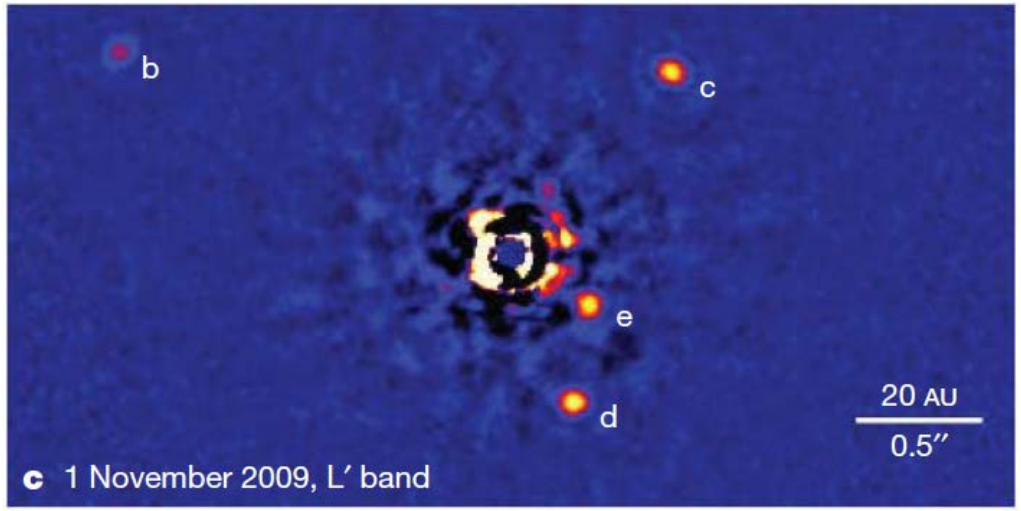
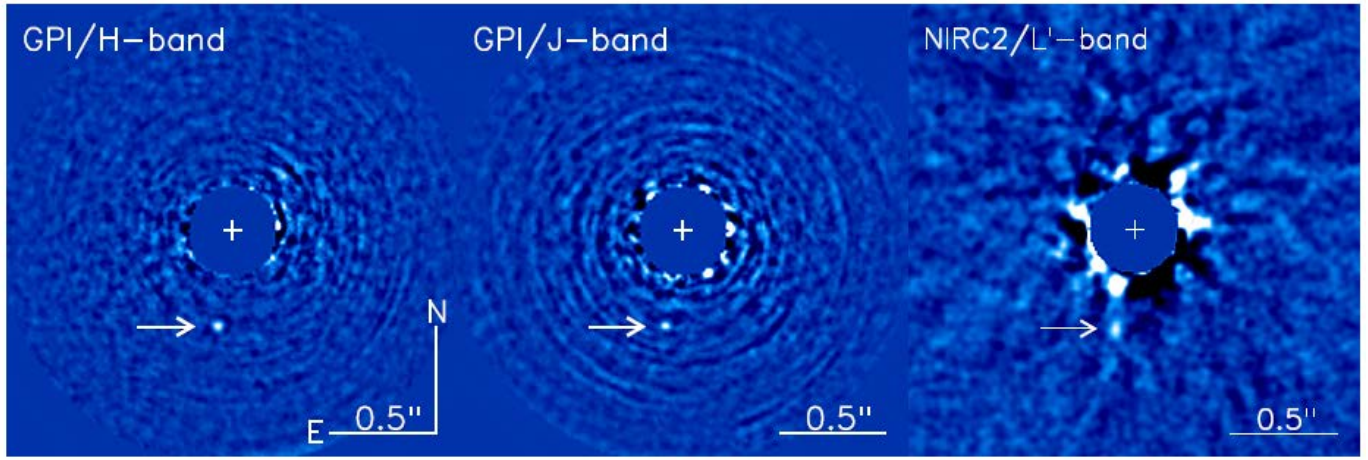
The Effect of Photochemistry and Quenching on the Atmospheric Composition of Young Directly Imaged Giant Planets

J. I. Moses, M. R. Line, M. S. Marley, J. J. Fortney, C. Visscher, T. S. Barman, N. K. Lewis



HR 8799 system (Fig. from Marois et al. 2010)



