Oral Defense Announcement

University of Missouri – St. Louis Graduate School

An oral examination in defense of the dissertation for the degree
Doctor of Philosophy in Physics

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M.S. in Physics, December 2017, University of Missouri-St. Louis
B.Ed. in Physics, July 2005, Bahir Dar University, Ethiopia

High-Resolution Spectroscopy of Interstellar Lines and Comets

Date: November 16, 2023
Time: 2:00 p.m. to 4:00 p.m.
Place: 432 Benton Hall

Abstract

The study of interstellar molecules such as CO is crucial because interstellar ices in the core of a pre-solar molecular cloud provide the starting point for volatile evolution in the protoplanetary disk. A record of the initial volatile composition of the protoplanetary disk can be obtained from the study of the chemical composition of cometary nuclei. Because of their long residence in the Oort cloud and infrequent passage through the inner solar system, long-period comets are one of the most primitive bodies in our solar system that can tell us about the composition of the early solar system. High-resolution infrared spectroscopy allows for measuring the chemical abundances of primary volatile species (sublimed native ices directly from the nucleus) in the comae of comets, which are crucial for their chemical taxonomic classification. Characterizing the chemical composition of comets over a range of heliocentric distances (R_h) is crucial to investigate whether the composition of the cometary nucleus varies with heliocentric distance or remains constant. There is a systematic enhancement of some molecules (C_2H_2, NH_3, H_2CO) for comets observed close to the Sun compared to those observed beyond ~1au. Measurements of the chemical abundance of primary volatile species in the long-period comet C/2020 S3 (Erasmus) observed near R_h ~0.5 au, presented in this study, contributes to the effort of investigating the chemical abundances at small heliocentric distances. Within 2 au from the Sun, cometary activity is mainly driven by the sublimation of H_2O ice. On the other hand, cometary outgassing beyond the sublimation region of H_2O (~ 3 au) is driven by hypervolatile species such as CO and CO_2. There have only been a few comet measurements made over the transitional heliocentric distance range R_h ~2.5-3.0 au because the majority of comets are either very faint or show low activity at this distance from the Sun. This leaves it uncertain as to where the transition from hypervolatile to H_2O-driven activity takes place. Observations of long-period comet C/2017 K2 (Pan-STARRS) spanning a range of R_h ~2.35 - 3.15 au were conducted to address this critical topic in cometary science.

Defense of Dissertation Committee

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