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A miniature laser mass spectrometer: a new tool for the in-situ planetary analysis.

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The Laser Mass Spectrometer (LMS), originally developed by the University of Bern, is part of the current challenge of reducing the size and the power consumption of small instruments devoted to be accommodated on landers or rovers, for in-situ studies of planetary environment.

It was designed initially to be deployed on an airless body, in the frame of the rover for the Bepi-Colombo mission to Mercury. But the concept can easily be adapted for planets with an atmosphere such as Mars, for example.

Its purpose is to measure the elemental and isotopic composition of solids (i.e. rocks and soils) in a single instrument. It is build around a laser ablation system and a miniature mass spectrometer where the ions are directly coupled in after they were formed by the laser ablation.

The key characteristics of the LMS are its small size and weight to accommodate it in a rover, a limited power consumption (i.e. an estimation of 3 W for the flight instrument), an ion source (via the laser ablation technique) which avoids the need for a sample preparation and a spatial resolution of 10 microns, smaller than the regolith grain size on Mercury. It should be noted that this resolution is vertical as well as lateral which would give an accurate insight on the mineralogy on Mercury and therefore helps to constraint the different evolution models of the planet.

The latest laboratory prototype, currently in the SCI-A lab, has a demonstrated mass resolution of 180 and a high dynamic range. It size is currently 100 x 80 x 70 mm but with further miniaturization a flight instrument is expected to have a size of 70 x 30 x

40 mm and a mass of 280 g.

A test set-up was implemented with which we will verify the behavior and measure the characteristics of the LMS as for example its mass resolution, its sensitivity, its dependence on the geometry of the ablation and the ion collection. For this purpose, we designed a test facility with high-speed acquisition card, distance sensor, high-resolution vacuum translation stages and an exchangeable sample stage… which will accommodate various samples: homogeneous glasses, metal and alloys foils, natural rocks…

In the mid-term, the objective is to adapt the prototype to make it able to survive a harsh extraterrestrial environment.