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TITLE: Probing Titan's Complex Atmospheric Chemistry Using the Atacama Large Millimeter/submillimeter Array

ABSTRACT BODY:

Abstract Body: Titan is Saturn's largest moon, with a thick (1.45 bar) atmosphere composed primarily of molecular nitrogen and methane. Atmospheric photochemistry results in the production of a wide range of complex organic molecules, including hydrocarbons, nitriles, aromatics and other species of possible pre-biotic relevance. Titan's carbon-rich atmosphere may be analogous to that of primitive terrestrial planets throughout the universe, yet its origin, evolution and complete chemical inventory are not well understood. Here we present spatially-resolved maps of emission from C₂H₅CN, HNC, HC₃N, CH₃CN and CH₃CCH in Titan's atmosphere, observed using the Atacama Large Millimeter/submillimeter Array (ALMA) in 2012-2013. These data show previously-undetected spatial structures for the observed species and provide the first spectroscopic detection of C₂H₅CN on Titan. Our maps show spatially-resolved peaks in Titan's northern and southern hemispheres, consistent with photochemical production and transport in the upper atmosphere followed by subsidence over the poles. The HNC emission peaks are offset from the polar axis, indicating that Titan's mesosphere may be more longitudinally variable than previously thought.

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