AstroPAH

A Newsletter on Astronomical PAHs

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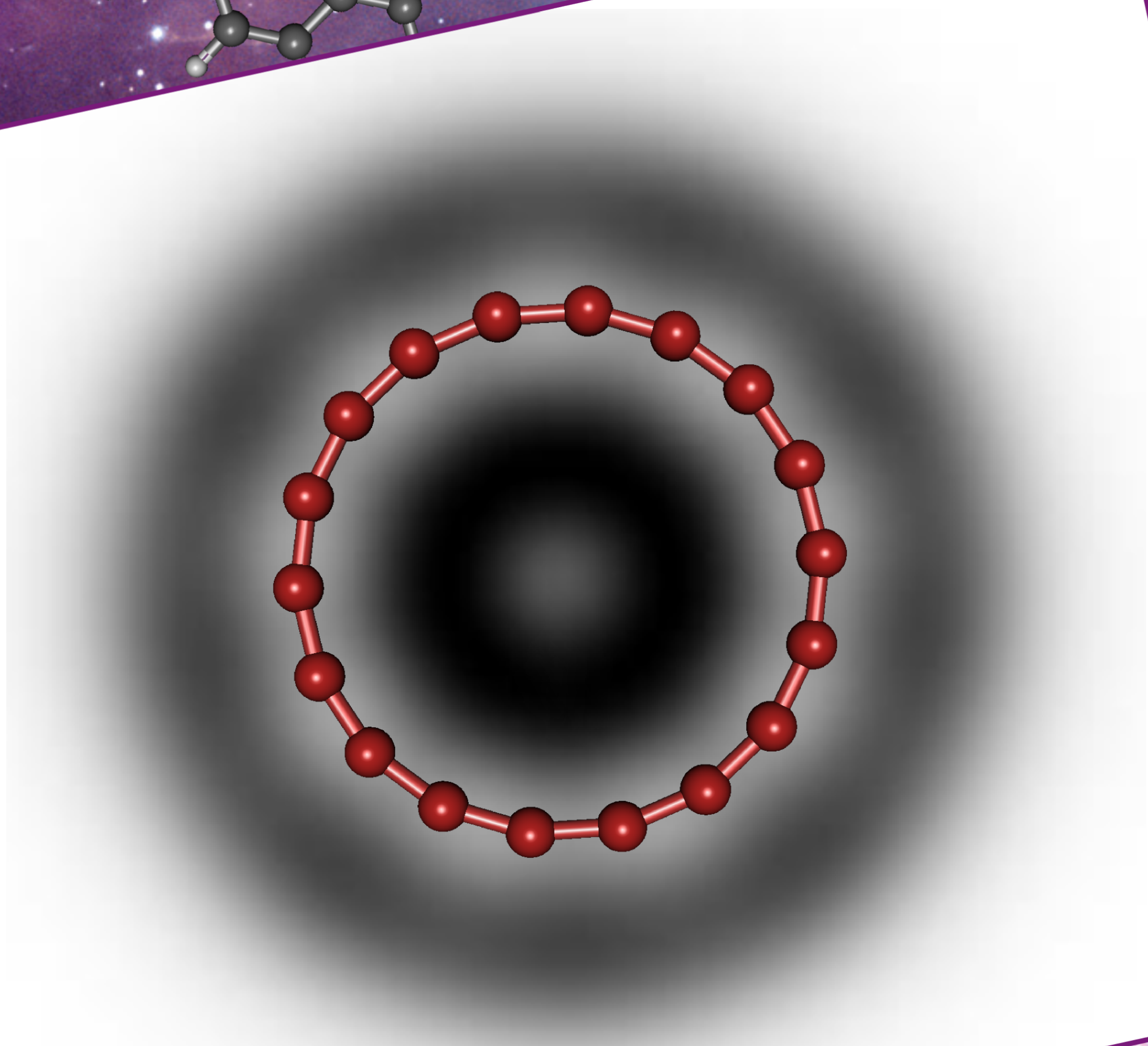

C_{18}: Ring Molecule

Editorial

Dear Colleagues,

Welcome to our October issue, no. 62! Our Picture of the Month features a new carbon allotrope, the C_{18} ring molecule, by Kaiser et al. (2019), a molecule which was synthesized and imaged with Atomic Force Microscopy.

We address our In Focus to Dr. Lou Allamandola and congratulate him for receiving the PAC Research Award! The Editorial Team also wishes to congratulate our Editor-in-Chief Prof. Alexander Tielens whose 40 years of work were celebrated last month at the Physics and Chemistry of the Interstellar Medium conference in Avignon, France. The meeting mainly focused on fields strongly influenced by Xander involving the physical and chemical processes controlling the interstellar medium: PDRs, interstellar and circumstellar dust, PAHs, ices and astrochemistry.

