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The electrons and ion characteristics of Saturn's plasma disk inside the Enceladus orbit

Michiko Morooka (1), Jan-Erik Wahlund (1), Sheng-Yi Ye (2), William Kurth (2), Ann Persoon (2), and Mika Holmberg (3)

(1) Swedish Institute of Space Physics (IRFU), Uppsala, Sweden (morooka@irfu.se), (2) Department of Physics and Astronomy, University of Iowa, Iowa City, IA, USA, (3) Institut de Recherche en Astrophysique et Planétologie (IRAP), France

Cassini observations revealed that Saturn's icy moon Enceladus and surrounding E ring are the significant plasma source of the magnetosphere. However, the observations sometimes show the electron density enhancement even inside the Enceladus orbiting distance, $4R_S$. Further plasma contribution from the inner rings, the G and the F rings and main A ring are the natural candidate as an additional plasma source. The Cassini/RPWS Langmuir Probe (LP) measurement provides the characteristics of the electrons and ions independently in a cold dense plasma. The observations near the center of the E ring showed that the ion density being larger than the electron density, indicating that there is additional particle as a negative charge carrier. Those are the small nm and μm sized dust grains that are negatively charged by the electron attachments. The faint F and G rings, located at R=$2R_S$ and $3R_S$, consist of small grains and similar electron/ion density discrepancies can be expected. We will show different types of the LP observations when Cassini traveled the equator region of the plasma disk down to $3R_S$. One with the electron density increasing inside $4R_S$, and another with the electron density decreasing inside $4R_S$. During the orbit 016 (2005 doy-284/285), the electron density continued to increase toward the planet. On the other hand, the ion currents, the LP measured currents from the negative bias voltage, turn to decreasing inside $4R_S$, implying the density decrease of the ions. By comparing the observed LP ion current characteristics and the modeled values using the obtained electron density, we found that the characteristic ion mass can be several times larger than the water ions (AMU=18) that we expected in this region. During the orbit 015 (2005 doy-266/267), on the other hand, the LP observed sharp electron density drop near $3R_S$. The dust signals from the RPWS antenna showed the density enhancement of the μm sized grains coincide the electron density drop and we have estimated that the characteristic ion mass can exceed AMU=100. Throughout the whole Cassini observation near the equator inside $4R_S$, we didn't find the case with the ion densities larger than the electron densities as were found near the E ring and the Enceladus plume. We suggest that Saturn's plasmadisk inside the Enceladus orbit is dynamic in ion characteristics where the water molecules coagulate and grow into a small icy dust grains. In the presentation we discuss the relationship between the electron/ion density and the density of the nm and μm sized grains.