EPSC Abstracts,
Vol. 4, EPSC2009-702-1, 2009
European Planetary Science Congress,

Are Saturn's inner satellites the children of Saturn's main rings ?

S. Charnoz (1), J. Salmon (1), A. Crida (2)

(1) Université Paris Diderot/ CEA Saclay FRANCE charnoz@cea.fr fax: +33 1 69 08 65 77
(2) Center for mathematical sciences, Cambridge, UK , A.Crida@damtp.cam.ac.uk

Abstract

The inner small satellites of Saturn (Atlas, Prometheus, Pandora, Janus, and Epimetheus) are located beyond the main-rings outer edge (~138000 km) and Mimas (181000 km). They are characterized by non-spherical shapes [1,2] and masses ranging from 10^{16} kg to 10^{18} kg, with mass increasing with distance to Saturn. Due to their small sizes, these bodies would have difficulties to survive the meteoroid bombardment over 4 billions years, a thus, may not be primordial. In addition, their dynamical interaction with the nearby massive ring system induces an outward migration. As a back-reaction the ring system is radially confined due to the satellite's torque. Spectroscopic observations of Saturn's small satellites [3] have shown strong similarities with Saturn's main rings.

We recently designed a new 1D finite-elements using nested grids hydrodynamical code and a dynamical simulation to study this 2 components system (rings+satellites), including the planet's tides. The dynamical and collisional evolution of the satellites are also computed with a simple model over 5 billion years.

We show that viscous spreading of Saturn's main through the Roche Limit may naturally form a population of small satellites with masses and a mass/distance relation very similar to observations, suggesting strongly that these bodies may be indeed made of ancient ring material accreted in the form of small satellites.

Self-limitating physical processes are also at work and limit the maximum mass of satellite formed by this process, in reasonable agreement with observations. Consequences for the large scale/long term evolution of the satellite population are also discussed.

References

[1] Porco C.C., Thomas P.C., Weiss J.W., Richardson D.C., (2007) *Science 318, 1602-1606*

[2] Charnoz S., Brahic A., Thomas P.C., Porco C.C. (2007) *Science 318, 1622*

[3] Poulet F., Karoschka E., Sicardy B. (1999). *JGR 104, 24095-24110*