



# AstroPAH

A Newsletter on Astronomical PAHs

Issue 113 • November 2024



**L1527 captured  
by the JWST's MIRI**



# Editorial

## Dear Colleagues,

Welcome to our 113<sup>th</sup> AstroPAH volume!

As we are approaching the end of the year already, we would like to welcome Dr. Sander Lemmens who just joined the board of editors for AstroPAH! Thank you, Sander!

The stunning JWST image of the material surrounding a protostar in the molecular cloud L1527 illustrates our cover.

In this month's issue, the *In Focus* was prepared by Prof. Alain Omont who is emeritus Research Director at Institut d'Astrophysique de Paris (IAP). The In Focus titled "40 years in dotted lines with PAHs: a perspective of PAHs in space" traces back a condensed summary of PAHs research and exploration over the past 40 years.

Our Abstracts section includes 7 new papers on IR spectra of cationic PAHs, computational studies on PAHs and NPAHs, and laboratory experiments on OPAHs.

Don't miss out on exciting meeting announcements for the next year! First, the "Astrochemistry and Astrobiology beyond the Second Period" session of the next PacifiChem in a little over a year. The other is a session on the Asia Oceania Geosciences Society 2025 on the "Astrochemical Processes Leading to the Formation of Planetary Bodies in the Solar System.

AstroPAH can help you promote your research! Send your contributions to [our email](#). If you are on Instagram, be sure to check out our next [PAH of the Month!](#)

Thank you all for all your contributions. We will see you next month for our last issue of the year!

**The Editorial Team**

**Next issue: 19 December 2024.  
Submission deadline: 06 December 2024.**

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## PAH Picture of the Month

This month's cover shows a stunning image of the molecular cloud L1527, which hosts a protostar. Captured by the NASA/ESA/CSA James Webb Space Telescope's MIRI instrument, the image reveals blue light from PAHs, while the red glow at the core originates from an energized, thick layer of gases and dust around the protostar.

**Credits:** L1527 image: NASA, ESA, CSA, STScI. The image is available [here](#).

## 40 years in dotted lines with PAHs A perspective of PAHs in space

**Alain Omont**

My first real encounter with PAHs occurred in Summer 1983 in the magnificent setting of Ecole des Houches facing Mont Blanc. Earlier, I had spent two very fruitful summers there, where I was introduced to two science breakthroughs: lasers in optics in 1964 and interstellar molecules in 1973. In August 1983, together with Robert Lucas, I was the director of a one-month school about star formation at Les Houches. The aim was to go through the recent achievements in infrared and millimeter observations and modelling of the interstellar medium (ISM), that were relevant for understanding star formation in galaxies. It was the year of the IRAS launch, after two decades of breakthroughs in infrared astronomy and 15 years of millimeter astronomy which had attracted me to Grenoble in the context of the founding of the IRAM (Institut de radioastronomie millimétrique).

Among school participants, my two friends, Jean-Loup Puget and Alain Léger, had decided to get the most of their meeting there to address the interpretation of the recently discovered interstellar unidentified infrared (UIR) emission bands from 3 to 12  $\mu\text{m}$ , with the idea that they seemed to be characteristic of polycyclic aromatic compounds. They asked me to take part in their discussions, and hence, I joined them for their first meeting. I found the PAH interpretation to be pretty exciting, both for the connection with the known importance of graphitic dust in interstellar dust, and for the need for transient heating of very small grains, as suggested by Kris Sellgren. However, I had the feeling that Alain and Jean-Loup were perfectly complementary and had their own proper respective background in physics and astrophysics for finalizing the PAH interpretation of the UIR emission features, whereas, at the time, I had no special expertise in PAH physics or infrared astronomy. Therefore, at the time of their second discussion, I thought I had more urgent problems to solve dealing with room repartition among school participants, and I did not show up to their subsequent meetings!

Nevertheless, in the following years, after the publication of their seminal paper and the simultaneous paper of Lou Allamandola, Xanders Tielens and John Barker, I remained fascinated by interstellar PAHs and I decided to explore whether I could contribute to the field. Therefore, in parallel with my work on circumstellar molecules and millimeter follow up of IRAS sources, I spent the full 1985 year writing a paper reviewing the basic PAH physics and chemistry. Therein, mechanisms determining the charge, temperature, chemical properties, formation, growth, sputtering, and destruction of PAHs in models of various interstellar clouds were explored in detail.

