A HIGH MASS-RESOLUTION ORBITRAP MASS SPECTROMETER FOR *IN SITU* ANALYSIS IN PLANETARY SCIENCE

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Solar System exploration is dealing more and more with chemically complex matter, potentially associated with astrobiology or prebiotic-related science objectives. It requires the development of new space instruments with improved capability to perform the measurements that address the related science goals. Due to its ability to reveal quantitatively the composition of any chemical material, mass spectrometry has served as an invaluable scientific analytical tool. The best mass resolution currently achieved by mass spectrometers in space is about 3,000 at mass 28 (ROSINA on board ESA's comet chaser Rosetta[1]). As mass-resolving power increases, several new plateaus of chemical information become accessible. Fourier Transform Mass Spectrometry (FT MS) offers (i) the multiple advantages of yielding the entire mass spectrum at once, rather than requiring that each peak be scanned through separately and (ii) in the zero-collision limit, mass-resolving power increases directly with data acquisition period. Purely electrostatic orbital traps in laboratory are showing mass resolution above 100,000 for $m/z \leq 400$, that provides separation for each detected isobaric species[2,3].

Our French consortium of laboratories, in collaboration with ThermoFischer Scientific, is currently working on the adaptation of this type of mass spectrometer for space instrumentation. It would open exciting new opportunities for molecular characterization, isotopic abundance evaluation, and more generally environmental characterization of the atmospheres and surfaces of planetary bodies.

In this presentation, we will describe this innovative concept of mass analyzer for space that is lightweight, uses (pulsed) DC voltages, and provides ultra-high mass-resolving power capabilities. Sample preparation, ionization and ion injection is specific for each envisaged space application. Our laboratory prototype uses a UV (337 nm) laser beam for the ablation and ionization of metal and organic samples. A mass resolution of 250,000 at mass 56 has been recently achieved on stainless steel samples. Measurements of the isotopic pattern have been tested with Zirconium doped with Molybdenum samples. The results obtained so far are demonstrating that this instrument has the capability to uniquely address science objectives related to *in situ* composition measurements, in particular those related to astrobiology, for future planetary missions to airless surfaces bodies as asteroid, comets or to planetary moons.

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