



Vacuum-UV photon-induced desorption from interstellar ice analogs



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Photodesorption : an universal phenomenon

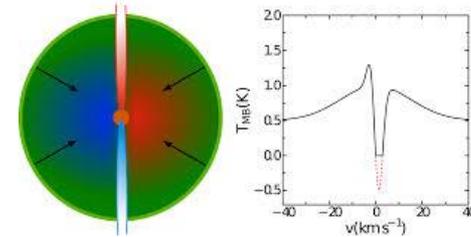
Inner and outer regions of molecular clouds (Hollenbach 2009)



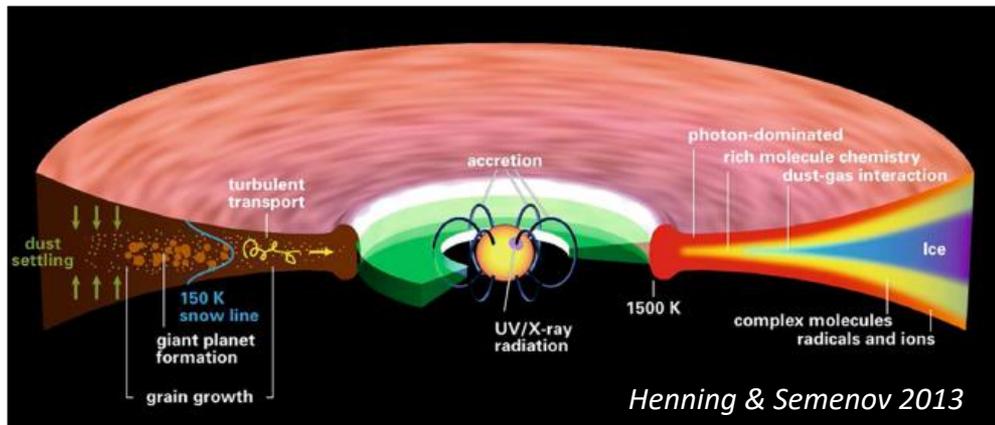
Prestellar cores (Caselli 2012)
cosmic-ray-induced FUV field



Outer parts of protostellar envelopes (Mottram 2012, Notsu 2021)

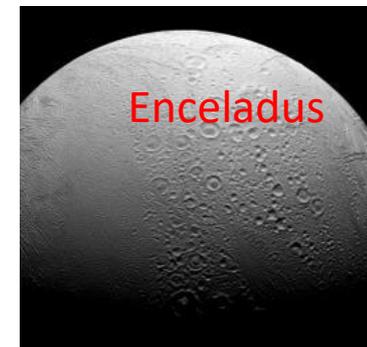


Protoplanetary disks (Dominik 2005, Bergin 2014, Walsh 2010, Salinas 2016)