From this time on, I kept in touch with the development of PAH studies and the involved

community, mainly with the French groups in astrophysics and physics in Orsay and later in Toulouse. I remember participating in a number of workshops, that allowed me to keep up with the refinements of PAH modelling and of the various extensions of the field such as: the early proposals that PAHs could carry DIBs, the possible role of hetero atoms, of aliphatic sidechains, anharmonic emission, PAH clusters, etc. This included the progress in understanding fundamental questions, such as size distribution, photodissociation, ionization, dehydrogenation and super-hydrogenation, fragmentation, that are still open. I was interested by the various controversies about interstellar PAHs, including even their existence. However, I always remained convinced that competing theories, implying dust emission, cannot account for the observed aromatic band ratios.

In the meantime, I had moved from Grenoble to IAP, Paris, and I was beginning to shift from AGB stars to infrared surveys and high-redshift molecules. Nevertheless, I kept occasionally working on PAHs. I had a low-level participation in a paper led by Daniel Rouan and Alain Léger addressing PAH rotational excitation. For several years, however, I more actively tackled the poorly named proto planetary nebulae (PPNs), the intermediate stage between AGB and planetary nebula. After their identification from IRAS colors and spectra, with my research team, we studied circumstellar dust and molecules in a number of them. After the success of the KAO (Kuiper Airborne Observatory) identification of a huge amount of far-infrared emission of ice in a unique IRAS source, that my friend, Mark Morris, christened “Frosty Leo”, I became an addicted user of the KAO for a while. A couple of these flights addressed the nature of the 21  $\mu\text{m}$  and 30  $\mu\text{m}$  bands of carbon-rich PPNs. These features are possibly linked with the peculiar 6-15  $\mu\text{m}$  aromatic band emission of these sources. This was with a limited success, since I understand that many questions that we had at the time remain not fully answered, as a nice goal for JWST.

Then came ISO (Infrared Space Observatory) in 1998. I still remember how I was struck by the universal strength of the PAH bands that dominate the mid-infrared spectrum of most galaxies. I met the PAHs again in our large Galactic ISO program. This project aimed at surveying star forming regions in the central Milky Way. Their PAH emission dominated the intensity in the 7  $\mu\text{m}$  photometric band of ISOCAM. However, the project was plagued by the too high sensitivity of ISOCAM, which forced us to avoid the most interesting PAH regions.

Spitzer was another opportunity to deal with high-redshift PAHs, prefiguring JWST. Their mid-infrared features provide a good way to distinguish starbursts and Active Galactic Nuclei among high-redshift ultra-luminous infrared galaxies. The Spitzer spectrometer was sensitive enough to allow us, with Nicolas Fiolet and Guilaine Lagache, to produce a good high-redshift infrared PAH spectrum 15 years ago, by stacking twenty or so  $z \sim 2$  starburst galaxies. This feat might seem derisory in the era of JWST!

However, the most important opportunity, that triggered my return to the physics of interstellar nanoparticles, was the invitation, by the organizers, Christine Joblin and Xanders Tielens, to give the final talk in the symposium commemorating the 25th birthday of PAHs, in 2010 at Toulouse. A couple of years later, I decided to enter the dangerous field of the diffuse interstellar bands (DIBs). I began by writing a review paper about the possible expectations for fullerene compounds as DIB carriers. I had then the chance to closely interact with my late friend, Sydney Leach, who was a great contributor to PAH physics. While I was learning about the enlightening properties of fullerenes, such as endothermal  $\text{H}_2$  within  $\text{C}_{60}$ , the identification of  $\text{C}_{60}^+$  as the carrier of a few DIBs by Bernard Foing and Pascale Ehrenfreund in 1994 was confirmed by action spectroscopy by Ewen Campbell, John Maier *et al.* in 2015. I remain convinced that other DIB identifications with fullerene

compounds will come.

At the same time, the participation in the scientific council of the Madrid-Toulouse European project Nanocosmos was a new opportunity for me to deal with PAHs, as relating to their detection in meteorites and the possibility they are carriers of DIBs. I remember that, during a Nanocosmos meeting in Madrid, Farid Salama introduced me to the optical spectrum of pentacene, stressing the similarity of its band profiles with that of DIBs. This triggered my interest for acenes and my collaboration with Holger Bettinger, which began by addressing the interest of polyacenes as possible DIB carriers. We are now completing our fourth paper about PAHs and other nanoparticles, mostly in the context of DIBs, and we have ideas for others.

