

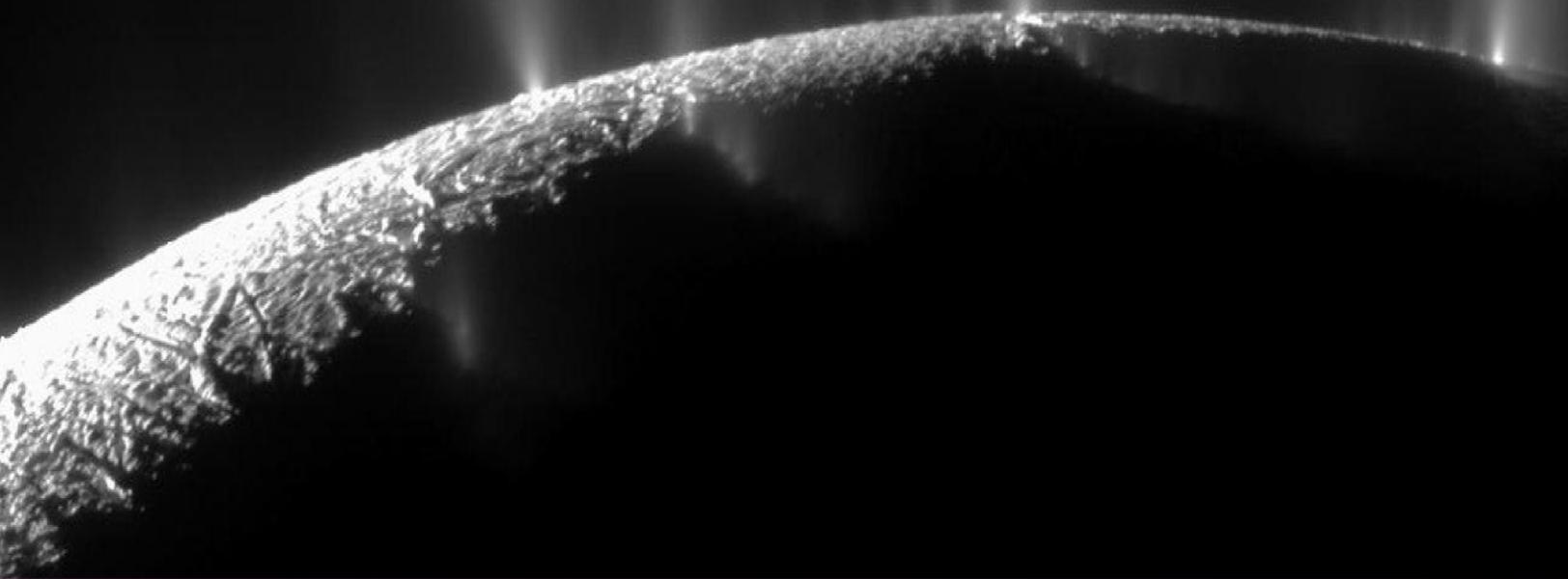
# AstropAH

A Newsletter on Astronomical PAHs

Issue 50 | July 2018

# Enceladus

plumes



# Editorial

**Dear Colleagues,**

We are glad to introduce our 50th issue this month! A nice milestone on our way to our 5th anniversary. We are also happy to announce that our editors have had some milestones too. Ella Sciamma-O'Brien has been appointed to a civil servant research scientist position at NASA Ames Research Center, Elisabetta Micelotta has been elected as a member of the Organizing Committee for Commission B5 (Laboratory Astrophysics), and the discoveries of a project led by Isabel Aleman that found far-infrared hydrogen laser emission in a planetary nebula was headlined by ESA ([see the web release here](#)) and other media.

Dear Ella, Elisabetta, and Isabel, Congratulations!

Our cover this month features Enceladus, one of the icy moon of Saturn, seen by Cassini.

In light of the final phase of the COST action 'Our Astrochemical History', our In Focus gives an overview of the history, aims, and events of this COST action presented by its Chair, Dr. Laurent Wiesenfeld. Remember too that there will be a final meeting in Assen (Netherlands) from 10 to 14 September 2018. Announcements of meetings on dust and SPICA are collected in the Meeting section.

We have a variegated collection of abstracts for you to read: studies of PAH dissociation, spinning dust, PAHs in AGNs and solid benzene.

