Foreword

Some twenty five years ago, driven by ground-based, airborne, and IRAS observations, the PAH hypothesis was first formulated to explain the strong emission features that dominate the mid-infrared spectra of most bright astronomical sources. In this hypothesis, the well-known infrared emission features – at 3.3, 6.2, 7.7, 8.6, and 11.2 μm – were attributed to large (<50 C-atom) Polycyclic Aromatic Hydrocarbon (PAH) molecules that are pumped by the strong far-ultraviolet photon flux from nearby stars. Since then, spectroscopy using the Short Wavelength Spectrometer and ISOCAM on the Infrared Space Observatory launched by the European Space Agency in 1995, the InfraRed Spectrograph on the Spitzer Space Telescope launched by NASA in 2005 and the InfraRed Camera onboard the Japanese AKARI satellite launched in 2006 have revealed the richness of the interstellar infrared emission spectrum and the variations therein. These spectral variations reflect variations in the molecular characteristics of the PAH family, reflecting the local physical and chemical conditions of the emitting regions. Parallel to these observational developments, experimental and theoretical studies of the physical and chemical properties of astrophysically relevant PAHs have really taken off. Such studies aim at elucidating the intrinsic infrared, visible, and ultraviolet properties of large PAH molecules and their dependence on molecular characteristics. In addition, dedicated experiments are performed to study the origin, evolution, and chemical role of PAHs in the interstellar medium. It is clear that this field has really taken off and the PAH hypothesis has evolved into the reigning paradigm.

Observations have shown that PAH molecules are abundant and ubiquitous in the interstellar medium. Conversely, PAHs may also be a dominant "force" in the interstellar medium, dominating the photoelectric heating of interstellar gas and may be important for the ionization balance inside dense molecular cloud cores. While much progress has been made, still more remains to be discovered including the role of derivative species such as nitrogenated PAHs, PAH clusters and PAH complexes with metals, and the relationship between PAH molecules and carbonaceous grains including Hydrogenated Amorphous Carbon and diamond. PAHs may also provide a catalytic surface for the formation of, for example, molecular hydrogen. Furthermore, photolysis of PAH related species may provide a source of small hydrocarbons particularly in regions rich in UV photons.

We are now reaching a stage where we can start to use the observations of the IR emission spectrum as diagnostic tools to determine the physical conditions in the emitting regions of, in particular, regions of star and planet formation. Because the IR emission features dominate the IR spectrum of regions of massive star formation, these bands are also often used as proxies to determine the importance of star formation on galactic scales. Specifically, the importance of star formation versus AGN activity for the luminosity source of (Ultra)Luminous InfraRed Galaxies is based upon a quantitative interpretation of the observed PAH emission from galactic nuclei. At this moment, the Herschel and Planck ESA space missions are geared towards probing the low frequency bending modes of PAHs

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and the rotational transitions of this spinning dust component. The James Webb Space Telescope and the Stratospheric Observatory for Infrared Astronomy, and the possible SPICA mission will provide in the coming years spectral imaging at high resolution and increased sensitivity. The future for the PAH universe looks bright.

We considered it therefore timely to organize a scientific meeting "*PAHs and the universe: A Symposium to celebrate the 25th anniversary of the PAH hypothesis*" with the goal to bring together experts in the area of astronomical observations, laboratory studies, and astronomical modeling of interstellar PAHs to discuss the state-of-the-art and to chart the future. Moreover, and more importantly, two of the pioneers of the interstellar PAH hypothesis – Lou Allamandola and Alain Léger – are reaching a milestone in their life – they soon will be 65 years young - and this meeting provided a good occasion to celebrate their accomplishments in opening up and driving this field.

The symposium was hosted in Toulouse (France) by the CESR and LCPQ (University of Toulouse and CNRS), May 31 through June 4$^{\text{th}}$, 2010. We are very grateful for their hospitality and want to acknowledge the hard work by the local organizing committee that was instrumental in making this symposium such a resounding success. This symposium would not have been possible without the generous financial support by INSU-CNRS, Université Paul Sabatier (UPS), CNES, Région Midi-Pyrénées, Ministère de l'Enseignement Supérieur et de la Recherche, ESA, IRSAMC-UPS, INC-CNRS, Réseau de chimie théorique, INP-CNRS, and Département de la Haute Garonne. We would like to thank the Scientific Organizing Committee for the well-conceived scientific program, which highlighted all aspects of interstellar PAHs. We also thank the participants for the reviews, contributed papers, and poster papers and the stimulating discussions. The PAH symposium was attended by some 130 scientists from 18 different countries and 5 continents, all united in their quest for the molecular Universe.

This is the first time in 25 years that a symposium was organized on this important topic and we felt that this warranted the publication of proceedings. The goal of the proceedings paralleled those of the symposium: to publish a lasting legacy of this meeting summarizing the field and charting the future. We have asked the reviewers to write review chapters at a graduate level pedagogical fashion to yield a reference text for years to come. In addition, these proceedings include the contributed papers, which provide a cross cut of the field as it is today. In reading these papers, we have been impressed by the hard work and care with which they were written. A symposium and its proceedings are only as good as the participants and speakers make it and, from that perspective, this meeting was top-notch.

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