51 Eri b (Fig. from Macintosh et al. 2015)

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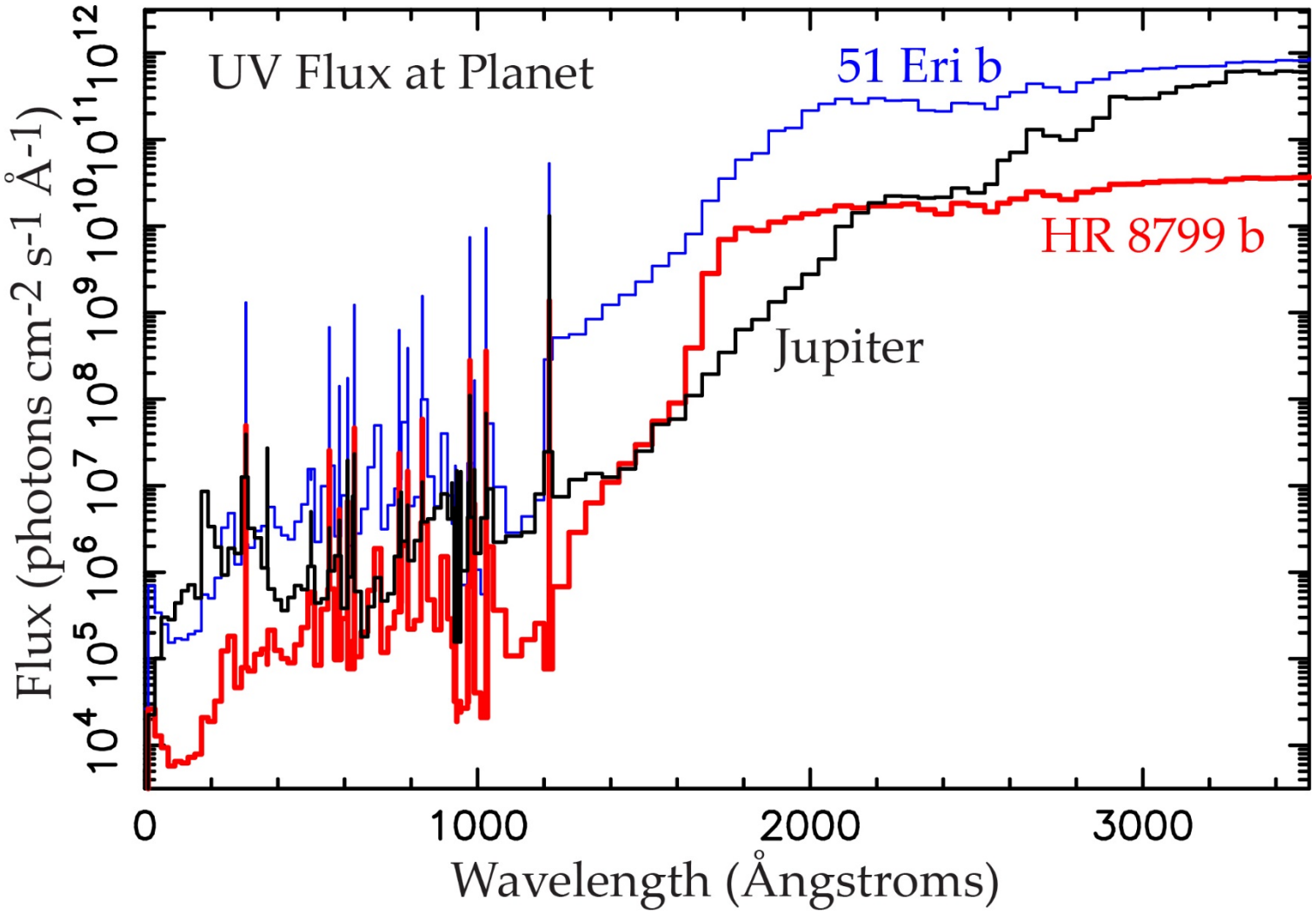
Stellar Flux at Planet



