Accelerated Ion-ENA beam for Planetary Space Weather

De Angelis E., Moroni M., Rispoli R., Colasanti L., Vertolli N., Nuccilli F., Milillo A., Orsini S.

Introduction:

In recent years, activities dedicated to the study of planetary environments as surface-exosphere-magnetosphere interaction systems have found a common interest between different scientific fields. These are improving our understanding of the formation, dynamics and perturbative effects experienced by solar system bodies.

At the Institute for Space Astrophysics and Planetology (IAPS) in Rome there is a vast experience in the study of the interaction between the Solar Wind and the Earth's environment. This topic has been further investigated during space programmes such as Bepi-Colombo for the planet Mercury and in numerous ESA missions dedicated to the bodies of the solar system (Mars, Venus, Jupiter, asteroids...), expanding in the so called field of Planetary Space Weather [Plainaki et al, 2016]

The prediction of perturbative events in terrestrial space weather applied to other bodies in the solar system has opened up a new line of research. For this reason several laboratory activities focused on the simulation of phenomena like bombardment on planetary analogues, gas or ice and interaction phenomena. In particular in I-ENA lab the effect of solar wind precipitation in terms of backscattered/sputtered particles and exosphere refilling effects are under study.

We present a possible interdisciplinary laboratory plan to better understand the global and specific effects of the arrival of a disturbance from the Sun.

Method:

At INAF/IAPS laboratory there is a facility of Ion and ENA beam that provide the opportunity to investigate the interaction of selectable ion/neutral beam with several samples and detectors [2]. It has supported missions such as Cluster, BepiColombo (SERENA), Mars and Venus Express, Sweaters.

The laboratory provides a high vacuum environment (10^-7mbar) with a charged particle source capable of generating a particle beam of energy 0-5 keV (He-Ar) that can be modulated in intensity, area and direction. The charged particle beam can then be made into a beam of accelerated neutral atoms (ENA-Energetic Neutral Atom) with a neutralisation cell for charge exchange effect.

This facility allows the study of solar wind interaction phenomena in the energy range (1-5 keV) and the possibility to investigate secondary effect like backscattering and sputtering as a detectable particle signal thanks to specific instrumentation.

In order to satisfy the different request of the community in terms of surface effect, exosphere refilling, space weather and space weathering analisys and simulation, it is recently proposed to extend the current facility to a higher energy range (10-30 keV). In fact, a higher energy source would make it possible to extend the range of investigation and simulation of the phenomena on the bodies of the solar system and the Earth, where the acceleration dynamics are crucial to study the circulation of particles due to perturbations. The IAPS facility is currently used for projects or testing materials, detectors or instrument subsystems for low-energy phenomena and interaction lab simulation. An extension of source energy range would provide a greater offer in terms of environments to be simulated and processes to be evaluated.

Conclusion:

The Ion-ENA beam facility has the possibility to simulate particle beam interaction with different samples to reproduce solar wind interaction with solar system bodies.

Several phenomena can be simualetd and investigated that have scientific return on different research field and open to interdisciplinary study of circumaplaneatry environement.

The large experience on solar wind effect aand space instrumentation allow to offer specific investigation of surface-exosphere-magnetosphere with laboratory simulation of particle releasing effect.

References:

[1] Plainaki et al., 2016, “Planetary space weather: scientific aspects and future perspectives” J. Space Weather Space Clim., 6, A31 (2016)

[2] De Angelis E. et al., 2016, “Ion and ENA beam Laboratory at INAF/IAPS: a facility for plasma-environment simulation and space instrument development”, Meeting of the Italian SOlar and HEliospheric community (SOHE)

Additional Information:

Contact point
elisabetta.deangelis@inaf.it