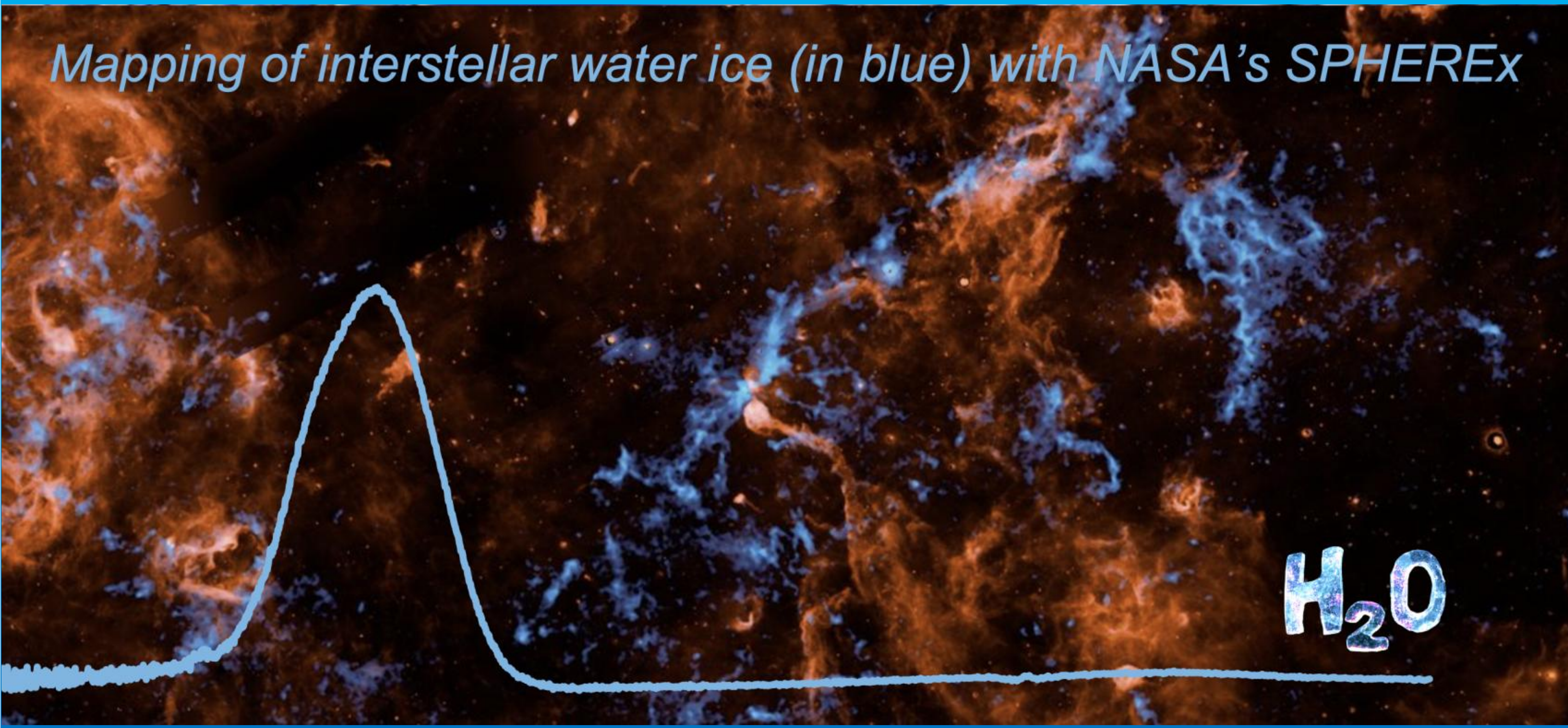
LABORATORY ASTROPHYSICS NEWSLETTER

JUNE 2026 | ISSUE 3



Mapping of interstellar water ice (in blue) with NASA's SPHEREx

Astrophysical Ices

Fun Facts and introduction to the 3 interstellar objects detected to date

Interview with Dr. Reggie Hudson

Presentation of laboratory facilities

Recent publications (April–June 2026)

Upcoming conferences

Image credit: NASA/JPL-Caltech/IPAC/Hora et al. (2026)
Spectrum credit: Öberg et al. (2007)

Letter from the Editors

Welcome to the third issue of the Laboratory Astrophysics Newsletter!

The goal of this newsletter is to enhance communication and interactions between experimentalists, theoreticians, modelers, and observers in the fields of Astrophysics and Planetary Science around the world.

This third issue of the Laboratory Astrophysics Newsletter focuses on **Astrophysical Ices**.

On the cover page, we show an observation made by NASA's *SPHEREx* (*Spectro-Photometer for the History of the Universe, Epoch of Reionization, and Ices Explorer*) showing the chemical signatures of water ice (in blue) and polycyclic aromatic hydrocarbons (in orange) in Cygnus X. One of the main goals of *SPHEREx*, which launched in 2025, is to map the chemical signatures of various types of interstellar ice.

In our ***Fun Facts*** section, we provide a list of websites/databases/publications reporting the molecules detected in space, as well as short description of the three interstellar objects detected to date.

Our ***Interview*** is with ***Dr. Reggie Hudson***, a research scientist at the NASA Goddard Space Flight Center who is an expert in the study and characterization of astrophysical ices. He gives us his perspective on the field.

In the ***Laboratory Facilities*** section, we present four laboratory facilities that conduct experimental work on the various processes affecting astrophysical ices. Facilities described in previous issues and relevant to this topic are also highlighted.

Our ***Publications*** section covers the broad laboratory astrophysics field and includes work published since April 2026.

Finally, the ***Meetings*** section provides a list of upcoming meetings relevant to the field of Planetary Science and Astrochemistry.

We hope you enjoy reading the Laboratory Astrophysics Newsletter and we encourage you to visit the newsletter website for current and past issues here.

Many more experimental facilities provide critical data for the analysis and interpretation of observations of ice signatures. We plan to have another issue in the future on the matter and highlight other facilities. Please contact us if you would like your facility to be featured.

We welcome contributions to the newsletter. You can share publications and announcements through our contribution form and join our mailing list or contact us at labastronewsletter@mail.nasa.gov.

We publish quarterly; keep an eye out for our next issue!

The Editorial Team

Michel Nuevo, Ella Sciamma-O'Brien, Partha P. Bera, Lora Jovanovic, Joseph Roser, and Aaron McKinnon

Astrophysical Ices Fun Facts

List of websites/databases reporting the molecules detected in space

Interstellar Molecules – The Cosmic Ice Laboratory – Astrochemistry Laboratory 691 – NASA's Goddard Space Flight Center https://science.gsfc.nasa.gov/691/cosmicice/interstellar.html

Cometary Molecules – The Cosmic Ice Laboratory – Astrochemistry Laboratory 691 – NASA's Goddard Space Flight Center https://science.gsfc.nasa.gov/691/cosmicice/cometary.html

Molecules in Space [CDMS classic documentation] https://cdms.astro.uni-koeln.de/classic/molecules

Molecules in Protoplanetary Disks https://www.astrochymist.org/astrochymist_disks.html

A Hyper-Bibliography of Known Astromolecules https://www.astrochymist.org/astrochymist_mole.html

Interstellar & Circumstellar Molecules https://www.astrochymist.org/astrochymist_ism.html

Interstellar & Circumstellar Molecules – Molecules detected in ice
https://www.astrochymist.org/astrochymist_ism_ice.html

List of Observed Interstellar Molecules https://molecules-in.space/index.html

Census of Interstellar, Circumstellar, Extragalactic, Protoplanetary Disk, and Exoplanetary Molecules
https://doi.org/10.3847/1538-4365/aae5d2 Brett A. McGuire (2018) *ApJS*, **239**, 17
https://doi.org/10.3847/1538-4365/ac2a48 Brett A. McGuire (2022) *ApJS*, **259**, 30

Common Molecular Components of Interstellar Ices	
Water (H_2O)	Formaldehyde (H_2CO)
Carbon monoxide (CO)	Carbon dioxide (CO_2)
Methanol (CH_3OH)	Cyanate ion (OCN^-)
Ammonia (NH_3)	Carbonyl Sulfide (OCS)
Methane (CH_4)	

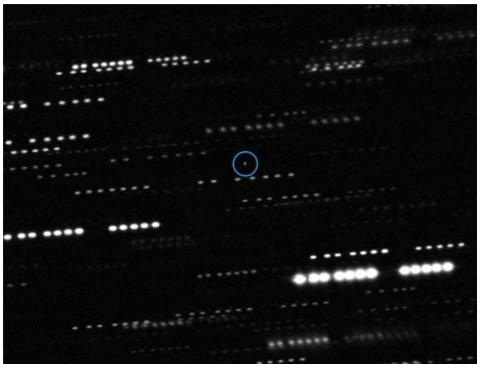
The Total Ice Mass of…	
The Greenland ice shelf:	~2.7×10^{18} kg
Saturn’s rings:	~1.5×10^{19} kg
Pluto’s ice surface:	~3.6×10^{21} kg
Measured Region of the Orion Silhouette Disk 114-426:	~2.5×10^{23} kg

3 Interstellar objects have been detected to date!

1I/‘Oumuamua	2I/Borisov	3I/ATLAS
Orbital Characteristics		
Last perihelion: 0.255912 AU	Last perihelion: 2.00652 AU	Last perihelion: 1.35645 AU
Date of perihelion: 9 Sep 2017	Date of perihelion: 8 Dec 2019	Date of perihelion: 29 Oct 2025
Eccentricity: 1.20113	Eccentricity: 3.3565	Eccentricity: 6.14135
Inclination: 122.8°	Inclination: 44.053°	Inclination: 175.12°
Incoming velocity: 26.33 km/s	Incoming velocity: 32.3 km/s	Incoming velocity: 58.0 km/s
Rotation period: 8.67 h	Rotation period: 4.3 h	Rotation period: 15.48 h
Physical Characteristics		
Dimensions: 55–114 m	Nucleus: ≤0.5 km	Nucleus: 0.32–5.6 km
Axis ratio: >6:1	Comet total magnitude: 13.8	Comet total magnitude: 12.5

1I/‘Oumuamua

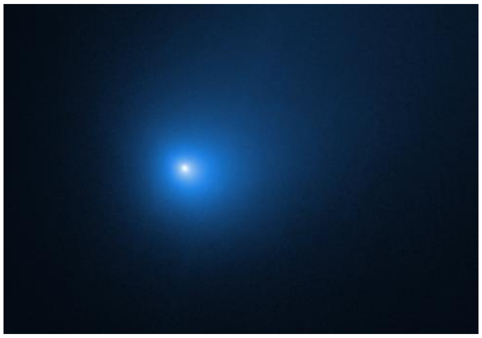
‘Oumuamua is the Hawaiian term for *scout or messenger sent from the distant past to reach out to us*. 1I/‘Oumuamua is the first confirmed interstellar object detected passing through the Solar System. Appearing asteroid-like, it was discovered using the *Panoramic Survey Telescope and Rapid Response System 1* (*Pan-STARRS1*) telescope at Haleakalā Observatory, Hawaii, on **19 October 2017**, with additional images acquired with the *Canada–France–Hawaii telescope* (*CFHT*) on 22 October 2017. Its composition and shape were investigated through complementary observations with the *European Southern Observatory – Very Large Telescope* (*ESO-VLT*) and the *Gemini South* telescope (Chile), as well as the *Keck II* telescope (Hawaii).



1I/’Oumuamua (blue circle). Credit: ESO/K. Meech et al.

