The Icy Giants & Triton’s Ionospheres – lessons learned from Cassini observations within Saturn’s and Titan’s ionospheres

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We discuss the importance to determine the structure and composition of the upper atmospheres and ionospheres of the Icy Giants (Uranus & Neptune) as well as Triton’s ionosphere in the light of numerous recently obtained Cassini results. The ionizing radiation and charging environment within the upper atmospheres of Saturn and Titan creates a very complex organic chemistry leading to charged sub-nm-sized to 100 nm-sized aerosols. The charged dust has a profound effect on the ionospheric structure and related chemistry, enhancing the ion number density well above photochemical equilibrium levels, while the electrons tend to become attached to the dust population. The organic chemistry leads to compounds reaching above 50,000 amu diffusing downward and possibly creating a pre-biotic chemistry. This process, involving nitrogen, methane and water may very well be a more general process, also applicable for the cases of Uranus, Neptune and Triton, were all have these starting species abundant in their upper atmospheres. We therefore propose that a future mission to the Ice Giants and the moon Triton has Langmuir probe, electron spectrometer, dust, ion- and neutral mass spectrometers onboard to make detailed in-situ measurements on both the orbiter and atmospheric probe in order to investigate this fundamental chemistry and aerosol formation.