We are happy to contribute a variety of publications in our Abstracts section, ranging from the topics of graphene in space and diffuse interstellar bands to new experimental tools for astrochemistry.

Thank you for your dedication and interest in AstroPAH. If you wish to contact us, feel free to use our email: astropah@strw.leidenuniv.nl. We hope you will enjoy reading our October newsletter, and look forward to seeing you again next month.

Enjoy reading our newsletter!

The Editorial Team

Next issue: 21 November 2019.
Submission deadline: 8 November 2019.

Contact us:

astropah@strw.leidenuniv.nl

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PAH Picture of the Month

Researchers at IBM and Oxford University synthetised and imaged through Atomic Force Microscope (grey image) a new carbon allotrope, the ring molecule C_{18} (red structure). More details can be found in the paper by Katharina Kaiser et al.'An sp-hybridized molecular carbon allotrope, cyclo[18]carbon', Science (2019).

Credits: IBM Research.

In Focus

Congratulations to Dr. Lou Allamandola

on receiving the 2019 PAC Research Award!

Information provided by Ivan A. Titaley

We are happy to announce that **Dr. Lou J. Allamandola is the recipient of the 2019 PAC Research Award**, an award presented to a researcher who has made major contributions to research related to Polycylic Aromatic Coupounds (PACs).

The award was presented to Dr. Allamandola during the 26th International Symposium on Polycyclic Aromatic Compounds (ISPAC), where her presented an invited lecture entitled *“Astronomical PAHs: Some history and today’s challenges”*. The 2019 ISPAC was held at Örebro University on September 9-12, 2019. Over 90 participants from 19 countries across 4 continents attended the meeting, which included over 90 combined platform and poster presentations.

Save the date! The next ISPAC will be held either in the first or second week of September 2021 in Corvallis, Oregon, USA.

Characterisation of the Planetary Nebula Tc 1 Based on VLT X-Shooter Observations

Isabel Aleman[1,2,3], Marcelo L. Leal-Ferreira[3,4], Jan Cami[5,6,7], Stavros Akras[8,9], Bram Ochsendorf[10], Roger Wesson[11], Christophe Morisset[12], Nick L.J. Cox[13], Jeronimo Bernard-Salas[13], Carlos E. Paladini[2], Els Peeters[5,6,7], David J. Stock[5], Hektor Monteiro[1], Alexander G. G. M. Tielens[3]

[1]Universidade Federal de Itajubá, Instituto de Física e Química, Itajubá, MG, Brazil

[2]IAG-USP, Universidade de São Paulo, São Paulo, SP, Brazil

[3]Leiden Observatory, University of Leiden, Leiden, The Netherlands

[4]Argelander-Institut für Astronomie, Universität Bonn, Bonn, Germany

[5]Department of Physics and Astronomy, The University of Western Ontario, London, Canada

[6]Institute for Earth and Space Exploration, The University of Western Ontario, London, Canada

[7]SETI Institute, Mountain View, USA

[8]Observatório Nacional/MCTIC, Rio de Janeiro, RJ, Brazil

[9]Instituto de Matemática, Estatística e Física, Universidade Federal do Rio Grande, Rio Grande, Brazil

[10]Space Telescope Science Institute, Baltimore, USA

[11]Department of Physics and Astronomy, University College London, London, UK

[12]Instituto de Astronomia, Universidad Nacional Autonoma de Mexico, Ensenada, México.

[13]ACRI-ST, Sophia-Antipolis, France

We present a detailed analysis of deep VLT/X-Shooter observations of the planetary nebula Tc 1. We calculate gas temperature, density, extinction, and abundances for several species from the empirical analysis of the total line fluxes. In addition, a spatially resolved analysis of the most intense lines provides the distribution of such quantities across the nebula. The new data reveal that several lines exhibit a double peak spectral profile consistent with the blue- and red-shifted components of an expanding spherical shell. The study of such components allowed us to construct for the first time a three-dimensional morphological model, which reveals that Tc 1 is a slightly elongated spheroid with an equatorial density enhancement seen almost pole on. A few bright lines present extended wings (with velocities up to a few hundred km s^{-1}), but the mechanism producing them is not clear. We constructed photoionization models for the main shell of Tc 1. The models predict the central star temperature and luminosity, as well as the nebular density and abundances similar to previous studies. Our models indicate that Tc 1 is located at a distance of approximately 2 kpc. We report the first detection of the [Kr III] 6825 Å emission line, from which we determine the Krypton abundance. Our model indicates that the main shell of Tc 1 is matter bounded; leaking H ionizing photons may explain the ionization of its faint AGB-remnant halo.

