Geophysical Research Abstracts, Vol. 9, 03730, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03730

Turbulent viscosity and lifetime of Saturn's rings

E. Griv (1), M. Gedalin (1) and C. Yuan (2)

(1) Dept. of Physics, Ben-Gurion University, Beer-Sheva 84105, Israel (griv@bgu.ac.il/972-8-6472904), (2) Academia Sinica Institute of Astronomy, Taipei 106, Taiwan

The viscosity (the angular momentum flux) in the disk of mutually gravitating particles of Saturn's rings is investigated. The hydrodynamic theory of the gravitational Jeans-type instability of small gravity perturbations (e.g., those produced by spontaneous disturbances) of the disk is developed. It is suggested that in such a system the self-sustained hydrodynamic turbulence may arise as a result of the instability. The turbulence is related to stochastic motions of "fluid" elements. The objective of this paper is to show that in the Jeans-unstable Saturnian ring disk the turbulent viscosity may exceed the ordinary microscopic viscosity substantially. The main result of local N-body simulations of planetary rings by Daisaka et al. (2001, *Icarus* **154**, 296-312) is explained: in the presence of the gravitationally unstable density waves, the effective turbulent viscosity $\nu_{\rm eff}$ is given as $\nu_{\rm eff} = CG^2\Sigma^2/\Omega^3$, where G, Σ, and Ω are the gravitational constant, the surface mass density of a ring, and the angular velocity, respectively, and the non-dimensional correction factor $C \approx 10$. We argue that both Saturn's rings and their irregular of the order of 100 m or or even less fine-scale structure are not likely much younger than the solar system.