



Development of a mass spectrometer for planetary exosphere exploration: from simulations to a flight like design

Stefan Meyer, Marek Tulej, and Peter Wurz

Bern, Physics Institute, Space Research & Planetary Sciences, Bern, Switzerland (stefan.meyer@space.unibe.ch)

The exploration of habitable environments 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 [3]. 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 started the development of NIM with detailed ion-optical simulations and optimisations using SIMION software. Based on the ion-optical design we developed a prototype of NIM with several iterations. We tested the prototype NIM under realistic mission conditions and thereby successfully verified its required functionality. We will present the development process from ion-optical simulation up to NIM prototype test results and the concluded flight like design. Furthermore, we will provide an insight into the working principle of NIM and its performance, based on measurement data.

References:

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