If you have not yet done so, please answer [our survey](#) for our 5th anniversary.

As always, do not forget to send us your contributions! For publication in the next AstroPAH, see the deadlines below. We will take a well-deserved break in August.

**The Editorial Team**

**Next issue: 20 September 2018.  
Submission deadline: 7 September 2018.**

# AstroPAH Newsletter

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## Contents

|                          |    |
|--------------------------|----|
| PAH Picture of the Month | 1  |
| Editorial                | 2  |
| Survey                   | 4  |
| In Focus                 | 5  |
| Recent Papers            | 10 |
| Meetings                 | 15 |
| Announcements            | 19 |

## PAH Picture of the Month

Cassini view of the icy Saturn moon Enceladus showing plumes near the South Pole. These plumes are known to contain methanol and other small organic molecules. Recently, it has been discovered that these plumes also contain macro organic molecules, including benzene ( $C_6H_6$ ), with atomic masses up to 200 (Postberg et al ,*Nature*, 2018, 558, 564).

**Credits:** NASA/JPL/Space Science Institute



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Newsletter Design: Isabel Aleman

Background image: NASA, ESA, and the Hubble Heritage Team (STScI/AURA)



# **AstroPAH Needs Your Feedback!**

**In preparation for our 5<sup>th</sup> anniversary celebration, we ask for some feedback from you, our readers and contributors.**

**Please take a few minutes to answer this survey. Your feedback will help us improve AstroPAH and how it serves our community.**

**[Click here to answer the survey.](#)**

**Thank you!**

**The Editors**



## Our Astrochemical History: An Ongoing COST Chemistry Action

by Laurent Wiesenfeld

In the 1960's, very few molecules had been identified in astrophysical environments and many astronomers considered that the harsh conditions of the inter- and circumstellar medium would prevent the existence of stable molecular species, with very few exceptions, like H<sub>2</sub> or CO.

This situation changed profoundly with the advent of telescopes in the cm-mm range. Evidence of rich rotational microwave spectra in many interstellar gases signaled the onset of molecular astrophysics and of what is known today as astrochemistry. Today, in the various conditions of the Interstellar Media (ISM), more than 200 molecular species have been identified, not including the many isotopologues. Organic molecules with three or more heavy atoms (so-called Complex Organic Molecules, COM's, in astrophysical parlance) are commonplace, even if they occur in the ISM as traces. Their relative abundances with respect to the main molecular gas, particularly H<sub>2</sub>, is less than 10<sup>-6</sup> at most, and usually less than 10<sup>-9</sup>. Many of these molecules are common organic building blocks such as methanol, methyl- and ethyl-cyanide, methyl formate. Another special class of molecules are the Polycyclic Aromatic Hydrocarbons (PAH's), well-known of course in this newsletter.

Nowadays, the European Union as well as the European Cooperation in Science and Technology (COST) action (<http://www.cost.eu/>) are actively funding research and cooperation in order to foster a better understanding of the numerous roles of molecules in the astrophysical, astrochemical environments, as well as in planetary sciences. As early as 2004, the Marie Curie network 'The Molecular Universe' (chaired by A.G.G.M Tielens) opened the way to cooperative research and helped in creating a very lively community throughout Europe; it helped the laboratory research and established astrochemistry as an important branch of physical chemistry in laboratories. It also helped in shaping observational needs for the 21st century and put the astrochemical problems on the front scene. Several other initiatives followed suit, like the COST action 'Chemical Cosmos' and the European ITN network 'LASSIE'.

## Scientific goals of the COST action 'Our Astrochemical history'

The main objective of the COST action 'Our Astrochemical history' (<http://cost.obs.ujf-grenoble.fr/>) is to bring together chemical and astrophysical laboratories to focus on the molecular evolution towards complexity, from early stages of star formation to the present day Solar System. Its scientific goals have been divided into four working groups, namely:

1. Chemistry in cold diluted gas
2. Icy grain surface chemistry
3. UV and X-ray photochemistry
4. Isotopic fractionation

The COST action aims at discussing and making progress in astrochemistry, considering the many peculiarities of this chemistry. The most relevant issues to consider for the studies in astrochemistry are summarized below:

(1) Because of the low density and temperature in the ISM, chemistry usually does not take place under conditions of thermodynamical equilibrium. Chemical processes are dominated by kinetics and branching ratios of the reactions and are at steady state at best, even if astrophysical timescales are relatively long, with characteristic times being of the order of  $10^4 - 10^6$  years. Only in planetary (or stellar) atmospheres is thermal equilibrium reached. In space, three-body collisions are absent or extremely unlikely. Reactions such as  $A + B \rightarrow AB$  may only occur significantly with radiative stabilisation or on the surface of a grain. These restrictions incur fundamental differences in many of the common assumptions of synthetic/organic chemistry.

