Announcing the Final Examination of Charles Schambeau for the degree of Doctor of Philosophy in Physics

Date: March 8, 2018
Time: 10:00 a.m.
Room: PSB 160
Dissertation title: Analysis of Nucleus Properties of the Enigmatic Comet 29P/Schwassmann-Wachmann 1

Abstract:
We present results from a continuing effort to understand activity drivers for the enigmatic Comet 29P/Schwassmann-Wachmann 1 (SW1). SW1 has been of interest since its discovery nearly 100 years ago because of its nearly continuous activity beyond the water-sublimation line and its highly variable outburst activity while receiving a nearly constant insolation due to its low eccentricity orbit. These characteristics make SW1 a useful target for investigating both distant cometary activity drivers and also cometary outburst behavior. We approach understanding these physical processes through a detailed analysis of SW1; first by measuring nucleus properties required for more accurate nucleus thermophysical modeling and second, by applying thermal modeling to replicate its activity. We also discuss possible drivers of the outburst behavior, giving examples of future thermal modeling methods that could shed light on the physical mechanisms underlying the activity.

Our project began with an analysis of *Spitzer Space Telescope* IRAC and MIPS infrared observations of SW1 from UT Nov. 2003. Coma removal techniques were applied to the images provided nucleus photometry measurements. Application of the Near Earth Asteroid Thermal Model (NEATM) to the measured photometry values resulted in an effective nucleus radius of 30.2 (+3.7/-2.9) km and a thermal beaming parameter of 0.99 (+0.26/-0.19). These results indicated that SW1 is one of the largest Jupiter-Family Comets and also has a relatively smooth overall surface and/or surface material with low thermal inertia. We next placed constraints on the nucleus' spin state through analysis of evolution seen in the coma's morphologic structure through two sets of outburst-coma observations. The first set analyzed is from five consecutive nights from the Kitt Peak 2.1-m telescope starting on UT Sept. 25, 2008 taken ~2 days after a major outburst. 3-D Monte Carlo coma modeling of the observations showed that the nucleus' spin period is on the order of days and/or the spin pole orientation was along the Earth's directions during observations. The second set analyzed is *Hubble Space Telescope* observations from UT Mar. 1996 ~15 hours after a major outburst. Modeling similarly showed a rotation period on the order of days. Due to the observing geometry differing between the 2008 and 1996 observations, we conclude the rotation period lower limit must be on the order of days even if the spin-pole direction was directed along the sub-Earth direction during one of the observing sets. The nucleus properties measured by our project were incorporated into a thermophysical model with the goal of replicating SW1's quiescent activity using the sublimation of the supervolatile species CO or CO_2 as the activity drivers. A progenitor nucleus was thermally evolved in SW1's current orbit using different plausible nucleus interior compositional and layering schemes. We discuss results of this analysis and additionally possibilities for future research to more accurately model SW1's activity drivers.

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

Educational Career:
M. S. Physics, University of Alabama in Huntsville, 2009

B. S. Physics, University of South Alabama, 2007

Committee in Charge:
Dr. Yanga Fernandez (Chair)
Dr. Daniel Britt
Dr. Viatcheslav Kokoouline
Dr. Nalin Samarasinha (External Committee Member)
Dr. Laura Woodney (External Committee Member)

Approved for distribution by Dr. Yanga Fernandez, Committee Chair, on Feb. 22, 2018.

The public is welcome to attend.