Orbitrap-based mass analyser for in-situ characterization of asteroids: ILMA, Ion Laser Mass Analyser

C. Briois[1], H. Cotti[2], L. Thirkell[1], French Space Orbitrap Consortium[K. Aradj[1], A. Bouabdellah[3], A. Boukrara[1], N. Carrasco[3], G. Chalumeau[1], O. Chapelon[1,2,3], F. Colin[1], P. Coll[2], C. Engrand[5], N. Grand[2], A. Kukui[1], J.-P. Lebreton[1], C. Pennanech[2], C. Szopa[3], R. Thissen[4], V Vuitton[4], P. Zapf][2], and A. Makarov[6]

[1]LPC2E (Universite d'Orleans-CNRS), Orleans Cedex 2, France
[2]LISA, Université Paris-Créteil, France
[3]LATMOS, Guyancourt, France
[4]IPAG, Grenoble, France
[5]CSNSM, Université Paris-Sud, Orsay, France
[6]Thermo Fisher Scientific (Bremen) GmbH, Germany

Since about a decade the boundaries between comets and carbonaceous asteroids are fading [1,2]. No doubt that the Rosetta mission should bring a new wealth of data on the composition of comets. But as promising as it may look, the mass resolving power of the mass spectrometers onboard (so far the best on a space mission) will only be able to partially account for the diversity of chemical structures present.

ILMA (Ion-Laser Mass Analyser) is a new generation high mass resolution LDI-MS (Laser Desorption-Ionization Mass Spectrometer) instrument concept using the Orbitrap technique, which has been developed in the frame of the two Marco Polo & Marco Polo-R proposals to the ESA Cosmic Vision program. Flagged by ESA as an instrument concept of interest for the mission in 2012, it has been under study for a few years in the frame of a Research and Technology (R&T) development programme between 5 French laboratories (LPC2E, IPAG, LATMOS, LISA, CSNSM) [3,4], partly funded by the French Space Agency (CNES). The work is undertaken in close collaboration with the Thermo Fisher Scientific Company, which commercialises Orbitrap-based laboratory instruments.

The R&T activities are currently concentrating on the core elements of the Orbitrap analyser that are required to reach a sufficient maturity level for allowing design studies of future space instruments. A prototype is under development at LPC2E and a mass resolution (m/Δm FWHM) of 100,000 as been obtained at m/z = 150 for a background pressure of 10^{-8} mbar.

ILMA would be a key instrument to measure the molecular, elemental and isotopic composition of objects such as carbonaceous asteroids, comets, or other bodies devoid of atmosphere such as the surface of an icy satellite, the Moon, or Mercury.

Acknowledgements: This development is carried out in the framework of a Research and Technology (R&T) development program partly funded by the French Space Agency (CNES), Region Centre, Labex ESEP and Labex Voltaire.

References: [1] Gounelle M. et al, Meteoritic and planetary science, 41, 135–150, 2006. [2] Jewitt D., Astronomical Journal 143, 2012. [3] Briois C. et al, LPI contributions 1719, 2888, 2013. [4] Cottin H. et al, the 38th COSPAR Scientific Assembly, Bremen, Germany, 18–25 July 2010.