Wrap-up of the **ESWW11 "Planetary Space Weather" Session**

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During the Planetary Space Weather Session of the 11the European Space Weather Week, a vast number of papers covering many aspects of the conditions in the Sun, solar wind and magnetospheric plasmas, at different planetary systems of our Solar System, influencing the performance and reliability of space-borne technological systems, were presented.

Logistics

The Planetary Space Weather session included a series of invited and simple oral presentations, as well as invited and simple poster presentations. The session received in total 29 contributions that were scheduled in the following way: 4 invited orals, 2 orals, 7 invited posters, 16 posters (see *Figure1*). In the context of a first-class poster programme, promoted within ESWW1, and in addition to the usual oral presentations, we included a series of micro-oral presentations destined to all papers scheduled as posters. In this way, the authors of the poster-contributions had the chance to give a brief outline of the work included in their posters in order to pre-prepare a direct dialogue with the rest of the session participants. We underline that the type of presentation was considered as a criterion for the assigned duration to each contribution.

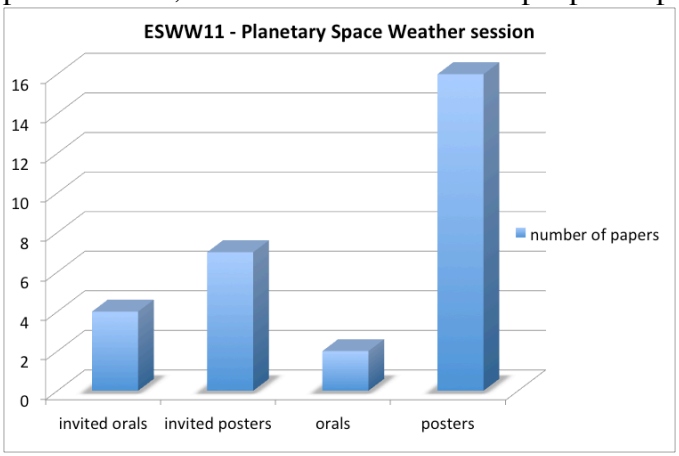

Figure 1: *Distribution of presentation-types in the Planetary Space Weather session of ESWW11.*

Science wrap-up

The ESWW11/Planetary Space Weather session's opening came with a presentation by N. Crosby (Belgian Institute for Space Aeronomy) on the Energetic Particle Populations and their Contribution to the Solar System Landscape. In this introductory talk, the implications of different particle radiation environments characterizing the Solar System landscape, were discussed with respect to their effects on technology and humans, as well as current and envisioned mitigation techniques.

During the session, a series of papers on planetary space weather in the Outer Solar System were presented. Planetary space weather phenomena at Uranus, a paradigm of outer solar system planetary-environments, were discussed by R. Prangé (LESIA, Observatoire de Paris). In that talk, a campaign of FUV observations of Uranus obtained in November 2011 with the Hubble Space Telescope (HST) during active solar wind conditions, was presented; the identified auroral signatures in several HST measurements, an evidence of planetary space weather action at the giant planet, were discussed. Saturn's energetic charged particle radiation environment in a planetary space weather perspective was discussed by E. Roussos (Max Planck

Institute for Solar System Research). The electron radiation belts variability, appearing to be controlled by various factors, such as the arrival of corotating interaction regions at Saturn, the EUV input to the Saturnian system and internal magnetospheric dynamics, was discussed. A summary of the related findings, together with open questions, limitations and challenges of using LEMMS data for space weather studies, were given. Space weather in the Saturnian system was the topic presented by A. Radioti (LPAP, Université de Liège). In that talk, the interaction of the solar wind with Saturn's magnetosphere, manifested among others in the auroral region, was discussed. *It was shown that dramatic enhancements of the nightside-dawn auroral emissions can be attributed to solar wind-induced auroral storms*. Additionally, recent auroral observations revealed the presence of a transpolar arc at Saturn, one of the most spectacular auroral features at Earth, which could be possibly related to solar wind driven tail reconnection. In the framework of the JUICE mission, space weather phenomena at the Galilean satellites atmospheres were discussed by G. Cessateur (PMOD/WRC). A model for the icy moons exosphere emissions features due to both solar UV flux as well as precipitating particles was presented and shown to have a good agreement with observational data. Planetary space weather interactions in an exoplanetary exosphere were discussed by A. Milillo (IAPS). An investigation of the interaction of stellar wind plasma with the exosphere and possibly with the planetary magnetospheric environment of close-in exoplanets, was presented. It was shown that *the atmospheric loss rate in such an extreme environment can be very high, so that a neutral and an ionized tail of escaping particles is formed*.