E-mail: bebel.aleman@gmail.com

MNRAS, accepted (2019)

https://arxiv.org/abs/1909.09768

How Much Graphene in Space?

Qi Li[1,2], Aigen Li[2], and B.W. Jiang[1]

[1] Department of Astronomy, Beijing Normal University, Beijing 100875, China

[2] Department of Physics and Astronomy, University of Missouri, Columbia, MO 65211, USA

The possible presence of graphene in the interstellar medium (ISM) is examined by comparing the interstellar extinction curve with the ultraviolet absorption of graphene calculated from its dielectric functions experimentally obtained with the electron energy loss spectroscopy (EELS) method. Based on the absence in the interstellar extinction curve of the $\sim$2755 Å π–π^* electronic interband transition of graphene, we place an upper limit of $\sim$20 ppm of C/H on the interstellar graphene abundance, exceeding the previous estimate by a factor of $\sim$3 which made use of the dielectric functions measured with the spectroscopic ellipsometry (SE) method. Compared with the SE method which measures graphene in air (and hence its surface is contaminated) in a limited energy range of $\sim$0.7–5 eV, the EELS probes a much wider energy range of $\sim$0–50 eV and is free of contamination. The fact that the EELS dielectric functions are substantially smaller than that of SE naturally explains why a higher upper limit on the graphene abundance is derived with EELS. Inspired by the possible detection of C_{24}, a planar graphene sheet, in several Galactic and extragalactic planetary nebulae, we also examine the possible presence of C_{24} in the diffuse ISM by comparing the model IR emission of C_{24} with the observed IR emission of the Galactic cirrus and the diffuse ISM toward $l = 44^{\rm o}20'$ and $b = -0^{\rm o}20'$. An upper limit of $\sim$20 ppm on C_{24} is also derived from the absence of the characteristic vibrational bands of C_{24} at $\sim$6.6, 9.8 and 20 µm in the observed IR emission.

E-mail: lia@missouri.edu, bjiang@bnu.edu.cn

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http://ui.adsabs.harvard.edu/abs/2019arXiv190912210L/abstract

Probing the Missing Link between the Diffuse Interstellar Bands and the Total-to-Selective Extinction Ratio R_V – I. Extinction versus Reddening

Kaijun Li[1,2], Aigen Li[2], and F.Y. Xiang[1,2]

[1] Department of Physics, Xiangtan University, 411105 Xiangtan, Hunan Province, China

[2] Department of Physics and Astronomy, University of Missouri, Columbia, MO 65211, USA

The carriers of the still (mostly) unidentified diffuse interstellar bands (DIBs) have been a long-standing mystery ever since their first discovery exactly 100 years ago. In recent years, the ubiquitous detection of a large number of DIBs in a wide range of Galactic and extragalactic environments has led to renewed interest in connecting the occurrence and properties of DIBs to the physical and chemical conditions of the interstellar clouds, with particular attention paid to whether the DIB strength is related to the shape of the interstellar extinction curve. To shed light on the nature and origin of the DIB carriers, we investigate the relation between the DIB strength and R_V, the total-to-selective extinction ratio, which characterizes how the extinction varies with wavelength (i.e., the shape of the extinction

curve). We find that the DIB strength and R_V are not related if we represent the strength of a DIB by its reddening-normalized equivalent width (EW), in contrast to the earlier finding of an anticorrelation in which the DIB strength is measured by the extinction-normalized EW. This raises a fundamental question about the appropriate normalization for the DIB EW.

E-mail: lia@missouri.edu

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Threshold Dissociation of the 1-Ethynylpyrene Cation at Internal Energies Relevant to H I Regions

Gaël Rouillé[1], Mathias Steglich[2], Patrick Hemberger[2], Cornelia Jäger[1] and Thomas Henning[3]

[1] Laboratory Astrophysics Group of the Max Planck Institute for Astronomy at the Friedrich Schiller University Jena, Institute of Solid State Physics, Helmholtzweg 3, D-07743 Jena, Germany

[2] Laboratory for Synchrotron Radiation and Femtochemistry, Paul Scherrer Institute, CH-5232 Villigen, Switzerland

[3] Max Planck Institute for Astronomy, Königstuhl 17, D-69117 Heidelberg, Germany

Photoelectron photoion coincidence spectroscopy has been used to measure the threshold photoelectron spectrum of 1-ethynylpyrene and to obtain the breakdown graph describing the dissociation of the 1-ethynylpyrene cation. The threshold photoelectron measurement has allowed us to improve the determination of the ionization energy of 1-ethynylpyrene at 7.391 $\pm$ 0.005 eV. Concerning the main dissociation channels, the analysis of the breakdown graph has given 3.70 $\pm$ 0.60 eV as the activation energy for the loss of one H atom and 2.98 $\pm$ 1.80 eV for the loss of a second independent H atom. The corresponding entropies of activation are affected by large errors as observed in similar studies of other polycyclic aromatic hydrocarbon cations. Minor dissociation channels were also detected and identified as the loss of the C_2H group and the loss of a C_2H_2 unit and/or that of an H atom plus the C_2H group. The activation energies and the entropies of activation of these minor pathways could not be derived from the measurements. It is found that the cation of 1-ethynylpyrene behaves like the cation of pyrene and is consequently more photostable than the cation of 1-methylpyrene. We conclude that photodissociation is not the leading cause of the low abundance, if not the absence, of ethynyl-substituted polycyclic aromatic hydrocarbon species in the interstellar medium.