Atmospheres of Icy satellites
in the outer solar system

UV Photons : H Ly- α

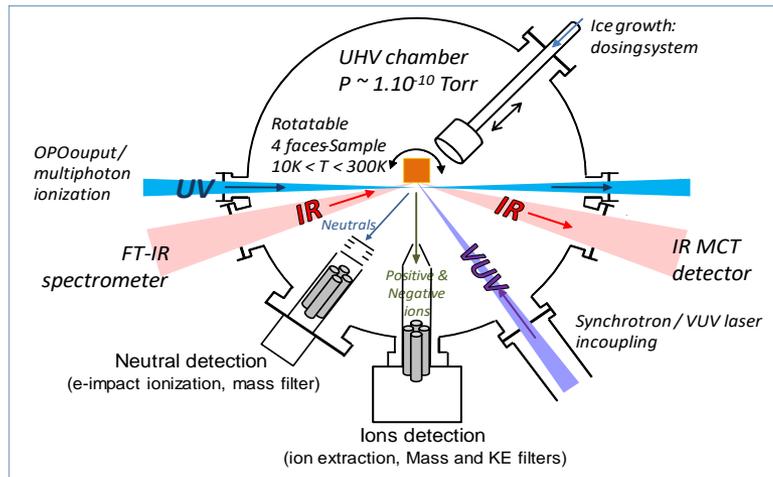


UV and X-ray photons

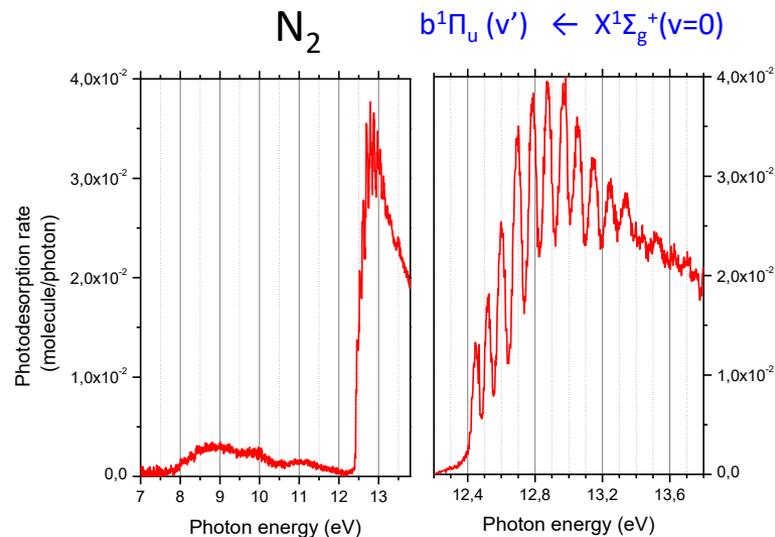
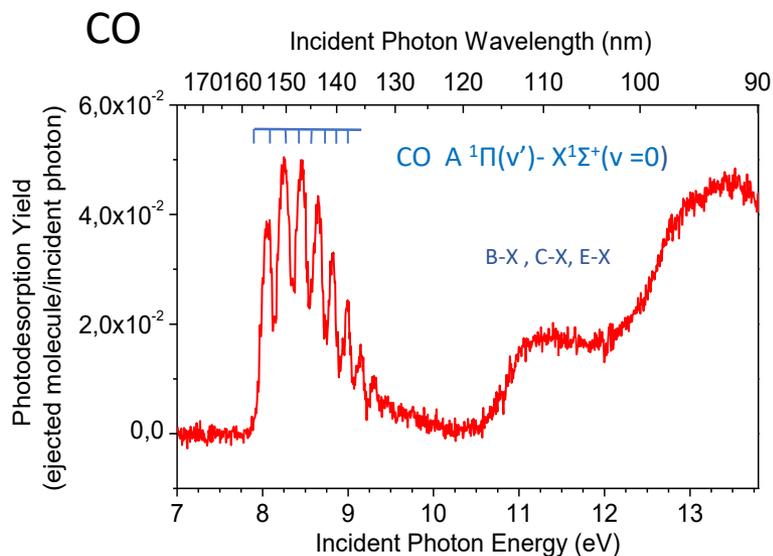
Experimental Strategy : tunable radiation (synchrotron)



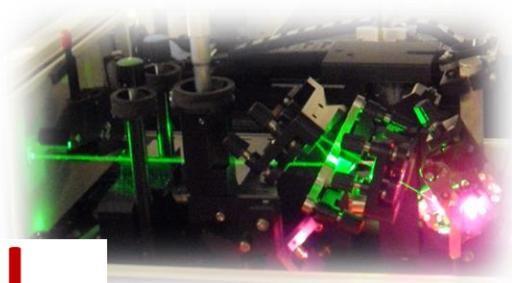
- Tunable over a wide spectral range
- 10^{12} – 10^{13} photons (30-40 meV bandwidth)
- Light polarisation (linear, circular etc)



Photodesorption Yields $Y = f(E)$ (molecules/photon)

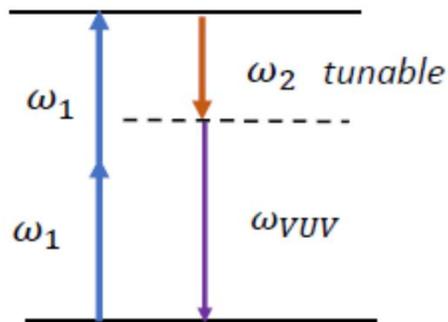


Experimental Strategy (Pulsed-Laser)



