From Interstellar Ices to Polycyclic Aromatic Hydrocarbons
A symposium to honor Lou Allamandola's Contributions to the Molecular Universe
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Snapshots from the PAHs studies at ISMO

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Since the initial proposition by Allamandola et al. (1985) and Léger & Puget (1984) that Polycyclic Aromatic Hydrocarbons (PAHs) could be responsible for the Unidentified Infrared Bands (UIBs), our research group gradually focused on laboratory experiments on PAHs, and became increasingly interested in the properties of these large molecules and in the fate of energy being injected in such species by absorption of interstellar UV/VUV photons.

We first focussed on the electronic spectroscopy of jet-cooled PAHs, from which a detection of Phenanthrene in the Halley's coma was proposed. At that time the possible connection between PAHs and DIBs (Diffuse Interstellar Bands) was giving rise to lively discussions. In this context we developed a new experimental scheme, designed to access the gas-phase electronic spectra of cold PAH cations. It was based on the spectral properties of the Van der Waals complexes formed by binding rare gas atoms to aromatic molecules, which we had earlier studied. But, up to now, no fully convincing detection allowing the assignment of any DIB to a PAH cation has been reported. Using experiment and theoretical modeling we also tackled the key question of interstellar PAHs stability, under local astrophysical conditions. A special attention was paid to H-atom loss rates, a process which dominates in many circumstances and can be easily monitored by mass spectrometry. To simulate the relevant physical chemistry the interplays between electronic absorption, dissociation and infrared emission were modeled using statistical approaches, including anharmonicity effects. Quantitative information on anharmonicity was obtained from electronic structure calculations or from experimental spectroscopic data in the near and far infrared ranges. Indeed, a Fourier-Transform synchrotron-based absorption experiment allows the study of the rotational structure of vibrationally excited states for the small PAH species. A specific set-up was also developed, to study carbonaceous nanograins formed in a sooting flame. After characterization of its PAHs content, it was used to study the evolution of infrared signatures under combustion conditions or fast ion irradiation. An original spectrometer optimized for infrared emission collection was also recently built, which allowed to directly access the UV to IR conversion efficiency in the case of gas phase benzene. Finally, thanks to collaborative experimental studies, we explored the properties of coronene clusters, placed either under pulsed laser irradiation or under VUV excitation.

A selection among these studies will be presented at the Symposium.

REFERENCES

Allamandola L.J., Tielens A.G.G.M., and Barker J.R. (1985) Astrophys. J. Lett., 290, L25
Léger A. and Puget J. L. (1984) Astron. Astrophys., 137, L5