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The potential of the LAb-CosmOrbitrap for future space studies in astrobiology

Laura Selliez[1], Christelle Briois[1], Nathalie Carrasco[2], Laurent Thirkell[1], Bertrand Gaubicher[1], Jean-Pierre Lebreton[1], and Fabrice Colin[1]
[1]LPC2E, UMR CNRS 7328, Université d'Orléans, Cedex 2, France
[2]Université Paris-Saclay, UVSQ, CNRS, LATMOS, 78280, Guyancourt, France

How Life has emerged on Earth? Can we find signs of Life on other celestial bodies in the Solar System? Are they harboring liquid water and complex-enough organic matter to initiate Life? What actually complex-enough organic matter means? Among other scientific questions, those related to astrobiology drive the future space missions for decades to come. The search for organic compounds in the Solar System, such as bio- and prebiotic molecules, has been defined as one of the highest priority by the Space Agencies [1, 2].

Significant improvements of the analytical performances of the future instruments will increase our knowledge of targets of interest for the search of Life, present or past, such as comets, asteroids, icy moons or ocean worlds. New generation of High Resolution Mass Spectrometers (HRMS) is currently being developed in order to provide univocal identifications, study of isotopic abundances and determination of mixing ratios with high analytical performances [3-6], including very HRMS-CosmOrbitrap based under collaborative development with University of Maryland/NASA Goddard Space Flight Center. The CosmOrbitrap mass analyzer is mainly funded by CNES, the French space agency, and developed by a consortium of 6 laboratories (LPC2E, LATMOS, LISA, IPAG, IJC lab, J. Heyrovsky Institute of Physical Chemistry) [7].

Here we address the results of a repeatability study based on three organic compounds and obtained with the LAb-CosmOrbitrap (Laser Ablation CosmOrbitrap) equipped with a commercial laser ionization system at 266 nm and no C-trap system. Organics studied are nitrogenous and sulfurous compounds, HOBt ($C_6H_5N_3O$+H) at *m/z* 136 and BBOT ($C_{26}H_{26}N_2O_2S$+H) at *m/z* 431; and a prebiotic compound, the well-known adenine ($C_5H_5N_5$+H) at *m/z* 136.

Hundreds of mass spectra have been recorded to demonstrate the reproducible analytical performances of the laser-CosmOrbitrap set-up. Mass resolving power has been studied as a function of the acquisition time and the FFT length. Different kind of mass calibrations have been tried to show the effect on the mass accuracy (internal mass calibration on the species of interest and external mass calibration on the metallic sample-holder). Finally, preliminary results on isotopic abundances ($^{13}C/^{12}C$, $^{15}N/^{14}N$ and $^{34}S/^{32}S$ replacements) have been obtained.

This work provides key information for specifying the required performances of future HRMS space instruments.

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