

A Tale of Two Molecules: The Underprediction of CO₂ and Overprediction of PH₃ in Atmospheric Models



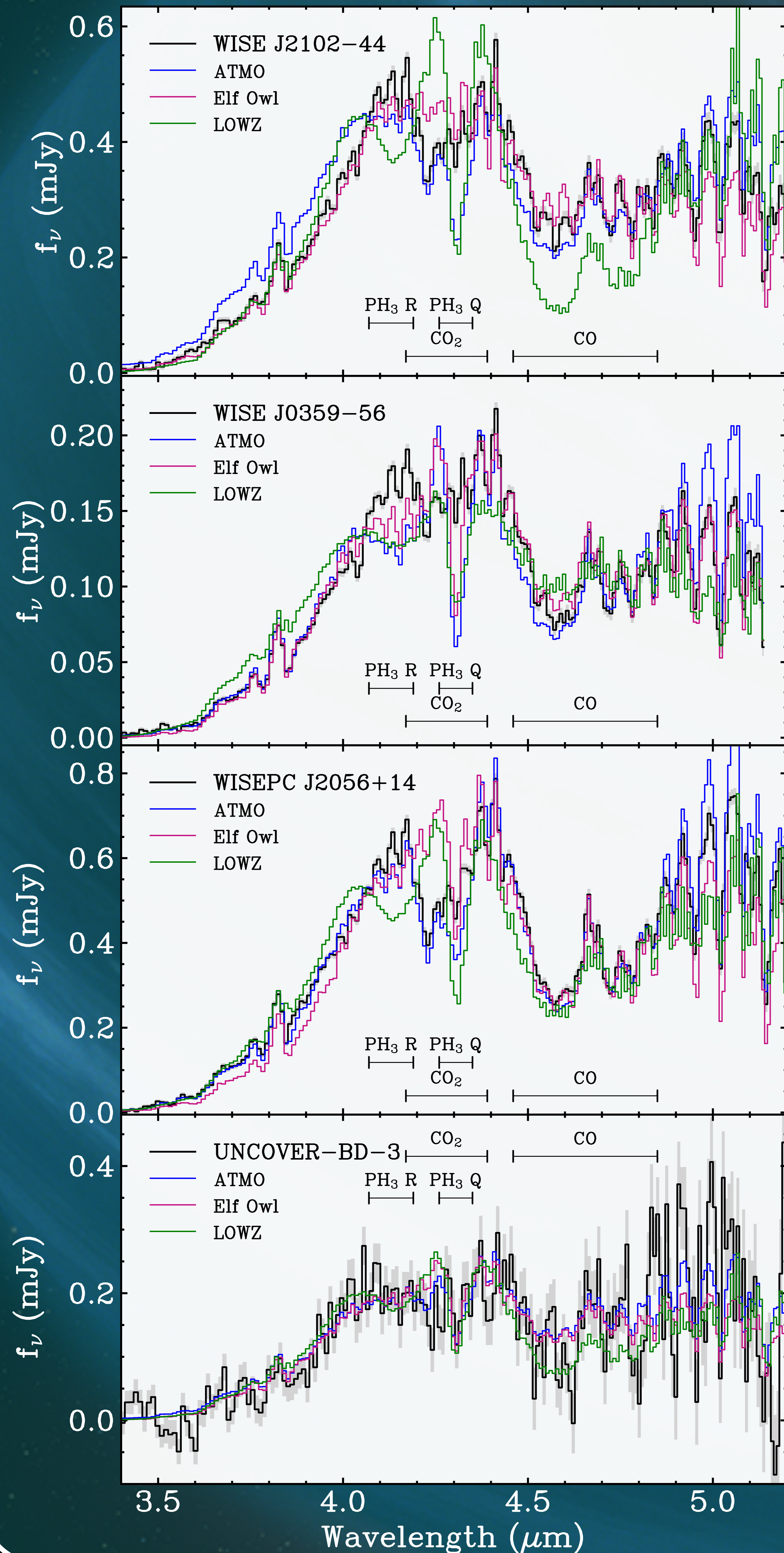
