Announcing the Final Examination of Zoe A. Landsman for the degree of Doctor of Philosophy in Physics

Date: Thursday, May 11, 2017
Time: 1:00 p.m.
Room: PSB 445
Dissertation title: The Physical Properties and Composition of Main-Belt Asteroids from Infrared Spectroscopy

Abstract:
Asteroids are the remnants of planet formation, and as such, they represent a record of the physical and chemical conditions in the early solar system and its evolution over the past 4.6 billion years. The study of asteroid composition and physical surface properties is vital to both our scientific understanding of the solar system's formation and evolution and to the development of asteroid missions, resource utilization schemes, and impact mitigation strategies. This dissertation uses infrared spectroscopy to investigate the composition and physical properties of main-belt asteroid surfaces. Our efforts are focused on two populations that are especially relevant to constraining thermal and collisional processes in the asteroid belt: the M-type "metallic" asteroids and primitive asteroid families.

To investigate volatiles in the M-type asteroids, we obtained 2-4 micron spectra of six M-type asteroids using NASA's Infrared Telescope Facility. We find spectral signatures of hydrated minerals on all six asteroids, with evidence for rotational variability of hydration in one target. Next, we carried out a thermal and compositional study of M-type asteroid and NASA mission target (16) Psyche using 5-14 micron spectra from the Spitzer Space Telescope. We find that Psyche's surface is smooth and most likely has a low thermal inertia. Psyche's emissivity spectrum is consistent with the presence of fine-grained magnesian pyroxene. We conclude that Psyche is likely covered in a fine silicate regolith, which may also contain iron grains. Finally, we considered two primitive asteroids families, ancient Themis (~2.5 Gyr) and young Veritas (~8 Myr). To test whether visible and near-infrared differences between the families, attributed to space weathering, are also apparent in the mid-infrared, we analyzed the 5-14 micron Spitzer Space Telescope spectra of 11 Themis-family asteroids and 9 Veritas-family asteroids. We detect evidence of a fine-grained and/or underdense silicate regolith in all 11 Themis-family spectra and 6 of the Veritas-family asteroids. Comparison with laboratory spectra of primitive meteorites suggests these asteroids have relatively low abundances of hydrated silicates. Our results indicate the Themis and Veritas family members show variation in regolith texture and/or structure within both families that is not correlated with family age.

Outline of Studies:
Major: Physics (Planetary Sciences track)

Educational Career:
B.S. in Physics, 2011, University of Central Florida

Committee in Charge:
Dr. Humberto Campins
Dr. Yanga R. Fernandez
Dr. Daniel Britt
Dr. Florencio Hernandez
Dr. Joshua P. Emery

Approved for distribution by Humberto Campins, Committee Chair, on April 26, 2017.

The public is welcome to attend.