

The ring and ionosphere interaction of Saturn: the RPWS observations during the Grand Finale

*Michiko W Morooka¹, Jan-Erik Wahlund¹, Lina Hadid¹, William Kurth², Ann M Persoon², William Farrell³, Hunter Waite⁴, Rebecca Perryman⁴, Donald Mitchel⁵

1. IRF Swedish Institute of Space Physics Uppsala, 2. University of Iowa, 3. NASA/Goddard Space Flight Center, 4. Southwest Research Institute, 5. Johns Hopkins University, Applied Physics Laboratory

On 15th September 2017, the Cassini spacecraft ended mission with a spectacular dive into Saturn's atmosphere. During the Grand Finale orbits Cassini performed a set of 22 flybys that flew through the equator region at the altitudes between the inner most ring, the D ring, and the ionosphere, provided unique in-situ measurements. The electron and ion measurements by the Radio and Plasma Wave Science (RPWS) instruments revealed a cold, dense, and dynamic ionosphere that interacts with the rings.

In the first orbit of Grand Finale orbits, plasma densities reached up to 1000 /cc, and electron temperatures below 1,160 K near closest approach. From the average ion mass inferred by the Langmuir probe, the dominance of the H⁺ ion species at the upper ionosphere were confirmed. However, some other high-altitude observations showed the signature of a heavier ion species (> 18 amu) dominance near the equator and differences in the ion and electron densities, indicating the presence of negatively charged dust.

During the last low-altitude orbits and the final plunge, the electron densities up to $6 \cdot 10^3$ /cc had been observed near the closest approach at 1,500 km altitudes. On the other hand, the ion densities were in excess of the electron density up to $5 \cdot 10^4$ /cc below the altitudes of 3,000 km, where heavier ion mass were also inferred. By comparing the RPWS observed electron and ion densities with the ion densities of various species detected by the Ion and Neutral Mass Spectrometer (INMS), a dominance of the heavy positive ion species and the possible presence of the heavy negatively charged cluster ions are identified.

The ion and electron density variations observed in various altitudes range during the Grand Finale orbits indicates the dynamic interaction between the D ring and the ionosphere.

Keywords: Saturn's ionosphere, Dust plasma interaction, Cassini Grand Finale