HRD Dust Results from Saturn's E and G Ring Crossings

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The High Rate Detector (HRD) is part of the CDA instrument on the Cassini mission and its overall objective is to obtain quantitative measurements of particle flux and mass distribution throughout the Saturn ring system. The particle mass range covered by the HRD ranges from 10^{-12} to about 10^{-7} g for differential flux measurements.

Cassini spacecraft entered Saturn orbit July 1, 2004 and started a long investigations of Saturn and its rings. The HRD has encountered very little dust during the cruise orbit to Saturn, but at the Saturn vicinity it has seen elevated activity every time the spacecraft crossed its rings. Particularly intensive activity has been observed during the Enceladus flybys on DOY 2005_48, 2005_68, 2005_122 and 2005_196. During these periods the HRD registered many particles larger than 2 μm. In the case of the DOY 2005_196 (July 14^{th}, 2005) flyby, the period of elevated activity lasted from about 10 minutes before the closest approach to about 10 minutes after the closest approach. The highest intensity, however, up to 10 particles per second larger than 2 μm, was centered not at the closest flyby distance as it was expected, but approximately one minute before the closest approach, when the Cassini spacecraft was flying over the south pole of the Enceladus satellite. Our results, together with the results from other Cassini instruments established that a specific site on the south pole seems to be one of the sources of the ice particles. Also, when the icy satellite surfaces are being bombarded with a micrometeoroid beam, particle ejecta are produced with velocities high enough to get them into high altitudes to form a dust particle torus around Enceladus. Some of these particles are getting into the orbit of Enceladus with high velocity to overcome the satellite gravity, or are swept by the solar wind, and eventually provide constant particle source for the E-ring.

On DOY 2005_248 at about 10:40, the Cassini spacecraft crossed the Saturn G ring at a distance of 2.93 R_S. During that crossing, the HRD has encountered the heaviest and most intensive dust particle flux so far for the entire mission. During a short period of a few seconds several dust particles heavier than 20 μm were detected by both HRD detectors. At the same period, counting rates of several hundreds counts per second were registered with both HRD detectors. Just before the crossing of the G ring a very large dust particle of more than 100 microns in diameter hit the large (M) HRD

detector, the signal of which exceeded all four size thresholds. This event apparently has changed the energy scale of the electronic system and the M1 channel of that detector became subsequently somewhat noisy. Raising the energy threshold removed the noise. Subsequently, an internal calibration indicated that the electronic system performed nominally as expected and the problem appeared to be at the front end in the sensor itself.