

Compositional Analysis of Titan's Atmosphere Using Spitzer Infrared Spectrograph Data

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Introduction: We present, for the first time, infrared spectra from the Spitzer Space Telescope's Infrared Spectrograph (IRS) (2004-2008) of Titan in both the short wavelength-low resolution (SL, $R=60\sim127$, $5.13\text{--}14.29\text{ }\mu\text{m}$) and short wavelength-high resolution channels (SH, $R=600$, $9.89\text{--}19.51\text{ }\mu\text{m}$) showing the emissions of CH_4 , C_2H_4 , C_2H_2 , C_2H_6 , HCN , CO_2 , HC_3N , C_3H_4 , C_4H_2 , and C_3H_8 .

Spitzer IRS data has been used to measure atmospheric composition of various Solar System bodies, including Neptune [1] and Uranus [2],[3]. Although Spitzer took multiple dedicated observations of Titan, none of the results have been modeled before. We conduct our own investigation of these datasets and search for new results.

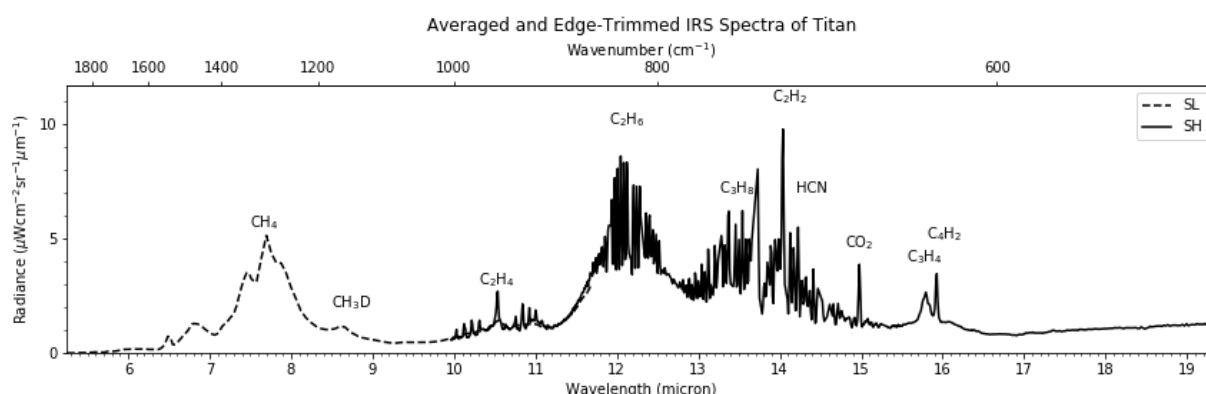
We retrieve temperature and gas composition profiles and compare the results obtained for Titan to those of the Cassini Composite Infrared Spectrometer (CIRS) and the Infrared Space Observatory Short Wavelength Spectrometer [4], and comment on the effect of spectral resolution on retrieved information content.

We conclude by recommending gaps in current spectroscopic knowledge of molecular bands that could be addressed by theoretical and laboratory study to aid future astronomical studies of Titan, for example the James Webb Space Telescope (JWST) and the Stratospheric Observatory for Infrared Astronomy (SOFIA)

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References:

- [1] Meadows et al. (2008) *Icarus*, 197 Issue 2, 585-589.
- [2] Orton et. al (2014) *Icarus*, 243, 494-513.
- [3] Rowe-Gurney et al. (2021) *Icarus*, 114506.
- [4] Coustenis et al. (2003) *Icarus*, 161 Issue 2, 383-403.



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