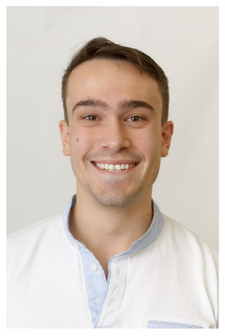
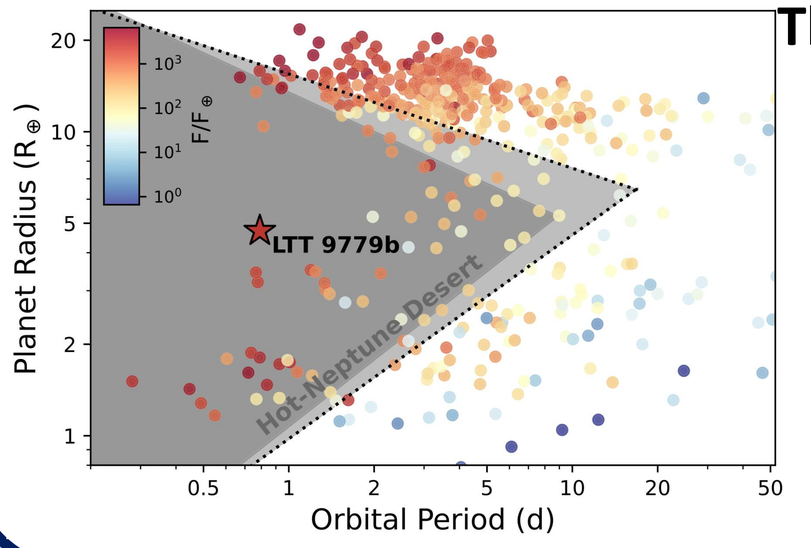
Ultraviolet-to-Infrared Atmosphere Spectroscopy of the Ultra-Hot-Neptune LTT 9779b

Michael Radica[1], Jake Taylor[2] , Louis-Philippe Coulombe[1], Hannah Wakeford[3], Björn Benneke[1], David Lafrenière[1], et al.

[1]Institut Trottier de recherche sur les exoplanètes (iREx), Université de Montréal; [2]Oxford University; [3]University of Bristol