In the meantime, a low-level participation in the JWST Early Release Science program “PDRs4All: Radiative feedback from massive stars”, is allowing me to participate in the excitement of JWST results about PAHs. I regret that JWST did not appear as a reasonable long term time investment for me, 10 years ago, but I am happy to witness the wonderful harvest of results about PAHs at various redshift, that is being achieved by the younger generations.

I would like to conclude by thanking the editor team of the AstroPAH Newsletter for giving me the opportunity and the fun of writing this little PAH saga, and moreover for the splendid work they have carried out for eleven years, in propagating the information about astroPAHs and keeping alive such a wonderful community.



**Prof. Alain Omont** Alain Omont is emeritus Research Director at Institut d’Astrophysique de Paris (IAP) (Sorbonne Université and CNRS) after being university professor and director of Grenoble Observatory and IAP. After a PhD in atomic physics, he has 45-year experience in the physics of the interstellar medium. His main research topics include: millimetre (and infrared) observations of molecules (and dust), circumstellar chemistry; infrared surveys; high-redshift dust and molecules; star formation and evolution of high-z galaxies and quasars; physics of interstellar PAHs, fullerenes and diffuse interstellar bands.

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# Abstracts

## IR spectra of cationic 1,5,9-triazacoronene and two of its cationic derivatives

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Infrared emission features are observed towards diverse astronomical objects in the interstellar medium (ISM). Generally, the consensus is that these IR features originate from polycyclic aromatic hydrocarbons (PAHs) and are hence named aromatic infrared bands (AIBs). More recently, nitrogen substituted PAHs (PANHs) are thought to contribute to the AIBs as well and it has even been shown that nitrogen inclusion in PAHs can improve the match with the AIBs, specifically around the 6.2  $\mu\text{m}$  feature. In order to determine which specific molecules or functional groups are at the origin of the AIBs, IR spectra of various PA(N)Hs are experimentally and computationally studied. In this work we expand on the spectroscopic investigation of PANHs by presenting the gas-phase mid-IR spectra of 1,5,9-triazacoronene<sup>•+</sup> (**TAC**<sup>•+</sup>,  $m/z$  303), a threefold nitrogenated congener of coronene<sup>•+</sup>, its protonated derivative **TACH**<sup>+</sup> ( $m/z$  304) and the product that forms when water adds to dehydrogenated **TAC**<sup>•+</sup>, [**TAC**–H+H<sub>2</sub>O]<sup>+</sup> ( $m/z$  320). We analyze the mid-IR spectra using the calculated vibrational modes on a B3LYP/6-311++G(d,p) level a theory and present a possible geometry for [**TAC**–H+H<sub>2</sub>O]<sup>+</sup>. The **TAC**<sup>•+</sup> mid-IR spectrum is compared to that of coronene<sup>•+</sup> and demonstrated to be remarkably similar. We put **TAC**<sup>•+</sup> and **TACH**<sup>+</sup> into astronomical context by comparing their recorded mid-IR spectra to observed ISM spectra of four spectral classes. From this we conclude that **TAC**<sup>•+</sup> and **TACH**<sup>+</sup> could both contribute to the AIBs, with **TACH**<sup>+</sup> being a more likely contributor than **TAC**<sup>•+</sup>.

