

The vertical distribution of CH₃CN in Titan's atmosphere by the ALMA archive data analysis

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We report the analysis of CH₃CN (methyl cyanide) in Titan's atmosphere using the Atacama Large Millimeter/submillimeter Array (ALMA) archive data ranging from 275 to 350 GHz. We developed a radiative transfer code for the multiple emission lines of CH₃CN in spherically symmetric distribution within the synthetic beamshape of ALMA, and derived the optimized vertical abundance profile for CH₃CN by the fittings of spectral line shapes. It was found that the abundance of CH₃CN readily increases around 200 km altitude, and then decreases along with the higher altitude. This result disagrees with various photochemical calculations for Titan's atmosphere, showing that the mole fraction of CH₃CN has a peak around 1000 km altitude. In contrast, our result is in reasonable accordance with that observed by the Cassini/Composite Infrared Spectrometer (CIRS) for the vertical distribution of HCN, which is as stable as CH₃CN from a chemical point of view. Our results also suggest the effect of Titan's atmospheric dynamics and seasonal change on the vertical profile of CH₃CN.

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