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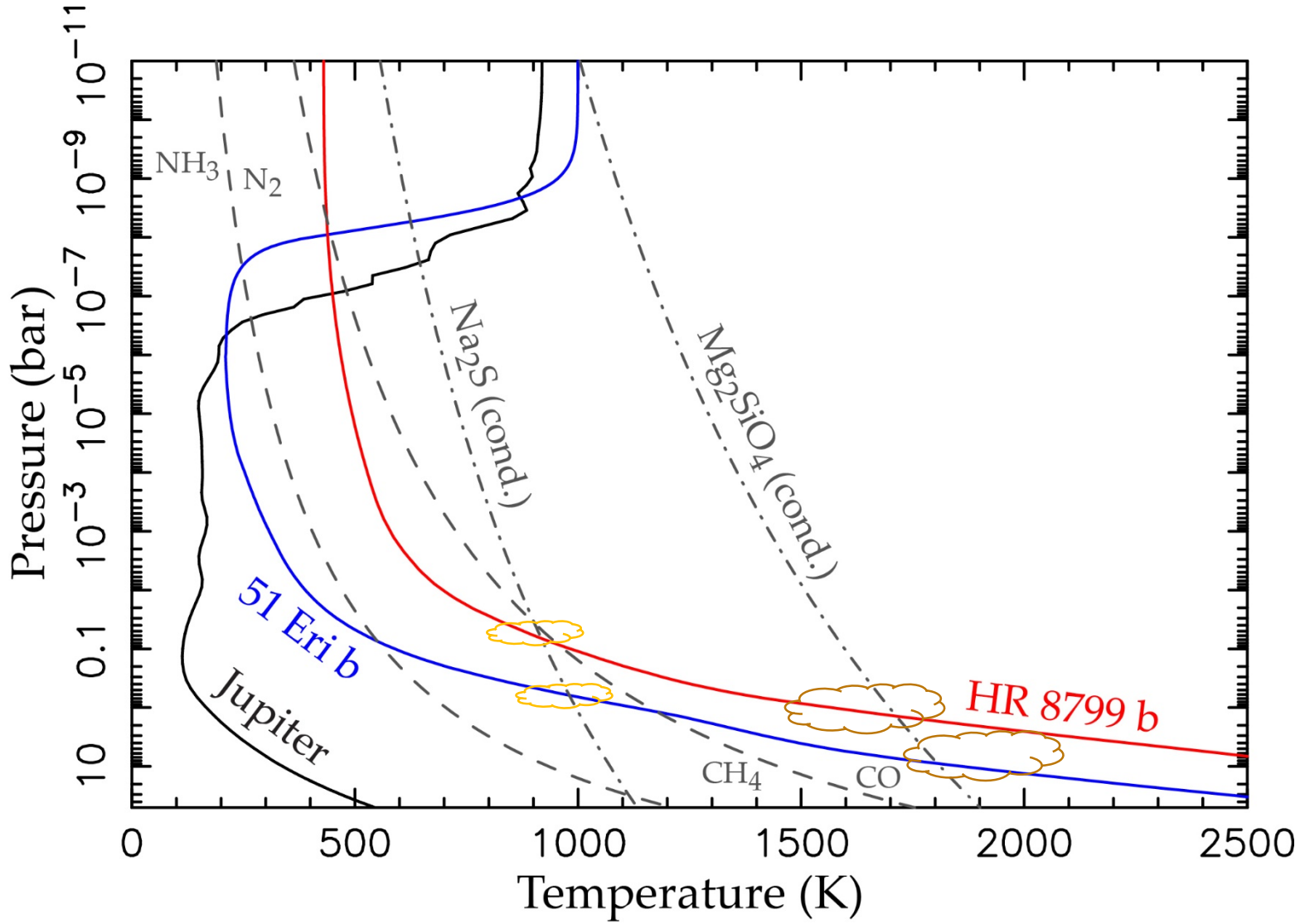
Thermal Structure



