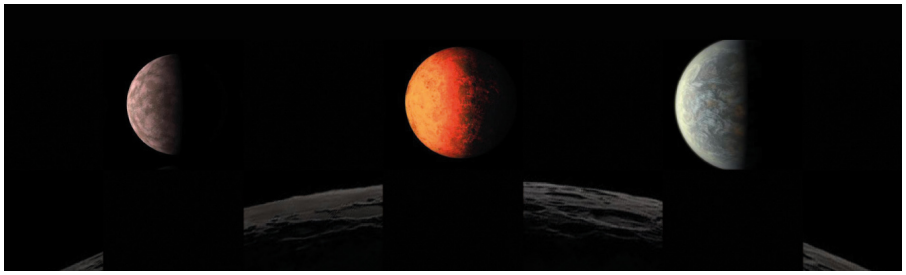

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Retrieval of phosphine as a biosignature: Forward modeling with petitRADTRANS

Thursday 23 October 2025 17:20 (15 minutes)

Phosphine (PH3) has emerged as a potential biosignature gas, particularly in high-pressure, CO2-dominated exoplanetary atmospheres analogous to Venus. This research explores the feasibility of detecting trace amounts of phosphine using simulated transmission spectra from petitRADTRANS (pRT). The central research question investigates how varying phosphine mixing ratios influence the observability of spectral features and how these signals vary across instruments, resolutions, and atmospheric contexts. Our methodology involved generating high-resolution synthetic spectra with varying PH3 abundances and calculating the area under the curve (AUC) of the phosphine absorption feature near 10.5 μm to estimate detectability. Key findings suggest that AUC correlates consistently with phosphine concentration, though signal strength is strongly influenced by cloud opacity, atmospheric temperature, and spectral resolution. These results validate the AUC method as a simplified yet informative detection metric for iosignature retrieval pipelines. This study contributes to optimizing spectral analysis strategies for future observatories such as JWST and highlights the importance of forward modeling in constraining biosignature detection thresholds for habitable and Venuslike exoplanets.

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