

The mass flux of micrometeoroids into the Saturnian system

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Abstract

There is an ongoing debate about the age of Saturn's rings being: a) rather young, or b) formed contemporaneously with the planet and its satellites. The water-ice rings contain about 5% of rocky material, originating from the continuous bombardment of the rings by 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, for example, 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 than observed today.

Here we report on the first direct measurement of the meteoroid flux into the Saturnian system by Cassini's Cosmic Dust Analyzer (CDA). We measured the impact velocity vectors of about 140 extrinsic micrometeoroids with radii $\geq 2\mu\text{m}$, and determined their orbital elements. On the basis of these measurements we determined the mass flux into the Saturnian system. Our findings suggest a ring exposure time of 4.5 billion years and is in support of an early ring formation scenario.