(2) The low temperatures often prevailing in interstellar space prevent many reactions from taking place, even those with modest activation barriers. However, some reactions proceed through tunnelling, especially if involving atomic H (or D). Also some tunnelling with heavier atoms is not to be excluded.

(3) Ion chemistry plays an important role in space. On the one hand, ions are long lived in the low-density interstellar environments, and on the other hand, ion-molecule reactions present an important alternative due to their long-range interaction and low or absent reaction barriers. Cations are most common, although anions are also present. Main ions are atomic species (in diffuse clouds) and protonated species (in molecular clouds), but some radical cations may be stable, especially for resonantly stabilized species such as the family of PAHs. An all-important ion is  $H_3^+$ , as it is a strong acid (proton donor) and the main vehicle driving deuteration via the slightly exothermic reaction  $H_3^+ + HD \rightarrow H_2D^+ + H_2$  and analogous reactions for  $HD_2^+$ ,  $D_3^+$ , and  $CH_3^+$ .

(4) In dilute interstellar environments, ionization of elements such as C and S is driven by photons with  $E < 13.6$  eV. All higher energy photons are being absorbed by atomic H. However, cosmic rays (CR) are ubiquitous, even in the denser parts of the ISM. They form the primary source of energy that initiates chemical reaction networks (by the reaction summarized by

$\text{H}_2 + \text{CosmicRay} \rightarrow \text{e}^- + \text{H}_2^+$  followed by  $\text{H}_2 + \text{H}_2^+ \rightarrow \text{H}_3^+ + \text{H}$ ).

(5) In regions of the ISM with low ionisation fraction, neutral-neutral reactions are of importance, especially those involving radicals. Some tend to have higher rates at low temperatures. However, ion/electron chemistry dominates the chemical evolution in many sectors of molecular complexity, like the successive hydrogenation of  $\text{NH}_n^+$  or  $\text{CH}_n^+$ .

(6) Because of the very low temperatures, nuclear spin statistics play an important role, yielding the various nuclear modifications of  $\text{H}_2$  or, less obviously,  $\text{ND}_3$ .

Let us also underline that the chemistry of the ISM is relatively rich. Among the almost two hundred molecules now detected, are some quite unusual ones from the terrestrial laboratory viewpoint: long carbon chains, polycyclic aromatic hydrocarbons, long chain anions and cations, carbenes, some cyclic molecules, many radicals and protonated species, like the common  $\text{N}_2\text{H}^+$  or  $\text{HCO}^+$  cations. It must not be underestimated that some heavier species, including amino acids and monosaccharides, present in meteorites, might also be present as traces in the ISM. However, confirming their detection by rotational spectroscopy is exceedingly difficult because of the unfavourable partition functions over many rotational levels.

The quantitative description of the chemistry of the ISM necessitates a non-equilibrium model of the radiative transfer of the most abundant molecular species. In order to achieve this, it has been known for a long time that the excitation/de-excitation of the various molecular levels is determined both by photon emission/absorption and by collisions with the main components of the molecular gas, or with electrons. In the ISM, the projectiles are mainly  $\text{H}_2$ ,  $\text{H}$ , and electrons. For planetary atmospheres, dense regions of proto-planetary disks and atmospheres of Solar System objects, the collision partners may be heavier, such as  $\text{H}_2\text{O}$  or  $\text{N}_2$ . In any case, the rates of energy exchange between the projectile and the target –the molecule being observed– determine the line intensities for most rotational transitions, and also for some ro-vibrational transitions, if the FIR emission rate is low enough. This is especially true for electric-dipolar forbidden transitions, like magnetic (fine-structure) transitions in open shell atoms or radicals. Also, elastic/inelastic scattering computations open the way to *ab initio* computing of pressure broadening and other collisional properties.

