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The Saturnian Dust Streams: Sources, Sinks and Formation

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Abstract

Dust streams are collimated beams of small, high velocity particles that maintain their coherence over very large distances (several A.U.). They were first detected by the Ulysses spacecraft as it was traveling by Jupiter in March 1992. Dust streams emanating from Saturn were first detected by Cassini in 2004. This phenomenon arises from the coupling of magnetic fields and dust production sources in circumplanetary environments. In 2000, we used time-frequency analysis to determine that the Jovian dust streams originated from Io and simulated their dynamical evolution in the Jupiter magnetosphere. The detection of streams from Saturn, however, requires other dust production mechanisms and raises the question of the range of circumstances under which dust streams can be generated. Possibilities include (but are not limited to) Enceladus geysers, fragmented E-ring particles, and collisional fragments from the Main rings. This work will examine the possible sources, quantify the range of conditions and mechanisms under which dust streams can arise in the Saturnian system. CDA includes a time-of-flight mass spectrometer, providing compositional information not available from Galileo and Ulysses, which will provide new insights and constraints to address particle source issues. This work will have implications for the existence of this phenomenon elsewhere in the solar system (e.g., Neptune) and its possible remote detection by spacecraft.

In this presentation, I will quantify the conditions under which collimated dust streams form and evolve in the Saturn system and compare it to the generation of dust streams in the Jupiter system.