sunbather • Simulating escaping exoplanet atmospheres and their transit spectra

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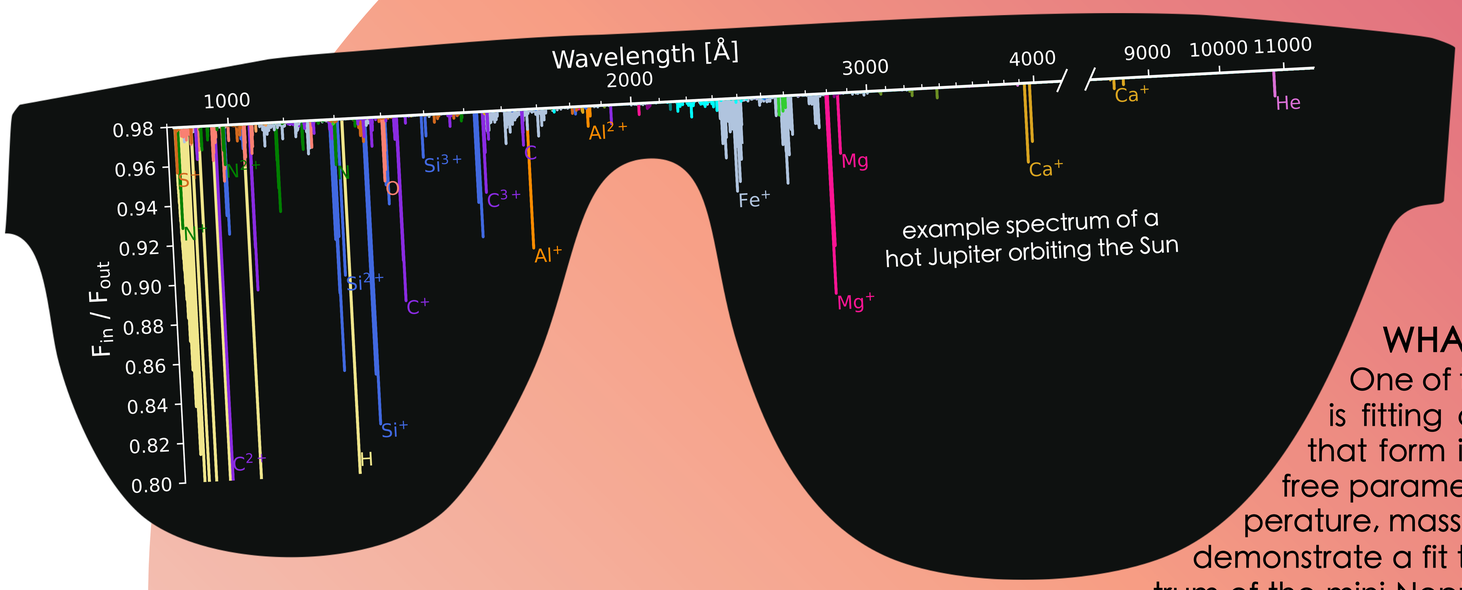
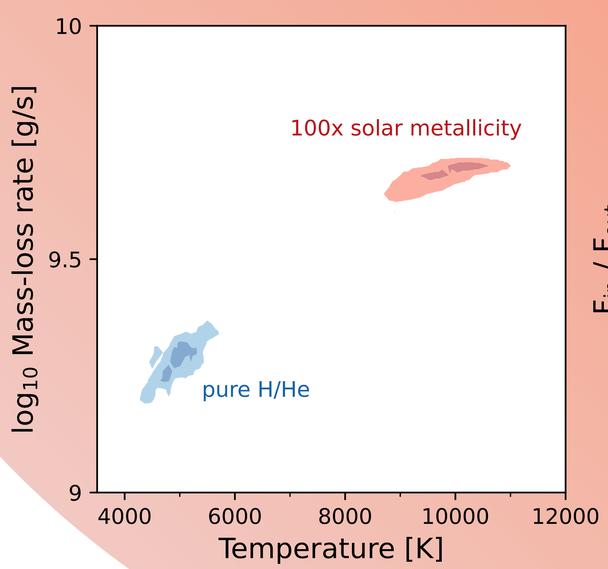
WHAT IS SUNBATHER?

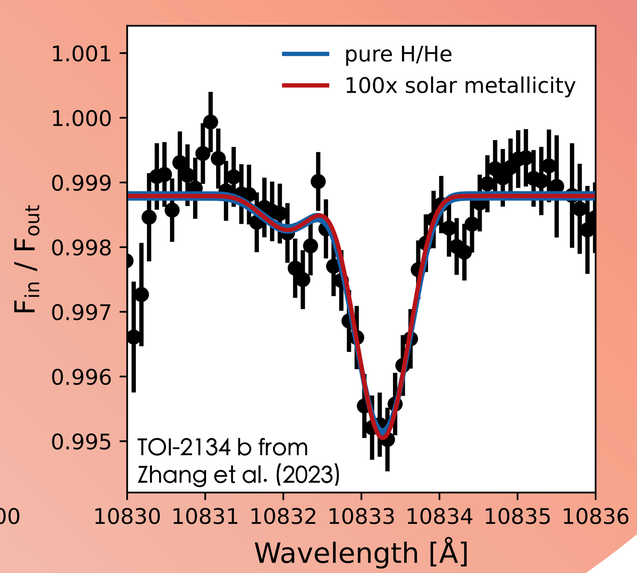
Observational evidence of atmospheric escape is mainly gained through transit spectroscopy in the Lyman-α, He 10830 Å, and UV metal lines. We present sunbather, a new open-source code to interpret such observations. It couples the Parker wind code p-winds[1] to the photoionization code Cloudy[2,3] to produce spectra for arbitrary composition and wavelength range.



WHAT CAN YOU DO WITH IT?

One of the applications of sunbather is fitting observations of spectral lines that form in the upper atmosphere. The free parameters of the model are the temperature, mass-loss rate, and composition. We demonstrate a fit to the metastable helium spectrum of the mini-Neptune TOI-2134 b[3]. Both a model assuming a pure H/He composition and a model assuming a 100x solar metallicity composition are able to explain the data, but do so for a different mass-loss rate and temperature. Therefore, as long as the composition of the upper atmosphere is unknown, the mass-loss rate is not well constrained. We may break this degeneracy by combining the helium data with observations of a different spectral line, and performing a joint fit[5].





REFERENCES

1. dos Santos et al. (2022)
2. Ferland et al. (2017)
3. Chatzikos et al. (2023)
4. Zhang et al. (2023)
5. Linssen & Oklopčić (2023)

Check out the code on github!

Check out the paper on arXiv!