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Statistical Analysis of Dust Impacts Acquired on the Cassini-Mission

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Abstract

The Cosmic Dust Analyser (CDA) aboard the *Cassini* spacecraft recorded more than 1.5 million potential impacts since the beginning of its operation in 1999. The whole data set covers various types of such events that are put into well-defined categories (e.g. "big", "fast", "Wall", "noise events") determined from the appearance of the signal. These categories are encoded in so-called "Counters" that generally reflect the activity of the instrument as well as the quality of our data. Moreover, the correlation between the Counter rates gives clues to the conditions of dusty particles in the interplanetary space and in the evironment of Saturn, in particular.

We present the time-dependend evolution of the Counters showing changes of the dust properties according to the spacecraft orbit: We investigate the features of the dust particles depending on the position within the Saturnian system. Different behaviour is investigated for ring particles, moon ejecta, dust streams, and interplanetary dust. Our measurements give rise to a more detailed analysis to check for dynamics, production rates, activity, and other internal phenomena in the environment of Saturn.

1. Introduction

The *Cassini* spacecraft was launched to her seven-year journey through the interplanetary space in 1997, and entered into the orbit of Saturn on July 1, 2004. Aboard, the Cosmic Dust Analyser (CDA) is the most state-of-the-art instrument to detect submillimeter particles within a mass range from 10^{-18} to 10^{-12} kg at velocities $v \approx 20$ km/s (Srama *et al.* 2004). It was put into operation in 1999, and achieved many outstanding discoveries, e.g. the chemistry of the Jovian dust streams (Postberg *et al.* 2006), Saturnian dust streams (Kempf *et al.* 2005); the release of water and ice grains at Enceladus (Spahn *et al.* 2006); and salts from an ocean below (Postberg *et al.* 2009).

2. Data Sample

Several previous analyses were focused on special issues on chemical compounds, evironment of the moons, or impact rates at prominent locations (e.g. Kempf 2008). However, a complete overview of the measurements has not been accomplished yet. We try to review the CDA database and present a statistics as a first approach.

At first, we scanned a data set of almost 1.3 million recorded signals from the raw data spanning the decade from 1999 to 2009. Figure 1 shows the unweightened and unprocessed histogramm of all signals on monthly bins. The shaded area is a subset of 579.933 confirmed impacts: 46% hit the Impact Ionisation Target (IIT), 10.6% hit the Chemical Analyzer Target (CAT), 8.2% stroke the weakly sensitive wall of the instrument and caused an avalanche of secondary electrons at the multiplier. The remaining records were either noise effects or uncomplete signals that may occur on the grids in front of the CDA.

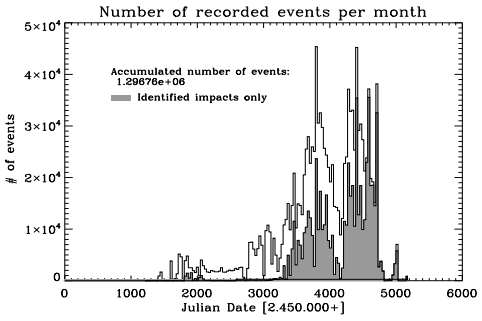

Figure 1: Recorded signals of the CDA and the subset of confirmed impacts (shaded area).

The decline of the data some months around February 2008 (JD $\approx$ 4200) is rather an artifact due to the observation geometry of the CDA. In the second half

of the year 2008 (JD $>$ 4800) the instrument was turned off due to maintanance of the software. Further results with detailed correlation of the Counters will be discussed during the presentation.

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