Opportunity Title: Submillimeter spectroscopy of sublimated interstellar and planetary ices
Opportunity Reference Code: 0217-NPP-MAR24-GSFC-Interdisc

Organization National Aeronautics and Space Administration (NASA)

Reference Code 0217-NPP-MAR24-GSFC-Interdisc

Application Deadline 3/1/2024 6:00:59 PM Eastern Time Zone

Description Our research group is part of the Astrochemistry Laboratory in the Solar System Exploration Division at NASA's Goddard Space Flight Center. We specialize in studying the submillimeter/millimeter pure rotational spectra, the chemistry, and the physical properties of sublimated species from interstellar/cometary/planetary ices.

Remote sensing with high resolution spectroscopy is currently the only method to detect trace species in the ISM and the primary method for comets and icy bodies in the Solar System due to limitations of sample return. Our group has successfully developed a new laboratory technique that utilizes gas-phase, direct-absorption millimeter and submillimeter spectroscopy to detect and identify desorbed species from interstellar and cometary ice analogs. Many of the known interstellar/cometary organic molecules cannot be explained by the gas-phase chemistry long invoked by the planetary and astrophysics communities. It is now presumed that some are produced by surface reactions of simple ices and/or grains and released into the gas phase by sublimation, sputtering, etc. This assumption has not been experimentally tested in great detail for sublimated gases, however laboratory simulations of interstellar and cometary ices have found that the solid remaining after ice sublimation contains complex organics. Analysis of the ice during processing reveals molecular changes, though the exact quantities and species formed are highly uncertain with current techniques due to overwhelming features of the simple ices, such as H2O—until now. Our experiment is designed to simulate interstellar, cometary, and planetary ices to detect trace species employing the same techniques used for remote observations. This will constrain the chemical complexity of the ices, the amount of processing that occurs, and interpret past and present data from missions that observe ice features.

In our laboratory we prepare ices by using a cryostat to condense gas-phase mixtures to temperatures as low as 15 K. The ices are made in an ultra-high vacuum system to simulate the low pressure environments we are trying to simulate, and also to avoid contamination from the Earth's atmosphere. An infrared spectrometer is used to study ices in our experiments, and a mass spectrometer and submillimeter spectrometer system are used to study the sublimating species. We process ices with ultraviolet (UV) photons (energy ~10 eV) and/or heat. We can then study the chemistry happening both within the ice mantle as well as gas-phase species that are formed and ejected during processing or subsequent gas-phase reactions in the chamber.

Opportunities that exist in our laboratory include

1. Studies of the formation of complex organic compounds (some of astrobiological interest). This involves processing simple ices and

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studying desorbed species by their pure rotational spectrum for unambiguous identification/quantification of each molecule formed to compare to astronomical observations and astrochemical models.
2. Processing of simple ices to determine isotope fractionation that may occur within a mantle. Diffusion studies will also be conducted for comparison within different ice layers/mixtures.
3. The identification and spectral analysis of new species formed from sublimated ices to inform astrophysical/planetary searches.

Location:
Goddard Space Flight Center
Greenbelt, Maryland

Field of Science: Interdisciplinary/Other

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Applications with citizens from Designated Countries will not be accepted at this time, unless they are Legal Permanent Residents of the United States. A complete list of Designated Countries can be found at: https://www.nasa.gov/oiir/export-control.

Eligibility is currently open to:

- U.S. Citizens;
- U.S. Lawful Permanent Residents (LPR);
- Foreign Nationals eligible for an Exchange Visitor J-1 visa status; and,
- Applicants for LPR, asylees, or refugees in the U.S. at the time of application with 1) a valid EAD card and 2) I-485 or I-589 forms in pending status

Eligibility Requirements

- **Degree:** Doctoral Degree.