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A High 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 questions, requiring optimized methods of analysis. Due to its ability to reveal quantitatively almost any chemical element, mass spectrometry has served as an invaluable scientific analytical instruments. Nevertheless the best mass resolution (M/deltaM) currently achieved by mass spectrometers in space is about 3000 at mass 28 (ROSINA's DFMS on board ESA's comet chaser Rosetta). This resolution allows separation of peaks for only a limited number of isobaric species (e.g. N2 / CO at 28 Da). Yet, purely electrostatic orbital traps in laboratory are showing mass resolution above 100 000 for m/z <= 400 [1, 2], that provides separation for each detected isobaric species. Therefore it opens new opportunity for molecular characterization, isotopic abundance evaluation, and more generally environmental characterization.
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. We present here this innovative concept of mass analyzer for space that is lightweight, uses DC voltages, and provides ultra high resolving power capabilities. A mass resolution of 140,000 at mass 56 has been recently achieved with our prototype.

References
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