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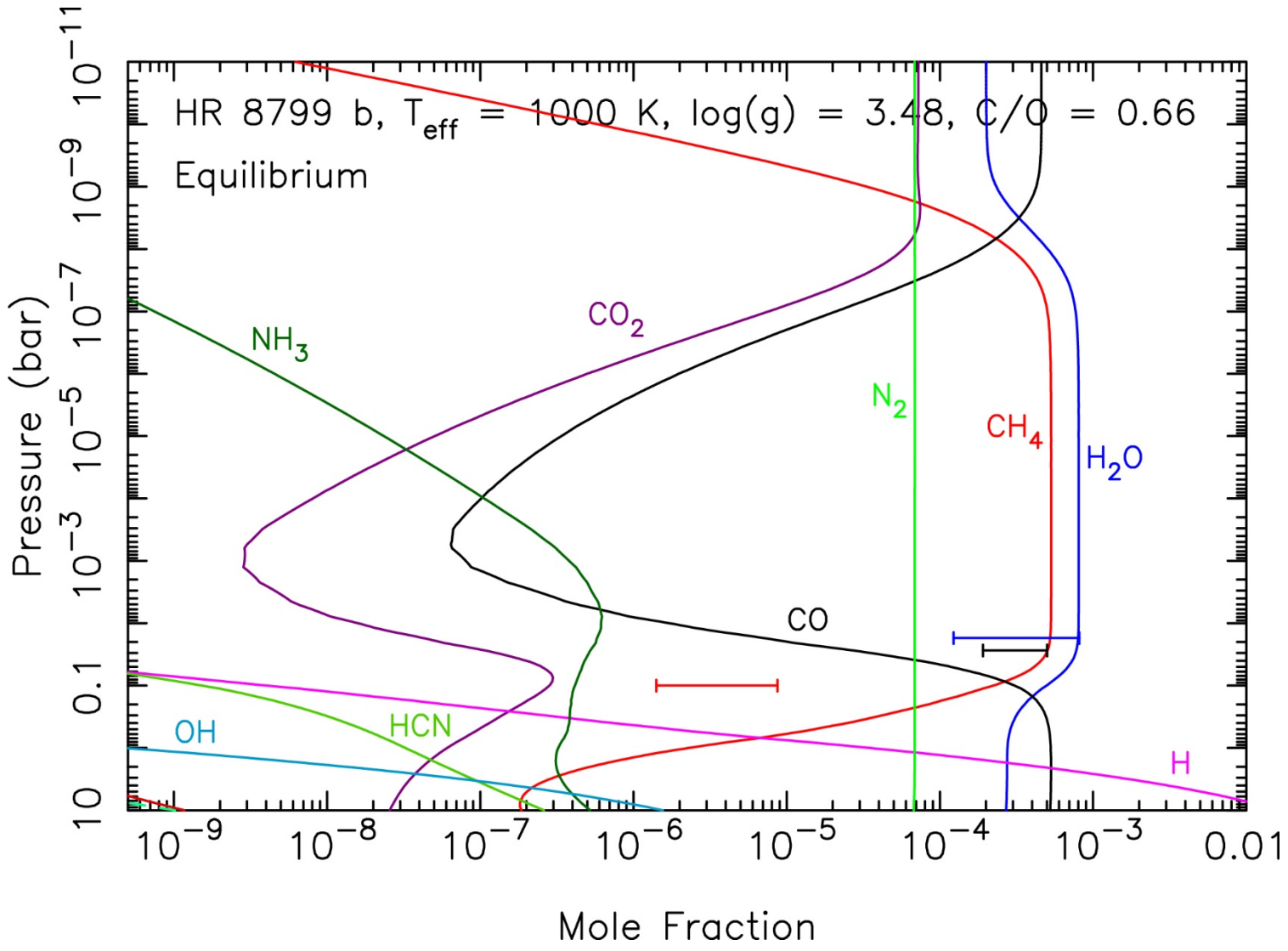