Chemistry occurs in many ways, whether in gasses, inside the grains, or else on the surface of carbonaceous or icy grains. Many experiments and theoretical work have dealt with reaction in gas phases. On the surface of grains, many reactions take place, which are at the focus of numerous experimental and theoretical studies, with or without radiation, and whose relevance for actual astrochemistry is the subject of intense scrutiny. The importance of microscopic knowledge is fully recognized nowadays, as for instance reflected in the many recent reviews devoted to this topic.

The characteristic physical chemistry of astrophysical environments summarized so far, makes it certainly different from regular terrestrial laboratory conditions. However, it shares some of those peculiarities with environments that are not uncommon to the experimental physical chemist. Let us mention here a few representative conditions:

(i) physicochemical studies of gaseous radicals have a long history and have traditionally focused on reactions of relevance in atmospheric and combustion processes. Many of the chemical rates used in astrochemical databases in fact make use of their extensive databases, even if physical conditions may be different. Especially the ubiquitous presence of  $\text{O}_2$  and

halogens make these networks very different;

(ii) the dilute and low temperature gas chemistry is prevalent in molecular beam instruments, which are used in many physical chemistry labs around the world to study spectroscopy in all wavelength ranges as well as scattering dynamics;

(iii) ion chemistry, ion-molecule chemistry and ion spectroscopy studies involving mass spectrometry instrumentation naturally operate under low-density conditions. Cryogenic ion traps add to the possibilities of approaching interstellar conditions;

(iv) and finally, high-level computational chemistry yield particularly accurate results when modelling molecular species in isolation and at low internal energies.

**In the last four years, the COST action 'Our Astrochemical History' has tried to address several of the points described above through cooperative research funded between many laboratories in 28 European countries.**

During its four years of existence, the COST action has organized several meetings in various European countries, from general meetings (in Prague (CZ) in 2015, and in Faro (PT) in 2017), to specialized meetings (in Munich (DE) in 2015, in Pisa (IT) in 2016, in Copenhagen (DK) in 2017), to summer schools (in Grenoble (FR) in 2016 and in Belgrade (SR) in 2017), and has actively promoted strong interactions between groups by giving grants for scientific missions through-out Europe.

## Final meeting of the COST Action "Our Astrochemical History: Past, Present, and Future"

The Final meeting of the COST Action "Our Astrochemical History: Past, Present, and Future" will be held in Assen (NL), from 10-14 September 2018. The main aim of the conference is to discuss the results from the four working groups on the chemistry in cold diluted gases, icy grain surface chemistry, UV and X-ray photochemistry and isotopic fractionation. We plan to have a strong focus on new collaborations and projects originating from our funded short term scientific missions. You can find more information on the website:

<http://cost.obs.ujf-grenoble.fr/conference2018/home>

## Acknowledgments

I very warmly thank all members of the COST action for making this action come true, and especially the members of the core group (H. Cuppen, J.H. Fillion, J. Jørgensen, O. Roncero, D. Semenov, P. Slaviček, C. Vastel, and C. Walsh), and the executive group (I. Kamp, H. Fraser, Y. Suleymanov, and L. Halonen).



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# Abstracts

## Dissociation of polycyclic aromatic hydrocarbons at high energy : MD/DFTB simulations vs collision experiments

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The whole process following collisions of polycyclic aromatic hydrocarbons (PAHs) with high energetic protons is modeled and compared to the experimental mass spectrum, allowing to propose a coherent scenario. Fragmentation of cationic pyrene  $C_{16}H_{10}^+$  is extensively studied by molecular dynamics simulations obtained by computing the electronic structure at the Self-Consistent-Charge Density Functional based Tight Binding (MD/SCC-DFTB) on-the-fly. An atomic model is used to quantify the energy transferred to the target after proton impact, and assuming fast internal conversion for the produced cations. From this model, after ionisation, the molecules show a broad distribution of internal energy with a rough exponential decrease. This distribution is used as an input for further extensive MD/SCC-DFTB simulations. The good agreement between experimental and theoretical spectra globally validates the SCC-DFTB potential, the wide distribution of fragments corresponding to statistical dissociation. The scenario for both the internal energy deposited distribution and the fast internal conversion assumption is validated. Using these assumptions, dissociation is shown to occur within a few hundreds of picoseconds. Moreover, adjusting the experimental mass spectrum with the theoretical spectra obtained for the various internal energies nicely returns the distribution modeled from the atomic contributions, reinforcing the coherence of the global approach. This study lays the foundations for further synergistic theoretical and experimental studies that will be devoted to other PAHs and prebiotic molecules of astrophysical interest.