TNL
Tunable LASER
Platform

- CW/ pulsed lasers
- IR to VUV

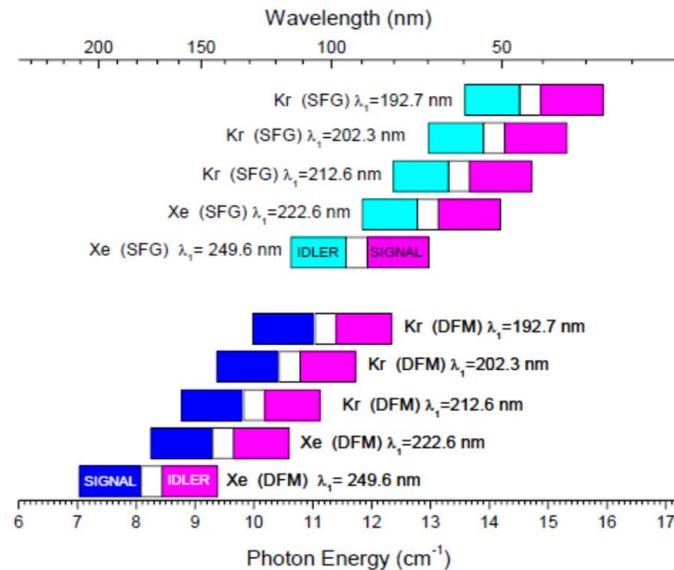


$$\omega_{VUV} = 2\omega_1 - \omega_2 \text{ (DFM)}$$

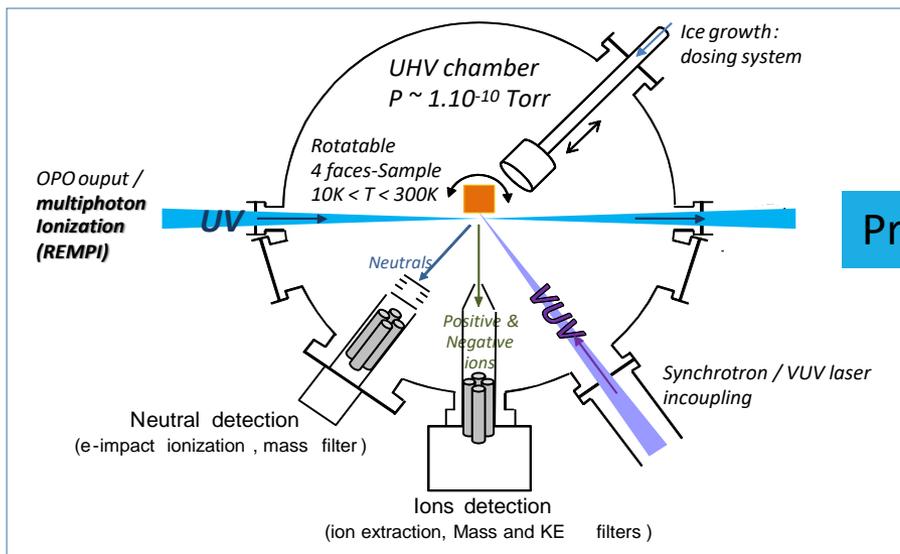
$$\omega_{VUV} = 2\omega_1 + \omega_2 \text{ (SFM)}$$

Pulsed VUV LASER

- Tunable over a narrow spectral range (8-10 eV)
- 10^8 – 10^9 photons/pulse (0.02 meV bandwidth @10 eV)
- Light polarisation (linear, Circular)
- Pulsed (10 Hz)

