EPSC Abstracts
Vol. 5, EPSC2010-844, 2010
European Planetary Science Congress 2010

Boom and Bust Cycles in Saturn's Rings

LW Esposito, BK Meinke, M Sremcevic, N Albers
LASP, University of Colorado, Boulder CO 80309-0392 USA

Abstract

UVIS occultation data show clumping in Saturn's F ring and at the B ring outer edge, indicating aggregation and disaggregation at these locations perturbed by Mimas and Prometheus. Timescales range from hours to months. The maximum clumping lags the moon by ĬĂ in the forcing frame. This indicates a direct relation between the moon and the ring clumping. We propose that the collective behavior of the ring particles resembles a predator-prey system: the aggregate mean size is the prey, which feeds the velocity dispersion; conversely, increasing dispersion breaks up the aggregates. For realistic values of the parameters this creates a limit cycle behavior, as for the ecology of foxes and hares or the boom-bust economic cycle. Solving for the long-term behavior of this forced system gives a periodic response at the perturbing frequency, with a phase lag consistent with the UVIS occultation measurements. We conclude that the agitation by the moons at both these locations in the F ring and at the B ring outer edge drives aggregation and disaggregation in the forcing frame. This agitation of the ring material allows fortuitous formation of solid objects from the temporary clumps, via stochastic processes like compaction, adhesion, sintering or reorganization that drives the denser parts of the aggregate to the center or ejects the lighter elements. These more persistent objects would then orbit at the Kepler rate. Such processes can create the equinox objects seen at the B ring edge and in the F ring, explain the ragged nature of those ring regions and allow for rare events to aggregate ring particles into solid particles, recycling the ring material and extending the ring lifetime.