RINGS

The game of the seven moons

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We were almost deprived of the magnificence of Saturn's ring system. In fact, a planetary ring tends to disperse radially: numerical models have predicted that Saturn's A ring, the outermost of the system (except for the faint F ring), would have dispersed in ~10^8 years. This phenomenon was averted due to Saturn's small moons. If a satellite is in orbital resonance with the inner or outer edge of a ring, it applies a torque on it, limiting its dispersion. It is usually believed that the A ring was contained by its 7:6 resonance with the moon Janus (with some help from the smaller Epimetheus). Radwan Tajeddine and colleagues instead show that seven small moons contribute to confinement.

The small moons can act on the rings with two main mechanisms: individual resonances, like the one described above, or 'envelopes' of overlapping resonances generated by different moons — a shepherding effect. Tajeddine et al. compute the variations of the angular momentum flux across the A ring due to resonances induced by all the small moons around it and show that the second mechanism is in play: Pan, Atlas, Prometheus, Pandora, Janus, Epimetheus and Mimas all have a significant effect, confining the ring and defining its internal structure. Also, as the rings exert a corresponding torque on the satellites, they affect the moons' orbital evolution. Tajeddine et al. could infer an upper limit of 1 Gyr for the age of these satellites. Interestingly, the B ring seems instead to be controlled only by the 2:1 resonance between Mimas and its internal edge.

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