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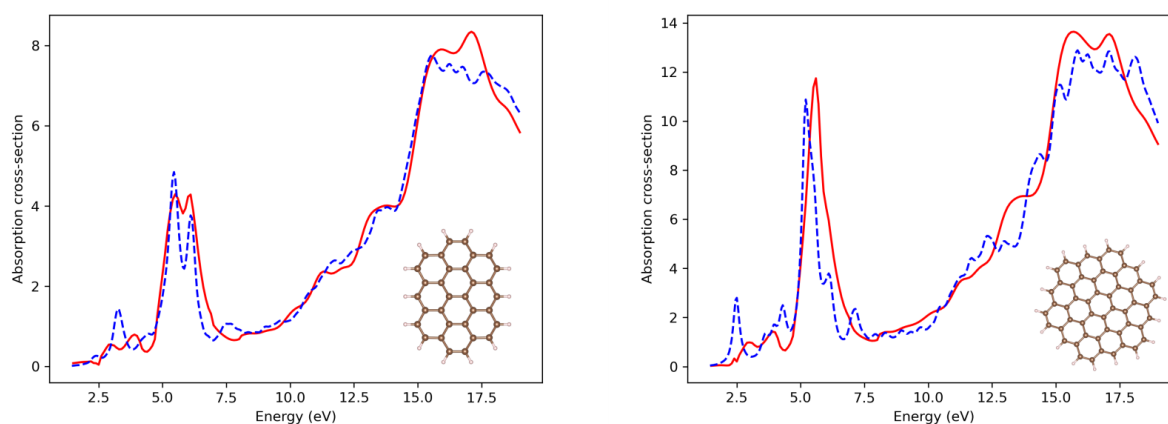
# The reverse-DADI method: Computation of frequency-dependent atomic polarizabilities for carbon and hydrogen atoms in hydrocarbon structures

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A specific method, combining some ingredients of the well-known DDA and PDI approaches, has been developed in our group since many years to calculate the absorption cross-sections of carbonaceous nanoparticles based on their atomistic details. This method, here named the Dynamic Atomic Dipole Interaction (DADI) model, requires the knowledge of the position and frequency-dependent polarizability of each atom constituting the nanoparticles. While the atomic positions can be quite easily obtained, for example as the results of molecular dynamics simulations, obtaining the frequency-dependent atomic polarizabilities is a trickier task. Here, a fitting procedure, named the reverse-DADI method, has been applied to calculate the frequency-dependent atomic polarizability values for carbon and hydrogen atoms involved in aromatic cycles or in aliphatic chains, on the basis of frequency-dependent molecular polarizabilities of various PAH and alkane molecules, calculated with the TD-DFT theory, in the UV–Visible range. Then, using these frequency-dependent atomic polarizabilities as input parameters in the DADI model has been shown to lead to an accurate representation of the absorption cross-sections of various PAH and alkane molecules with respect to the corresponding values obtained at the TD-DFT level, with however the great advantage of a much shorter time of calculations. Furthermore, these results are indications of a good transferability of the frequency-dependent atomic polarizability values obtained here to any C or H atom of any PAH or alkane molecule. This opens the way for building large databases of optical properties for carbonaceous species of atmospheric or astrophysical interests.



**Figure 1** – Values of the absorption cross-sections (in  $\text{\AA}^2$ ) of ovalene (left) and circumcoronene (right), calculated as a function of the energy, either with the DADI model (red curves) or with the TD-DFT method (blue dashed curves)



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# The Dustiest Galactic S Stars: Mid-Infrared Spectra from SOFIA/FORCAST

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We present spectra of 12 of the reddest, and hence dustiest, S stars in the Milky Way, observed with the FORCAST grisms on SOFIA. S stars are asymptotic giant branch (AGB) stars with  $C/O \sim 1$ , so their molecular and dust chemistries are dominated by neither O nor C, often leading to atypical spectral features from their molecules and dust grains. All of the stars in our sample have strong dust emission features at 10–11  $\mu\text{m}$ , but the shape of the feature in most of the stars differs from the shapes commonly observed in either oxygen-rich or carbon-rich AGB stars. Two stars also show the 13  $\mu\text{m}$  feature associated with crystalline alumina. Two have a water absorption band at  $\sim 6.5\text{--}7.5 \mu\text{m}$ , and a third has a tentative detection, but only one of these three has the more common SiO absorption band at 7.5  $\mu\text{m}$ . Three others show a red 6.3  $\mu\text{m}$  emission feature from complex hydrocarbons consistent with “Class C” objects, and in a fourth it appears at 6.37  $\mu\text{m}$ , redder than even the standard Class C hydrocarbon feature. Class C spectra typically indicate complex hydrocarbons which have been less processed by UV radiation, resulting in more aliphatic bonds relative to aromatic bonds. None of the S stars shows a strong 11.3  $\mu\text{m}$  hydrocarbon feature, which is also consistent with the presence of aliphatic hydrocarbons.