2I/Borisov

2I/Borisov is the first confirmed interstellar comet and the second interstellar object ever observed. It was discovered on **29 August 2019** by amateur astronomer Gennadiy Borisov using a custom-built 0.65-meter telescope. It was then observed by the *Hubble Space Telescope* (*HST*) in the fall of 2019. It reached perihelion in December 2019. 2I/Borisov does not have an asteroidal appearance but instead was observed to be surrounded by a coma, a cloud of dust and gas, hence its designation as an interstellar comet. The object possesses a highly hyperbolic orbit (eccentricity of 3.36) proving it originated from beyond our Solar System. It reached perihelion at 2 AU (300 million km) and passed through at a peak speed of 177,000 km/h.



Comet 2I/Borisov. Credit: NASA, ESA and D. Jewitt (UCLA)

3I/ATLAS

3I/ATLAS appears to be a relic from the Milky Way’s early chemical evolution. This interstellar comet is the third interstellar object detected as it passed through the inner Solar System, reaching perihelion on **October 25, 2025**, at 1.36 AU. Discovered by the *ATLAS* (*Asteroid Terrestrial-impact Last Alert System*) survey telescope in July 2025, it was soon identified by *SPHEREx* as having a CO_2-dominated coma in August 2025. Because it brightened more than previous interstellar objects, observatories worldwide were able to obtain both pre- and post-perihelion measurements, including high-quality, spatially resolved *James Webb Space Telescope* (*JWST)* spectra that provided some of the most detailed insights into its composition. Observationally, coma activity was dominated by CO_2 before perihelion, but after perihelion *JWST* found CO production exceeding both CO_2 and H_2O—a behavior that is atypical of comets at similar distances from the Sun.

3I/ATLAS. Credit: International Gemini Observatory/NOIRLab/NSF/ AURA/B. Bolin

Section header image credits: NASA, ESA, K. Luhman, T. Esplin, et al., ESO, Gladys Kober

Interview with Dr. Reggie Hudson

Astrochemist at NASA Goddard Space Flight Center

Reggie Hudson is a research astrochemist at the NASA Goddard Space Flight Center (GSFC) in Greenbelt, Maryland. He earned his PhD in physical chemistry with low-temperature spectroscopic studies of radiation-produced free radicals. He served as the 2016–2017 Chair of the American Chemical Society's Astrochemistry Subdivision and was awarded the American Astronomical Society's Laboratory Astrophysics Prize in 2023. His current area of interest is the formation, destruction, and properties of molecules that make up interstellar and Solar System ices.

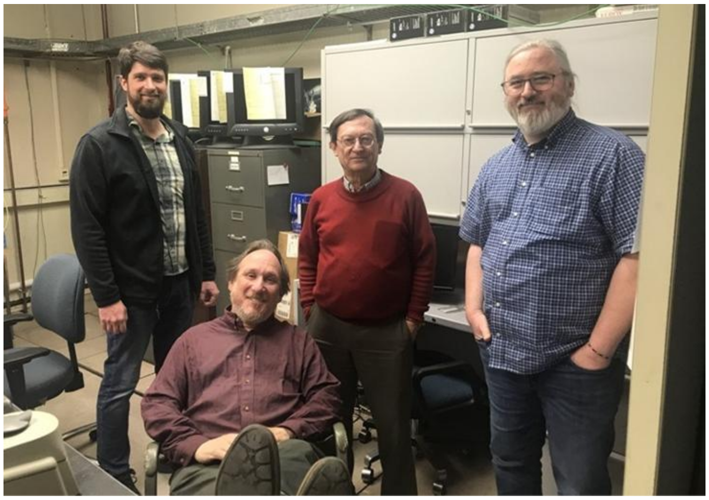
What inspired you to become a scientist?

I grew up in the middle of the Space Race, following each NASA launch and splashdown. At one time I could recite the names of all of the Mercury and Gemini astronauts in the order in which they were launched from Florida. An exciting time for sure and I wanted to be in on the action.

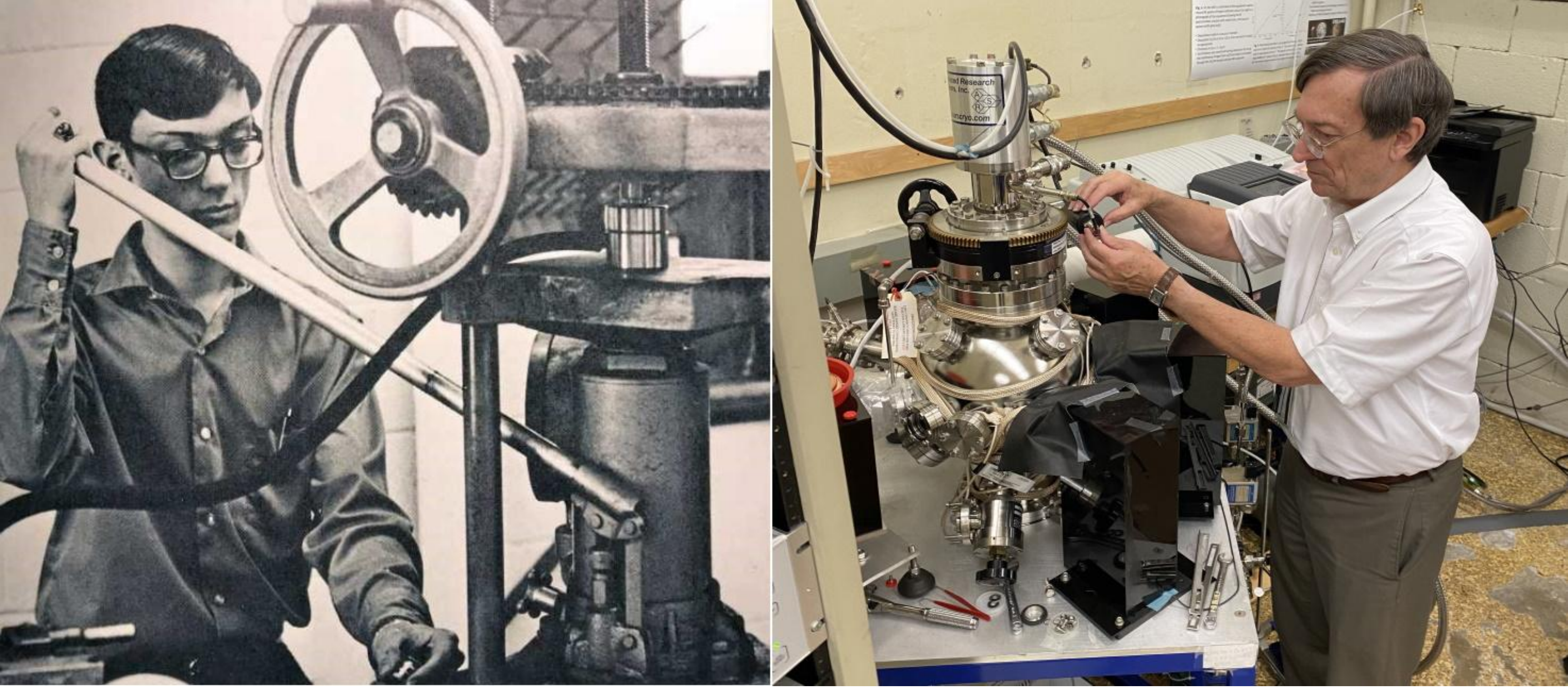
What is your current research about?

As a youngster, I had no clue how to become an astronaut, but astronomer seemed to be the next best thing. I started stargazing but still had no real knowledge of the astronomical profession. However, lab scientists were on TV and in movies, so I ended up with chemistry sets and then it was on to chemistry in high school, college, and beyond. After grad school I had a great career teaching (Eckerd College, Florida), but it was hard to stay at the research level. A summer fellowship with NASA changed that.

Progress was extremely slow in the first decade, with Marla Moore as the only full-time employee working on ices. The arrival of Perry Gerakines in 1999 was a milestone as he brought in European contacts, knowledge of the *Infrared Space Observatory* (*ISO*), and experience with far-ultraviolet (UV) photolysis. He and I both got job offers from NASA about 10 years later. Mark Loeffler was with us for a few years before answering the siren call of academia. Chris Materese soon joined the group and skillfully handles most of our radiation work. We've had productive interactions with many NASA and non-NASA researchers, as well as large missions such as *Galileo*, *Cassini*, *New Horizons*, *Spitzer*, *Hubble*, and of course *JWST*.



The Cosmic Ice Laboratory group (standing from left to right: Chris Materese, Reggie Hudson, and Perry Gerakines) with Max Bernstein (sitting), now a lab astrophysicist at NASA Headquarters.



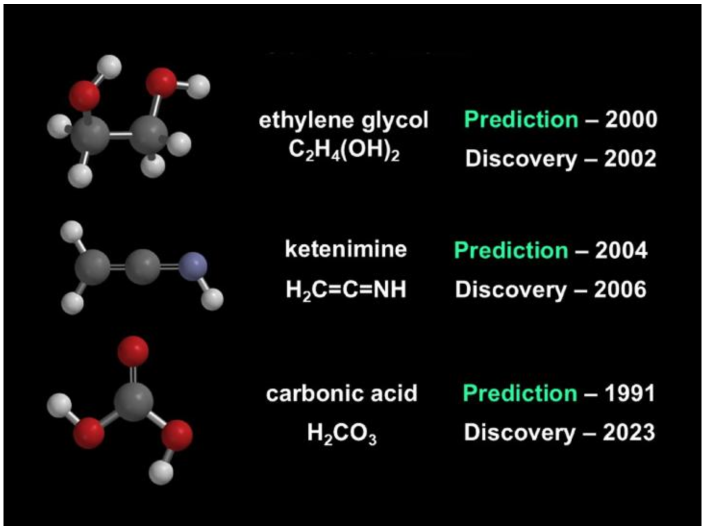
Reggie Hudson preparing for infrared experiments in 1974 (left) and 2024 (right).

How has the field of astrochemistry evolved since you started your career?

A big change is what can be called the "professionalization" of the field. There now are astrophysics/astrochemistry groups within both the American Astronomical Society and American Chemical Society. Related to this change is that the standards and expectations for laboratory work have risen over the past few decades. The "quick and dirty" measurements from the past have given way to work at a higher and more rigorous level in many research groups. There also has been a welcome influx of theoreticians with a molecular focus, calculating structures, spectra, reaction paths, and physical properties. The internet has made communication much faster and offers the potential for ready exchange of results. Unfortunately, there still are too many research groups that seem to have a mortal fear of sharing data and computer codes. One thing that does not seem to have changed is a reluctance to make testable predictions.

What impact has your research had in the field? What do you consider to be your greatest achievement in your research regarding astrochemistry in general and astrophysical ices in particular?

Science is a community effort, so it's hard to judge my own impact. My guess is that I've influenced activity in the field of "radiation astrochemistry" by showing the many types of chemical and physical changes resulting from radiolysis of extraterrestrial ices, such as oxidations, reductions, eliminations, acid–base reactions, and so forth. I also think that I played an influential role in the "cyanate wars", showing that the cyanate anion can be formed in many ways in laboratory and interstellar ices and identified by infrared (IR) spectroscopy. In another area, I think my colleagues and I have been influential in helping to clean the literature of some older, questionable laboratory results, delivering state-of-the-art measurements of IR band strengths and optical constants. Finally, I believe that I've influenced the field by encouraging my colleagues to post lab data and open-source computer routines (okay, code) on websites for free and easy access, something that our group started doing about 25 years ago.



