Geophysical Research Abstracts
Vol. 12, EGU2010-6281, 2010
EGU General Assembly 2010

A Driving Mechanism for Moonlets Formation in Saturn's A Ring

Evgeny Griv and Michael Gedalin
Department of Physics, Ben-Gurion University, P.O. Box 653, Beer-Sheva 84105, Israel (griv@bgu.ac.il/972-8-6472904)

Tiscareno et al. (2006, 2008) and Sremčević et al. (2007) have detected in recent Cassini images of Saturn's A ring localized features – "propellers"– which may be interpreted as signatures of small moonlets of some 100 m in size embedded within the ring. The features, believed to be disturbances generated by *unseen* embedded small moonlets (tens to hundreds of meters in diameter), are concentrated in three bands in the mid-A ring. The propellers are most abundant in a 3 000 km-wide belt, about 130 000 km from Saturn's center. It is estimated that the A ring contains thousands of such objects. Some very large propellers (from > 100 m objects) are found in the outermost A ring farther from Saturn than the population in the propeller-rich belt. It was especially noted that the lack of significant brightening at high phase angle indicates that these bodies are likely composed primarily of macroscopic particles, rather than dust. Herein, the linear stability of the Saturnian ring disk of mutually gravitating and physically colliding macroscoping particles is examined. Jeans' instabilities of small-amplitude gravity perturbations (e.g., those produced by a spontaneous disturbance) are analyzed analytically through the use of dynamical equations of a compressible fluid. The approach taken in this article differs from traditional dynamical views by taking into account the three-dimensional effects. The simple model of the system is considered: the ring disk is considered to be a thin slab with plane-parallel symmetry and its structure is considered in a horizontally local short-wave approximation. The used is a viscous isothermal fluid, viscosity is driven by physical collisions between particles, and the analysis is linear. It is shown that Jeans' gravitational instability (discussed first by Lin and Shu in context of the formation of spiral arms of normal galaxies) of both radial and spiral perturbations can lead to formation of porous moonlets with diameters $\approx 100 - 200$ m of preferred mass $\approx 10^7$ g each embedded in broad rings, and this process is believed to occur at distances $r \gtrsim 130\,000$ km from Saturn, near the center and in the outer regions of the A ring. Although this has yet to be directly measured.

This work was sponsored by the Israel Science Foundation and the Binational U.S.–Israel Science Foundation.