



## **Mass spectrometry for Exploration of Jupiter's Icy Moons Exospheres: Development of the NIM Instrument**

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Investigation of habitable environments around gas giant planets is one of the main interests in upcoming space missions. For this reason, the JUICE mission will investigate Jupiter's environment and its icy moons Ganymede, Callisto and Europa as an example of such an environment. Part of the JUICE science payload is the Particle Environment package (PEP) experiment, where the Neutral gas and Ion Mass spectrometer (NIM) is one of the six scientific instruments. The task of NIM is to measure the exospheric composition of these moons. NIM will be able to measure the thermal exosphere and the sputtered particles of the moons' surface. The particle composition will give the chemical composition of the moons' surfaces from which constraints about how these moons were formed will be derived.

NIM is a Time of Flight mass spectrometer with two entrances for the neutral gas and ions. Through the open source the external gas enters the ion source directly with spacecraft velocity, and through the closed source the external gas enters via an antechamber where it gets thermalized before proceeding into the ion source. Ionospheric ions can also be measured using the open source.

Initial performance tests were done with a complete prototype of the instrument. In succession, the ion optics for the flight unit was simplified and simulations showed almost no performance loss. Using the prototype, tests of improved sub-units designs and of flight components, as they become available, have been performed for ion-optical elements and electronics, and necessary trade-off studies between the available limited resources and measurement performance. Further development has been performed on sub-units, e.g. the ante-chamber of the closed source or the high voltage pulser of the ion source. First flight elements, like the flight-like ion mirror (reflectron), were tested and showed good performance.