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<https://iopscience.iop.org/article/10.3847/1538-4357/ad6dfa>

<https://arxiv.org/abs/2409.20316>

# High-Resolution Far- to Near-Infrared Anharmonic Absorption Spectra of Cyano-Substituted Polycyclic Aromatic Hydrocarbons from 300 to 6200 $\text{cm}^{-1}$

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Cyano-substituted polycyclic aromatic hydrocarbons (CN-PAHs) may contribute to the emission detected in the 7 - 9  $\mu\text{m}$  (1430 - 1100  $\text{cm}^{-1}$ ) and 11 - 15  $\mu\text{m}$  (900 - 670  $\text{cm}^{-1}$ ) regions of astronomical IR spectra. Anharmonic quantum chemical computations of 14 CN-PAH isomers for 4 small PAHs and Benzene reveal strong, broad absorption features across the entire 300 - 6200  $\text{cm}^{-1}$  (33 - 1.6  $\mu\text{m}$ ) frequency range. In particular, when a FWHM of 15  $\text{cm}^{-1}$  is applied, the composite CN-PAH spectrum greatly overlaps with the unsubstituted-PAH spectrum across the entire 300 - 6200  $\text{cm}^{-1}$  range besides the 2200 - 2500  $\text{cm}^{-1}$  region that arises from the strong CN stretch fundamental of CN-PAHs and is addressed in a separate publication. At high resolution, however, the infrared absorption spectra reveal unique, identifiable features of CN-PAHs in the 700 - 950, 1100 - 1300, 2000 - 2500, and 3400 - 3600  $\text{cm}^{-1}$  ranges. The in-plane and out-of-plane CH bending vibrational frequencies of CN-PAHs are shifted when comparing isomers and to their unsubstituted counterparts, making their differentiation in mixed laboratory experiments possible. The overall aromatic CH stretch fundamental (2950 - 3200  $\text{cm}^{-1}$ ) and first overtone (5950 - 6200  $\text{cm}^{-1}$ ) regions are relatively unaffected by the cyano-substitution, with changes only to the frequency range covered by, and the intensity of, the bands. Detailed spectroscopic data on the normal mode components of each state reported herein provide the means to directly assign future laboratory spectra and to guide direct IR observations of astronomical regions with, e.g., JWST.

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# Polycyclic Aromatic Hydrocarbon Emission in the Central Regions of Three Seyferts and the Implication for Underlying Feedback Mechanisms

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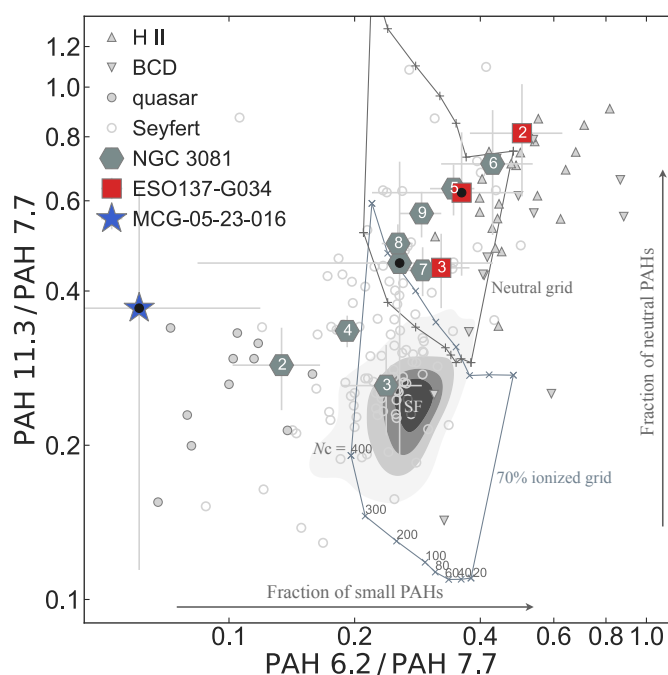
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We analyze JWST Mid-Infrared Instrument/Medium Resolution Spectrograph integral field unit observations of three Seyferts from the Galactic Activity, Torus, and Outflow Survey (GATOS) and showcase the intriguing polycyclic aromatic hydrocarbon (PAH) and emission-line characteristics in regions of  $\sim 500$  pc scales over or around their active galactic nuclei (AGN). Combing the measurements and model predictions, we find that the central regions containing a high fraction of neutral PAHs with small sizes, e.g., those in ESO137-G034, are

