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How the Enceladus dust plume forms Saturn's E ring

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Before Cassini, dynamical models of Saturn's E ring (Horanyi et al., 1992) failed to reproduce its peculiar vertical structure inferred from earth-bound observations (de Pater et al., 2004). After the discovery of an active ice-volcanism in the south pole terrain of Saturn's icy moon Enceladus the relevance of this particle source for the vertical ring structure was swiftly recognised (Juhasz et al., 2007, Kempf et al., 2008). However, ad-hoc models for the plume particle injection predict too a small vertical ring thickness and overestimate the amount of the injected dust.

Here we report on numerical simulations of the particle ejection into the ring. We run a large number of dynamical simulations including gravity and Lorentz force to investigate the earliest phase of the ring particle life span. The evolution of electrostatic charge carried by the initially uncharged grains is treated selfconsistently. Freshly ejected plume particles are moving in almost circular orbits because Enceladus' orbital speed exceeds the particles' ejection speeds by far. Only a small number of the ejected grains survives against re-collision with the moon after their first orbit. Thus, the flux and the size distribution of those plume particles replenishing the E ring differs significantly from the size distribution and flux in the plume itself. Our numerical simulations reproduce the vertical ring profile measured by the Cassini dust instrument CDA (Kempf et al., 2008a) and it is consistent with edge-on images obtained by the Cassini camera ISS (Burns et al., 2005).