VUV processing of large PAHs

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As a part of interstellar dust, polycyclic aromatic hydrocarbons (PAHs) are processed by the interaction with vacuum ultraviolet (VUV) photons that are emitted by young stars [1]. After absorption of a VUV photon, an isolated PAH can undergo different relaxation processes: ionization, dissociation and radiative cooling, including infrared (IR) fluorescence which results in the aromatic infrared bands (AIBs) observed in many astronomical objects [2].

We investigate the two relaxation processes of photoionization and photodissociation of large PAH cations ranging from 30 to 48 carbon atoms. The ions are trapped in the LTQ linear ion trap of the DESIRS beamline at the synchrotron SOLEIL and energized by VUV photons in the range of 8 to 20 eV. All resulting photoproducts are mass-analyzed and recorded as a function of photon energy. Photoionization is found to be the dominating relaxation channel at all energies, which differs from an earlier study on smaller PAHs [3]. We determined the photoionization threshold to be between 8.8 and 9.9 eV, while the photoionization yield increases with the number of carbon atoms. The dissociation yield is found to be difficult to quantify due to a slow, gradual increase. Action spectra are obtained from the photoproducts' relative intensities and compared to the theoretical photoabsorption cross sections. The latter have been computed using the real time, real space implementation of time dependent density functional theory (TD-DFT) from the OCTOPUS code [4].

Dissociation thresholds are important parameters in models of the chemical evolution of PAHs in HI photodissociation regions since they govern the stability of PAHs in these conditions [1]. In order to refine the threshold energies and to investigate the variation of the dissociation yield with the excitation scheme, we are using the PIRENEA setup which combines cryogenic trapping and laser interaction.

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