Attempting to Detect Methane in Titan's Atmosphere with ETSI

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Abstract

Our research aims to detect methane in the atmosphere of Saturn's moon Titan using the innovative ETSI instrument. ETSI measures multiple wavelengths of light simultaneously, which allows for ultra-precise ground-based measurements. On July 8, 2022 Titan transited a known star (HIP 107569) illuminating its atmosphere and allowing us to possibly measure various molecular species, including methane. The poster will detail our methodology, the significance of methane detection, and the current status of our research.

Motivation & Discussion

The detection of methane in Titan's atmosphere is crucial for understanding its complex atmospheric processes and potential habitability. Methane, a key component of Titan's atmosphere, influences its climate and weather patterns. By studying methane's presence and variations, we can gain insights into Titan's surface and atmospheric chemistry (Lockwood et al. 1986).

The innovative ETSI instrument allows us to observe multiple wavelengths of light simultaneously, enhancing our ability to detect and analyze methane with high precision (Schmidt et al. 2024). The transit of Titan across the star HIP 107569 on July 8, 2022, provided a rare opportunity for detailed spectroscopic analysis. Utilizing ETSI, we aim to gather comprehensive data on methane distribution and concentration, contributing valuable knowledge to our understanding of Titan's atmospheric dynamics. Figure 1 shows the occlusion of HIP 107569 by Titan.

We flattened and normalized the ETSI observations of the occultation using the NUMPY implementation POLYFIT. This is show in the right panel of Figure 2.

We then measured the difference in flux both in and out of the occultation for each wavelength to get a representative understanding of the flux from the planet itself. We compared our flux measurements with previous measurements. Our results are currently inconclusive and we are currently investigating the discrepancies.