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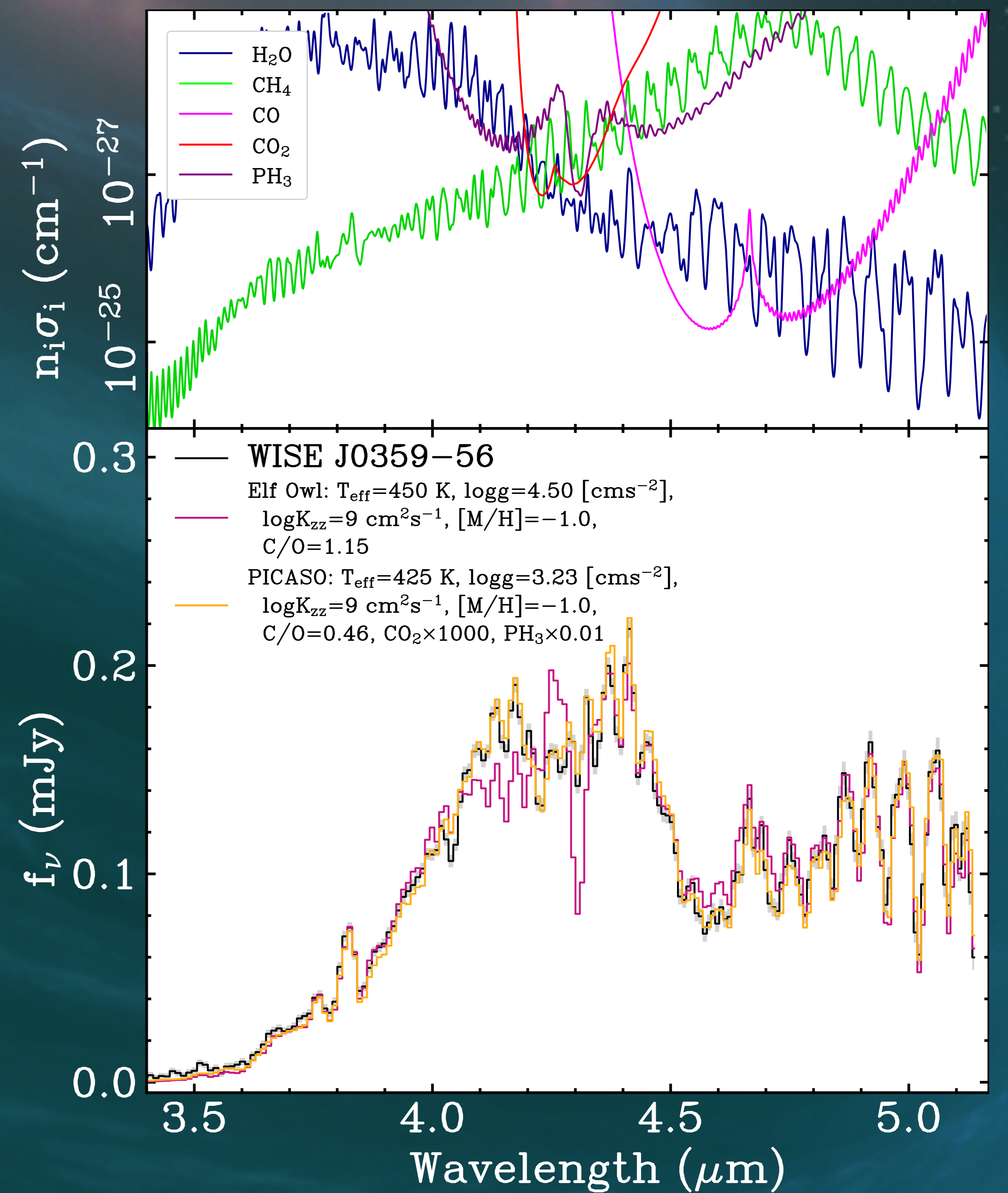
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Atmospheric Models Generally Fit Well... But...