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Theor. Chem. Acc.137:106 (2018)

<https://doi.org/10.1007/s00214-018-2287-z>

<https://rdcu.be/2vCg>

# Circumnuclear Star Formation and AGN Activity: Clues from Surface Brightness Radial Profile of PAHs and [S IV]

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We studied the circumnuclear mid-IR emission in a sample of 19 local active galactic nuclei (AGNs) with high spatial resolution spectra using T-ReCS (Gemini) and CanariCam (GTC), together with IRS (*Spitzer*) observations. We measured the flux and the equivalent width for the 11.3  $\mu\text{m}$  PAH feature and the [S IV] line emission as a function of galactocentric distance. This allowed us to study the star formation (SF) at subkiloparsec scales from the nucleus for a large sample of nearby AGNs. The [S IV] line emission could be tracing the AGN radiation field within a few thousand times the sublimation radius ( $R_{sub}$ ), but it often peaks at distances greater than 1000  $R_{sub}$ . One possibility is that the SF is contributing to the [S IV] total flux. We found an 11.3  $\mu\text{m}$  PAH emission deficit within the inner few tens of parsecs from the AGN. This deficit might be due to the destruction of the molecules responsible for this feature or the lack of SF at these distances. We found a sensible agreement in the expected shift of the relation of the AGN bolometric luminosity and the SF rate. This indicates that numerical models attributing the link between AGN activity and host galaxy growth to mergers are in agreement with our data, for most inner galaxy parts.

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<https://doi.org/10.3847/1538-4357/aabcbc>

# Probing the interaction between solid benzene and water using vacuum ultraviolet and infrared spectroscopy

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We present results of a combined vacuum ultraviolet (VUV) and infrared (IR) photoabsorption study of amorphous benzene:water mixtures and layers to investigate the benzene–water interaction in the solid phase. VUV spectra of 1:1, 1:10 and 1:100 benzene:water mixtures at 24 K reveal a concentration dependent shift in the energies of the  $^1B_{2u}$ ,  $^1B_{1u}$  and  $^1E_{1u}$  electronic states of benzene. All the electronic bands blueshift from pure amorphous benzene towards gas phase energies with increasing water concentration. IR results reveal a strong dOH- $\pi$  benzene–water interaction via the dangling OH stretch of water with the delocalised  $\pi$  system of the benzene molecule. Although this interaction influences the electronic states of benzene with the benzene–water interaction causing a redshift in the electronic states from that of the free benzene molecule, the benzene–benzene interaction has a more significant effect on the electronic states of benzene. VUV spectra of benzene and water layers show evidence of non-wetting between benzene and water, characterised by Rayleigh scattering tails at wavelengths greater than 220 nm. Our results also show evidence of benzene–water interaction at the benzene–water interface affecting both the benzene and the water electronic states. Annealing the mixtures and layers of benzene and water show that benzene remains trapped in/under water ice until water desorption near 160 K. These first systematic studies of binary amorphous mixtures in the VUV, supported with complementary IR studies, provide a deeper insight into the influence of intermolecular interactions on intramolecular electronic states with significant implications for our understanding of photochemical processes in more realistic astrochemical environments.

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Phys. Chem. Chem. Phys., 2018,20, 15273-15287

