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In-situ dust measurements during Cassini's F-ring and proximal orbits

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Abstract

The Cosmic Dust Analyzer (CDA) onboard Cassini characterized successfully the dust environment at Saturn since 2004. The instrument measured the primary charge, speed, mass and composition of individual submicron and micron sized dust grains. Starting in December 2016 Cassini performed ring plane crossings at radial distances of 2.48 Saturn radii and at 1.05 Saturn radii (proximal orbits, starting in April 2017). For the first time, an in-situ dust detector explored the F-ring region of Saturn. CDA determined particle densities, particle mass distributions and compositional measurements. Furthermore, the High Rate Detector (HRD) was activated using a high time and spatial resolution. The relativ impact speed of dust grains at the instrument target during ring plane crossings was 20 km/s (F ring orbits) and 30 km/s (proximal orbits), respectively. The high impact speeds allowed a sensitive compositional analysis and the detection of grains well below 50 nm. CDA successfully characterized the F-ring region and found, that the inner edge of the E-ring reaches radial distances of 2.5 Rs. Larger grains above 0.8 micron are focused to the ring plane, whereas smaller grains were measured as far as 60.000 km away from the ring plane.
For the first time, in-situ measurements were performed inside Saturn's main ring system at radial distances of 1.05 Saturn radii. The overall dust density within Saturn's main ring and close to Saturn is much lower than expected. Especially larger grains above 0.7 micron are depleted. The characterization of the "ring rain" from Saturn's main ring towards Saturn was an ultimate goal of CDA.