Announcing the Final Examination of Stephanie Eckert for the degree of Doctor of Philosophy in Physics

Date: April 7, 2022
Time: 1:00 p.m.
Room: PSB 445
Dissertation title: Characterizing the particle size distribution in Saturn's rings using Cassini UVIS stellar occultation data

Abstract:
NASA's Cassini mission to Saturn revolutionized modern understanding of the planet's vast and intricate ring system. We use stellar occultation data from Cassini's UVIS High Speed Photometer (HSP) to characterize the particle size distribution in the rings with two methods. First, we discern the sizes of the smallest particles at ring edges by forward-modeling observed diffraction signatures which appear as spikes in the signal, the shape and amplitude of which depends on the size and abundance of the smallest particles. We then probe the upper end of the size distribution using occultation statistics.

Although the distribution of photon counts in the absence of ring particles follows Poisson statistics for which the variance is equal to the mean, random variations in the sizes and abundance of particles introduce excess variance. Previous studies have interpreted excess variance in stellar occultation data in terms of an effective particle size. The assumption of small particles is invalid in Saturn's A and B rings where ring particles cluster together into elongated structures called self-gravity wakes. We calculate the statistical moments within spiral density waves, undulating structures excited throughout Saturn's rings at locations of resonance with satellites.

In our diffraction analysis, we find more detections of diffraction at edges near the outer A and B rings than at edges within the C ring and Cassini Division, consistent with the prediction that edges directly perturbed by satellites have a greater population of sub-cm particles than edges confined by other mechanisms. In our moments analysis, we find that the granola bar model for regularly spaced wakes cannot match the observed statistics of both density wave troughs and peaks with a single set of parameters *S* and *W*, which may indicate that wakes are more opaque in the wave crests due to compression than they are in the troughs.

Outline of Studies:
Major: Physics, Planetary Sciences Track

Educational Career:
B. S. Furman University, SC, 2015

Committee in Charge:
Dr. Joshua Colwell (Chair)
Dr. James Cooney
Dr. Philip Metzger
Dr. Richard Jerousek
Dr. Stuart Pilorz (External Committee Member)

Approved for distribution by Dr. Joshua Colwell, Committee Chair, on March 25, 2022.

The public is welcome to attend.