<http://pubs.rsc.org/en/content/articlelanding/2018/cp/c8cp01228h#ldivAbstract>

# Cross-sectional alignment of Polycyclic Aromatic Hydrocarbons by anisotropic radiation

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We study the effect of anisotropic radiation illumination on the alignment of polycyclic aromatic hydrocarbons (PAHs) and report that the cross-sectional mechanism of alignment earlier considered in terms of gas-grain interactions can also be efficient for the photon-grain interaction. We demonstrate this by first calculating the angle-dependence rotational damping and excitation coefficients by photon absorption followed by infrared emission. We then calculate the degree of PAH alignment for the different environments and physical parameters, including the illumination direction, ionization fraction, and magnetic field strength. For the reflection nebula (RN) conditions with unidirectional radiation field, we find that the degree of alignment tends to increase with increasing angle  $\psi$  between the illumination direction and the magnetic field, as a result of the decrease of the cross section of photon absorption with  $\psi$ . We calculate the polarization of spinning PAH emission using the obtained degree of alignment for the different physical parameters, assuming constant grain temperatures. We find that the polarization of spinning PAH emission from RNe can be large, between 5% and 20% at frequencies  $\nu > 20$  GHz, whereas the polarization is less than 3% for photodissociation regions. In realistic conditions, the polarization is expected to be lower owing to grain temperature fluctuations and magnetic field geometry. The polarization for the diffuse cold neutral medium is rather low, below 1% at  $\nu > 20$  GHz, consistent with observations by WMAP and Planck. Our results demonstrate that the RNe are the favored environment to observe the polarization of spinning dust emission and polarized mid-IR emission from PAHs.

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ApJ, 2018, 860, 158

<http://adsabs.harvard.edu/abs/2018ApJ...860..158H>

# Spinning dust emission from circumstellar disks and its role in excess microwave emission

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Electric dipole emission from rapidly spinning polycyclic aromatic hydrocarbons (PAHs) is widely believed as an origin of anomalous microwave emission (AME), but recently it encounters a setback due to the non-correlation of AME with PAH abundance seen in a full-sky analysis. Microwave observations for specific regions with well-constrained PAH features would be crucial to test the spinning dust hypothesis. In this paper, we present physical modeling of microwave emission from spinning PAHs from protoplanetary disks (PPDs) around Herbig Ae/Be stars and T-Tauri stars where PAH features are well observed. Guided by the presence of 10  $\mu\text{m}$  silicate features in some PPDs, we also model microwave emission from spinning nanosilicates. Thermal emission from big dust grains is computed using the Monte Carlo radiative transfer code (RADMC-3D; Dullemond et al. 2012). Our numerical results demonstrate that microwave emission from either spinning PAHs or spinning nanosilicates dominates over thermal dust at frequencies  $\nu < 60$  GHz, even in the presence of significant grain growth. Finally, we attempt to fit mm-cm observational data with both thermal dust and spinning dust for several disks around Herbig Ae/Be stars that exhibit PAH features and find that spinning dust can successfully reproduce the observed excess microwave emission (EME). Future radio observations with ngVLA, SKA and ALMA Band 1 would be valuable for elucidating the origin of EME and potentially open a new window for probing nanoparticles in circumstellar disks.

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ApJ in press (2018)

<http://adsabs.harvard.edu/abs/2018arXiv180311028H>

## The First TagKASI International Conference: Cosmic Dust and Magnetism

Daejeon, South Korea

October 30 - November 2, 2018

### Organizers:

Jungyeon Cho (CNU)  
Thiem Hoang (KASI, UST)  
Jinho Kim (KASI)  
Alex Lazarian (UW-Madison)  
Dongsu Ryu (UNIST)

**Abstract/Rationale:** Dust and magnetic fields are ubiquitous in the universe. Interstellar dust is the seeds of star and planet formation, while magnetic fields play an important role in many astrophysical phenomena, including star formation, cosmic ray transport, and synchrotron emission. The alignment of non-spherical dust grains with magnetic fields, resulting in dust polarization, provides a powerful tool to map magnetic fields. Dust polarization has been successfully used to trace magnetic fields in various scales, from  $\sim$ kpc to  $\sim$ 1000 AU scales. Recent polarization observations at mm-cm wavelengths from disks ( $\sim$ 100 AU scales) by ALMA reveal that dust polarization may not trace magnetic fields, but grain growth and planetesimal formation. At the same time, polarized dust emission is considered the most critical challenge for understanding how the universe was born through so-called B-modes polarization. The aim of this conference is to bring together local and international experts to discuss the most important aspects of cosmic dust, magnetic fields, and its implication.