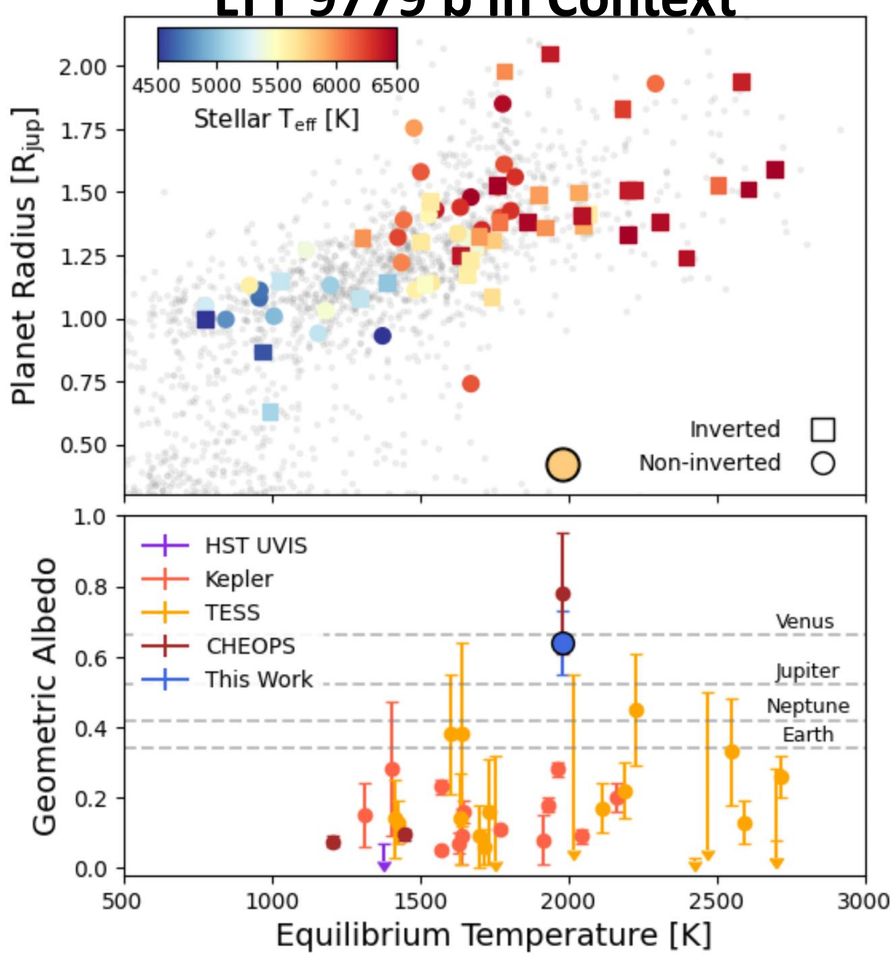


The Hot-Neptune Desert



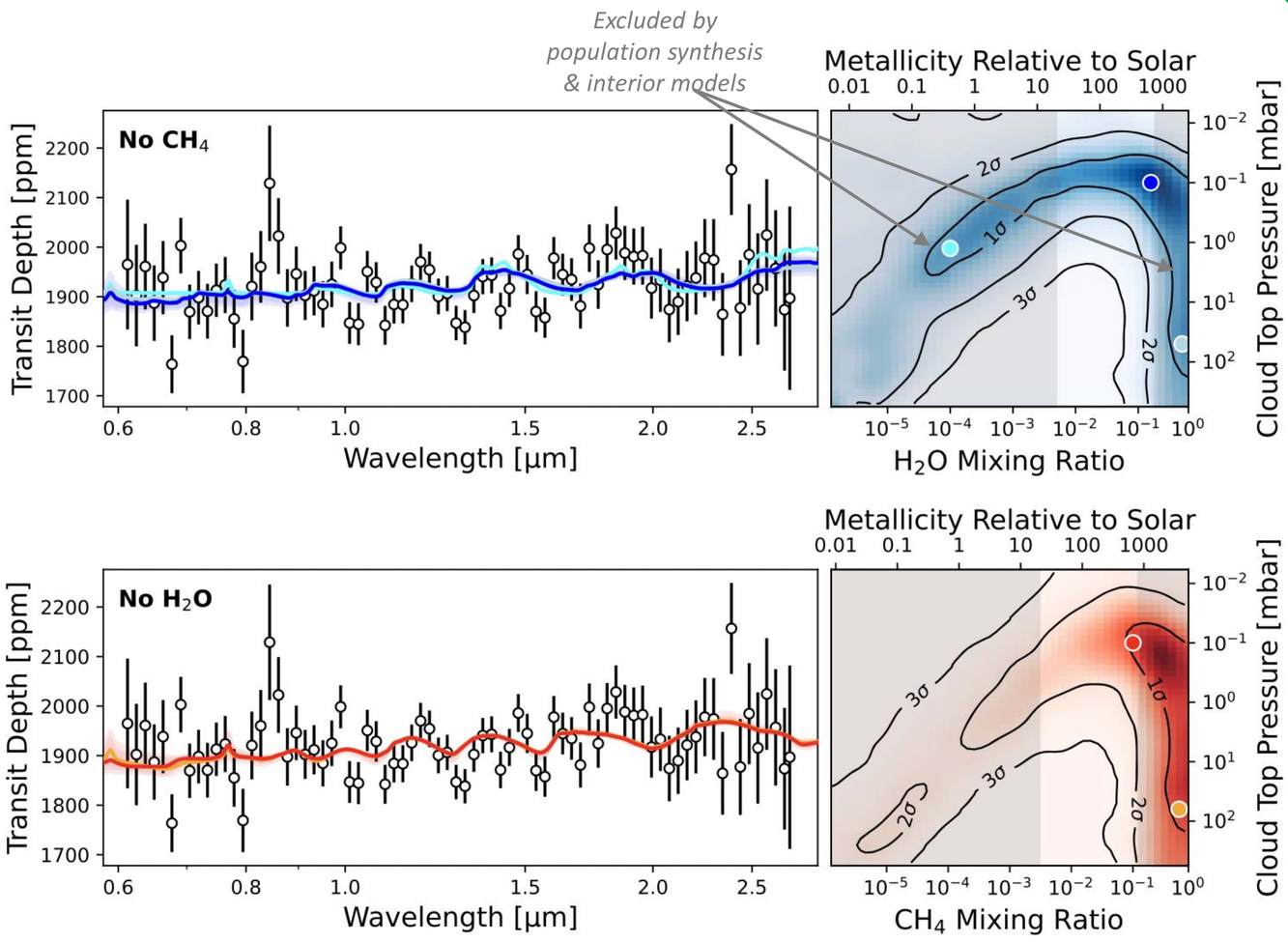
- Dearth of Neptune-mass planets with orbital periods < 3 days [1,2].
- Thought to be a result of photoevaporative mass loss driven by high-energy radiation from the host star [3,4].
- LTT 9779 b is currently the only-known ultra-hot-Neptune to have retained a substantial H/He atmosphere [5,6,7].