Three molecules predicted by the experimental work conducted at the GSFC Cosmic Ice Laboratory

Which open question in astrochemistry would you like to see answered in the near future?

There are so many that it's hard to choose just one. The diffuse interstellar bands are probably on every spectroscopist's list. Two ice problems in which our group has been involved are the missing nitriles and the missing sulfur issues in interstellar ices. Many interstellar nitriles have been identified in the gas phase, but none in interstellar ices. We suspect that nitriles in H_2O-rich irradiated ices get converted to cyanate and then to CO_2, but quantitative studies remain to be done. Similar thoughts apply to H_2S and thiols. Our suspicion is that they are missing due to ready oxidation, but relevant experiments are scarce. See also my answer to the next question.

What do you consider to be important laboratory astrophysics data still needed?

Our group almost exclusively studies the IR spectra and chemical and physical properties of ices. We've used our lab results to successfully predict new interstellar molecules, but we'd like to have quantitative measurements connecting the ice and gas phases. We published some rather primitive experiments years ago, but we could not quantitatively connect ice composition and gas-phase composition. Quantification is difficult.

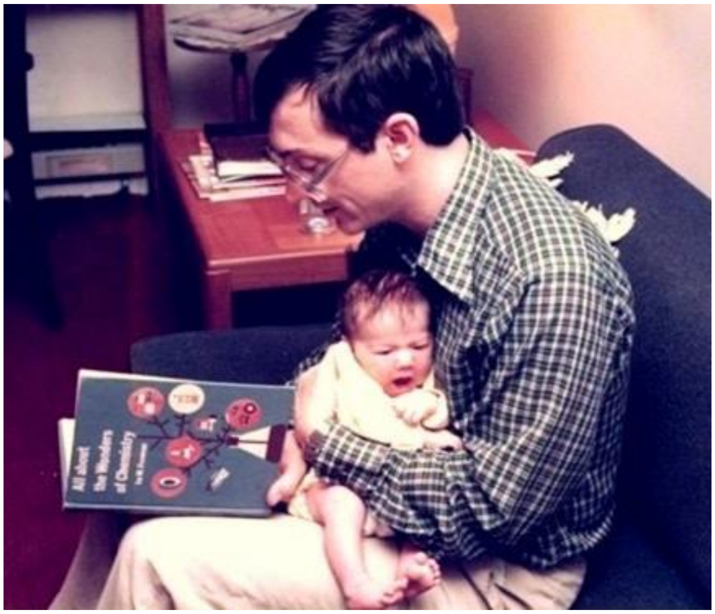
What was the most important advice somebody gave you? Do you have any advice for early-career scientists who are interested in working in astrochemistry?

Perhaps the most important advice, which I've tried to follow, is to read widely and deeply. For early-career people, remember that science didn't start in the year 2010, so be sure to study the old, original references for whatever you cite in your papers. Such work can lead to interesting new research ideas and can help to avoid mistakes.

Lab work is very expensive, so I also would recommend a focus on new research problems, as opposed to reinventing the wheel. I can also mention a comment attributed to Niels Bohr: "An expert is someone who has made all the mistakes in a particular field." Don't hesitate to talk to experts. They can save you lots of time.

How do you balance your professional and personal life? What do you do outside of work?

I wish I could say that I'm still an amateur astronomer, but the light pollution in the Baltimore-Washington DC area has pretty much brought that hobby to an end for me. I've long been a history-of-science buff, stretching back almost to elementary school. This has led my family and me, and also my co-workers, on some interesting treks in search of scientific sites. I'm also a book nut, haunting local sales for old and unusual volumes.



Reggie's early education experiments, reading a chemistry book to his son, Ian, when he was 2 months old. "You can see that he's rather bored. He's now Lt. Col. Hudson, USAF, and was the logistics officer who moved OSIRIS-REx from Colorado to Florida. You just can never tell how early experiments will turn out."

You can find a description of the Cosmic Ice Laboratory at NASA Goddard Space Flight Center in [the first issue of the Laboratory Astrophysics Newsletter]()

Section header image credits: NASA, ESA, K. Luhman, T. Esplin, et al., ESO, Gladys Kober

Laboratory Astrophysics Facilities:

Laboratory Facilities Studying Astrophysical Ices

In this third issue of the Laboratory Astrophysics Newsletter, we present four laboratory facilities that conduct experimental work on various processes affecting astrophysical ices, from the measurement of spectral positions and band strengths, to their irradiation with energetic light and particles, to desorption processes: the Photoprocessing & Spectroscopy Laboratory at National Central University, the Interstellar Ice Facilities at Leiden Laboratory for Astrophysics, the Laboratory Astrochemistry Experimental Set-ups at Harvard, and the Electron and Photon Induced Chemistry on Surfaces (EPICS) facility at the Georgia Institute of Technology.

Photoprocessing & Spectroscopy Laboratory at National Central University

Yu-Jung (Asper) Chen (asperchen@phy.ncu.edu.tw)
https://pps-lab75.webnode.tw/

Interstellar Ice Facilities at Leiden Laboratory for Astrophysics

Ko-Ju Chuang (chuang@strw.leidenuniv.nl), Franciele Kruczkiewicz, Thanh Nguyen, Katie Slavicinska,
Cecilie Homen, Milan Heinsohn
https://labastro.strw.leidenuniv.nl/

Laboratory Astrochemistry Experimental Set-ups at Harvard

Karin Öberg (koberg@cfa.harvard.edu), Mahesh Rajappan (mrajappan@cfa.harvard.edu)
https://karinoberg.cfa.harvard.edu

Electron and Photon Induced Chemistry on Surfaces (EPICS) at the Georgia Institute of Technology

Thomas Orlando (thomas.orlando@chemistry.gatech.edu), Brant Jones (brant.jones@chemistry.gatech.edu)
https://orlando.chemistry.gatech.edu/

Check also the **I^{3}OLAB**, **MIOCI**, and **Cosmic Ice Laboratory** facilities in the Laboratory Astrophysics Newsletter issue 1, which are used to produce and characterize astrophysical ice analogs.

Section header image: SPHEREx image of Cygnus X. Credits: NASA/JPL-Caltech/IPAC/Hora et al. (2026)

Photoprocessing & Spectroscopy Laboratory at National Central University

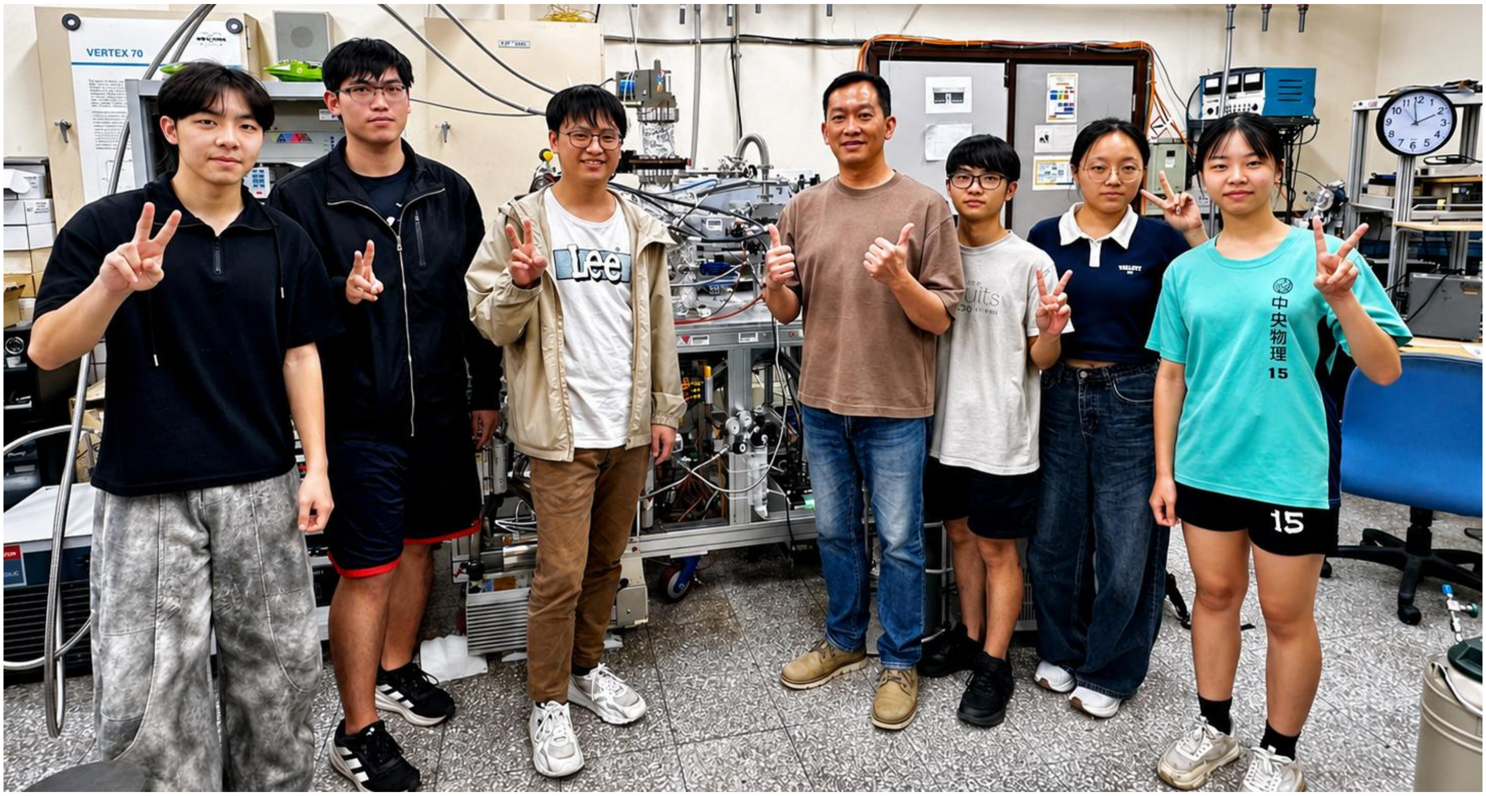
Yu-Jung (Asper) Chen (asperchen@phy.ncu.edu.tw)
https://pps-lab75.webnode.tw/

The Photoprocessing & Spectroscopy Laboratory (PPS Lab) at National Central University, Taiwan, performs experimental simulations of energetic processing in astrophysical ice and dust analogs. To this purpose, our laboratory has developed several ultra-high-vacuum (UHV) set-ups dedicated to laboratory astrochemistry and enabled investigations of photon-, electron-, and atom-induced processes across a broad energy range, from the vacuum ultraviolet range (VUV) to soft X-rays.

Experimental Set-Ups

Our laboratory operates a series of complementary experimental set-ups, which are designed to simulate environments relevant to interstellar and circumstellar regions while allowing *in situ* monitoring of ice chemistry and desorption processes through infrared (IR) spectroscopy and mass spectrometry (MS).