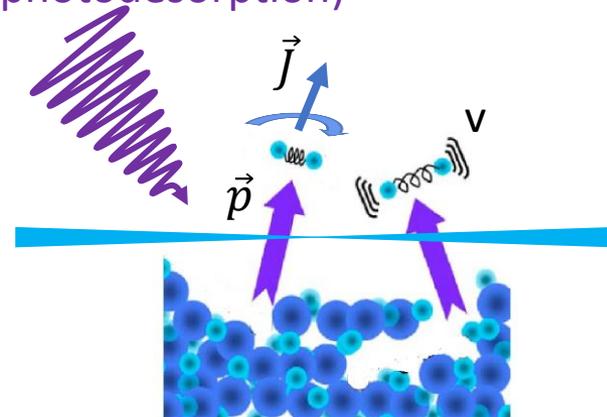


Probing the kinetic and internal energy



Probe LASER

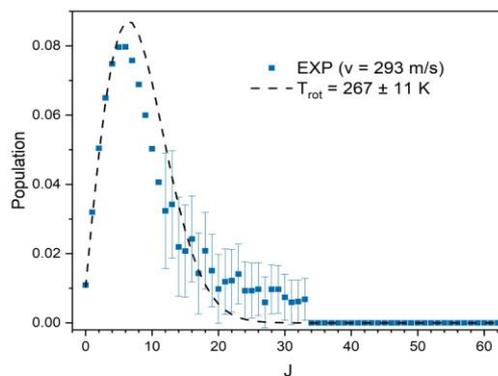
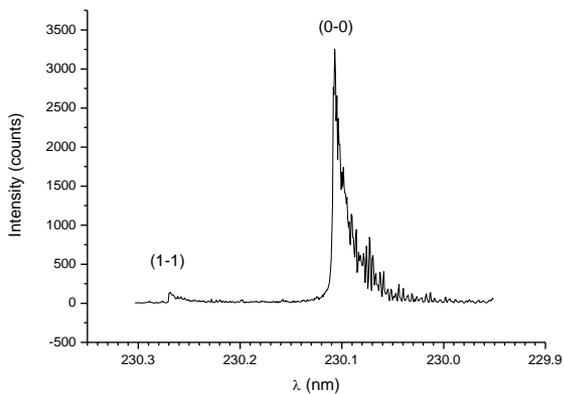
VUV (photodesorption)



REMPI Spectra



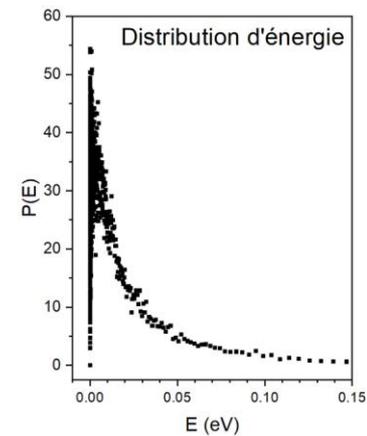
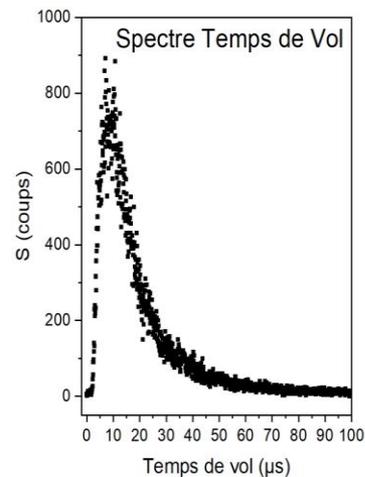
Rovibrational energy



