
Combined analysis of the 12.8 and 15 microns JWST/MIRI eclipse observations of TRAPPIST-1 b

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Résumé

Due to their transiting nature, combined with the infrared brightness and the small size of their host star, as well as the resonant architecture of the system that allows mass measurements via the transit timing variations (TTV) method, the TRAPPIST-1 planets are currently the best known terrestrial planets beyond our own solar system. The first JWST/MIRI photometric observations of TRAPPIST-1 b allowed for the detection of the thermal emission of the planet at 15 microns, suggesting that the planet could be a bare rock with a zero albedo and no redistribution of heat. In this talk we present five new occultations of TRAPPIST-1 b observed with MIRI in an additional photometric band at 12.8 microns. We perform a joint fit of the 10 eclipses and derive a planet-to-star flux ratio of 452 ± 86 ppm and 775 ± 90 ppm at 12.8 microns and 15 microns, respectively. We test a large range of models and find that the data can be well fitted by either an airless planet model with an unweathered (fresh) ultramafic surface, that could be indicative of relatively recent geological processes, or, more surprisingly, by a thick pure CO₂ atmosphere with photochemical hazes that create a temperature inversion and results in the CO₂ feature being seen in emission. Our results highlight the challenges in accurately determining a planet's atmospheric or surface nature solely from broadband filter measurements of its emission, but also point towards two very interesting scenarios that should be distinguishable from each other with the very recently acquired phase curve of TRAPPIST-1b (GO 3077, PIs: Gillon and Ducrot). To conclude the presentation we shortly present this double phase curve program (TRAPPIST-1 b+c) and discuss our first results.

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