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0.1 Titan's ionospheric chemistry: Experimental and theoretical studies

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The Ion and Neutral Mass Spectrometer (INMS) performed the first composition measurements of Titan's ionosphere during the T5 close pass by the Cassini spacecraft through Titan's upper atmosphere. Although the closest approach occurred on the nightside, INMS detected approximately 50 ion species. This suggests that the ionization of N_2 and CH_4 by energetic charged particles from Saturn's magnetosphere initiates a chemistry far more complicated than was expected by the pre-Cassini models. In order to identify these ions and understand their formation process, we developed a dual experimental and theoretical approach.

First, we conducted laboratory experiments simulating Titan ionospheric chemistry in a Fourier-transform ion cyclotron resonance mass spectrometer. Electron bombardment of simple carbon and nitrogen containing gas mixtures with relevant densities were performed, producing ions that were let to react for several minutes. The high resolution of the FT-ICR spectrometer allowed to unambiguously identify many complex hydrocarbons and nitrogen species, providing valuable information on the nature of the ions detected on Titan.

Second, we developed a model of Titan's ionospheric chemistry for ions containing up to 4 (C+N) atoms. In order to reproduce the INMS spectrum, reactions of ions with N-containing neutrals not yet detected in Titan's atmosphere but observed in the experiment had to be included. This strongly suggests the presence

of a small abundance of NH_3 as well as CH_3CN, C_2H_3CN and C_2H_5CN in Titan's upper atmosphere.