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## Saturn's Rings

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### Abstract Text:

The rings are changing before our eyes; structure varies on all timescales and unexpected things have been discovered. Many questions have been answered, but some answers remain elusive (see Cuzzi et al 2010 for a review). Here we highlight the major ring science progress over the mission to date, and describe new observations planned for Cassini's final three years.

Ring Composition and particle sizes: The rings are nearly all water ice with no other ices – so why are they reddish? The C Ring and Cassini Division are “dirtier” than the more massive B and A Rings, as shown by near-IR and, recently, microwave observations. Particle sizes, from stellar and radio occultations, vary from place to place.

Ring structure, micro and macro: numerous spiral density waves and ubiquitous “self-gravity wakes” reveal processes which fostered planet formation in the solar system and elsewhere. However, big puzzles remain regarding the main ring divisions, the C Ring plateau structures, and the B Ring irregular structure.

Moonlets, inside and out, seen and unseen: Two gaps contain sizeable moonlets, but more gaps seem to contain none; even smaller embedded “propeller” objects wander, systematically or randomly, through the A ring. Rubble pile ringmoons just outside the rings may have escaped from the rings, and the recently discovered “Peggy” may be trying this as we watch.

Impact bombardment of the rings: Comet fragments set the rings to rippling on century-timescales, and boulders crash through hourly; meanwhile, the constant hail of infalling Kuiper belt material has a lower mass flux than previously thought.

Origin and Age of the Rings: The ring mass and bombardment play key roles. The ring mass is well known everywhere but in the B Ring (where most of it is). New models suggest how tidal breakup of evolving moons may have formed massive ancient rings, of which the current ring is just a shadow.

During its last three years, the Cassini tour profile will allow entirely new observations: direct measurement of the still-unknown ring mass; direct *in-situ* sampling of ring particle composition (targeting the iron- or carbon-based red nonicy component); and radar backscattering observations.

Cuzzi, J. N. et al. (2010) An Evolving View of Saturn's Dynamic Rings; Science (Inv. Review) 19 March 2010: 327. no. 5972, pp. 1470 - 1475

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**Title:** Saturn's Rings

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