IPS. The Interstellar Photoprocess System (IPS) was the first developed in our laboratory to investigate photon-induced processes in astrophysical ices. The system consists of an ultra-high-vacuum (UHV) chamber (base pressure: ~10^{-10} torr) providing contamination-free conditions that mimic the low-density environments in interstellar space. A sample holder mounted on a closed-cycle helium cryostat is used to deposit ices at temperatures as low as 10–15 K, representative of cold molecular clouds. Astrophysical ice analogs are prepared by depositing gases onto the cold substrate under controlled conditions. The chemical composition and evolution of the ices are monitored *in situ* using Fourier-transform infrared (FTIR) spectroscopy, while a quadrupole mass spectrometer (QMS) is employed to detect desorbing species and gas-phase products. The primary irradiation source of IPS is a microwave-discharge hydrogen-flow lamp (MDHL), which provides VUV photons in the 114–170 nm range. Unlike the conventional use of the MDHL as a fixed VUV source, our laboratory has systematically characterized and optimized its emission properties. By controlling the H_2 pressure and employing H_2/He gas mixtures, we can tune the relative intensities of the Ly-α line (121.6 nm) and the molecular hydrogen emission bands, thereby modifying both the spectral energy distribution and average photon energy



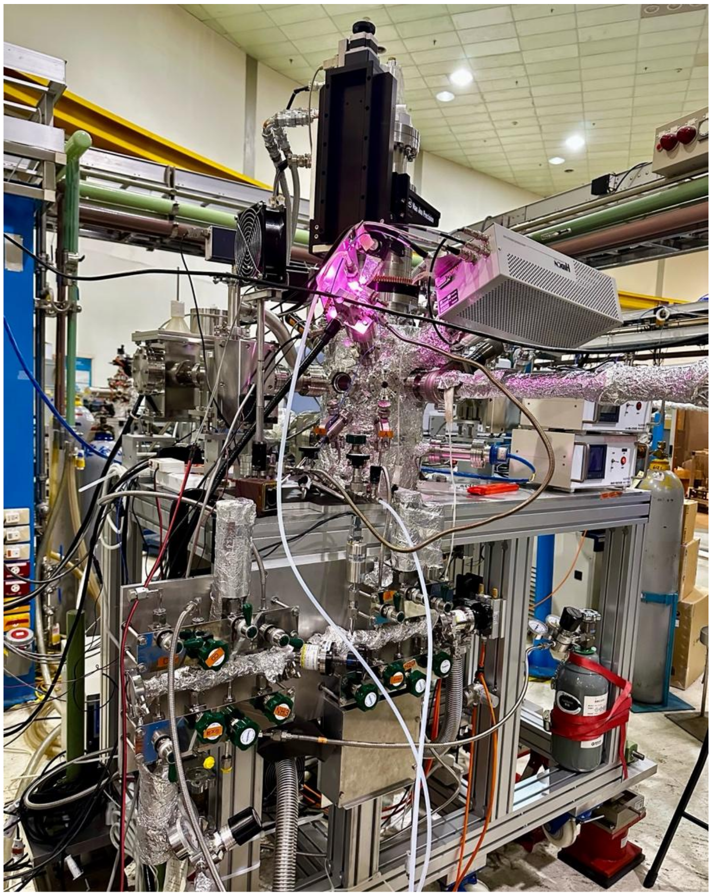
The PPS Lab group. From left to right: Hann Lin (undergraduate), Barry Wang (undergraduate), Kai Lee (PhD), Asper Chen (PI), Ryan Tsou (Master), Gina Chiu (PhD), Joy Lee (undergraduate) delivered to the ice sample. This capability enables wavelength-dependent laboratory astrochemistry experiments and provides a more realistic simulation of diverse astrophysical radiation environments.

IEPS. To extend our studies beyond photon-induced chemistry, the Interstellar Energetic-Process System (IEPS) was developed as a second-generation set-up. This set-up shares the same basic capabilities as IPS, but it incorporates additional energetic particle sources to simulate a broader diversity of astrophysical environments. A significant feature of IEPS is its electron irradiation capability, allowing for investigations of electron-induced chemistry, molecular dissociation, and desorption processes relevant to secondary electrons generated by cosmic ray and X-ray radiation. The system was recently upgraded with an H/D atom beam source, enabling laboratory studies of hydrogenation and deuteration. These experiments provide valuable insights into grain–surface reaction pathways, molecular hydrogenation, deuterium fractionation, and isotope-dependent chemistry in cold astrophysical environments.

WING. The Wavelength-dependent INterstellar photo-processinG (WING) set-up is the newest generation of our laboratory experimental platforms and was specifically designed for wavelength-dependent studies (e.g., photochemistry, photodesorption, ionization, and radiation-induced molecular evolution) using synchrotron radiation at the National Synchrotron Radiation Research Center (NSRRC) in Taiwan. Using different beamlines, WING has access to photon energies from the VUV/EUV range (TLS03, 5–45 eV) to soft X-rays (TLS08B, 80–1250 eV). A recent upgrade of WING is the installation of a Hiden ion desorption probe QMS, extending detection capabilities to positive and negative ions for the study of ion desorption, charged photofragments, dissociative electron attachment, and ion-mediated chemistry.

Processing Ices with Photons, Electrons, and Atoms

Our studies have explored photodesorption mechanisms ices, wavelength-dependent VUV processing, soft X-ray-induced chemistry in mixed molecular ices, and the formation of complex organic molecules under astrophysical conditions. We have also investigated energy transfer processes within molecular solids and their impact on desorption efficiencies and photochemical evolution of ices.



The WING experimental set-up connected to the NSRRC TLS08B synchrotron beamline.

The exposure to different energetic sources results in distinct excitation and ionization pathways, leading to complementary chemical outcomes. VUV photons primarily induce electronic excitation in the upper ice layers, while soft X-rays penetrate deeper into the ice and generate extensive secondary electron cascades. Energetic electrons and reactive H/D atoms further contribute to molecular dissociation, hydrogenation, and non-thermal desorption processes. The combination of these mechanisms plays a critical role in shaping the molecular inventories that are observed in dense clouds and protoplanetary disks.

Our work has also expanded toward understanding the chemistry at the interface between water ice and carbonaceous dust analogs. Using synchrotron-based UV/EUV irradiation experiments, we study how energetic photons drive chemical reactions at dust–ice interfaces, including the formation of CO_2 and carbonaceous species on hydrogenated amorphous carbon grains. These experiments aim to better understand how energetic processing of dust–ice surfaces alters the composition of both the volatile ice mantles and the underlying refractory dust materials in protoplanetary environments.

Another important research topic is the study of layered interstellar and circumstellar ice mantles. In realistic astrophysical environments, ice mantles are not homogeneous and exhibit chemically segregated structures composed of polar and apolar layers. By combining multi-component ices with energetic processing from VUV photons, electrons, and soft X-rays, we study how chemical complexity develops under astrophysically realistic conditions.

Interstellar Ice Facilities at Leiden Laboratory for Astrophysics

Ko-Ju Chuang (chuang@strw.leidenuniv.nl), Franciele Kruczkiewicz, Thanh Nguyen, Katie Slavicinska,
Cecilie Homen, Milan Heinsohn
https://labastro.strw.leidenuniv.nl/

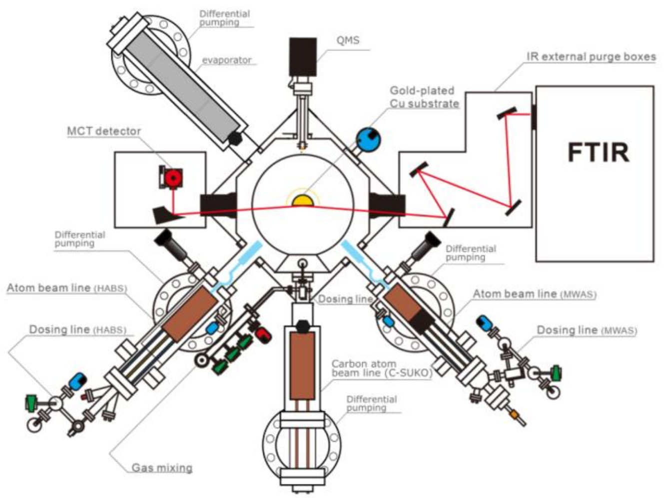
Experimental studies of solid-state processes in extraterrestrial environments have been conducted at **the Leiden Laboratory for Astrophysics (LfA),** Leiden University, since the 1970s. Building on the pioneering vision of Prof. Mayo Greenberg and through ongoing expansions by successive generations of principal investigators, the laboratory has developed a suite of dedicated experimental platforms to investigate the physics and chemistry of interstellar ice analogs. Here, we highlight two key set-ups targeting (i) non-energetic surface reactions (SURFRESIDE), and (ii) energetic processing by UV photons (CRYOPAD).

SURFRESIDE: Simulating Dark Cloud Chemistry

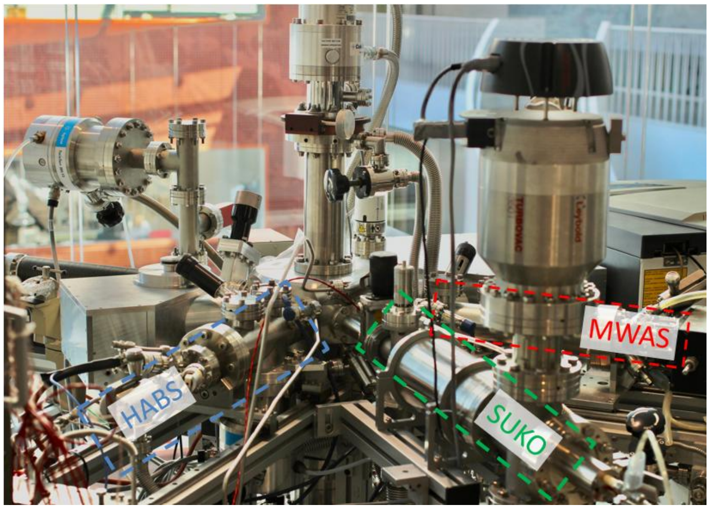
The LfA SURFace REaction SImulation Device (SURFRESIDE) is a custom-built ultra-high vacuum (UHV) apparatus designed to investigate solid-state astrochemical pathways under dark molecular cloud conditions, where external radiation fields are largely absent. The system operates at base pressures in the low 10^{-10} mbar range and employs a gold-plated copper substrate cooled by a closed-cycle helium cryostat and controlled via a proportional-integral-derivative (PID)-regulated heater, enabling experiments over astrophysically relevant temperatures (8–500 K).

A central feature of SURFRESIDE is its suite of atomic beam sources for H/D, O/N, and ground-state C atoms, produced by a hydrogen atom beam source (HABS; thermal cracking), a microwave atom source (MWAS; plasma dissociation), and a carbon sublimation source (SUKO), respectively. We employ a nose-shaped quartz pipe for multiple collisions to thermalize and quench excited species electronically prior to surface interaction, ensuring well-defined, low-temperature surface chemistry dominated by ground-state atoms and radicals. These beams can be operated independently or in combination, enabling systematic exploration of increasingly complex reaction networks. Ice evolution is monitored *in situ* using reflection–absorption infrared spectroscopy (RAIRS) and temperature programmed desorption coupled with quadrupole mass spectrometry (TPD–QMS), allowing for the identification of both solid-phase products and desorbing species, including trace complex organic molecules (COMs).