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# Exploring the Infrared Universe: The Promise of SPICA

Crete, Greece  
20 – 23 May 2019

The infrared wavelength range is key to understand the origin and evolution of galaxies, stars and planetary systems, which are obscured by dust during a large part of their life cycles. With a large cold mirror and a sensitive suite of instruments, SPICA, recently selected as a candidate for ESA's Cosmic Visions program, stands poised to revolutionize these fields by providing ultra-deep spectroscopy in the 12-230  $\mu\text{m}$  range, as well as imaging (17-37  $\mu\text{m}$  and 100-350  $\mu\text{m}$ ) and polarimetry (100-350  $\mu\text{m}$ ). With launch planned for 2030, SPICA will complement current and upcoming facilities, filling the spectral gap between JWST and ALMA, while providing a huge leap over previous infrared space missions. We would like to invite the international astronomical community to participate in the conference, Exploring the Infrared Universe: The Promise of SPICA, which will take place on the island of Crete on 20-23 May 2019. At this conference, participants will learn about the capabilities and current design of SPICA, which includes a significant Guest Observer program, while discussing the exciting scientific promise of the mission. Up to date information about the SPICA mission and its instruments can be found at <http://www.spica-mission.org>, in addition to links to a set of whitepapers recently published in the journal PASA, that focus on some of extragalactic science enabled by SPICA.

Topics to be addressed at the meeting include:

- The rise of metals and dust across cosmic time
- Feedback and feeding processes in galaxy evolution
- Star formation and the baryon cycle in galaxies
- Magnetic fields and turbulence in star formation
- Protoplanetary disks and the formation of habitable planets
- Debris disks, planetary systems, and the Solar system

**Confirmed invited speakers include:** Susanne Aalto, Yuri Aikawa, Françoise Combes, Bill Dent, Edith Falgarone, Davide Fedele, Andrea Ferrara, Javier Goicoechea, Masateru Ishiguro, Patrick Koch, Leon Koopmans, Ilse de Looze, Roberto Maiolino, Thomas Müller, Tohru Nagao, Klaus Pontoppidan, Alexandra Pope, and Peter Roelfsema.

For further information about the conference, please visit <http://www.spica2019.org/>

Looking forward to seeing you in Crete!

**The Scientific Organizing Committee:** Lee Armus, Marc Audard, Vassilis Charmandaris, Yasuo Doi, Eiichi Egami, David Elbaz, Martin Giard, Matt Griffin, Carlotta Gruppioni, Doug Johnstone, Inga Kamp, Hidehiro Kaneda, Ciska Kemper, Kotaro Kohno, Sue Madden, Mikako Matsuura, Stefanie Milam, Paco Najarro, Takashi Onaka, Luigi Spinoglio, Floris van der Tak (chair), Jan Tauber.

# First IAU Symposium on Laboratory Astrophysics: From Observations to Interpretation

## IAUS 350

Cambridge, UK  
14 – 19 April 2019

### FIRST ANNOUNCEMENT

#### Please save the date!

The First International Astronomical Union Symposium on Laboratory Astrophysics, IAUS 350: Laboratory Astrophysics: from Observations to Interpretation, will be held in Cambridge, UK, from 14 - 19 April 2019.

The active synergy between astronomical observation, laboratory experiment and theoretical modeling has been reinforced by the creation, at the 2015 IAU General Assembly, of a new IAU Commission (CB5) on Laboratory Astrophysics ([https://www.iau.org/science/scientific\\_bodies/commissions/B5/](https://www.iau.org/science/scientific_bodies/commissions/B5/)).

With the IAU Symposium on Laboratory Astrophysics: from Observations to interpretations (IAUS350), we hope to build on this momentum and bring together active researchers in observational astronomy, space missions, experimental and theoretical laboratory astrophysics and astrochemistry to discuss the major topics and challenges that face today's Astronomy. We expect that interactions between researchers will result in a solid roadmap for future research that will lead to advances in our understanding of astronomical observations and guide the design of future observational instruments. You can read more on the objectives of the Symposium at <https://www.iau.org/science/meetings/proposals/loi/2019/1991/>.

To register your interest in this meeting, please send an email to:

[IAUS350-labastro2019@open.ac.uk](mailto:IAUS350-labastro2019@open.ac.uk).

You will then receive regular updates on the meeting.

