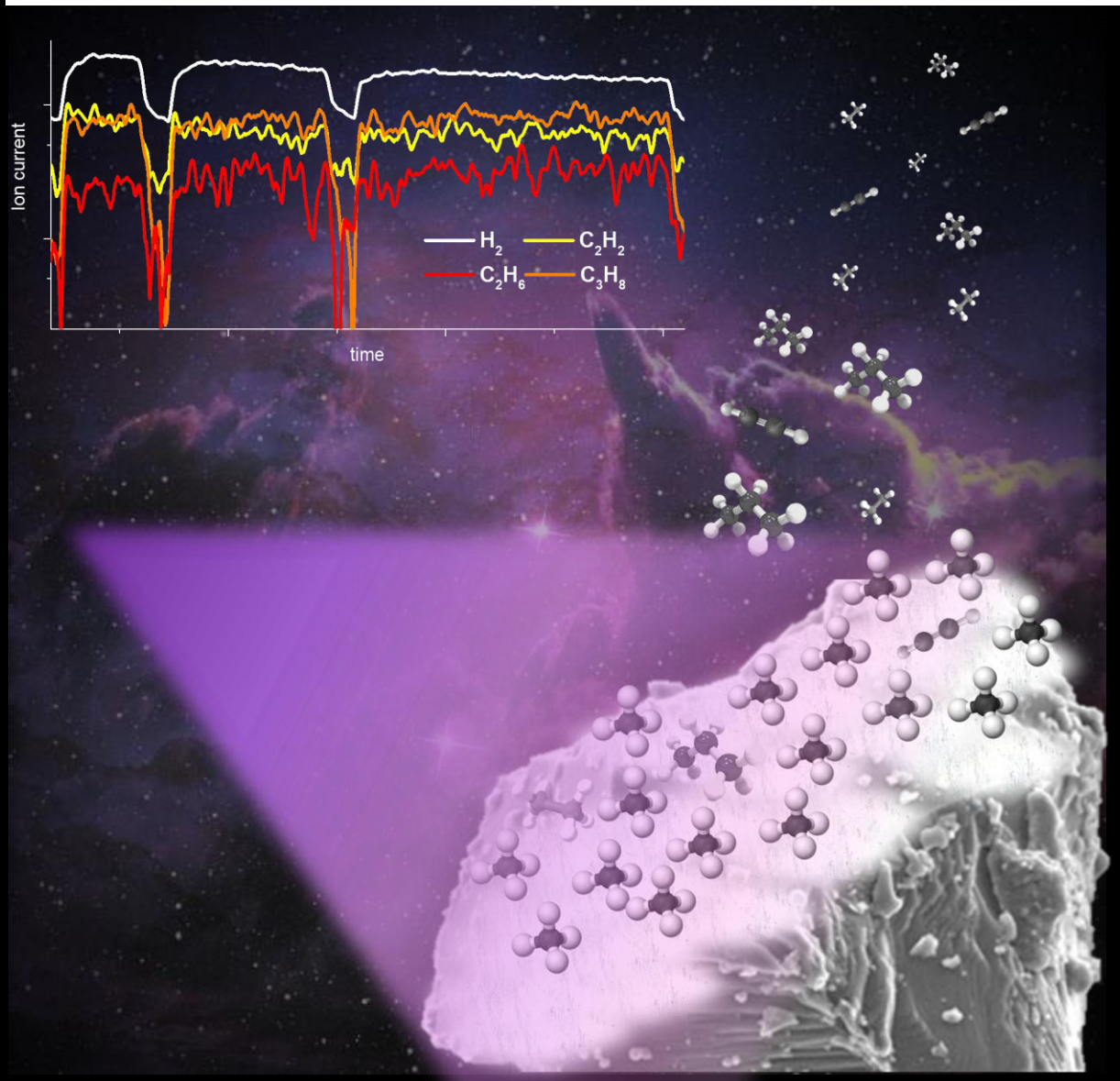
Photon-induced desorption of larger species in UV-irradiated methane (CH_4) ice



At the low temperatures found in the interior of dense clouds and circumstellar regions, along with H_2O and smaller amounts of species such as CO, CO_2, or CH_3OH, the infrared features of CH_4 have been observed on icy dust grains. Ultraviolet photons induce different processes in ice mantles, affecting the molecular abundances detected in the gas-phase.

This work aims to understand the processes that occur in a pure CH_4 ice mantle submitted to UV irradiation. We studied photon-induced desorption processes for the different photoproducts arising in the ice upon UV irradiation.

Experiments were carried out in ISAC, an ultra-high vacuum chamber equipped with a cryostat and a UV-lamp mimicking interstellar conditions. Infrared spectroscopy and quadrupole mass spectrometry were used to monitor the solid and gas-phase, respectively, during the formation, irradiation, and warm-up of the ice.

The process by which a molecule absorbs a photon and desorbs to the gas phase is known as photodesorption. It helps to explain the gas phase abundances found in the ISM. Direct photodesorption of pure CH_4 was not observed. UV photons form $CH_3\cdot$ and $H\cdot$ radicals, leading to photoproducts such as H_2, C_2H_2, C_2H_6, and C_3H_8. Evidence for the photodesorption of C_2H_2 and photochemical desorption of C_2H_6 and C_3H_8 was found, the latter species is so far the largest molecule found to photodesorb through a chemical reaction.

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