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# Mass spectrometry of planetary exospheres at high relative velocity: direct comparison of open- and closed source measurements

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The exploration of habitable worlds around the gas giants in the Solar System is of major interest in upcoming planetary missions. Exactly this theme is addressed by the Jupiter Icy Moons Explorer (JUICE) mission of ESA, which will characterise Ganymede, Europa and Callisto as planetary objects and potential habitats [1], [2].
We developed a prototype of the Neutral gas and Ion Mass spectrometer (NIM) of the Particle Environment Package (PEP) for the JUICE mission intended for composition measurements of neutral gas and thermal plasma. NIM/PEP will be used to measure the chemical composition of the exospheres of the icy Jovian moons. Besides direct ion measurement, the NIM instrument is able to measure the inflowing neutral gas in two different modes: in neutral mode the gas enters directly the ion source (open source) and in thermal mode, the gas gets thermally accommodated to wall temperature by several collisions inside an equilibrium sphere before entering the ion source (closed source).
We performed measurements with the prototype NIM using a neutral gas beam of 1 up to 5 km/s velocity in the neutral and thermal mode. The current trajectory of JUICE foresees a flyby velocity of 4 km/s at Europa, other flybys are in the range of 1 up to 7 km/s and velocity in Ganymede orbits is around 2 km/s. Different species are used for gas beam, such as noble gases Ne, Ar, Kr as well as molecules like H2, Methane, Ethane, Propane and more complex ones. We will present the results of these measurements with respect to fragmentation and density enhancements in the closed source mode. Furthermore, we will give a direct comparison between open and closed source mode measurements.

References:
[1] ESA, “JUICE assessment study report (Yellow Book)”, ESA/SRE(2011)18, 2012.
[2] O. Grasset, M.K. Dougherty, A. Coustenis, E.J. Bunce, C. Erd, D. Titov, M. Blanc, A. Coates, P. Drossart, L.N. Fletcher, H. Hussmann, R. Jaumann, N. Krupp, J.-P. Lebreton, O. Prieto-Ballesteros, P. Tortora, F. Tosi, T. Van Hoolst, “JUpiter Icy moons Explorer (JUICE): An ESA mission to orbit Ganymede and to characterise the Jupiter system”, Planet. Space Sci., 2013, 78, pp. 1 – 21.