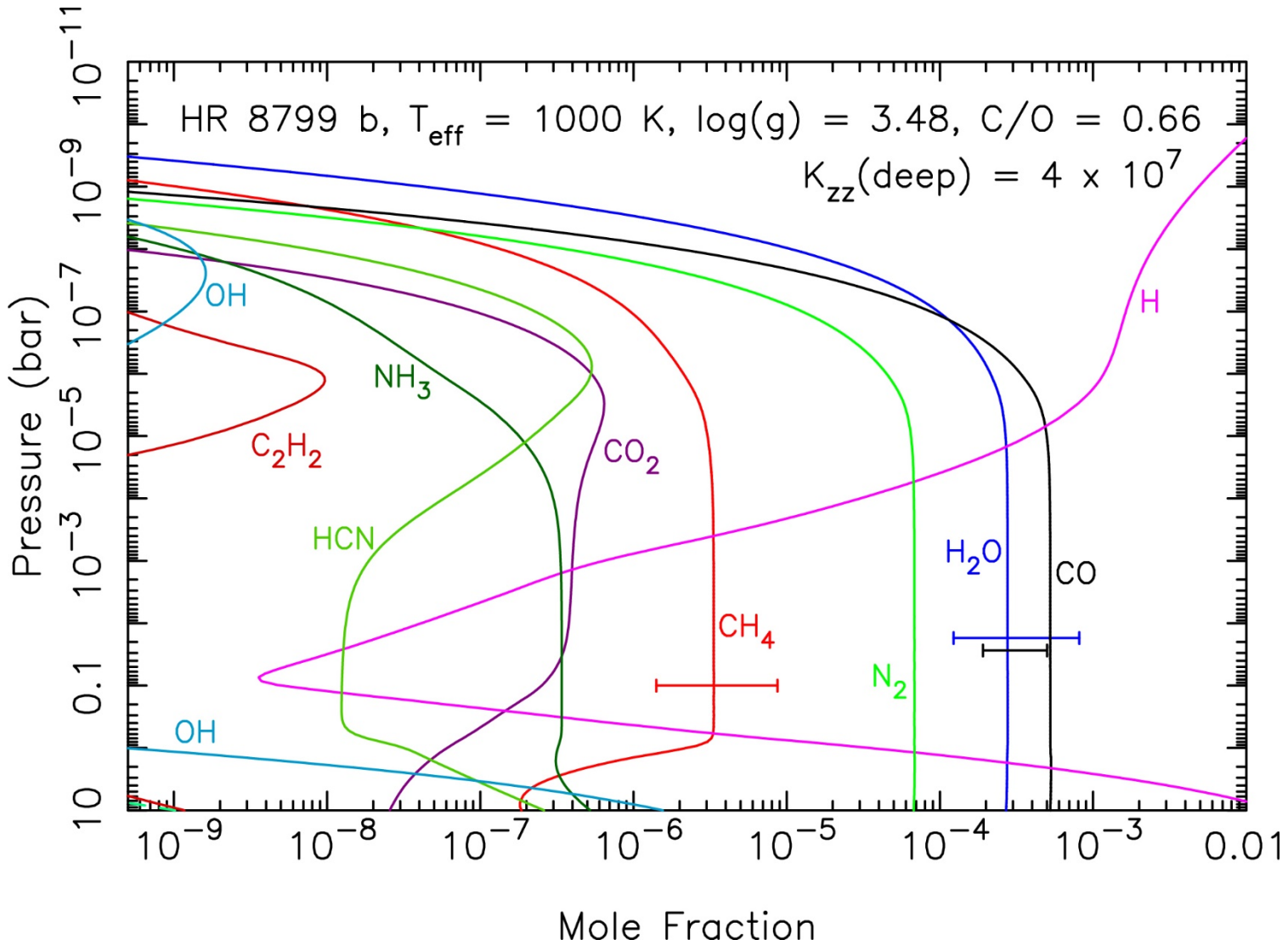
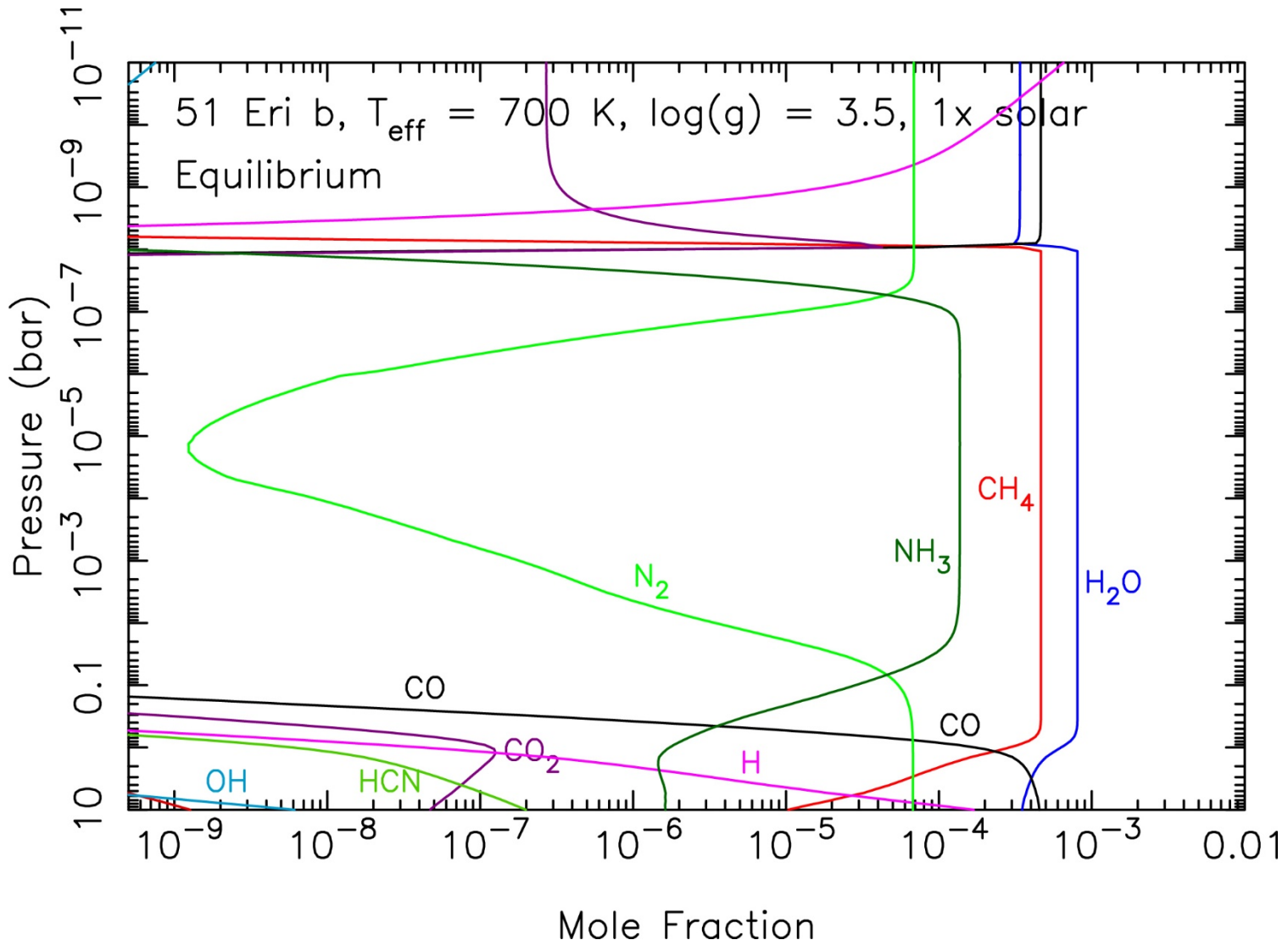
HR 8799 b Thermochemical Equilibrium



