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Electron contribution to photon-induced desorption in molecular ices

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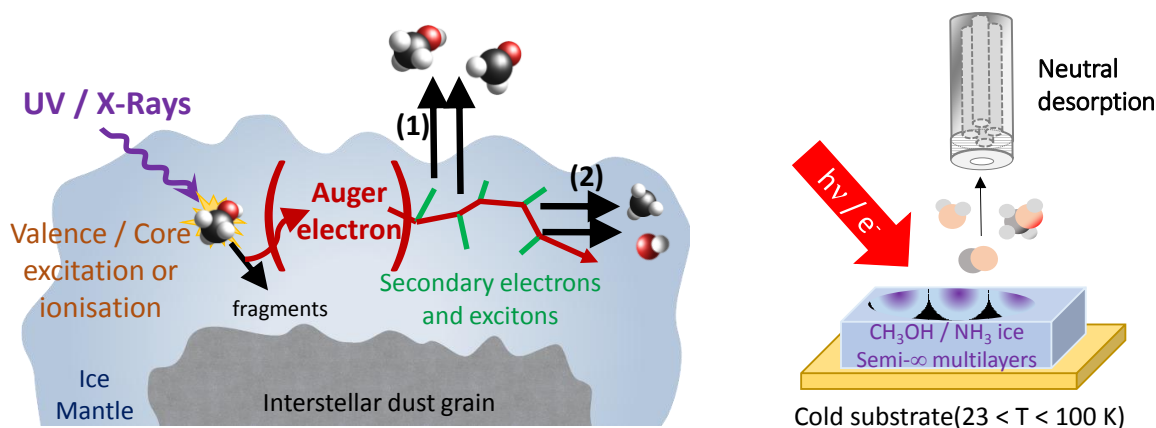
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Chemistry in the interstellar medium (ISM) takes place both in the gas phase and on the surface of interstellar dust grains, where films of physisorbed molecules accumulate. These ices are processed by photons, cosmic rays and the large number of secondary electrons produced inside the ice. Desorption is the key step in this interaction between gas phase, solid phase and radiation, and is at the heart of the interpretation of the most recent observational data obtained by the latest generation of telescopes (ALMA, NOEMA, JWST).

Our aim is to assess the contribution of electron-induced processes to the non-thermal desorption of cryogenic molecular films subjected to photon irradiation, and to better understand the complex surface chemistry in icy mantles. We carry on comparative measurements of electron- and photon-induced desorption (ESD and PSD) using two setups, the E/SOLID setup at ISMO and the SPICES setup in the LERMA group. Model molecular ices of methanol (CH_3OH) [1,2] and ammonia (NH_3) [3,4] are irradiated either in the core-shell or in the valence-shell energy range, and the desorption of neutral species is monitored by mass spectrometry. Desorption efficiencies per incident/absorbed particle are compared for electron and photon irradiations, either as a function of incident energy in the low-dose regime (spectroscopic study), or as a function of cumulative dose at a fixed irradiation energy (kinetic study).



[1] D. Torres-Díaz et al., ChemPhysChem (2023) e202200912(1-7)

[2] R. Balsagete et al., A&A 647, A35 (2021)

[3] L.A. Sala, PhD Thesis, Univ. Paris-Sud, 2018 <https://theses.hal.science/tel-02073621>

[4] R. Dupuy, PhD Thesis, Sorbonne Univ., 2019, <https://tel.archives-ouvertes.fr/tel-02354689v2>