EXOPLANETS

Clouds over TRAPPISTs

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Clouds and hazes (collectively 'aerosols') play an essential role in exoplanetary studies, because of their impact on the atmospheric physics and chemistry but also because they can mask the atmospheric features of the spectra we observe. Sarah Moran and colleagues use a combination of Hubble Space Telescope (HST) spectra, laboratory results on exoplanetary hazes and an atmospheric cloud model in order to characterize the aerosols of the TRAPPIST-1 planets around the classical habitable zone (from TRAPPIST-1 d to g).

Moran et al. explore the vast parameter space that includes atmospheric composition (hydrogen- or volatile-rich), metallicity and various combinations of cloud decks and haze layers. The quality of HST spectra for TRAPPIST-1 g is not good enough to reach clear conclusions, but for TRAPPIST-1 d, e and f the results support the presence of volatile-rich secondary atmospheres, whose spectral features are probably muted by aerosols. The nature of such aerosols is more difficult to pinpoint: in order to fit the spectra, the model needs a thick high-altitude layer that is hard to maintain physically and chemically, and/or a huge haze production that is not fully supported by the laboratory experiments (even though these cannot be directly extrapolated to the conditions on TRAPPIST-1 d to g). In addition, Moran et al. do not rule out completely hydrogen-rich atmospheres for TRAPPIST-1 e and f, contrary to previous studies that used an old estimate for the planets' masses.

Moran et al. provide some much-needed constrains that further observations can refine. In particular, the upcoming James Webb Space Telescope could provide the precision needed to discriminate between cloudy and clear atmospheres and to better characterize their composition (and thus metallicity) and aerosol properties.

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