Over the past decade, SURFRESIDE studies have reproduced key formation routes to astronomically relevant molecules such as H_2O, NH_3, CH_4, OCS, and CH_3OH (Ioppolo et al., 2010, 2011; Fedoseev et al., 2015; Chuang et al., 2018; Qasim et al., 2020; Santos et al., 2024), as well as more complex O-bearing COMs formed via hydrogenation and radical–radical recombination at temperatures as low as 10 K (Chuang et al., 2016; Fedoseev et al., 2017; He et al., 2022). These results demonstrate that significant molecular complexity can emerge already during the



Schematic view of the SURFRESIDE apparatus



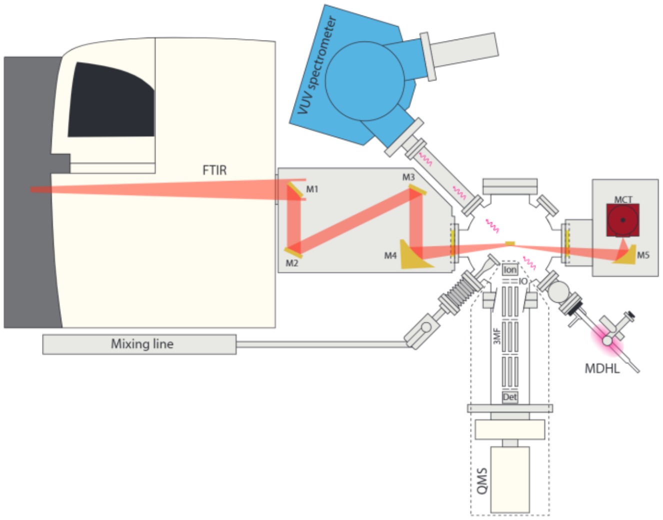
The SURFRESIDE experimental apparatus and its 3 atomic beam sources (HABS, MWAS, and SUKO) prestellar phase, setting the initial chemical inventory that may be inherited by comets and planetesimals.

CRYOPAD: Probing UV-Driven Chemistry in Interstellar Ices

While ice formation in dense interstellar clouds is dominated by non-energetic atom-addition reactions, many astrophysical environments are strongly influenced by ultraviolet (UV) radiation. The CRYOgenic Photoproduct Analysis Device (CRYOPAD) is designed to investigate the chemical evolution of interstellar and circumstellar ice analogs under such irradiation.

CRYOPAD uses a microwave-discharge hydrogen-flow lamp (MDHL) coupled to the main chamber via an MgF_2 window, delivering vacuum-ultraviolet (VUV) photons in the 115–180 nm range. This radiation simulates both the secondary UV field induced by cosmic rays in dense clouds and the intense stellar UV fields present in star-forming regions. UV irradiation drives key processes such as photodissociation, producing reactive radicals, and photodesorption, non-thermally releasing molecules from the ice into the gas phase. Operating under UHV conditions ($\sim10^{-10}$ mbar) over a wide temperature range (15–800 K), CRYOPAD enables controlled preparation of ice analogs via micro-capillary deposition, ensuring uniform and reproducible samples prior to irradiation. *In situ* diagnostics combine RAIRS for solid-state monitoring with QMS for gas-phase detection, complemented by TPD to characterize photoproducts.

Early CRYOPAD studies provided quantitative photodesorption yields for key astrophysical ices (H_2O, CO, N_2, CO_2), helping to explain the persistence of gas-phase species in cold environments (Öberg et al., 2009a, 2009b, 2009c). More recent work has demonstrated how UV processing reshapes complex organic molecules formed on grains, including efficient formation pathways toward prebiotic species in O- and N-bearing ices relevant to protoplanetary disks (Ligterink et al., 2018; DeVine et al., 2016). These results provide critical constraints on radiation-driven ice chemistry across astrophysical environments.



Schematic view of the CRYOPAD apparatus

Complementary Facilities

In addition to SURFRESIDE and CRYOPAD, the Mass Analytical Tool to Research Interstellar ICES (MATRIICES, Samarth et al., 2023) apparatus employs time-of-flight mass spectrometry to probe solid-state photochemistry of hydrocarbons, alongside the Optical Absorption Setup for Ice Spectroscopy (OASIS, Kofman et al., 2019) and InfraRed Absorption Setup for Ice Spectroscopy (IRASIS, Rachid et al., 2020) apparatus for systematic spectroscopic measurements from the UV–visible (200–800 nm) to infrared (2–20 μm) domains. Together, these facilities provide a comprehensive experimental framework for studying the evolution of the interstellar ice mantle throughout star and planet formation. The overarching goal is to identify the physical and chemical pathways that drive molecular complexity in space, and to deliver laboratory-based constraints, including reaction networks, kinetic parameters, optical constants, and spectroscopic fingerprints, that support the interpretation of astronomical observations and astrochemical models.

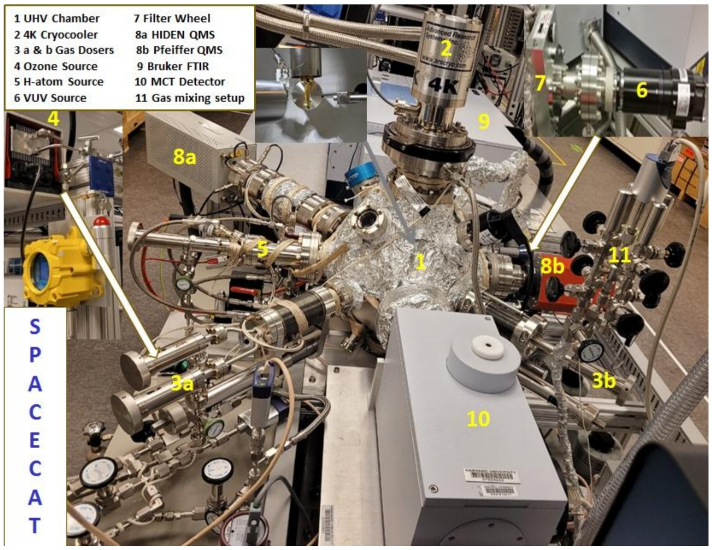
Laboratory Astrochemistry Experimental Set-ups at Harvard

Karin Öberg (koberg@cfa.harvard.edu), Mahesh Rajappan (mrajappan@cfa.harvard.edu)
https://karinoberg.cfa.harvard.edu

The Harvard Center for Astrophysics has designed four experimental set-ups to simulate the chemistry and physics of interstellar ices in order to explore the chemical complexity and molecular diversity of the planetary, stellar, and circumstellar environments that evolve from dense molecular clouds. These four set-ups are described in detail below.

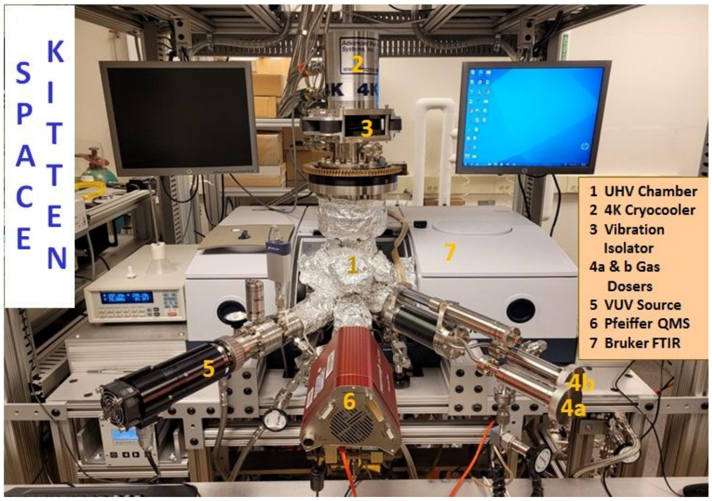
SPACECAT

The Surface Processing Apparatus for Chemical Experimentation to Constrain Astrophysical Theories (SPACECAT) set-up is developed to carry out time series measurements during thermal and energetic processing to follow induced chemical and morphological changes in the ice mantle. This is done using broadband vacuum ultraviolet (UV) sources (such as high-brightness deuterium lamp, electrodeless RF excited lamps, etc.) with filter wheel, state-of-the-art Fourier-transform infrared (FTIR) spectroscopy and mass spectrometry. SPACECAT also incorporates a hydrogen atom beam source to carry out hydrogenation experiments, and an ozone source to carry out excited oxygen atom ice chemistry, a new pathway to interstellar organics at cryogenic temperatures. A Hiden ion desorption probe installed on the chamber can detect positive and negative ions, as well as neutrals and radicals even in low abundances. SPACECAT is primarily used to investigate the impact of ice structure, composition and temperature on the ice chemistry that is regulated by UV photons.



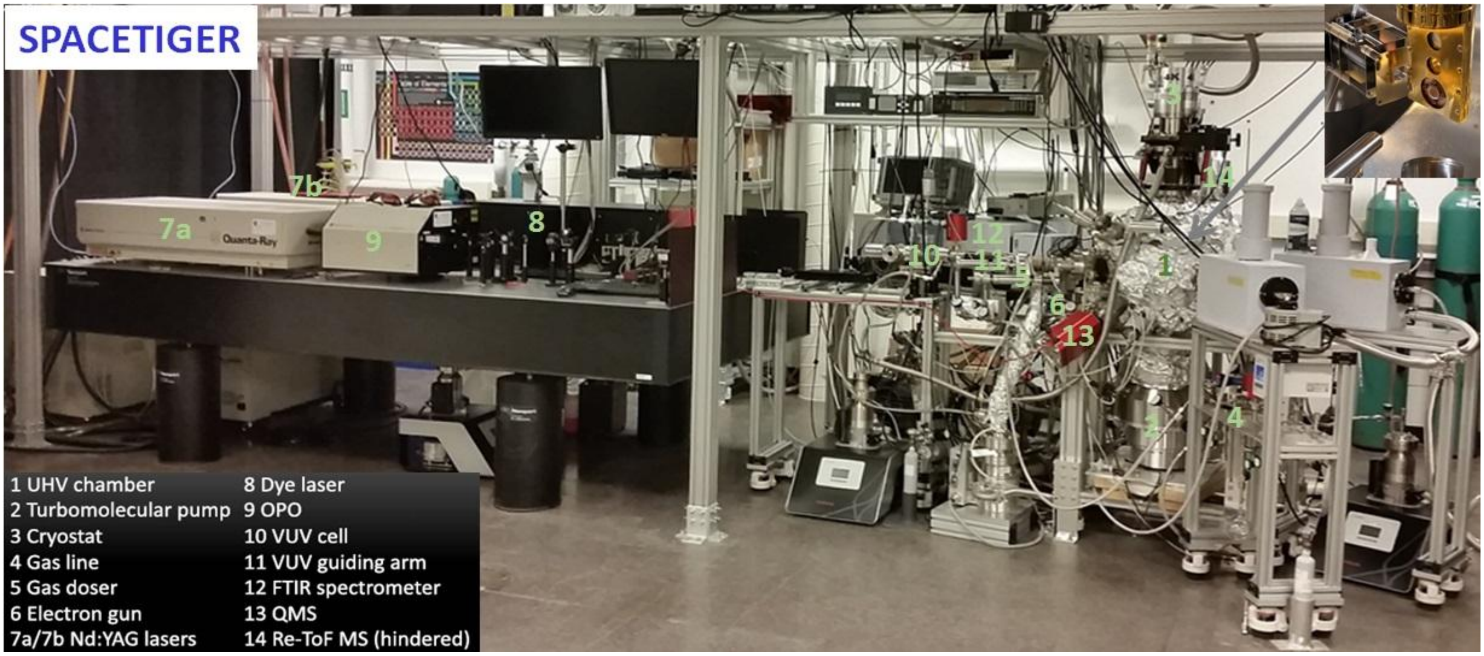
SPACEKITTEN

The Surface Processing Apparatus for Chemical Experimentation – Kinetics of Ice Transformation in Thermal Environments (SPACEKITTEN) set-up is designed as the miniature version of SPACECAT with the added advantage of portability to carry out experiments both in-house and in other high-energy laboratories (e.g., synchrotron facilities). This is done by modifying the sample compartment of the FTIR spectrometer in order to place the reaction chamber such that the IR optical path of the spectrometer coincides with the central axis of the chamber. The DMX-20 interface which uses helium exchange gas to decouple the Cesium Iodide substrate from the cold tip of the cryocooler has been employed to prevent almost all vibration from being transmitted to the substrate as well as the spectrometer. This set-up is extensively used to investigate volatile entrapment in ice matrices that can profoundly impact the distribution of volatiles in protoplanetary disks, but also has a UV irradiation capability.



