**EVOLUTION OF ORGANIC MOLECULES IN SPACE: CHARACTERIZATION AND ISOTOPE COMPOSITION OF EXPERIMENTAL ANALOGUES .**

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**Introduction:** Gas and dust grain in the interstellar medium (ISM) can be found in a variety of environments differing in density and temperature. Among them, dense clouds and circumstellar regions around young stars are favorable for the accretion of ice mantles around dust grains and their irradiation by energetic particles (UV-photons and cosmic rays). In such conditions -low temperature and energetic irradiation - isotopic fractionation are expected to be effective for the ice components.

Over the past 20 years, numerous organic compounds including relatively complex carbonaceous molecules have been identified in the ISM thanks to infrared spectroscopy performed by space telescopes [1]. Heavy isotope enrichments are commonly observed e.g. [2]. Laboratory experiments have shown that UV irradiation and heating of organic ice can lead to a refractory organic residue stable at room temperature that contains, among others, prebiotic organic precursors [3].

Proto-planetary disks surrounding newly formed stars are made of dust, ice and gas inherited from the parent molecular cloud. Our solar system might thus have incorporated such organic-rich mantled dust. Organic compounds observed in comets and in some meteorites, that display a wide range of chemical and isotopic composition, may have incorporated the ISM organic residue. However, the link between organics observed in the ISM and in our solar system is not straightforward: the solar system objects highly suffer of multiple reprocessings and alteration from the ISM. The improvement and the plurality of laboratory experiments are thus necessary to investigate the different steps of the organics formation and evolution in space.

**Experimental apparatus:** Here, we present a new laboratory experimental apparatus developed at Hokkaido University, Japan. Typical ISM gases ($H_2O$, CO, $NH_3$, $CH_3OH$) are deposited on a cold substrate (~12K) and simultaneously irradiated by UV under ultra-high vacuum. This apparatus, inspired from previous laboratory works [3, 4], is focused on organic compound evolution through UV irradiation and heating. In this experiment, gases are deposited onto the three faces of a refrigerated copper-substrate. Three UV-lamps are used to irradiate the three faces independently. After irradiation, the sample holder can be heated up to 800K. Gases, desorbed from the ice during heating, are monitored by a high-resolution quadrupole mass spectrometer in the vacuum chamber. A precise characterization of the organic residue after heating is done by a combination of analytical techniques including HPLC-MS and GC-MS. The isotope composition of the organic residue is measured in situ using ion probes IMS1280/1270.

**References:** [1] Herbst E. and van Dishoeck E. F. 2009. *Annu. Rev. Astron. AStrophys.* 47:427-480. [2] Bergin E. A. et al. 2006. *Protostars and Planets V.* 751–766. [3] Greenberg J. M. 2002. *Surface Science* 500:793-822. [4] Watanabe N. and Kouchi A. 2008. *Prog. Surface Science* 83:439-489.