Announcing the Final Examination of Wesley Chambers for the degree of Doctor of Philosophy in Physics

Date: July 6, 2020
Time: 9:30 a.m.
Room: https://ucf.zoom.us/j/92553953925?pwd=bnhtODZIck0wVVFXSG14OG9keFY4dz09
Dissertation title: Experimental and Computational Investigation of Plume Surface Interactions in Vacuum Microgravity

Abstract:
Plume surface interactions (PSI) are caused by rocket exhaust impinging on planetary surfaces. PSI-induced environmental changes pose hazards to spacecraft and astronauts; thus, it is crucial to understand the gas-particle dynamics of these systems. We have conducted novel experimental and computational work to study PSI effects in relevant vacuum microgravity environments. To study flow effects and regolith instability we developed a computational model that describes the gas flow through a porous medium based on Darcy's Law. This flow depends on regolith properties, and the resulting subsurface pressure distribution is used to estimate ejecta mass. We find flow behaviors and the resulting ejecta are significantly affected by the surface pressure distribution, pulse duration, and material properties. We have also developed an experimental apparatus, the Gas Regolith Interaction Testbed (GRIT), for studying PSI in vacuum microgravity in the UCF Drop Tower. It consists of a small, cylindrical vacuum chamber in which a cold gas jet interacts with a bed of regolith simulant. Video data is analyzed to determine PSI trends based on gravity level, nozzle distance, simulant type, and plume duration. We observe PSI effects ranging from perturbation of the granular media to ejection of the entire simulant mass. Phenomena are significantly more pronounced for experiments conducted at microgravity than at Earth gravity (1*g*). We measure peak ejecta velocities up to tens of m/s, and note how particle properties, jet distance, and pulse duration affect ejecta angle and cratering depth. Our numerical and experimental results have implications for the validity of existing studies of PSI that are conducted in 1*g* and under ambient conditions, and can be used to inform modeling, lander design, and risk assessment for future missions that will aim to land on or interact with planetary surfaces.

Outline of Studies:
Major: Physics, Planetary Sciences Track

Educational Career:
A.A. Seminole State College of Florida, FL, 2010
B.S. University of Central Florida, FL, 2012

Committee in Charge:
Dr. Daniel Britt (Chair)
Dr. Adrienne Dove (Co-Chair)
Dr. Philip Metzger
Dr. Joshua Colwell
Dr. Zhisheng Shuai (External Committee Member)

Approved for distribution by Dr. Daniel Britt, Committee Chair, on June 22, 2020.

The public is welcome to attend remotely.