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The Cassini RPWS/LP Observations of Dusty Plasma in the Kronian System

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Saturn's icy moons and ring system are ideal places to study the nm-dust. Nearly thirteen years of its orbital period around Saturn Cassini revealed the presence and the size/charge state of nm to μm dust in many places. Observations in different places shows the different type of generation mechanisms (coagulation and fragmentation) of grains depending on the different environments. The electrical dust-plasma interaction was first identified in the E ring (Wahlund *et al.* 2009). The E ring dust consists of mostly 0.01-100 μm ice grains, and the ring has a structure that the dusty plasma of smaller nm-grains surrounds the ring core consisting of larger (μm) sized dust. Similar dusty plasma structure was found near the F ring as well (Morooka *et al.* 2011). The Water jets out of the Enceladus Tiger strips create a plume of dusty plasma. Multi-instruments study confirmed a size distribution of the dust in the plume (e.g., Morooka *et al.* 2011) and that magnetic field in the plume is affected by the charged dust (Engelhardt *et al.* 2015). In Titans atmosphere and ionosphere Multi-instruments observations confirmed series of hydrocarbon-nitrile compounds (Waite *et al.* 2007) as well as positively and negatively charged heavy ions of up to 50,000 amu (Coates *et al.* 2007). The observation is a signature of aerosol formation. Statistical study revealed the EUV control of this formation (Shebanits *et al.* 2017). Aerosols grows as a result of the complex chemistry and the charge balance. During the last phase of the mission, called the Grand Finale, Cassini made 22 Saturn flybys drove in between the D ring and atmosphere of Saturn. The results of different dust and plasma characteristics depending on the altitude of Saturn indicates that the ring materials are falling down to the planet, accumulated in the ionosphere to create a dust layer, and create a dusty negative ion ionosphere of Saturn (Morooka *et al.* 2018b).

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