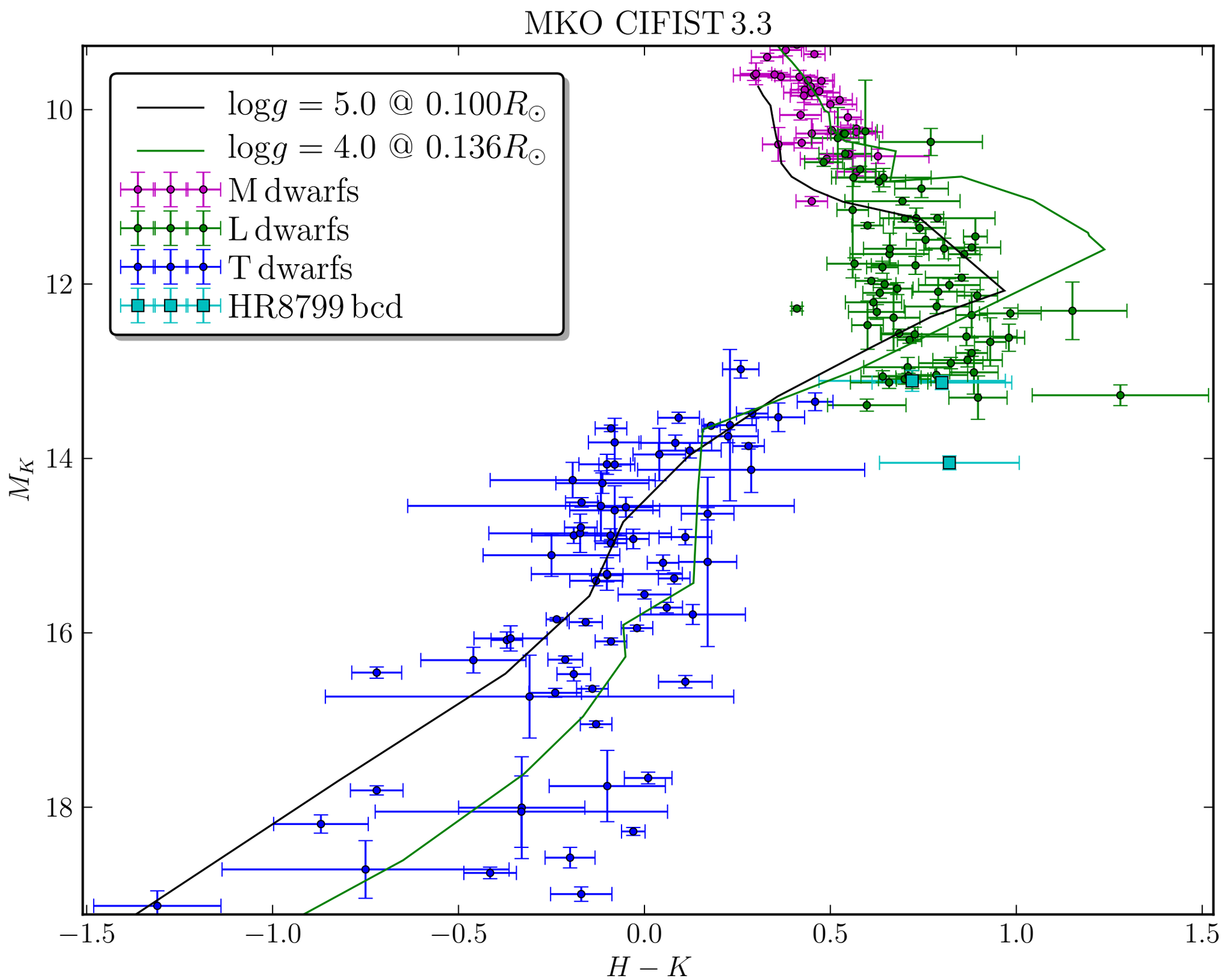
Evolution over the L-T transition



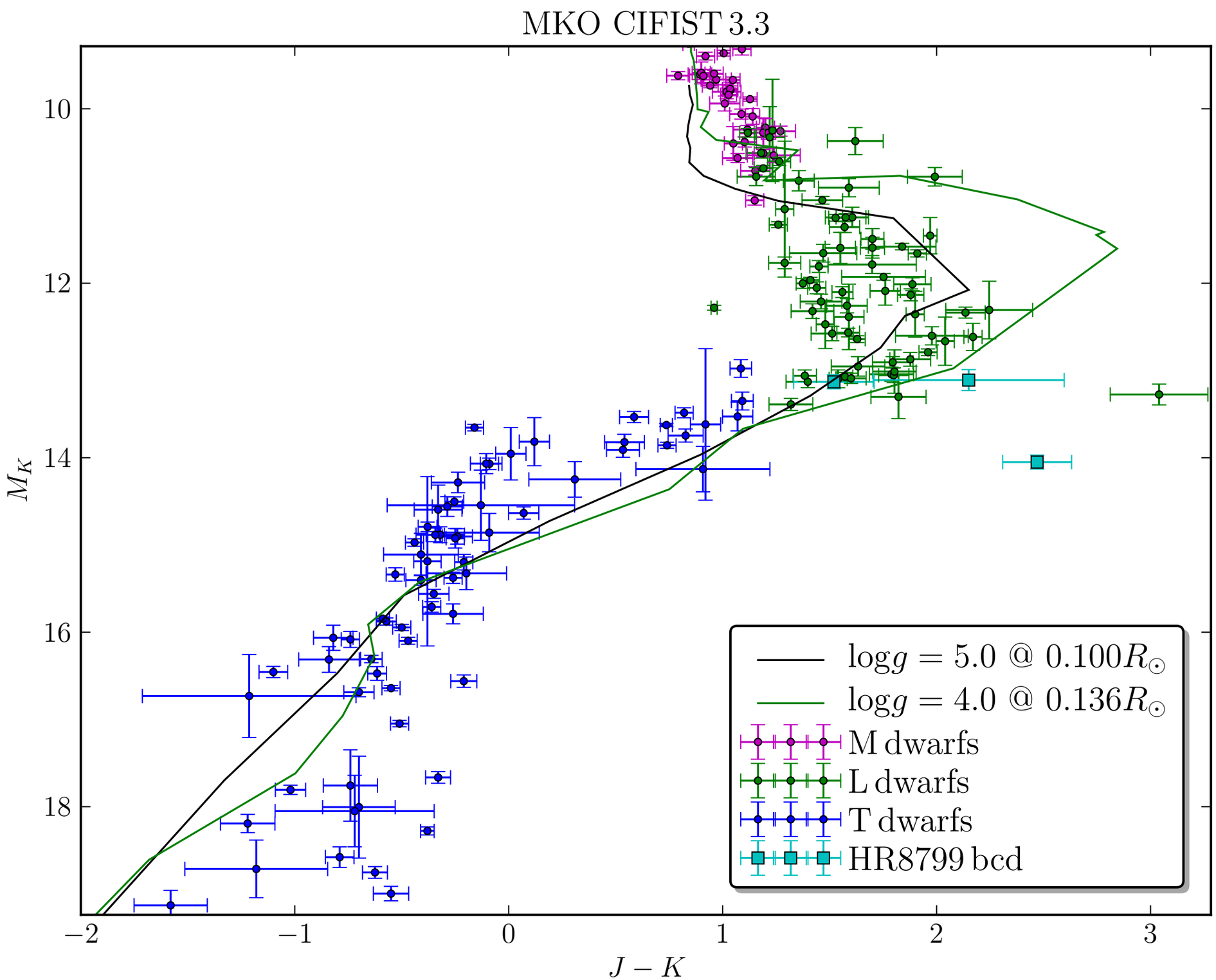
Mixing and Diffusion - a closer Look



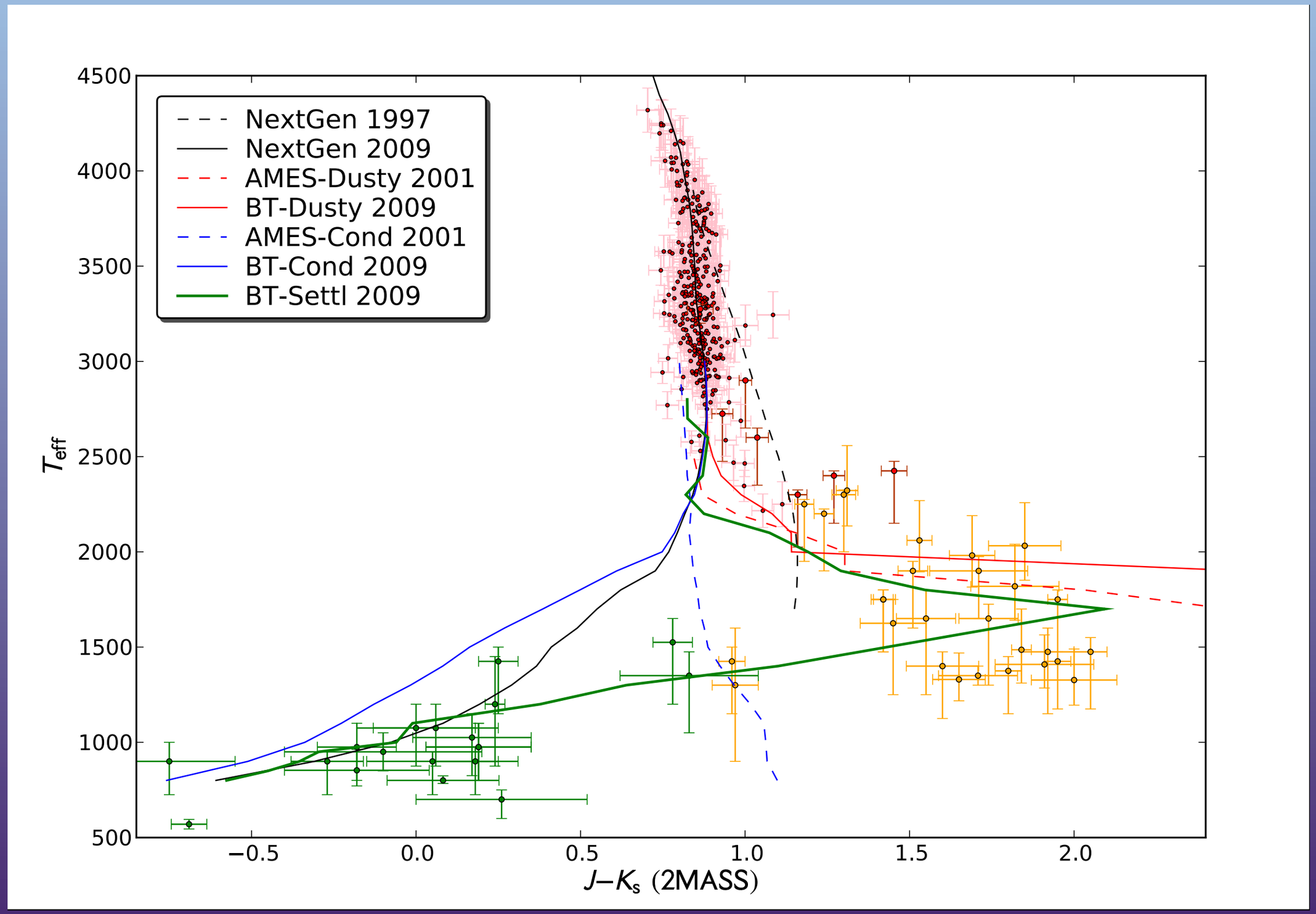
Fitting the M-L-T transitions



Fitting the M-L-T transitions



Model grids for cool and ultracool dwarfs



Allard et al. 1997

Allard et al. 2001

Freytag et al. 2010

Allard et al. in prep.

Casagrande et al. 2008

Golimowski et al. 2004

Vrba et al. 2004

- 8 Years after: updated opacities, line profiles, abundances, and a new cloud model!