Fitting JWST NIRSpec spectra of T8–Y0 dwarfs with a variety of forward models reveals poor fits at ~4.3 microns where there are CO₂ and PH₃ features

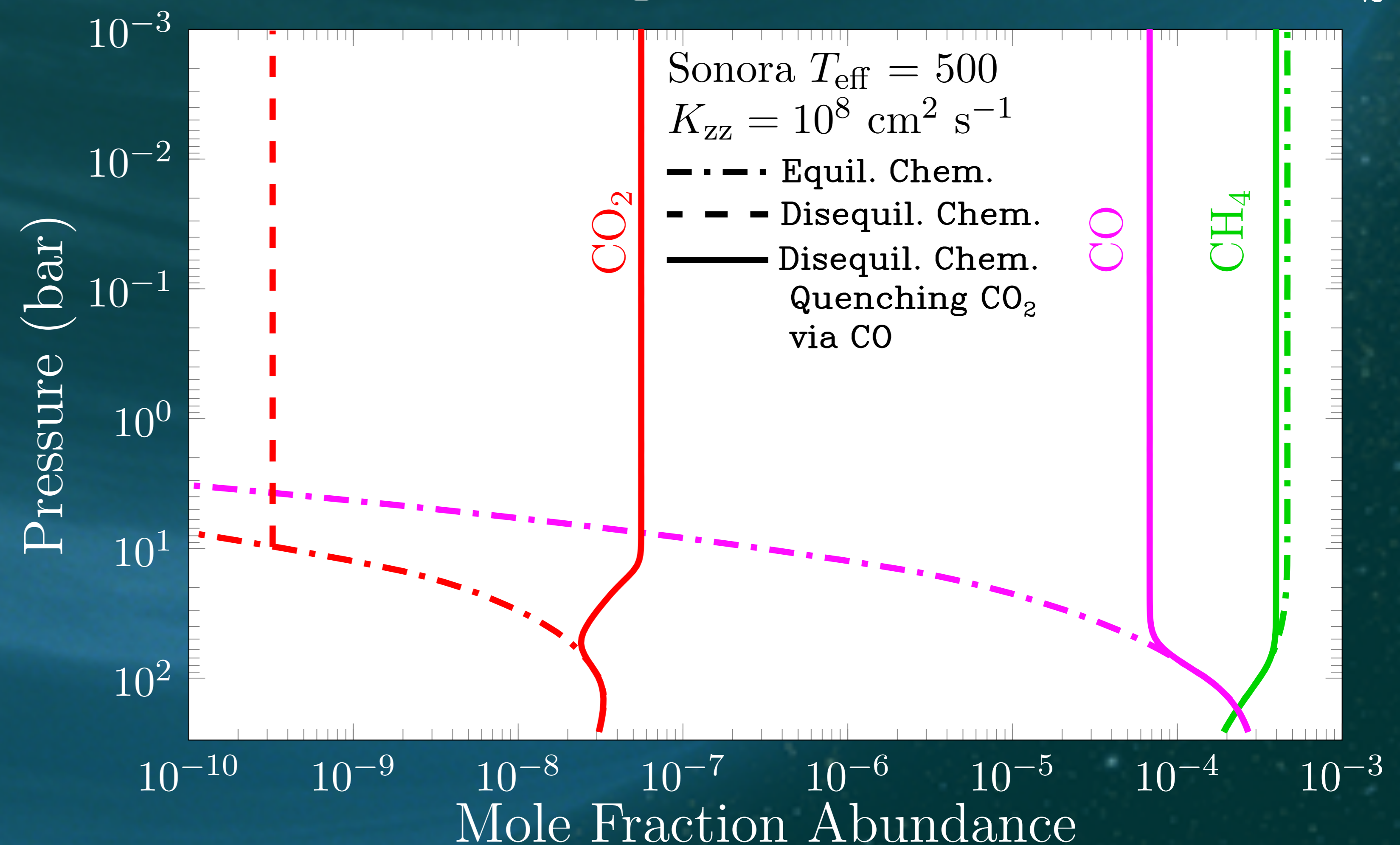


PICASO model grid that includes CO₂ and PH₃ as parameters prefers >1000× more CO₂ and >2× less PH₃



What physical or chemical processes could result in these abundances?

Quenching CO₂ via CO instead of CH₄ results in ~500× higher abundances of CO₂



Our understanding of P pathways is incomplete and/or NH₄H₂PO₄ is condensing

- References:
- [1] Beiler et al., 2024, Submitted
 - [2] Burgasser et al., 2022, ApJ, 962, 177
 - [3] Mukherjee et al., 2024, Preprint
 - [4] Meisner et al., 2021, ApJ, 915, 120
 - [5] Phillips et al., 2019, A&A, 637, A38
 - [6] Mukherjee et al., 2023a, ApJ, 942, 71
 - [7] NASA, ESA, CSA, Leah Hustak (STScI)