in highly heated environments, due to collisional shock heating, with hard and moderately intense radiation fields. Such environments are proposed to result in inhibited growth or preferential erosion of PAHs, decreasing their average size and overall abundance. We additionally find that the central regions containing a high fraction of ionized PAHs with large sizes, e.g., those in MCG-05-23-016, are likely experiencing severe photoionization because of the radiative effects from the radiative shock precursor besides the AGN. The severe photoionization can contribute to the ionization and further destruction of PAHs. Overall, different Seyferts, even different regions in the same galaxy, e.g., those in NGC 3081, can contain PAH populations of different properties. Specifically, Seyferts that exhibit similar PAH characteristics to ESO137-G034 and MCG-05-23-016 also tend to have similar emission-line properties to them, suggesting that the explanations for PAH characteristics of ESO137-G034 and MCG-05-23-016 may also apply generally. These results have promising application in the era of JWST, especially in diagnosing different (i.e., radiative and kinetic) AGN feedback modes.



**Figure 2** – Diagnostic diagram of PAH 11.3/7.7 vs. 6.2/7.7  $\mu\text{m}$  band ratios for the  $\sim 500$  pc apertures in the three target Seyferts.

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<https://ui.adsabs.harvard.edu/abs/2024ApJ...975L...2Z/abstract>

<https://luluzhang.myportfolio.com>

# Ultrafast Time-Domain Spectroscopy Reveals Coherent Vibronic Couplings Upon Electronic Excitation in Crystalline Organic Thin Films

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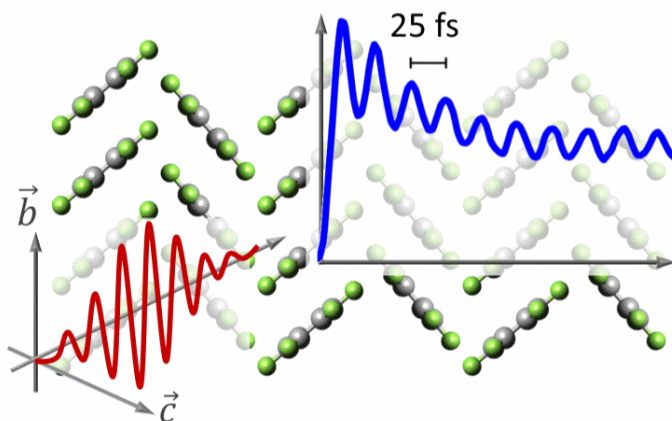
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The coherent coupling between electronic excitations and vibrational modes of molecules largely affects the optical and charge transport properties of organic semiconductors and molecular solids. To analyze these couplings by means of ultrafast spectroscopy, highly ordered crystalline films with large domains are particularly suitable because the domains can be addressed individually, hence allowing azimuthal polarization-resolved measurements. An impressive example of this are highly ordered crystalline thin films of perfluoropentacene (PFP) molecules, which adopt different molecular orientations on different alkali halide substrates. Here, we report polarization-resolved time-domain vibrational spectroscopy with 10-fs time resolution and Raman spectroscopy of crystalline PFP thin films grown on NaF(100) and KCl(100) substrates. Coherent oscillations in the time-resolved spectra reveal vibronic coupling to a high-frequency, 25-fs, in-plane deformation mode that is insensitive to the optical polarization, while the coupling to a lower-frequency, 85-fs, out-of-plane ring bending mode depends significantly on the crystalline and molecular orientation. Comparison with calculated Raman spectra of isolated PFP molecules in vacuo supports this interpretation and indicates a dominant role of solid-state effects in the vibronic properties of these materials. Our results represent a first step toward uncovering the role of anisotropic vibronic couplings for singlet fission processes in crystalline molecular thin films.