E-mail: cornelia.jaeger@uni-jena.de

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LV-DIB-s4PT: A new tool for astrochemistry

E. K . Campbell[1] and P. W. Dunk[2]

[1] School of Chemistry, University of Edinburgh, Joseph Black Building, Kings Buildings, David Brewster Road, Edinburgh EH9 3FJ, United Kingdom

[2] National High Magnetic Field Laboratory, Florida State University, Tallahassee, Florida 32310, USA

The combination of a 3 K cryogenic radiofrequency ion trapping apparatus and a laser vaporization source is described. This instrument was constructed for the synthesis and characterization of gas phase molecules, particularly those that are difficult to make using traditional organic chemistry routes. The flexible time scale for storage and relaxation afforded by the trap enables spectroscopic investigation of ions that are challenging to cool using supersonic expansions. Routine *in situ* tagging of cations with helium facilitates one-photon experiments. The potential of this instrument is demonstrated by providing data on the $^2\mathrm{B}_2 \leftarrow X\,^2\mathrm{A}_1$ electronic transition of cyclic C_6^+, a system that had thus far evaded spectroscopic interrogation in the gas phase.

E-mail: e.k.campbell@ed.ac.uk

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Investigation of the Origin of the Anomalous Microwave Emission in Lambda Orionis

Aaron C. Bell[1,2], Takashi Onaka[1,3], Frédéric Galliano[4,5], Ronin Wu[5,6],Yasuo Doi[7], Hidehiro Kaneda[8], Daisuke Ishihara[8] and Martin Giard[9]

[1] University of Tokyo, Graduate School of Science, 7-3-1 Hongo, Bunkyo-ku, Tokyo, Japan113-0033

[2] Ridge-i Inc., 1-6-1-438 Otemachi, Chiyoda-ku, Tokyo, Japan 100-0004

[3] Department of Physics, Meisei University, 2-1-1 Hodokubo, Hino, Tokyo, Japan 191-0042

[4] IRFU, CEA, Université Paris-Saclay, F-91191 Gif-sur-Yvette, France

[5] Université Paris-Diderot, AIM, Sorbonne Paris Cité, CEA, CNRS, F-91191 Gif-sur-Yvette,France

[6] Iris.ai, Edelgranveien 28 Bekkestua, 1356 Norway

[7] Department of Earth Science and Astronomy, University of Tokyo, Komaba 3-8-1, Meguro,Tokyo, Japan 153-0902

[8] Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-8602, Japan

[9] IRAP, Université de Toulouse, CNRS, CNES, 31028, Toulouse Cedex 4, France

The anomalous microwave emission (AME) still lacks a conclusive explanation. This excess of emission, roughly between 10 and 50 GHz, tends to defy attempts to explain it as synchrotron or free-free emission. The overlap with frequencies important for cosmic microwave background explorations, combined with a strong correlation with interstellar dust, drive cross-disciplinary collaboration between interstellar medium and observational cosmology. The apparent relationship with dust has prompted a “spinning dust” hypothesis. The typical peak frequency range of the AME profile implicates spinning grains on the order of 1 nm. This points to polycyclic aromatic hydrocarbons (PAHs). We use data from the AKARI/Infrared Camera(IRC), due to its thorough PAH-band coverage, to compare AME from the Planck Collaboration astrophysical component separation product with infrared dust emission in the λOrionis AME-prominent region. We look also at infrared dust emission from

other mid IR and far-IR bands.The results and discussion contained here apply to an angular scale of approximately 1°. We find that certainly dust mass correlates with AME, and that PAH-related emission in the AKARI/IRC 9 µm band correlates slightly more strongly. Using hierarchical Bayesian inference and full dust spectral energy distribution (SED) modeling we argue that AME in λOrionis correlates more strongly with PAH mass than with total dust mass, lending support for a spinning PAH hypothesis within this region. We emphasize that future efforts to understand AME should focus on individual regions, and a detailed comparison of the PAH features with the variation of the AME SED.

E-mail: abell@astron.s.u-tokyo.ac.jp

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astropah@strw.leidenuniv.nl

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