SPACETIGER

The Surface Processing Apparatus Creating Experiments To Investigate Grain Energetic Reactions (SPACETIGER) set-up is developed for mechanistic ice investigations and involves a pulsed radiation source with frequency resolution. The radiation source includes a laser system capable of producing two powerful tunable nanosecond pulses for nonlinear four wave mixing process of vacuum UV (VUV) generation in a rare gas mixture (Kr:Ar). The



first pulse (frequency doubled or tripled dye laser output) is in two-photon resonance with the electronic transition of the rare gas atom. The second pulse is generated by a broadly tunable 355-nm pumped optical parametric oscillator (OPO). The OPO offers the flexibility of fast VUV energy tuning in the 8–11.2 eV range. High power Nd:YAG lasers pump both the dye laser and the OPO.

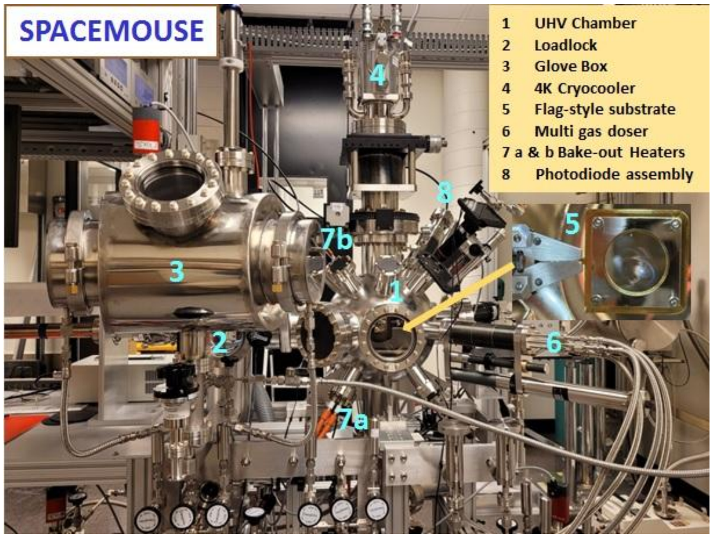
The frequency resolution enables the activation of specific molecular transitions. The pulsed laser-based tunable vacuum ultraviolet (VUV) light source is used for gas phase ionization and processing of ices. A reflection time-of-flight (Re-TOF) mass spectrometer is employed during gas-phase ionization for the detection of isomer-specific species and for extracting their formation and desorption mechanisms. The single photon ionization process produces very few fragments in contrast to electron impact ionization and simplifies the analysis.

SPACETIGER is also equipped with a tunable electron source with fast pulsing capabilities and tunable energy range of 1–2000 eV, a beam current range of 1 nA–10 mA, and beam spot size range of 0.5–5 mm. Ice compositions can be monitored either in transmission or reflection absorption modes.

SPACEMOUSE

The unique feature of the Surface Processing Apparatus for Chemical Exploration of Meteoritic Organics Under Simulated Environments (SPACEMOUSE) set-up is the ability to insert and remove the substrates from the low-temperature sample holder without breaking the vacuum. In order to transfer the substrate from the multi-substrate parking station located in the load-lock chamber to the custom substrate receiver attached to the cryostat extension, a magnetically coupled transporter is used.

The substrate with the refractory organic residue obtained after irradiation of ice mixtures is moved first to the load-lock chamber, sealed in an inert atmosphere in a glovebox and further analyzed *ex situ*. With this new set-up, we are embarking on a systematic survey of the formation of large complex organic molecules, including amino acids and peptides, in the interstellar medium, and how they compare to meteorite and cometary samples.



EPICS Lab at the Georgia Institute of Technology

Thomas Orlando (thomas.orlando@chemistry.gatech.edu), Brant Jones (brant.jones@chemistry.gatech.edu)
https://orlando.chemistry.gatech.edu/

The Electron and Photon Induced Chemistry on Surfaces (EPICS) Laboratory at the Georgia Institute of Technology specializes in applying experimental techniques from the surface science and atomic/ molecular physics communities to unravel the details of non-thermal processes occurring under a variety of non-equilibrium conditions in solar nebula, the interstellar media, as well as in the inner and outer solar system. The science programs and investigations also include scattering and electronic structure theory with the ultimate aim of understanding the dynamics and important roles of inelastic scattering and electronic excitations in non-thermal chemical transformations on surfaces, at interfaces and in low-temperature solids including pure and mixed ices.

The EPICS Laboratory was host of the NASA Solar System Exploration Research Virtual Institutes (SSERVI) – Radiation Effects and Volatile Exploration of Asteroids and Lunar Surfaces (REVEALS) node and currently hosts the SSERVI Center for Lunar Environment and Volatile Exploration Research (CLEVER). The EPICS lab and CLEVER researchers are partnering with NASA to help return humans to the Moon for sustained periods, a key part of NASA's Artemis program. Volatile molecules (i.e., water, oxygen, methane, and hydrogen) are required for supporting human activity on the Moon.

The EPICS Laboratory therefore focuses on some fundamental questions: What are the origins of volatiles, particularly water, in the Universe? How are solar system ices and comets formed and processed by solar wind, X-rays and cosmic rays? What is the "source" of Lunar water (Jones et al., 2024)? Is there enough water (in permanently shadowed regions or the Lunar south pole basin) to sustain a human presence? If so, how do we retrieve and utilize it?

The approach: The EPICS Laboratory has multiple ultrahigh vacuum (UHV, 10^{-10} torr) chambers for surface analysis including temperature programmed desorption (TPD), scanning X-ray and Auger photo-electron spectroscopy, Fourier-transform infrared (FTIR), mass-selected ion-beam bombardment, and electron- and photon-stimulated desorption (Figure 1).

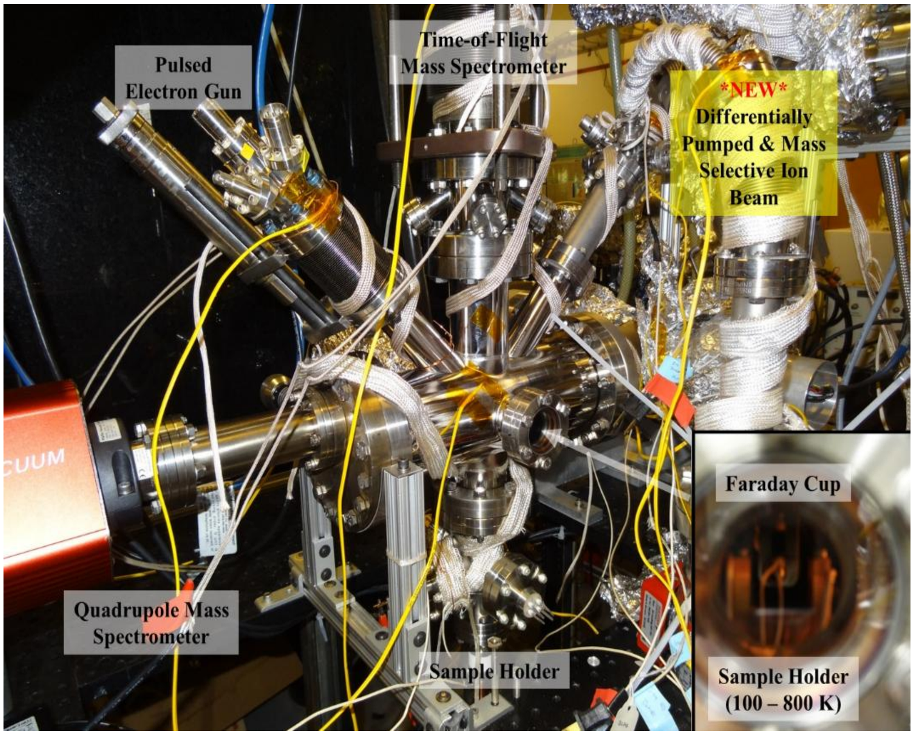
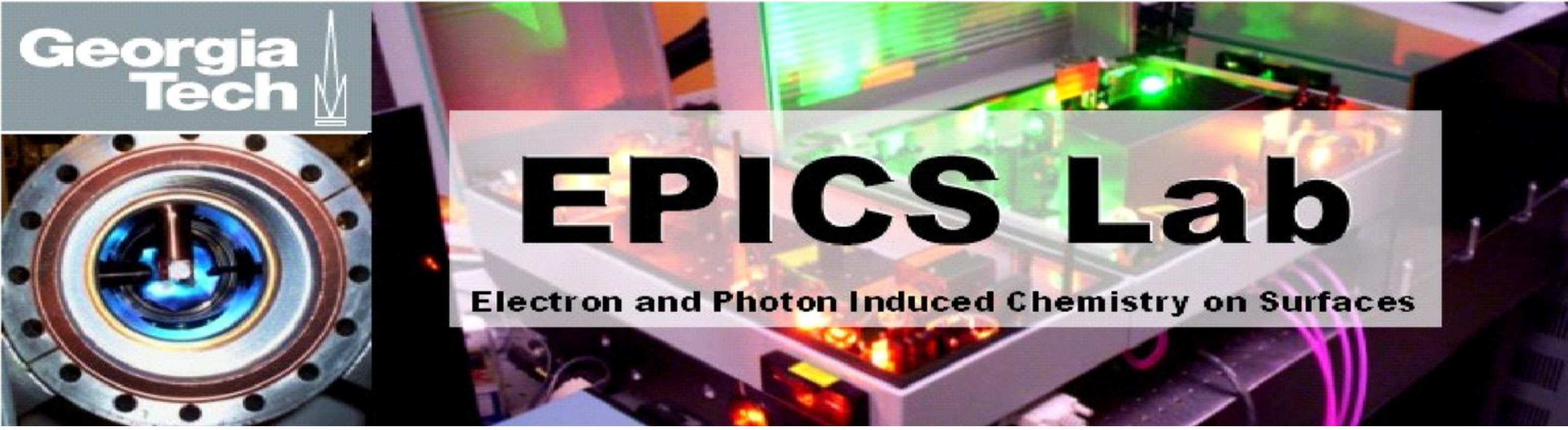


