EGU22-6601
https://doi.org/10.5194/egusphere-egu22-6601
EGU General Assembly 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Shape and compression of self-gravity wakes in Saturn's rings

Larry W. Esposito[1], Miodrag Sremcevic[1], Joshua Colwell[2], Stephanie Eckert[2], and Richard Jerousek[2]
[1]University of Colorado, LASP, Boulder, CO 80303-7820, United States of America (larry.esposito@lasp.colorado.edu)
[2]UCF, Dept. of Physics, 4111 Libra Drive, Orlando FL 32816-2385 (josh@ucf.edu)

The varying geometry of Cassini star occultations by Saturn's rings constrains both the size and shape of structures that block starlight. Statistics of UVIS star occultations measure structures as small as meters, on times scales of minutes to decades. We calculate the excess variance, skewness and kurtosis including the effects of irregular particle shadows, along with a granola bar model of gaps, ghosts (local openings) and self-gravity wakes. In this model, the widths **W** and separation **S** of rectangular clumps play an analogous role to the size of the particle shadows, **R.** In the first model considered, our calculations are based on the moments of the transparency **T** in the ring region sampled by the occultation, thus extending the work of Showalter and Nicholson (1990) to larger **τ** and fractional area **δ**, and to higher central moments, without their simplifying assumptions. We also calculate these statistics using an approach based on the autocovariance, autocoskewness and autocokurtosis.

These new approaches compare well to the formula for excess variance from Showalter and Nicholson in the region where all are accurate, **δτ□1**. Skewness for small **τ** has a different sign for transparent and opaque structures, distinguishing gaps from clumps. The higher order central moments are calculated from higher powers of the shadow size, thus more sensitive to the extremes of the size distribution. We explain the **τ** dependence of the excess variance for Saturn's background C ring by the observation of Jerousek *etal*(2018) that the measured optical depth is correlated with particle size in the region between 78,000 and 84,600km from Saturn.

Statistics calculated from the granola bar model give different predictions from those based on individual spherical particles. The density waves clearly show compression that triggers clump growth, as predicted by the **Predator-Prey** model (Esposito *etal.* 2012, Icarus 217, 103-114). The **radial profiles** and observed **τ dependence** suggest that the wave crests compress the gaps more than the wakes, along with broader self-gravity wakes in the wave crests, including transparent ghosts. The UVIS observations fall between the most regular and the most irregular granola bar models. Analysis of ring transparency favors irregularly-spaced elongated clumps. A closer analysis of this particular case gives **H/W < 0.12**, smaller than Colwell *etal.* (2007, Icarus 190, 127-144), suggesting wakes are more like ***linguine*** than ***granola bars***.