LTT 9779 b in Context



- LTT 9779 b has a non-inverted dayside temperature profile[6] and an extremely high geometric albedo[8] – at odds with the broader population of ultra-hot-Jupiters[9,10].

Excluded by population synthesis & interior models

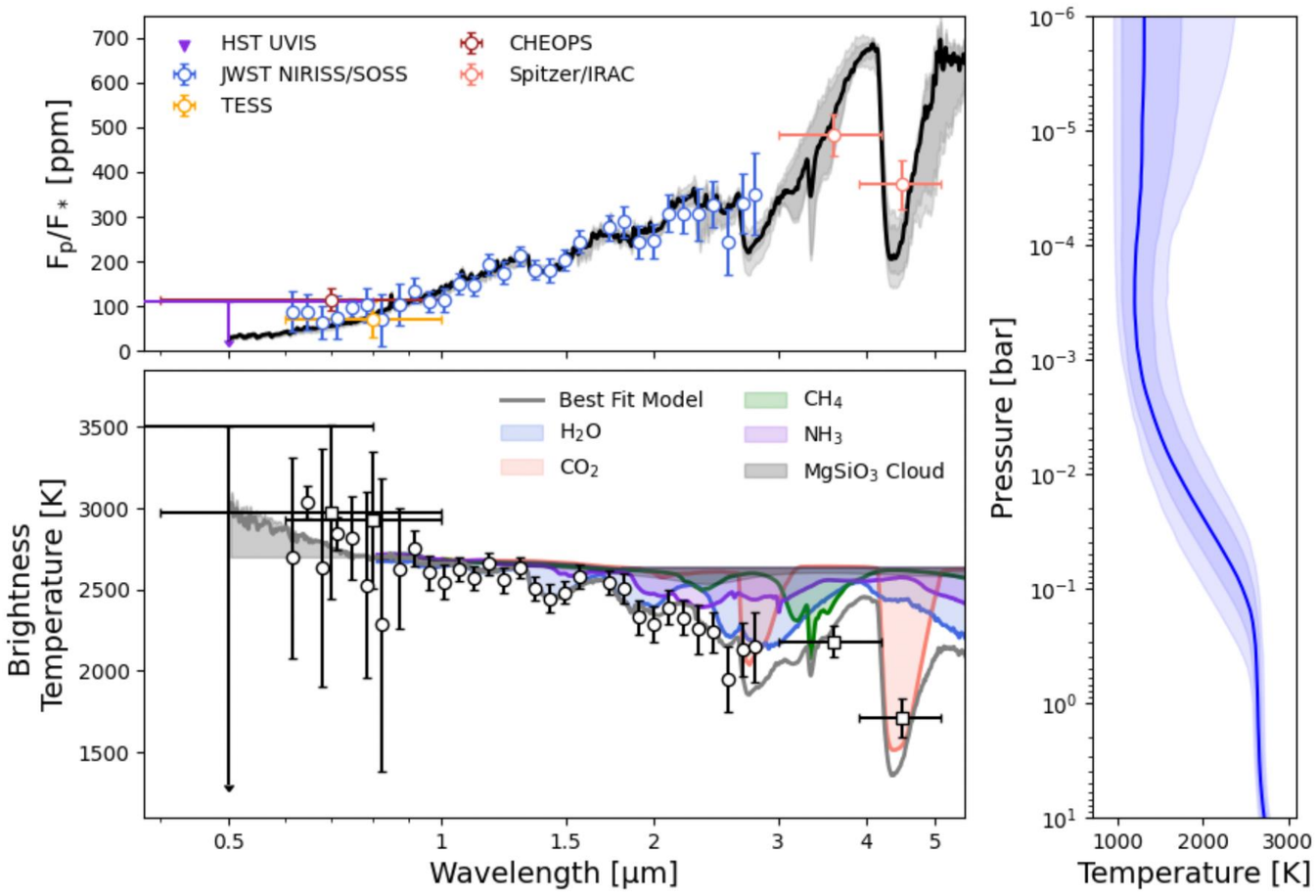


Transmission Spectroscopy Results

- Observed full orbit phase curve of LTT 9779 b with JWST NIRISS/SOSS[11]. Reduced observations with *exoTEDRF* (formerly *supreme-SPOON*) [12,13].
- Muted features in transmission spectrum are best explained by either H_2O or CH_4, as well as high-altitude clouds.
- Clouds are advected onto dayside by winds, explaining the high reflectivity[14]. May also be part of a feedback loop, increasing the planet's albedo and reducing the efficiency of atmosphere loss.

Eclipse Spectroscopy Results

- Supplement JWST NIRISS/SOSS data with *Spitzer*, TESS, and CHEOPS[6,8] eclipses as well as unpublished HST/UVIS (PI: Radica).
- Light curves reveal the characteristic signatures of stellar granulation noise, which can limit eclipse depth precision.
- Find scattering signatures of $MgSiO_3$ clouds at optical wavelengths, and confirm that the dayside temperature structure is non-inverted.



Future Work

- *Could the presence of high-albedo $MgSiO_3$ clouds suppress the emergence of a thermal inversion?*
- We are performing the first general circulation model simulations of an ultra-hot-Neptune to explore this possibility.
- These simulations will help reconcile LTT 9779 b with the broader population of ultra-hot-Jupiters.

References

[1] Szabó, G. M., & Kiss, L. L. 2011, ApJL, 727, L44; [2] Mazeh, T., Holczer, T., & Faigler, S. 2016, A&A, 589, A75; [3] Owen, J. E., & Wu, Y. 2013, ApJ, 775, 105; [4] Owen, J. E., & Lai, D. 2018, MNRAS, 479, 5012; [5] Jenkins, J. S., et al. 2020, NatAs, 4, 1148; [6] Dragomir, D., et al. 2020, ApJL, 903, L6; [7] Crossfield, I. J. M., et al. 2020, ApJL, 903, L7; [8] Hoyer, S., et al. 2023, A&A, 675, A81; [9] Krenn, A. F., et al. 2023, A&A, 784 672, A24; [10] Baxter, C., et al. 2020, 688 A&A, 639, A36; [11] Albert, L., et al. 2023, PASP, 135, 075001; [12] Radica, M., et al. 2023, MNRAS, 524, 835; [13] Feinstein, A. D., et al. 2023, Natur, 614, 670; [14] Coulombe, L., et al., NatAs, submitted.

LINK TO PAPER!