*On behalf of the Organizing Committee for IAUS 350,*

Farid Salama  
President  
IAU Commission B5

#### IAUS 350 SOC:

Farid Salama (Chair), USA, Paul Barklem, Sweden, Helen Fraser, UK, Thomas Henning, Germany, Christine Joblin, France, Sun Kwok, China, Harold Linnartz, Netherlands, Lyudmila Mashonkina, Russia, Tom Millar, UK, Osama Shalabiea, Egypt, Gianfranco Vidali, USA, Feilu Wang, China, Giulio Del- Zanna, UK

# Announcements

## Facility Manager W.M. Keck Research Laboratory in Astrochemistry University of Hawaii

The Reaction Dynamics Group, Department of Chemistry, College of Natural Sciences, University of Hawai'i at Manoa, invites applications for a Facility Manager for the W.M. Keck Research Laboratory in Astrochemistry. This is a permanent, full time state-funded position starting May 1, 2019, at a level of 75,000 USD per year plus fringe benefits. To apply, please submit a cover letter indicating how you satisfy each of the minimum and desirable qualifications, names of 3 professional references and Ph.D. certificate to the address below (copies accepted, but original document required upon hire). Send application materials as single PDF file attachments to Prof. Ralf I Kaiser ([ralfk@hawaii.edu](mailto:ralfk@hawaii.edu)). Please include position title in the subject line.

- Title: Facility Manager W.M. Keck Research Laboratory in Astrochemistry
- Hiring Unit: College of Natural Sciences
- Location: Manoa Campus
- Date Posted: June 20, 2018
- Closing Date: **August 20, 2018**
- Annual Salary (11 Months): 75,000 USD
- Projected Starting Date: May 1, 2019
- Full Time/Part Time: Full Time
- Temporary/Permanent: Permanent
- Working Title: Facility Manager W.M. Keck Research Laboratory in Astrochemistry

## **Duties and Responsibilities:**

1. Responsible for implementing and overseeing the daily operation of the W.M. Keck Research Laboratory in Astrochemistry and enforcement of standard operation procedures (<http://www.chem.hawaii.edu/Bil301/KLA.html>)
2. To request biannually user proposals from the scientific community by disseminating open calls in electronic newsletters of, e.g., the American Chemical Society (ACS), the American Geophysical Union (AGU), and the American Astronomical Society (AAS).
3. To coordinate merit reviews and allocate experimental time to successful proposals.
4. To design and to conduct in collaboration with (inter)national and local faculty members, scientists, postdoctoral fellows, and students experiments in the W.M. Keck Research Laboratory in Astrochemistry.
5. To disseminate in collaboration with (inter)national and local scientists the results from the experiments in peer-reviewed journals.
6. To maintain the W.M. Keck Research Laboratory in Astrochemistry such as lasers, cryosystems, and pumping systems.
7. To modify existing research instruments to add capabilities that extend the usefulness of the instrument and the laser systems.
8. Responsible for inventory management (chemicals, vacuum components) related to the W.M. Keck Research Laboratory in Astrochemistry.
9. To co-organize a biannual "Laboratory Astrophysics Workshop" for current and prospective users to be promoted, e.g., via the American Chemical Society (ACS), the American Geophysical Union (AGU), and the American Astronomical Society (AAS).
10. Other duties as assigned.

## **Minimum Qualifications:**

1. Possession of a Ph.D. degree in physics, physical chemistry, or planetary sciences or related field with at least 5 year(s) of responsible professional experience with operating ultra high vacuum experimental setups and tunable laser systems (solid state, dye lasers).
2. Demonstrated ability to disseminate research results in internationally-circulated, peer-reviewed publications.
3. Considerable working knowledge of principles, practices, and maintenance techniques in cryosciences (cold heads, liquid nitrogen plants).
4. Considerable working knowledge and understanding of gas phase time of flight and condensed phase spectroscopy data fitting and analysis procedures.
5. Demonstrated ability to work in an (international) team.
6. Demonstrated ability to present research results at (international) conferences.

7. Demonstrated ability to operate a personal computer, work stations, apply word processing software, programming (C or C<sup>++</sup>), labview, and autocad/solidworks.
8. For supervisory work, demonstrated ability to lead subordinates and to manage work priorities and projects.
9. Ability to work outside of normal work hours, including evenings, weekends & holidays.
10. Ability to plan, organize, direct, and evaluate the activities of subordinates.
11. Ability to travel for purposes of attending meetings, training and other activities.

## **AstroPAH Newsletter**

<http://astropah-news.strw.leidenuniv.nl>  
[astropah@strw.leidenuniv.nl](mailto:astropah@strw.leidenuniv.nl)

Next issue: 20 September 2017  
Submission deadline: 7 September 2017