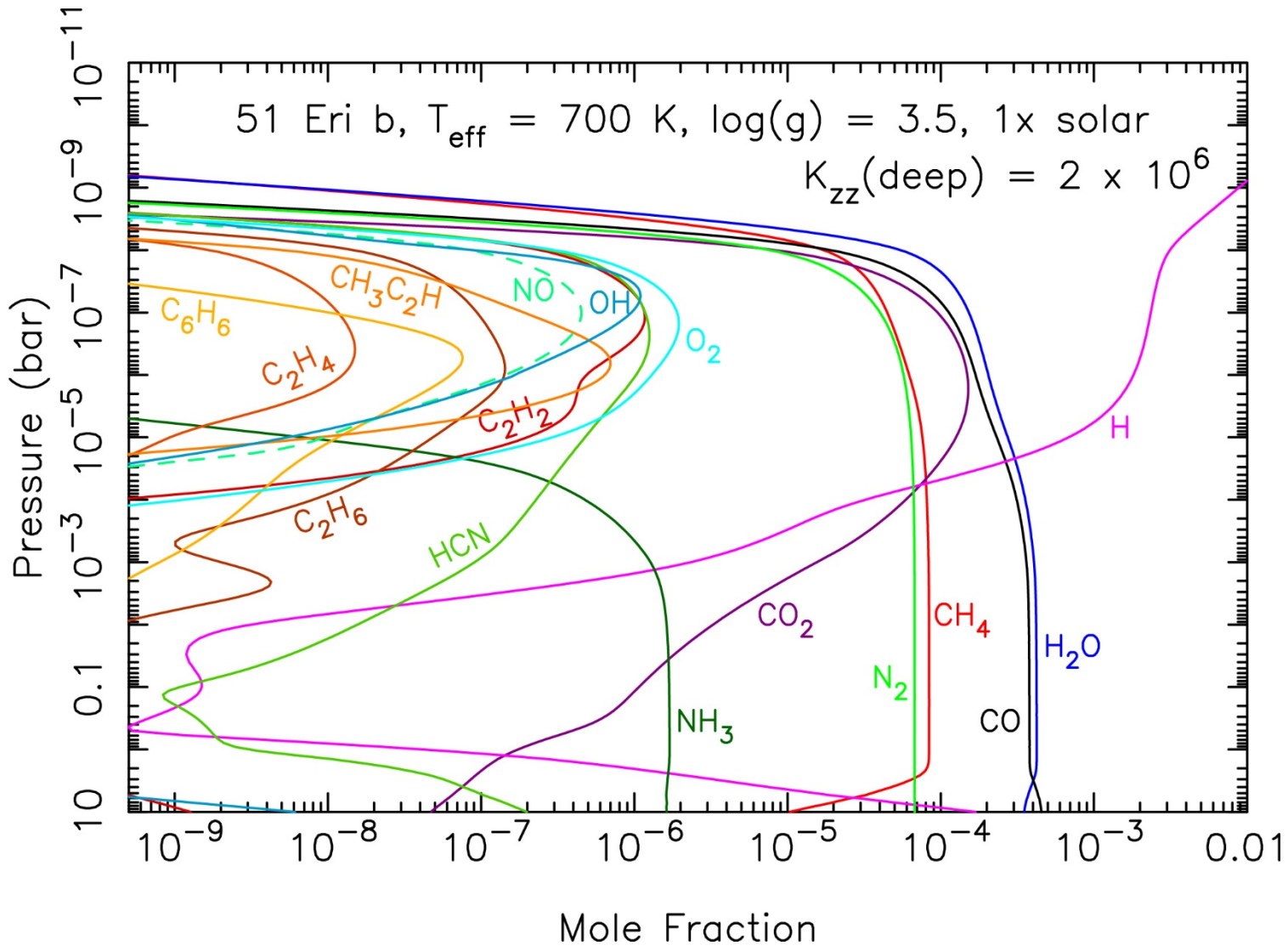
HR 8799 b Photochemistry and Quenching



51 Eri b Thermochemical Equilibrium



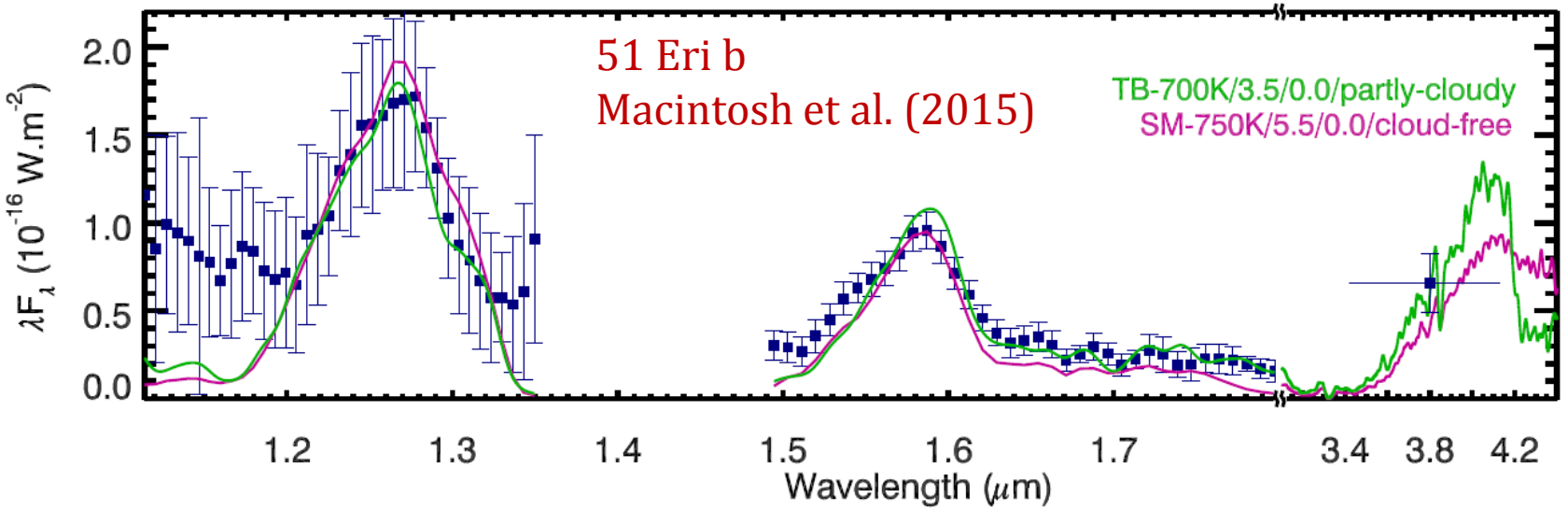
51 Eri b Photochemistry and Quenching

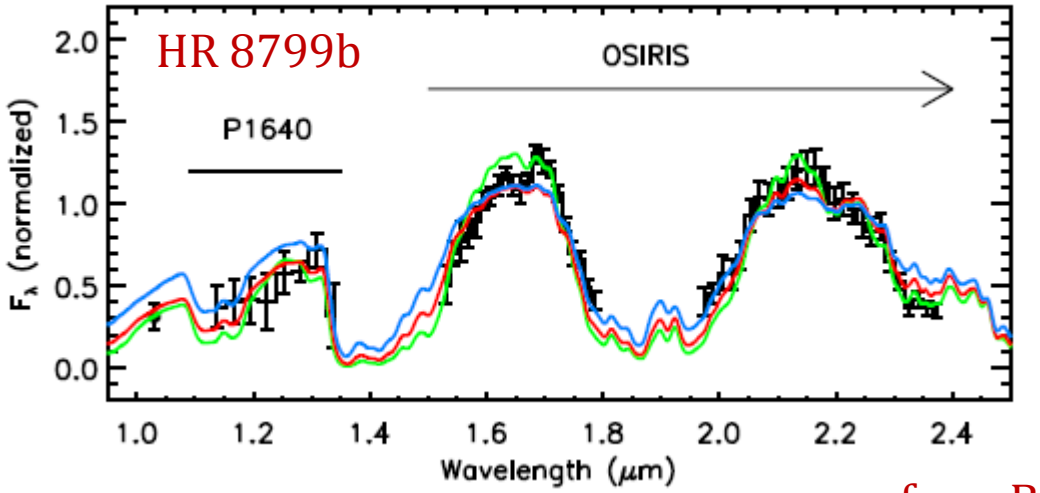


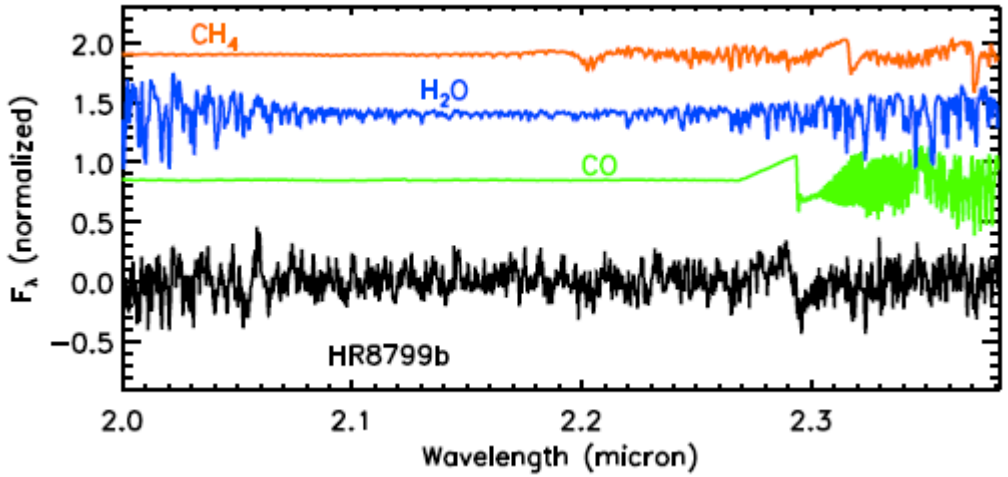
Conclusions

- Warmer directly imaged giant planets can have a chemistry/composition similar to close-in “hot Jupiter” exoplanets
