30 Years of Photodissociation Regions:
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INVITED TALK

The role of PAHs in PDRs

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Observe any PDR in the mid-infrared, and you will see beautiful emission bands peaking at $\sim$ 3.3, 6.2, 7.7, 11.2 and 12.7 μm. They are called the "Aromatic Infrared Bands" (AIBs) and are attributed to the emission of large carbonaceous molecules: Polycyclic Aromatic Hydrocarbons (PAHs), and very small carbonaceous grains (VSGs), heated by the UV photons pervading the PDR.

The intensity and shape of the AIBs is tightly connected to the chemical evolution of PAHs and VSGs which depends on the local physical conditions: mainly the intensity of the radiation field, the electron density, and, to a lesser extent, to the gas temperature. The AIBs therefore offer a unique way to probe physical conditions in PDRs, including at high angular resolution (e.g. in protoplanetary disks or distant galaxies). But PAHs and VSGs are more than tracers, they are key actors in the physics of PDR. The most energetic far-UR photons can ionize them, therefore liberating electrons which carry a fair amount of kinetic energy (a couple eV or so), and heat the gas through collisions. This mechanism, called the UV-photoelectric heating, is in fact the most efficient source of gas heating and it therefore determines the thermal balance of PDRs. Finally, PAHs and VSGs are suspected to be a favored site for the formation of H_2 which is another key process in the chemical and thermal balance of PDRs.

In this presentation, I will describe the recent progress that has been achieved in understanding the photo-chemical evolution of PAHs in PDRs, how this relates to the observed spectra, and how, in turn, mid-infrared spectroscopy can be used to trace the physical conditions in PDRs. I will discuss our current understanding of the photoelectric heating by PAHs and VSGs in PDRs, from the theoretical and observational point of view, and I will briefly discuss the role of PAHs and VSGs in the formation of H_2.