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Laboratory studies of molecular growth in Titan ionosphere

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Experimental simulations of the initial steps of the ionic chemistry occurring in the ionosphere of Titan were performed at the synchrotron source ELETTRA in Trieste. The measurements consisted in irradiating gas mixtures with a monochromatic beam of variable wavelength (from the methane ionization edge at 12.6 eV, up to the molecular nitrogen dissociative ionization edge, beyond 24.3 eV). Three gas mixtures of increasing complexity were used: N2/CH4 (0.97/0.03), N2/CH4/C2H2 (0.97/0.03/0.01) and N2/CH4/C2H2/C2H4 (0.97/0.03/0.01/0.01). The resulting ionic chemistry was followed by recording high resolution mass spectra (FT-ICR ion trap) as a function of time and VUV photon energy. A Titan ionospheric model has been adapted in order to simulate the laboratory results. Comparison between observed and modeled ion densities validates the kinetic model (reactions, rate constants, product branching ratios) for the primary steps of molecular growth. It also reveals differences which we attribute to heterogeneous chemistry on surfaces. This suggests that heterogeneous chemistry on aerosols might efficiently produce HCN and NH3 in Titan upper atmosphere.