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On the Amount of Heavy Molecular Ions in Titan's ionosphere

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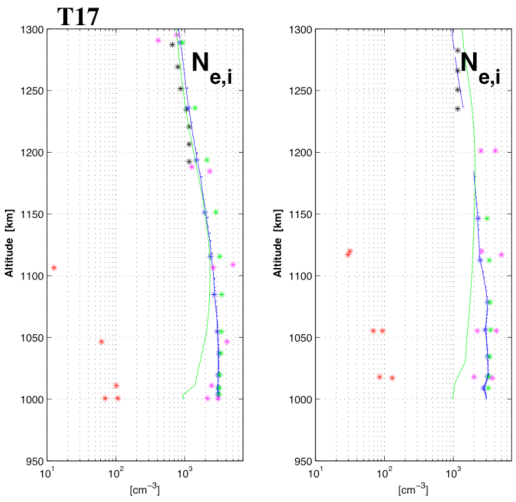
Abstract

We present observational evidence that the ionosphere of Titan below an altitude of 1150 km is a significant source of heavy (>100 amu) molecular organic species. This study is based on measurements by five instruments (RPWS/LP, RPWS/E, INMS, CAPS/ELS, CAPS/IBS) onboard the Cassini spacecraft during three flybys (T17, T18, T32) of Titan. The ionospheric peaks encountered at altitudes of 950-1300 km had densities in the range 900-3000 cm^{-3}. Below these peaks the number densities of heavy positively charged ions reached 100-2000 cm^{-3} and approached 50-70% of the total ionospheric density with an increasing trend toward lowest measured altitudes. Negatively charged ion densities were in the range 50-150 cm^{-3}. These results imply that ~10^5-10^6 heavy charged ions/m^3/s are continuously recombining into heavy neutrals and supply the atmosphere of Titan. The ionosphere may produce 0.1-1 Mton/year of heavy organic compounds. Although, this result needs confirmation by further analysis of the Cassini data, it is indicative that the ionosphere of Titan is an important source of the complex chemistry leading to the formation of the aerosol haze and other heavy organic molecules found in Titan's atmosphere and on the surface of Titan.



The discrepancy between the INMS ion density (green line) and the RPWS LP electron density (blue line) in the lower ionosphere is indicative of heavy molecular organic ions (> 100 amu).

The corresponding ion number density of heavy molecular ions is relatively large (100-2000 cm^{-3}), and is expected to prevail down to at least 400 km altitude according to the Radio Science experiment onboard Cassini. We therefore predict that Titan's ionosphere is dominated by heavy (>100 amu) ions below 950 km.