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# Can OPAH Ions be a Source of CO and HCO in the Interstellar Medium? Lessons Learned From the Unimolecular Dissociation of Dibenzofuran and Dibenz[b,f]oxepin Radical Cations

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Unlike polycyclic aromatic hydrocarbons (PAHs), which are recognized to be key players in interstellar and astrochemistry, less is known about the astrochemical relevance of oxygen-containing PAHs (OPAHs). Small O-containing molecules such as CO and HCO are ubiquitous in the interstellar medium and understanding how OPAHs may be a source for these critical small molecules is important. To this end, we have studied the unimolecular reactions of two ionized OPAHs, dibenzofuran ( $1^{+\bullet}$ ) and dibenz[b,f]oxepin ( $2^{+\bullet}$ ) with tandem mass spectrometry (collision-energy resolved dissociation) and imaging photoelectron photoion coincidence spectroscopy (iPEPICO). Collision-induced dissociation (CID) results show the competition between the loss of carbon monoxide (CO) and loss of 29Da (either the formyl radical (HCO) or sequential H loss), with the latter being the dominant reaction. Rice–Ramsperger–Kassel–Marcus (RRKM) modeling of the iPEPICO data, on the other hand, is consistent with the loss of CO from the parent ion at the dissociative ionization onset, and, in the case of  $2^{+\bullet}$ , sequential H-atom loss from this product. There is significant difference between the two structurally similar systems. In  $1^{+\bullet}$ , dissociation requires around 4 eV of ion internal energy, while only 2.5 eV internal energy is required for  $2^{+\bullet}$  to fragment. Calculations at the CAM-B3LYP/6-311++G(d,p) level of theory were used to examine the reaction pathways. For CO loss in  $1^{+\bullet}$ , the reaction is initiated by a ring expansion followed by contraction of the central ring forming an ion–molecule complex between protonated cyclopenta[3,4]cyclobuta[1,2]benzene and CO. HCO loss is preceded by H migration to a bridging carbon vicinal to the oxygen atom and subsequent ring re-organization to form a low energy cyclopenta[c][1]benzopyran cation. This channel is higher enough in energy to preclude its participation near threshold, but not at higher internal energies reached in the CID experiment, which could therefore involve both sequential H loss and HCO loss. In  $2^{+\bullet}$ , the reaction starts with an opening of the central O-containing ring, lowering the energy demand relative to  $1^{+\bullet}$ .

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# VUV/Vis absorption spectroscopy of different PAHs

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The present study provides new solid-phase absorption data of different Polycyclic Aromatic Hydrocarbon (PAHs) molecules in the Far Ultraviolet (FUV) and UV/Visible regions. Two features of interstellar extinction curves fall in this region: the FUV rise and the UV bump. Here, thin films of PAHs were prepared by means of the spin coating method onto a transparent substrate, and their solid phase absorption spectra were recorded. Spectra of isolated molecules simulated by Time-Dependent Density Functional Theory (TD-DFT) calculations were also produced for comparison. The results fit quite well with the FUV rise but not with the UV bump. Given the scarcity of FUV experimental absorption data of PAHs in the literature and especially in solid phase, these results are also interesting for reference for other studies ranging from thin films applications to interstellar medium models.

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<https://doi.org/10.1007/s00339-024-07959-w>



# Meetings

## Astrochemistry and Astrobiology beyond the Second Period

PacifiChem 2025

Honolulu, HI, USA  
15-20 December 2025

<https://pacifichem.org/>

The formation of molecules in extraterrestrial environments has fascinated scientists since the pioneering detection of CH, CH<sup>+</sup>, and CN. We now know of some 300 molecules in deep space ranging in complexity from diatomics such as molecular hydrogen (H<sub>2</sub>) to polyatomics like the sugar-related molecule glycolaldehyde (HOCH<sub>2</sub>CHO) and fullerenes (C<sub>60</sub>, C<sub>70</sub>). Whereas an understanding of the formation of carbon, oxygen, nitrogen, and hydrogen (CHON) bearing organics in these extreme environments is beginning to emerge, the origin of molecules carrying third row atoms silicon, phosphorus, and sulfur have remained unanswered or contentious. In searching for answers to this question, we also obtain crucial information relevant to the chemistry of our immediate environment: the rules of chemistry, after all, are universal, even when the conditions are very different.

