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VUV photoprocessing of large PAH cations: an experimental study

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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].
Following an earlier work on smaller PAHs [3], we investigate in this experimental study the two relaxation processes of photofragmentation and photoionization of large PAH cations ranging in size 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 - 20 eV. All resulting photoproducts are mass-analyzed and recorded as a function of photon energy. The photoionization process is found to strongly dominate the competition, with the photoionization yield increasing with number of carbon atoms. From the relative intensities of the photoproducts, action spectra are obtained and compared to the 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]. This study gives insights into the photostability of interstellar PAHs in astrophysical environments.

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