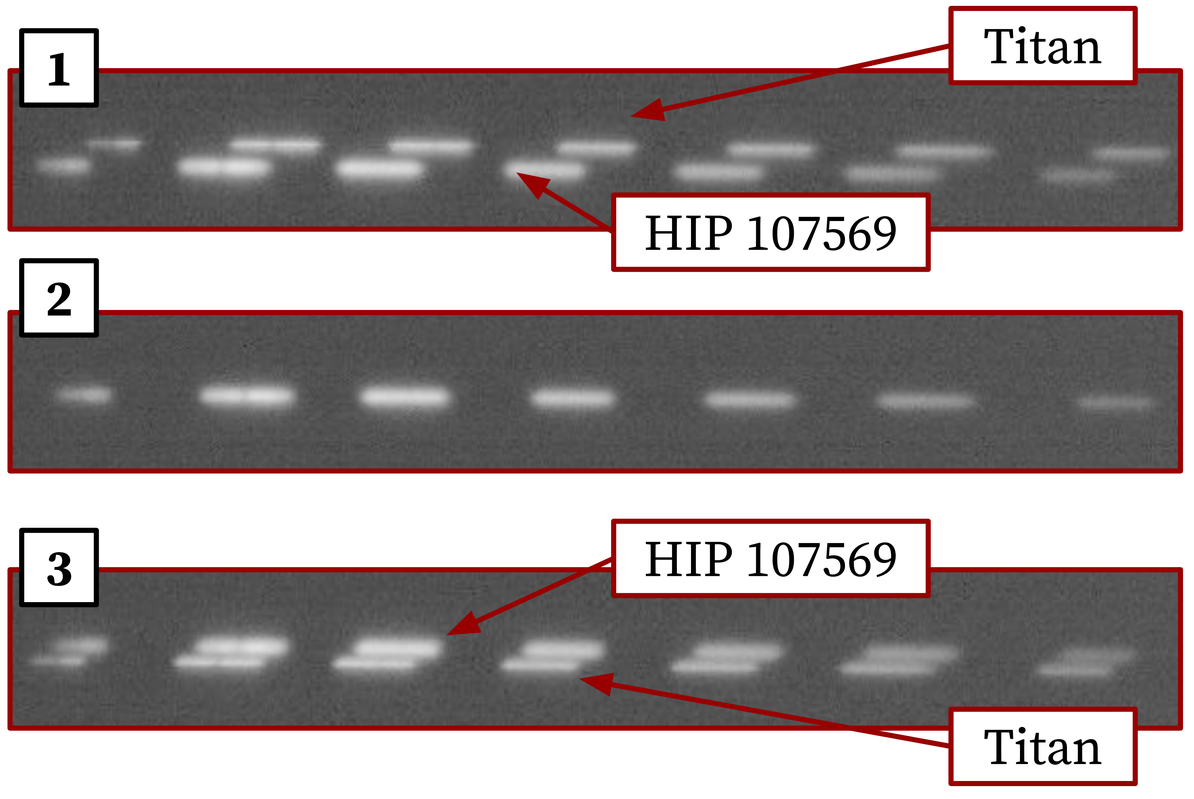

Figure 1: The occultation of HIP 107569 by Titan as a function of time. Panel [1] shows Titan and HIP 107569 before the occultation, Panel [2] shows the two objects during the occultation, and Panel [3] shows the two objects after the occultation.

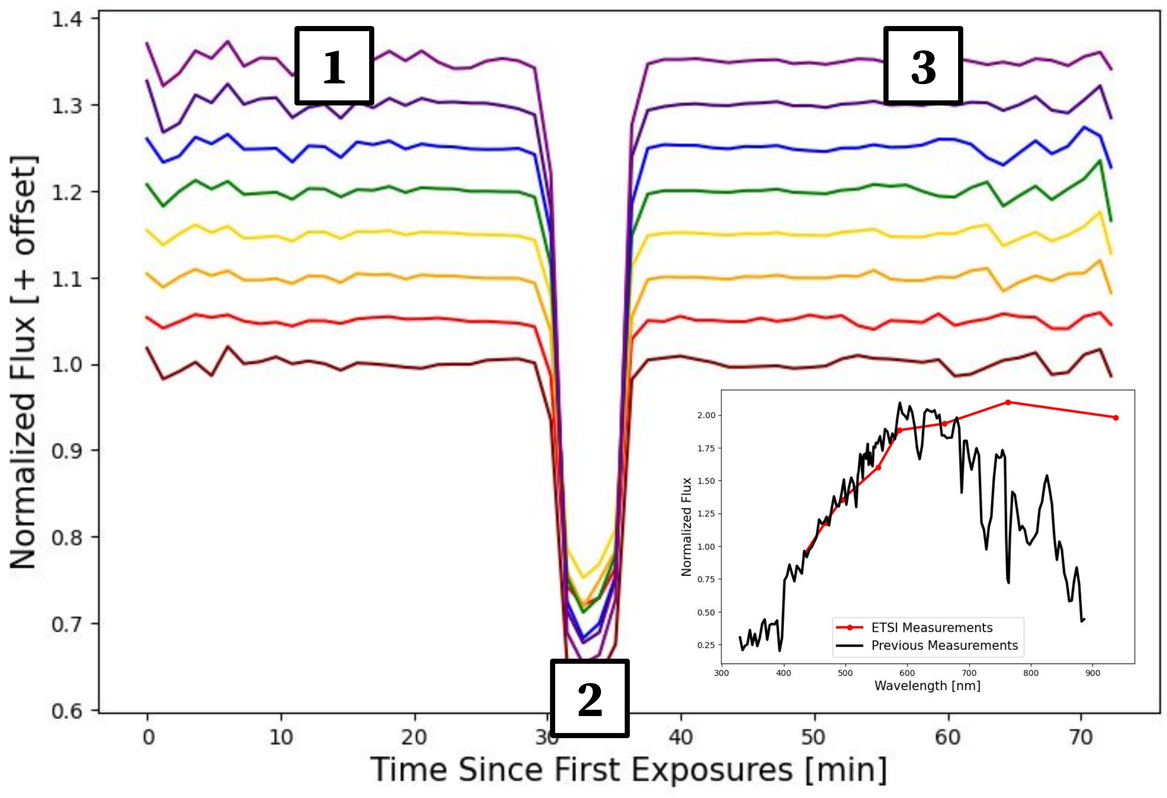

Figure 2: The light curve of HIP 107569 as it is occulted by Titan as a function of time. The numbers correspond to the panels in Figure 1. The figure inset shows the expected transmission spectrum of Titan (black) and our observed spectrum (red). More analysis is needed to reconcile the differences in observation.

References

1. Lockwood, G.W., et al, 1986, AJ, 303, 511
2. Schmidt, L.M., Oelkers, R.J., et al. 2024, submitted

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