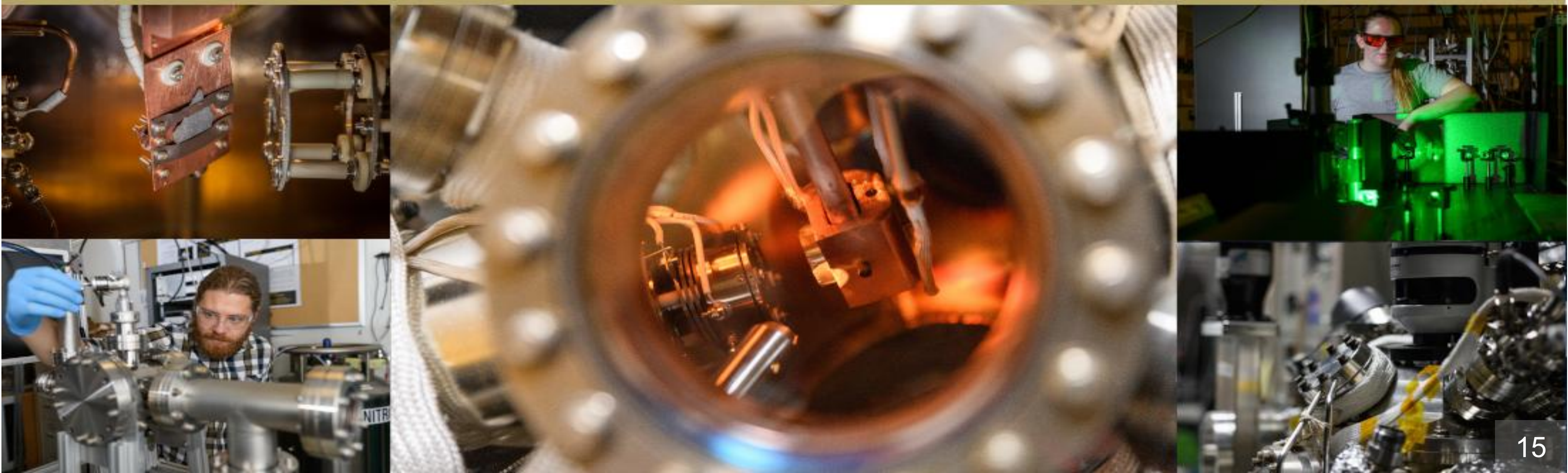
Figure 1. *Solar Wind UHV Chamber to study processes occurring during electron, proton and VUV photon irradiation of clean and ice-covered asteroids and lunar materials. Note that irradiation using all three sources simultaneously is possible, thereby fully simulating the synergistic effects of the low-temperature solar wind plasma.*



Multifunction manipulators provide vertical translation and 360° rotation. Sample temperatures are controllable from 10 to 1000 K using closed-cycle helium cryostats and a high-temperature attachment. Other accessories include high power (femtosecond to nanosecond) pump-dye and solid-state lasers for resonance enhanced multiphoton ionization detection of neutral products, VUV frequency tripled light sources, time-of-flight mass spectrometers, pulsed low-energy electron guns, and quadrupole mass spectrometers with secondary ion detection. An UHV chamber (Figure 2) built and interfaced with an FTIR spectrometer and liquid aerosol doser quantified how ice formation history, mineral composition, and loading control the molecular structure and infrared signatures of water ice mixed with Lunar-relevant minerals (Buffo et al., 2025). Near-IR/IRVIS reflectance and TPD experiments were also done in partnership with the *Volatiles Investigating Polar Exploration Rover* (*VIPER*) NIRVSS spectrometer team (NASA Ames). This allowed controlled vapor-deposition of H_2O “ice” onto surrogate and actual *Apollo* soils. From a mission-support perspective, this EPICS Laboratory/CLEVER experimental capability helps provide the foundational physics required to accurately characterize the inventory and resource potential of polar volatiles for future *in situ* resource utilization (ISRU).

Figure 2. *Low-temperature ice vacuum chamber equipped with vapor deposition and liquid aerosol injection to simulate samples on lunar surfaces and cryovolcanism on outer solar system bodies such as Europa and Enceladus.*

Answering the questions that will allow humans to safely explore our solar system



Recent Publications

From the Laboratory Astrophysics Community
April–June 2026

Broadband spectroscopy of astrophysical ice analogues – V. Optical constants of Ih, Ic, and amorphous H_2O ices in the terahertz-infrared range
Gavdush, A. A., Ribeiro, F., Matveishina, M. K., et al.
Astronomy & Astrophysics, **710**, A89 (2026)
https://doi.org/10.1051/0004-6361/202659623

The H, C and N abundances and isotopic compositions of samples with outer Solar System heritage: asteroid Bennu and the Tarda and Tagish Lake meteorites
Foustoukos, D. I., Alexander, C. M. O'D., Cody, G. D., et al.
Geochimica et Cosmochimica Acta, **424**, 113 (2026)
https://doi.org/10.1016/j.gca.2026.05.028

The bulk abundances and isotopic compositions of H in CM and CI carbonaceous chondrites
Alexander, C. M. O'D., Foustoukos, D. I.
Geochimica et Cosmochimica Acta, **424**, 176 (2026)
https://doi.org/10.1016/j.gca.2026.05.027

Mechanical properties of salty ice powders as analogues of Europa's recently erupted ices
Jabaud, B., Artoni, R., Le Menn, E., et al.
Icarus, **458**, 117190 (2026)
https://doi.org/10.1016/j.icarus.2026.117190

Vapor pressures of low-temperature C_2H_x hydrocarbon ices
Grundy, W. M., Tan, S. P., Steckloff, J. K., et al.
Icarus, **458**, 117179 (2026)
https://doi.org/10.1016/j.icarus.2026.117179

CO line profiles in accreting ices
Aslam, R., Lee, C.-Y., Chiu, Y.-H., et al.
The Astrophysical Journal, **1003**, 3 (2026)
https://doi.org/10.3847/1538-4357/ae6111

Assessment of the impact of CN-reactions with NH_3 and CH_3NH_2 in the chemistry of a dark interstellar cloud: Experimental kinetic study and gas-phase model
González, D., Ballesteros, B., Agúndez, M., et al.
The Astrophysical Journal, **1003**, 62 (2026)
https://doi.org/10.3847/1538-4357/ae624b

The reactions of $N(^2D)$ with monocyclic and polycyclic aromatic hydrocarbons and their role in the atmospheric chemistry of Titan
Mancini, L., Balucani, N., Rosi, M.
Icarus, **457**, 117152 (2026)
https://doi.org/10.1016/j.icarus.2026.117152

Prebiotic chemistry insights for Dragonfly. II: Thermodynamic favorability of nucleobases, ribose, and fatty acids in Selk Crater on Titan
Madan, I., Pearce, B. K. D.
Planetary Science Journal, **7**, 107 (2026)
https://doi.org/10.3847/PSJ/ae5f91

Feeling the pressure: Effects of formation pressure on the physical properties of Titan haze analogs
Husic, A., Yu, X., Blase, R. C., et al.
Planetary Science Journal, **7**, 111 (2026)
https://doi.org/10.3847/PSJ/ae63ca

Adhesion force of Titan tholin at low temperatures: Saltation threshold wind speed, roles of alteration with liquid methane, and aeolian transport of organics on Titan
Hirai, E., Itoh, H., Sekine, Y., et al.
Icarus, **457**, 117154 (2026)
https://doi.org/10.1016/j.icarus.2026.117154

Electron irradiation of methanol ices: Implications for organic chemical diversity on Europa's surface
Carrasco-Herrera, R., Bouquet, A., Noble, J. A., et al.
Icarus, **456**, 117136 (2026)
https://doi.org/10.1016/j.icarus.2026.117136

Radiolysis versus photolysis of nitrile ices: Laboratory constraints for interstellar chemistry
Borengasser, Q. D., Moore, B. M., Hager, T. J., et al.
Astronomy & Astrophysics, **709**, A168 (2026)
https://doi.org/10.1051/0004-6361/202658969

Cryogenic bottom-up formation of the benzene cation from acetylene in helium nanodroplets
Foitzik, F., Richardson, V., Maurice, C., et al.
Journal of the American Chemical Society, **148**, 18615 (2026)
https://doi.org/10.1021/jacs.6c04278

Characterization of the chemical evolution of CH_4 ices under processing by cosmic ray analogs with the PROCODA code – II. Dominant chemical reactions for the formation and consumption of CHCH, C_2H_6, and C_3H_8
Gerasimenko, S., Carvalho, G. A., Zanatto, F., et al.
Monthly Notices of the Royal Astronomical Society, **548**, stag805 (2026)
https://doi.org/10.1093/mnras/stag805

Modeling the chemical evolution of cosmic-ray irradiated H_2O:CO_2 ices with PROCODA: Implications for protostars and trans-Neptunian objects
Moraes, L., Pilling, S.
Monthly Notices of the Royal Astronomical Society, **549**, stag816 (2026)
https://doi.org/10.1093/mnras/stag816

Influence of CO versus CH_4 on organic haze formation in atmospheres of diverse terrestrial exoplanets
Wang, S., Yang, Z., Li, H., et al.
Astronomy & Astrophysics, **709**, A166 (2026)
https://doi.org/10.1051/0004-6361/202658994

Seasonal variability of Pluto’s haze formation revealed by laboratory simulations
Yang, Z., He, C., Liu, Y., et al.
Planetary Science Journal, **7**, 103 (2026)
https://doi.org/10.3847/PSJ/ae5e70

Abundant hydrocarbons in a buried galactic nucleus with signs of carbonaceous grain and polycyclic aromatic hydrocarbon processing
Garcia-Bernete, I., Pereira-Santaella, M., Gonzalez-Alfonso, E., et al.
Nature Astronomy, **10**, 420 (2026)
https://doi.org/10.1038/s41550-025-02750-0

A chemistry-first centered icy chemical inventory of protostellar sources with JWST
Turner, A. M., Yang, Y.-L., Gross, R., et al.
The Astrophysical Journal, **1000**, 17 (2026)
https://doi.org/10.3847/1538-4357/ae3743

Hydrocarbon complexity and photochemical shielding of prebiotic feedstock molecules in exoplanet atmospheres
Braam, M., Gopaoco, E., Tsai, S.-M., et al.
Icarus, **452**, 117032 (2026)
https://doi.org/10.1016/j.icarus.2026.117032

Molecular evolution of H_2O:O_2 ices at different temperatures in simulated space environments. II. Evolution of reaction pathways
Silva, J. R. C., Queiroz, L. M. S. V., Ferrão, L. F. A., et al.
The Astrophysical Journal, **1002**, 19 (2026)
https://doi.org/10.3847/1538-4357/ae579d

An interstellar energetic and non-aqueous pathway to peptide formation
Hopkinson, A. T., Wilson, A. M., Pitfield, J., et al.
Nature Astronomy, **10**, 531 (2026)
https://doi.org/10.1038/s41550-025-02765-7

Irradiation of methanol ice on a sulfur-rich dust analogue at 25 K: A mid-infrared spectroscopic study
Mifsud, D. V., Kanuchova, Z., Auriacombe, O., et al.
Physical Chemistry Chemical Physics, **28**, 3642 (2026)
https://doi.org/10.1039/D5CP03973H

Impact of N_2 addition on cation and anion chemistry in C_2H_2/Ar plasmas
Tanarro, I., Peláez, R. J., Herrero, V. J.
Plasma Sources Science and Technology, **35**, 045018 (2026)
https://doi.org/10.1088/1361-6595/ae5e05

On the importance of laboratory experiments for interpreting exoplanet observations
Thompson, M. A.
Astrophysics and Space Science, **371**, 33 (2026)
https://doi.org/10.1007/s10509-026-04564-6

Formation and trapping of CO_2 from cryogenic irradiation of carbonate
Pandya, A., Chandra, S., Brown, M. E.
The Planetary Science Journal, **7**, 93 (2026)
https://doi.org/10.3847/PSJ/ae595b

Hydrolyzed hazes on water-rich exoplanets: Optical constants and detectability
Pesciotta, C., Hörst, S. M., Radke, M. J., et al.
The Astrophysical Journal, **1002**, 221 (2026)
https://doi.org/10.3847/1538-4357/ae5b99

Physical analysis of Bennu samples reveals regolith production by collisional disruption on near-Earth asteroids
Ballouz, R.-L., Ryan, A. J., Macke, R. J., et al.
The Planetary Science Journal, **7**, 87 (2026)
https://doi.org/10.3847/PSJ/ae4fad

