EPSC Abstracts
Vol. 18, EPSC-DPS2025-796, 2025, updated on 11 May 2026
https://doi.org/10.5194/epsc-dps2025-796
EPSC-DPS Joint Meeting 2025

On the equatorial dayside ionosphere of Saturn – In-situ observations give evidence for a dynamic and layered structure in disequilibrium

Jan-Erik Wahlund[1], Anders Eriksson[1], Michiko Morooka[1], Stephan Buchert[1], Moa Persson[1], Erik Vigren[1], Joshua Dreyer[2], William Kurth[3], Jack Waite[4], Jean-Pierre Lebreton[5], William Farrell[6], and Ingo Müller-Wodarg[7]

[1]Swedish Institute of Space Physics, Uppsala Division, Uppsala, Sweden (jwe@irfu.se)

[2]Royal Observatory of Belgium, Brussels, Belgium

[3]University of Iowa, Iowa City, Iowa, USA

[4]Department of Physics and Astronomy, University of Alabama, Tuscaloosa, Alabama, USA

[5]Laboratoire de Physique et Chimie de l’Environnement et de l’Espace (LPC2E), CNRS-Université d’Orléans-CNES, France

[6]NASA/Goddard Space Flight Center, Greenbelt, Maryland, USA

[7]Imperial College London, UK

The Cassini observations of Saturn’s ionosphere during the proximal orbits 288-293 in the altitude range 1450 – 4000 km (above 1-bar level) are revisited. A thorough re-analysis is made of all 159 available Langmuir probe sweeps of the Radio & Plasma Wave Science (RPWS) measurements. We relate them to the RPWS plasma wave inferred electron number densities and compare them with the available Ion Neutral Mass Spectrometer (INMS) measurements of the $H^+$and H_3^+ number densities. Different analysis methods are used by RPWS to provide consistent electron number density values for the whole measured altitude interval. Consistent RPWS electron number density (n_e) and INMS positively charged ion number density (n_{i+}) profiles are derived for altitudes above ~2200 km. Below this altitude the inability of INMS to measure ions above 8 amu at the 34 km/s flyby speed lead us to infer the presence of heavy ions (> 8 amu) and a negatively charged ion component, presumably related to infalling material from the D-ring of Saturn with its associated local ion-molecule-aerosol chemistry. This lower altitude region shows a highly time variable layered structure. The Langmuir probe data in this region are strongly affected by secondaries emitted from the spacecraft and sensor surfaces when traversing a molecule-rich atmosphere at 34 km/s. There are clear signatures of secondary electron and ion emissions from the spacecraft and sensor surfaces in the data. In the Langmuir probe sweep analysis, we correct for the effect of such impact-generated products. This gives corrected total ion number densities that can be compared to the INMS ion number densities and the electron number densities. From this analysis the number of negative ions and/or nm-sized aerosol/dust particles can be constrained. A clear ionospheric peak is not identified, not even at the lowest observed altitude of approximately 1450 km. There are clear latitudinal variations and temporal evolving structures, which we infer are representative of the difference in infalling material from different regions of the D-ring. In addition, there are indications of a strong heating source for the ambient electrons that are well above expected thermal equilibrium levels (up to 4000 K). The cause of this heating is unknown but may be linked to collisional deacceleration of infalling ring material. The observational profiles presented here can be used for ionosphere theory/model comparisons in the future.