- Cooler directly imaged giant planets are in an interesting photochemical regime that is very different from both close-in hot Jupiters and our own solar-system giant planets – lots of CO_2 !
- Predictions regarding the increased CO_2 abundance will have to await confirmation from space-based telescopes such as JWST
- Small hydrocarbons/nitriles ≠ haze – lab experiments are needed to investigate haze formation under suitable conditions for directly imaged planets

Spectra

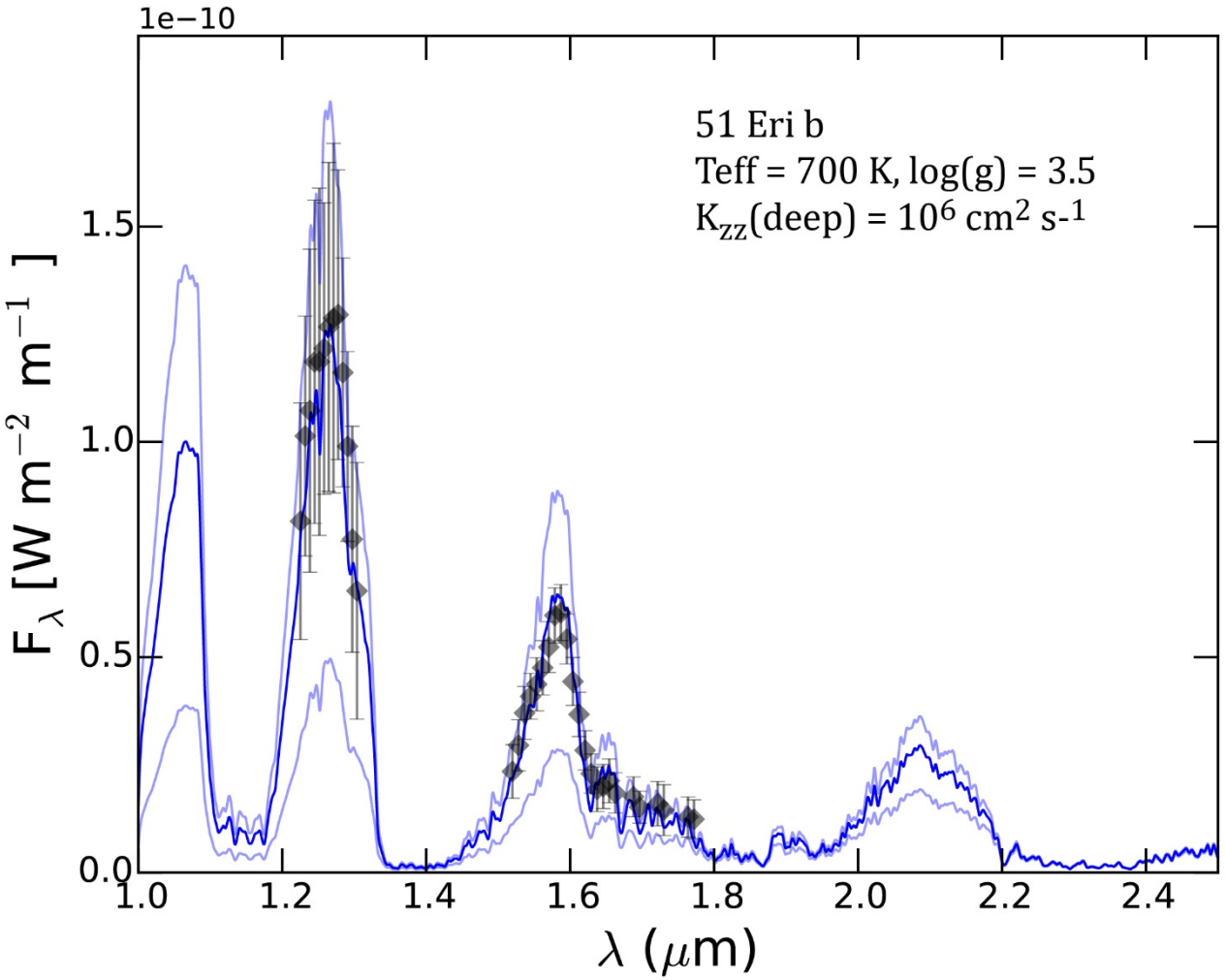






from Barman et al. (2015)

Spectra: Photochemical Model-Data Comparison



Spectral modeling by
Michael Line

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