Collective dynamics of Saturn's rings

E. Griv, **M. Gedalin** and Yu. Lyubarsky

Department of Physics, Ben-Gurion University, Beer-Sheva 84105, Israel
(griv@bgu.ac.il/Phone: +972-8-6461645/Fax: +972-8-6472904)

A semi-review is given of recent studies of morphology and dynamics of low and moderately high optical depth regions of the Saturnian ring system of discrete mutually gravitating and rarely colliding particles with special emphasis on its fine-scale radial structure (irregular cylindric structures of the order of 100 m or so). The very existence and the value of the critical wavelength $\lambda_{\rm crit} \sim 100$ m of the fine-scale irregular structure, arising due to classical gravitational Jeans-type instability of gravity perturbations, in a local version of kinetic stability theory is explained. The same interpretation is suggested to explain the gravitational, tightly-wound spiral wakes in simplified N-body computer simulations in local or Hill's equations context of an orbiting patch of the ring. The stability analysis presented here would have to be regarded as an explanation of the long-term recurrent, tightly wound spiral structure in the range of a few tens to a few hundreds meters in regions of Saturn's main A, B, and C rings with optical depth $\tau \lesssim 2$ that could be compared to CASSINI spacecraft high-resolution measurements. Interestingly, initial results on Saturn's rings by the CASSINI Imaging Science Subsystem (Porco et al. 2005, *Science*) indicate that one region at 92,330 km exhibits such an irregular hyperfine structure in a relatively high-optical depth part of the B ring. We argue that perhaps confirming evidence will come from the UVIS stellar occultations.

The authors were supported in part by the Israel Science Foundation, the Israeli Ministry of Immigrant Absorption, and the Binational U.S.–Israel Science Foundation.