A second group of papers regarding space weather phenomena in the Inner Solar System was also presented. Space Environment Effects inside a Comet Coma, and specifically, an analysis of the ROSINA/DFMS Measurements onboard Rosetta, were discussed by De Keyser (Belgian Institute for Space Aeronomy). In that talk the roles of the neutral gas composition, the ionized fraction, and the dust component, and some of their effects on the spacecraft were addressed. An interesting discussion within the audience followed the talk by De Keyser. It came out that *the knowledge of the current space weather conditions is a necessary pre-requisite in order to interpret the data obtained during planetary missions*. The Solar Variability Effects on the Martian Atmosphere were discussed in an in depth review by F. González-Galindo (Instituto de Astrofísica de Andalucía, CSIC). In that talk, it was evidenced that a *good understanding of the long-term evolution of the Martian atmosphere requires the identification of the different sources of variability of the upper atmosphere*. A new scheme incorporated into the Mars GCM developed at the Laboratoire de Météorologie Dynamique (LMD-MGCM) in order to take into account the observed day-to-day variability of the UV solar flux was presented in detail and an analysis of the results of the respective simulations was presented. An overview of the SEP, GCR, and Energetic Ion Precipitation in the Martian Atmosphere and their Impact on Human Exploration was given in the talk by C. Mertens (NASA LaRC). In that talk, ionization due to proton and heavy ion precipitation from GCR or SEP events, investigated by the Aeroplanet/Planetocosmics and NAIRAS/HZETRN models, were discussed and analyzed in the frame of the human exploration of the Martian surface. After a discussion among the Session participants it came out that *solar energetic particles can indeed cause space weather phenomena that are detectable in the Martian atmosphere*. Cosmic Ray interactions with the Venusian atmosphere and their variability during different solar wind conditions, were discussed by T. Nordheim. A simulation of the atmospheric energy deposition by cosmic rays at solar minimum and maximum conditions as well as during solar energetic particle events

and computed cosmic ray ionization profiles between 0-100 km in the Venusian atmosphere, were presented. The importance of these results to investigations of electrical processes and radiation hazard in the Venusian atmosphere was evidenced and discussed. The space weather interactions between solar energetic particles propagating in the Mercury environment and the planet's surface, were discussed by M. Laurenza (IAPS). The production of secondary particles, X-ray fluorescence, and possibly changes of Mercury's exosphere was evidenced through an in depth review of the different types of interactions. Plasma-surface interactions at Mercury and their implications to space weather were discussed by A. Milillo (IAPS). In that talk it was shown that it is of crucial importance to perform accurate and comprehensive simulations of all kinds of space weather interactions, in order to maximize the science return of future missions to Mercury. An updated view of the plasma-surface interactions at Mercury and exosphere generation processes, trying to identify the key observations needed to get a comprehensive investigation, was given.

Linking the two groups of papers referring to the Outer and Inner Solar System, a comparative study of the Earth, Jupiter and Saturn's radiation belts was presented by A. Sicard-Piet (ONERA). The ONERA/DESP physical model of the radiation belts, called Salammbô-3D was presented and discussed through a comparative exposure of its application results to three different planets, Earth, Jupiter and Saturn. The effects of Jupiter's radiation belts on the Amalthea moon were also discussed.

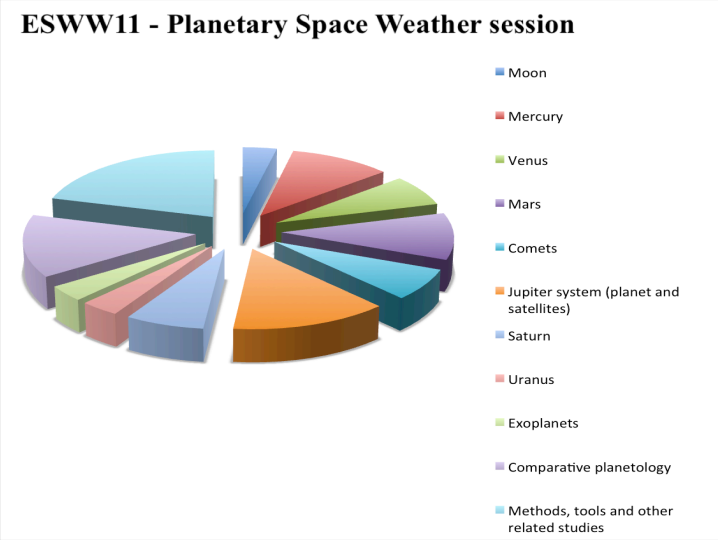

Figure 2: *Distribution of the various themes within the Planetary Space Weather session of ESWW11.*

A series of micro-talks, corresponding to poster contributions, gave rise to numerous interesting discussions during the poster viewing session. These talks discussed different planetary space weather issues: solar wind turbulence in the Venusian Magneto-sheath; the aurora signatures at Mars; modeling of the solar wind interaction with Lunar magnetic anomalies or comets; solar wind interaction with the magnetosphere of Jupiter; space weather interactions at the Galilean satellites; magnetospheric modes and magnetic reconnection; Forbush decreases and their precursors; Planetary Simulations Database and Tools. For a complete graphical representation of the distribution of the contributions among the various themes within the Planetary Space Weather Session see *Figure 2*.

As a concluding remark, it is pointed out that the Planetary Space Weather session of ESWW11 has been a successful attempt **to extend the terrestrial space weather concept to other environments in our Solar System**, taking into consideration the different interactions between planetary surfaces/atmospheres and radiation environment.