Thermal evolution of the sulfur-rich, small terrestrial planetary core as inferred from the experimental study of the Fe-S-O-H System
Lee, J., Keum, J., Kim, T., et al.
Journal of Geophysical Research: Planets, **131**, e2025JE009141 (2026)
https://doi.org/10.1029/2025JE009141

Raman spectroscopy of salt deposits from the simulated subsurface ocean of Enceladus
Takeshita, J., Cho, Y., Tabata, H., et al.
The Planetary Science Journal, **7**, 91 (2026)
https://doi.org/10.3847/PSJ/ae548e

The spectroscopic impact of sublimation under Martian surface conditions: Implications for sample analysis by the Rosalind Franklin Rover and biosignature preservation
Preston, L. J., Minns, C. H., Roussouli, I., et al.
Journal of Geophysical Research: Planets, **131**, e2025JE009430 (2026)
https://doi.org/10.1029/2025JE009430

Proton irradiation of primitive atmospheres of young exoplanets and early Earth: N_2O greenhouse warming and prebiotic synthesis
Kobayashi, K., Airapetian, V. S., Udo, T., et al.
The Astrophysical Journal Letters, **1002**, L12 (2026)
https://doi.org/10.3847/2041-8213/ae5491

Direct observation of organic molecules in asteroid Ryugu revealed by high-resolution atomic force microscope
Iwata, K., Oba, Y., Naraoka, H., et al.
Nature Communications, **17**, 3416 (2026)
https://doi.org/10.1038/s41467-026-71484-y

Desorption dynamics of interstellar molecule on amorphous solid water investigated by machine learning potential-based PaCS-MD simulation
Watanabe, N., Kästner, J., Hori, Y., et al.
The Journal of Chemical Physics, **164**, 144310 (2026)
https://doi.org/10.1063/5.0325531

The reaction between atomic carbon and molecular nitrogen as a source of cyanamide and carbodiimide on interstellar ices
Hickson, K. M., Loison, J.-C., Coutens, A.
ACS Earth Space Chemistry, **10**, 1122 (2026)
https://doi.org/10.1021/acsearthspacechem.6c00032

Nanoscale infrared spectroscopy reveals complex organic–mineral assemblages in asteroid Bennu
Yesiltas, M., Dopilka, A., Kostecki, R., et al.
Proceedings of the National Academy of Sciences USA, **123**, e2601891123 (2026)
https://doi.org/10.1073/pnas.2601891123

Distribution of extraterrestrial nucleobases, other N-heterocycles, and their precursors in a sample from asteroid Bennu
Oba, Y., Koga, T., Takano, Y., et al.
Communications Chemistry, **9**, ,132 (2026)
https://doi.org/10.1038/s42004-026-01966-z

CO and N_2 produced from H_2O, CO_2, and NH_3 cometary ice analogs
McKinnon, A., Simon, A., Brann, M. R., et al.
The Astrophysical Journal, **1001**, 125 (2006)
https://doi.org/10.3847/1538-4357/ae53e1

Nondiffusive formation of acetaldehyde on interstellar ices: An atomistic perspective
Martínez-Bachs, B., Rimola, A.
The Astrophysical Journal Letters, **1000**, L58 (2026)
https://doi.org/10.3847/2041-8213/ae4a8e

Spectral similarity in the thermal infrared between sulfide-rich carbonaceous chondrite meteorites, Jupiter Trojans, and other D- and P-type asteroids
Bates, H. C., King, A. J., Donaldson Hanna, K. L., et al.
The Planetary Science Journal, **7**, 90 (2026)
https://doi.org/10.3847/PSJ/ae5931

Quantifying building blocks of life in planetary analog materials: Implications for prebiotic chemistry and biosignature identification
Luo, X., He, C., Yang, Z., et al.
The Planetary Science Journal, **7**, 82 (2026)
https://doi.org/10.3847/PSJ/ae593e

The effects of propane on nitrogen–hydrocarbon mixtures relevant to Titan's lakes and seas
Thieberger, C., Hanley, J., Tan, S. P., et al.
The Planetary Science Journal, **7**, 81 (2026)
https://doi.org/10.3847/PSJ/ae4fb3

Replenishment of methane in Titan's atmosphere by intrusion-driven thermal destabilization of methane clathrate hydrates
Davies, A. G., Choukroun, M., Sotin, C., et al.
The Planetary Science Journal, **7**, 75 (2026)
https://doi.org/10.3847/PSJ/ae47df

Quantum chemical insights into the dissociation of phenol for impact ionisation mass spectrometry: Understanding molecular fragmentation relevant for icy moon exploration
O'Sullivan, T., Bera, P.P., Khawaja, N., et al.
ACS Earth and Space Chemistry, **10**, 1033 (2026)
https://doi.org/10.1021/acsearthspacechem.5c00318

Spectroscopic studies of polycyclic aromatic hydrocarbons: Interstellar aromatic chemistry revealed
McCarthy, M. C., McGuire, B. A.
Annual Review of Physical Chemistry, **77**, 345 (2026)
https://doi.org/10.1146/annurev-physchem-082324-010544

UV irradiation of ethanol-containing interstellar ice analogs: Photostability in CH_3CH_2OH:CO mixtures
DeVine, J. A., Terwisscha van Scheltinga, J., Ioppolo, S., et al.
Astronomy & Astrophysics, **708**, A186 (2026)
https://doi.org/10.1051/0004-6361/202557923

Broadband spectroscopy of astrophysical ice analogues. IV. Optical constants of N_2 ice in the terahertz and mid-infrared ranges
Kruczkiewicz, F., Gavdush, A. A., Ribeiro, F., et al.
Astronomy & Astrophysics, **707**, A344 (2026)
https://doi.org/10.1051/0004-6361/202556818

Broadband infrared spectroscopy of methanol isotopologues in pure, H_2O-rich, and CO-rich ice analogues
Vyjidak, A., Giuliano, B. M., Jusko, P., et al.
Astronomy & Astrophysics, **707**, A214 (2026)
https://doi.org/10.1051/0004-6361/202557702

Broadband spectroscopy of astrophysical ice analogues: III. Scattering properties and porosity of CO and CO_2 ices
Gavdush, A. A., Ivlev, A. V., Zaytsev, K. I., et al.
Astronomy & Astrophysics, **701**, A287 (2025)
https://doi.org/10.1051/0004-6361/202556110

CO desorption from interstellar icy grains induced by IR excitation of superhydrogenated PAHs
Slumstrup, L., Thrower, J. D., Hopkinson, A. T., et al.
Astronomy & Astrophysics, **704**, A74 (2025)
https://doi.org/10.1051/0004-6361/202556399

The survival of aromatic molecules in protoplanetary disks
Piacentino, E. L., Balkanski, A., Calahan, J., et al.
The Astrophysical Journal, **994**, 155 (2025)
https://doi.org/10.3847/1538-4357/ae1134

Community Announcements

Upcoming Conferences, Meetings, and Workshops Relevant to Laboratory Astrophysics

Earth and Planetary Cloud Workshop 2026
22–24 June 2026
Pasadena, CA, USA
https://www.nasa.gov/jpl/pcarf/workshop-2026/
Abstract submission: Closed
Registration: Closed

International Astronomical Union (IAU) Symposium 407: Origins 2026
5–11 July 2026
Paris, France
https://originsparis.sciencesconf.org/resource/page/id/20
Abstract submission: Closed
Registration deadline: 5 July 2026

Exploring the aromatic universe in the JWST era
6–10 July 2026
London, Ontario, Canada
https://www.aromaticuniverse.space/
Abstract submission: Closed
Registration: Closed

2026 Sagan Summer Workshop – Exoplanets with Roman Surveys: Microlensing and Transits
20–24 July 2026
Pasadena, CA, USA
https://nexsci.caltech.edu/workshop/2026/
Abstract submission deadline: Mid-July 2026 (Posters)
Registration deadlines: 20 May 2026 (NASA & JPL employees), Mid-July 2026 (Other attendees)

Committee for Space Research (COSPAR) 2026 46th General Assembly
1–9 August 2026
Florence, Italy
https://cospar2026.org/
Abstract submission: Closed
Registration deadlines: 15 July 2026 (Regular), 1 August 2026 (Onsite)

88th Annual Meteoritical Society Meeting
9–14 August 2026
Frankfurt, Germany
https://www.metsoc2026-frankfurt.com/
Abstract submission: Closed
Registration deadlines: 3 July 2026 (Early Bird), 9 August 2026 (Onsite)

4th Annual Texas Area Planetary Sciences Meeting
20–21 August 2026
Austin, TX, USA
https://cvent.utexas.edu/event/taps-2026/home
Abstract submission: Closed
Registration deadline: 15 July 2026

American Chemical Society (ACS) Fall Meeting 2026
Astrochemistry Subdivision Symposium: “Astrochemistry in Planetary Science”
23–27 August 2026
Chicago, IL, USA
https://www.acs.org/events/fall.html
Abstract submission: Closed
Registration dates: 23 July 2026 (Advance), 24 August 2026 (Regular)

17th Atmospheric Spectroscopy Applications (ASA) workshop, jointly with the International HITRAN conference
26–28 August 2026
Reims, France
https://www.univ-reims.fr/asa-hitran/second-circular/second-circular,30319,46874.html
Abstract submission: Closed
Registration deadline: 1 July 2026 (Early bird), 25 August 2026 (Regular)

Community Science (AdASTRA) Workshop
1–3 September 2026
Pasadena, CA, USA and virtual
https://science.nasa.gov/astrophysics/programs/physics-of-the-cosmos/community/ad-astra/
Abstract submission: 24 June 2026
Registration deadlines: 15 August 2026 (In-person attendees), 31 August 2026 (Virtual attendees)

Europlanet Science Congress (EPSC)
6–11 September 2026
The Hague, The Netherlands
https://www.epsc2026.eu/
Abstract submission: Closed
Registration dates: To be announced

Final COST NanoSpace – Joint Scientific Meeting
15–17 September 2026
Tenerife, Canary Islands, Spain
https://meetings.iac.es/nanospacefjsm2026/
Abstract submission deadline: 30 June 2026
Registration deadline: 30 June 2026

European Conference on Laboratory Astrophysics (ECLA) 2026
21–26 September 2026
Heidelberg, Germany
https://www.mpia.de/ecla2026
Abstract submission: Closed
Registration: Closed

Workshop on the Integrated Science of Comets – From Laboratory Studies of Cometary Materials to Remote Observations
22–24 September 2026
Houston, TX
https://www.hou.usra.edu/meetings/integratedsciencecomets2026/
Abstract submission deadline: 12 July 2026
Registration deadline: 24 September 2026

Cosmic Rays 4: The Salt of the Star Formation Recipe
5–9 October 2026
Pisa, Italy
https://sites.google.com/view/cosmic-rays-4/
Abstract submission: Closed
Registration dates: TBD

58th Annual Meeting of the Division for Planetary Sciences
25–30 October 2026
Spokane, WA, USA
https://aas.org/meetings/dps58
Abstract submission: Closed
Registration deadlines: 28 July 2026 (Regular), 22 October 2026 (Late), 23 October 2026 (Onsite)

Habitable Worlds Observatory 2026
30 November–4 December 2026
Paris, France
https://hwo2026.sciencesconf.org/
Abstract submission: Closed
Registration deadlines: 30 June 2026 (Early Bird), 8 November (Regular)

American Geophysical Union Annual Meeting
7–11 December 2026
San Francisco, CA, USA
https://www.agu.org/annual-meeting
Abstract submission deadline: 5 August 2026
Registration dates: Opens mid-July 2026