This symposium focuses on the interdisciplinary fields of astrochemistry and astrobiology, bringing together speakers from laboratory astrochemistry (dynamics, kinetics, spectroscopy), astrochemical modeling (physicists), theoretical astrochemistry (computational chemists), and observational astrochemistry (astronomers). By focusing on the interplay between observational data, kinetic modeling, electronic structure calculations, along with gas phase and ice laboratory studies, we seek to evaluate the generalized concepts on the formation of astrochemically important molecules carrying silicon (Si), phosphorus (P), and sulfur (S) – among them astrobiologically important molecules such as alkylsulfonic and alkylphosphonic acids. Through the exploration of the current boundaries of astrochemical knowledge, we can more effectively design new laboratory experiments and guide observations in space to resolve key unanswered aspects of molecular synthesis in extraterrestrial space. The symposium is very timely as observational capabilities have reached the sensitivity and resolution to achieve not only the mere detection, but also the spatial distribution of molecules, while the lessons learned from the formation of CHON organics will direct the search for the exotic formation routes of the isovalent silicon, sulfur, and phosphorus counterparts.

**Abstracts:** This symposium features 20 invited (35 min) and 20 contributed (20 min) talks. Poster contributions are open as well. The abstract submission system opens 1 January 2025.

**Confirmed Invited Speakers:**

Musahid Ahmed, LBNL, USA  
Cecilia Ceccarelli, IPAG, France  
Asper Chen, National Central University, Taiwan  
Ryan C. Fortenberry, University of Mississippi, USA  
Kenji Furuya, University of Tokyo, Japan  
Shane Goettl, University Hawaii, USA  
Viviana Guzman, Instituto de Astrofísica, PUC, Chile  
Ilzaskun Jimenez-Serra, Centro de Astrobiología, Spain  
Alexander M. Mebel, Florida International University, USA  
Gunnar Nyman, University of Goteborg, Sweden  
Yasuhiro Oba, Hokkaido University, Japan  
Octavio Roncero, Instituto de Física Fundamental, Italy  
Nien Sie, Hokkaido University, Japan  
Sven Thorwirth, Universität Köln, Germany  
Gianmarco Vanuzzo, University Perugia, Italy  
Stefan Vogt, Universidad de Concepción, Chile  
Kaijun Yuan, Dalian Institute of Chemical Physics, China  
Xiaoqing Zeng, Fudan University, China  
Lucy Ziurys, University of Arizona, USA  
Ziwei E. Zhang, RIKEN, Japan

**Organizers:**

Ralf I. Kaiser, University of Hawaii at Manoa, USA  
Naoki Watanabe, Hokkaido University, Japan  
Tao Yang, East China Normal University, China  
Stefano Bovino, Universidad de Concepción, Chile  
Nadia Balucani, University of Perugia, Italy

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# Asia Oceania Geosciences Society 2025

## Astrochemical Processes Leading to the Formation of Planetary Bodies in the Solar System

Sands Expo & Convention Centre, Singapore  
27 July – 1 August 2025

<https://www.asiaoceania.org/aogs2025/>

This Session will bring together researchers in the fields of planetary science, astrophysics, astrochemistry, and atmospheric science whose work focuses on the study of molecular interactions towards the formation of organic compounds in planetary environments, including comets, asteroids, planetary object (planets, dwarf planets, and moons) surfaces, and planetary object atmospheres. This also includes studies covering the formation of simple chemical precursors up to larger and more complex macromolecular organic compounds.

Research areas that are encouraged include, but are not limited to, all spectral ranges of laboratory investigations, particle (electrons, protons, cosmic rays) and radiation (ultraviolet, extreme ultraviolet, X-ray photons) interaction with all phases of matter including ices and tholins, and theoretical and laboratory cross sections and reaction rates, with emphasis on applications to planetary, cometary, and astronomical observations.

Experimentalists, observers, theorists, and modelers are all encouraged to present their work to disseminate and advance scientific knowledge in this very interdisciplinary field, further discuss emerging ideas and insights on planetary science, astrophysics, and astrochemistry. It is important to promote the dialogues among interdisciplinary researchers, in Asia, Oceania, and the rest of the world, and to increase collaborations and the cross fertilization of ideas to ensure the continual growth of scientific understanding in our community.

**Abstracts:** This Session features invited and contributed talks. Poster contributions are also open. Abstract submission is open until February 18 2025.

**Organizers:**

David Dubois, NASA Ames Research Center, USA

Asper Chen, National Central University, Taiwan

Michel Nuevo, NASA Ames Research Center, USA

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## AstroPAH Newsletter

<http://astropah-news.strw.leidenuniv.nl>

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Submission deadline: 06 December 2024