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Highlights and discoveries of the Cosmic Dust Analyser (CDA) during its 15 years of exploration

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Abstract

The interplanetary space probe Cassini/Huygens reached Saturn in July 2004 after seven years of cruise phase. Today, the German-lead Cosmic Dust Analyser (CDA) is operated continuously for 10 years in orbit around Saturn. During the cruise phase CDA measured the interstellar dust flux at one AU distance from the Sun, the charge and composition of interplanetary dust grains and the composition of the Jovian nanodust streams. The first discovery of CDA related to Saturn was the measurement of nanometer sized dust particles ejected by its magnetosphere to interplanetary space with speeds higher than 100 km/s. Their origin and composition was analysed and an their dynamical studies showed a strong link to the conditions of the solar wind plasma flow. A recent surprising result was, that stream particles stem from the interior of Enceladus.
Since 2004 CDA measured millions of dust impacts characterizing the dust environment of Saturn. The instrument showed strong evidence for ice geysers located at the south pole of Saturn‘s moon Enceladus in 2005. Later, a detailed compositional analysis of the salt-rich water ice grains in Saturn‘s E ring system lead to the discovery of liquid water below the icy crust connected to an ocean at depth feeding the icy jets. CDA was even capable to derive a spatially resolved compositional profile of the plume during close Enceladus flybys.
A determination of the dust-magnetosphere interaction and the discovery of the extended E ring allowed the definition of a dynamical dust model of Saturn’s E ring describing the observed properties. The measured dust density profiles in the dense E ring revealed geometric asymmetries. Cassini performed shadow crossings in the ring plane and dust grain charges were measured in shadow regions delivering important data for dust-plasma interaction studies. In the last years, dedicated measurement campaigns were executed by CDA to monitor the flux of interplanetary and interstellar dust particles reaching Saturn. Currently, the composition of interstellar grains and the meteoroid flux into the Saturnian system are in analysis.

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