Time-of-Flight

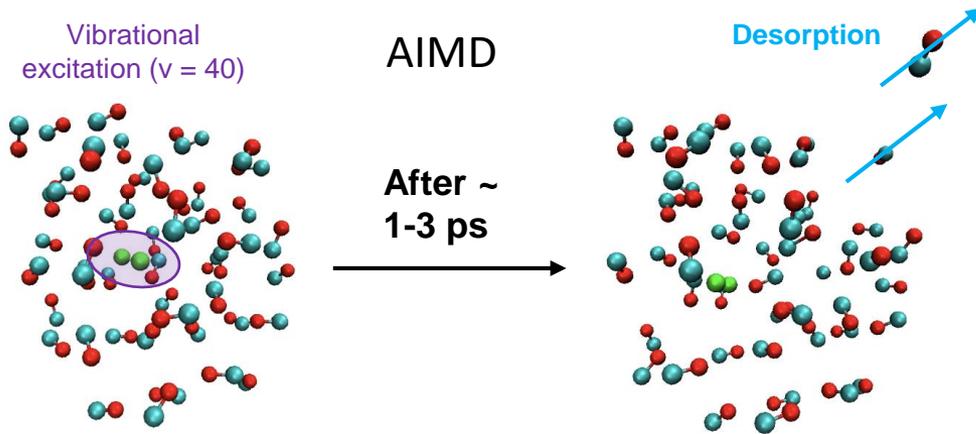


Kinetic energy

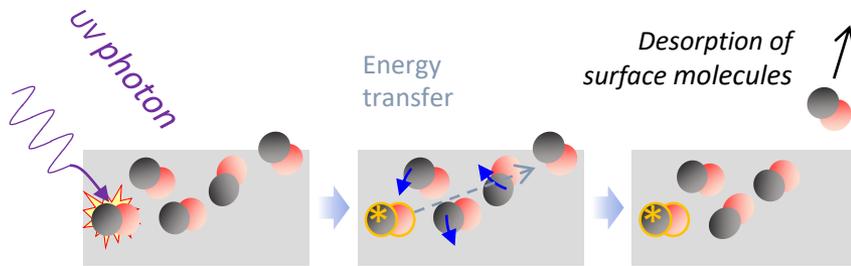


Deciphering the photo desorption mechanism

CO Photodesorption

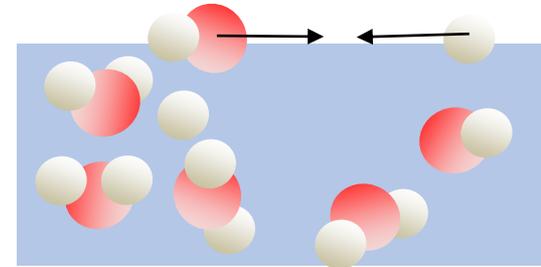


Indirect desorption



H₂O Photodesorption

Chemical Recombination and desorption



Surface chemistry

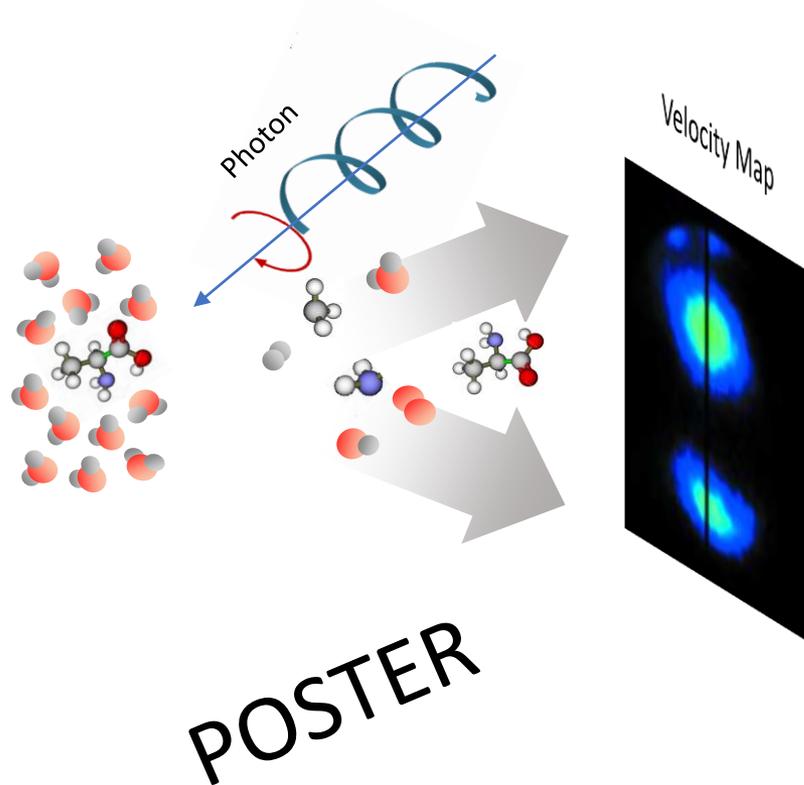
VMICES Project : Photodesorption from ices using 3D surface Velocity Map Imaging

anr[®]

PCRI VMICES

SPICES-VMI coupled to :

- VUV pulsed-laser source (8-10 eV)
- Synchrotron radiation (4-20 eV)



Collaboration :

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Thomas Greenwood (Manchester, UK)

Laurent Nahon (SOLEIL)

(1) Desorption mechanisms of neutral particles for interstellar ice analogues (CO or H₂O-rich).

(2) Photodesorption of amino acids under circular polarization, in link with the still open question of the origin of life's homochirality.