From Interstellar Ices to Polycyclic Aromatic Hydrocarbons
A symposium to honor Lou Allamandola's Contributions to the Molecular Universe
Annapolis, MD, USA - September 13^{th} to September 17^{th}, 2015

Organic Molecules In Titan's Atmosphere From Cassini Infrared Spectroscopy

Conor Nixon[1], Richard Achterberg[2], Bruno Bézard[3], Valeria Cottini[2], Athena Coustenis[3], Patrick Irwin[4], Donald Jennings[1], Nicholas Teanby[5], Sandrine Vinatier[3]

[1] NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA.

[2] University of Maryland, College Park, MD 20742, USA.

[3] LESIA, Observatoire de Paris, CNRS, 5 Place Jules Janssen, 92195 Meudon Cedex, France.

[4] University of Oxford, Clarendon Laboratory, Oxford OX1 3PU, UK.

[5] University of Bristol, Wills Memorial Building, Queen's Road, Bristol, BS8 1RJ, UK.

e-mail: conor.a.nixon@nasa.gov

Since July 2004 the Cassini spacecraft has been orbiting Saturn, and making continuous scientific observations of the planets, its moons, rings and atmosphere. Titan has received particular scrutiny, with Cassini making more than 110 close encounters to date with the hazy giant moon, and receiving a visit from the Huygens probe in January 2005 that descended to the surface. The Cassini orbiter carries on-board 12 scientific instruments, including the Composite Infrared Spectrometer (CIRS, Flasar et al. 2004) built and operated by NASA GSFC. During the last 11 years of the mission, CIRS has mapped Titan at wavelengths from 7 to 1000 μm, permitting measurement of atmospheric and surface temperature, clouds, hazes, and gas abundances. Titan's atmosphere is composed mostly of nitrogen and methane (98.4% and 1.5% in the stratosphere, respectively), which feed a complex photochemistry in the upper atmosphere induced by the action of solar UV and Saturnian magnetospheric electrons. The result is a panoply of organic molecules, including predominantly hydrocarbons (C_2H_6, C_3H_8, C_2H_2 etc) nitriles (HCN, HC_3N, C_2N_2 and more) (Teanby et al. 2008, Coustenis et al. 2010, Vinatier et al. 2010). The most complex molecule conclusively identified to date is benzene (C_6H_6) first tentatively detected by ISO (Coustenis et al. 2003) and later confirmed by CIRS, although direct sampling of Titan's ionosphere with Cassini mass spectrometers (INMS, CAPS) confirms the presence of many heavier macromolecules and haze particles with masses of 10^3 to 10^5 Daltons and beyond. One PAH has been tentatively identified from CAPS spectra (anthracene, Waite et al. 2007). In this presentation we will review the chemical complexity of Titan's stratosphere as revealed by Cassini CIRS, including recent seasonal changes at the south pole. We will also discuss the possibilities for further detections of more complex molecules including PAHs during the remainder of the mission.

REFERENCES

Coustenis et al. (2003) Icarus, 161, 383
Coustenis et al. (2010) Icarus, 207, 461

Flasar et al. (2004) Space Sci. Rev., 115, 169
Teanby, N. A. et al. (2008) Icarus, 193, 595
Vinatier, S., et al. (2010) Icarus, 205, 559
Waite et al. (2007) Science, 316, 870