

The Age of Saturn's Rings Constrained by the Meteoroid Flux Into the System

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The origin of Saturn's ring is still not known. There is an ongoing argument whether Saturn's ring are rather young or have been formed shortly after Saturn together with its satellites. The water-ice rings contain about 5% rocky material resulting from continuous meteoroid bombardment of the ring material with interplanetary micrometeoroids. Knowledge of the incoming mass flux would allow to estimate the ring's exposure time. Model calculations suggest exposure times of 10^8 years implying a late ring formation. This scenario is problematic because the tidal disruption of a Mimas-sized moon or of a comet within the planet's Roche zone would lead to a much larger rock content as observed today.

Here we report on the measurement of the meteoroid mass flux into the Saturnian system obtained by the charge-sensitive entrance grid system (QP) of the Cosmic Dust Analyser (CDA) on the Cassini spacecraft. Interplanetary dust particles (IDPs) entering Saturn's sphere of gravitational influence are identified through the measurements of their speed vectors. We analyzed the full CDA data set acquired after Cassini's arrival at Saturn in 2004, identified the impact speed vectors of 128 extrinsic micrometeoroids $\geq 2\mu\text{m}$, and determined their orbital elements. On the basis of these measurements we determined the mass flux into the Saturnian system. Our preliminary findings are in support of a young ring. The knowledge of the meteoroids orbital elements allows us for the first time to characterize the meteoroid environment in the outer solar system based on direct measurements.