Planetary and Space Science 130 (2016) 1–2

Contents lists available at ScienceDirect

Planetary and Space Science

journal homepage: www.elsevier.com/locate/pss

Preface to the special issue of PSS on “Surfaces, atmospheres and magnetospheres of the outer planets and their satellites and ring systems: Part XI”

This issue contains original research work and reviews presented during the past year in sessions organized at several international meetings and congresses (such as those of the European Geosciences Union (EGU) or the European Planetary Science Congress (EPSC) among others). The manuscripts discuss recent observations and models of the atmospheres, magnetospheres and surfaces of the giant planets and their satellites, in particular from current space missions. Concepts of architecture and payload for future space missions are also presented.

We briefly describe hereafter the nine articles the reader can find in the present issue, which carry us on a long journey through the Solar System, starting with the Jovian system and ending with Pluto.

In the paper *“Analytical model of Europa's O_2 exosphere”* Anna Milillo and co-authors outline that the currently used exospheric models based on the Monte Carlo method, are not fully adequate to simulate the results of the interaction of the plasma with the icy surface of Europa (radiolysis) that is believed to be the process responsible for the production and release of molecular oxygen from the surface to the exosphere. To try to overcome the problem, the authors propose an analytical 3-D model that is able to describe the molecular oxygen exosphere by reproducing the observed two-component profiles and the asymmetries due to diverse configurations among Europa, Jupiter and the Sun. The model is based on the use of a non-linear fit that allows to describe in detail various exospheric properties.

In their related study “*Loss rates of Europa's tenuous atmosphere*” Alice Lucchetti and co-authors examine the interaction of Europa's exosphere with its plasma and magnetic environment. They present calculations of exospheric H_2O, O_2 and H_2 loss rates due to interactions with the surrounding plasma environment of Jupiter's magnetosphere. The changing nature of this environment as a function of Jupiter's rotation affects electron impact ionization and dissociation, leading to time-varying and non-uniform escape rates across Europa. Their calculations represent important predictions in the context of ESA's forthcoming JUpiter ICy moons Explorer (JUICE) mission.

Laura M. Parro et al. report findings over multiple epochs of chaos formation on Europa in their study *“Timing of chaotic terrain formation in Argadnel Regio, Europa, and implications for geological history.”* The analysis explores the stratigraphic relationships between chaos and other landforms based on visible images returned by the *Galileo* spacecraft. Chaos are believed to be the surface expressions of solid-state convection or diapirism, hence a better understanding of their occurrence relative to other geological features can help track the internal and geological evolution of Europa. Since most chaos regions appear to be among the youngest geological units observed on Europa, the authors propose that the older chaos unit they have identified point to local heterogeneities in Europa's shell properties during a period when endogenic activity was otherwise quiescent.

Paul Hartogh and colleagues present a concept for *“a passive low frequency instrument for radio wave sounding the subsurface oceans of the Jovian icy moons: an instrument concept”* considered to be complementary to an active ice penetrating radar sounder, which is part of the selected payload of the JUpiter ICy moons Explorer (JUICE) space mission. This manuscript thus describes a method to do sub-surface radio sounding of icy moons around Jupiter, by using the Jovian radio emissions below 1 MHz as the “transmitter” and then detect the reflected radio waves from the icy crust/ocean by a radio instrument. Exploration of subsurface oceans in the Jovian icy moons is a key issue of the icy moons' geology and electromagnetic wave propagation and the method proposed is a privileged way to probe their icy mantles from orbit.

Leonardo Regoli and co-authors examine the precipitation of energetic particles into Titan's upper atmosphere in their study entitled “*Access of energetic particles to Titan's exobase: a study of Cassini's T9 flyby*”. Their calculations of particle trajectories in Titan's magnetic and plasma environment as defined by A.I.K.E.F. hybrid model obtain global maps of H^+ and O^+ fluxes at energies between 1 keV and 1 MeV incident upon Titan's exosphere. Due to large gyro-radii of some of the ion populations, these fluxes vary greatly with location. By combining their calculations with particle fluxes measured by Cassini's MIMI/CHEMS instrument, the authors obtain normalized fluxes which are used to infer energy deposition and N_2 ionization rates from both O^+ and H^+ precipitation.

In their study entitled “*Periodic motion of the magnetodisk as a cause of quasi-periodic variations in the Kronian magnetosphere*“, Zoltan Nemeth and co-authors present an analysis of quasi-periodic variations of the plasma properties in Saturn's magnetosphere. Using a simple model of magnetodisk and assuming a known functional dependence of key parameters such as the radial component of Saturn's magnetic field with distance from the magnetodisk, they fit the calculated parameters to observations and thereby obtain an estimate for the distance of an observer from a wavy magnetodisk. This procedure can be applied to any planetary magnetodisk with known periodicities.

http://dx.doi.org/10.1016/j.pss.2016.08.001
0032-0633/

The interaction of Saturn's magnetosphere plasma with the plumes of Enceladus is examined by Shotaro Sakai and co-authors in their paper entitled "*Ion energy distributions and densities in the plume of Enceladus*". Using test particle and Monte Carlo models, they investigate the energy distributions, ion species and densities of water group ions in the plume of Enceladus in an effort to interpret observations made by the Cassini Plasma Spectrometer (CAPS) and the Cassini Ion and Neutral Mass Spectrometer (INMS). While good agreement is obtained with these measurements, suggesting predominance of H_3O^+ ions in the plume, their peak ion densities are about a factor of 3 lower than peak electron densities measured by Cassini's Langmuir Probe. Their simulations suggest that most ions in their study were created not by photoionization but particle impact ionization during the interaction of the neutral plume with background magnetospheric plasma. Their investigations also gave a new insight into the dominant chemical ion-neutral chemical processes in Enceladus' plume.

The manuscript presented by Olivier Mousis et al. entitled "*The Hera Saturn Entry Probe Mission*" reports on a joint ESA–NASA mission concept proposed in response to ESA's 2014 call for M-class missions. The mother–daughter architecture includes a probe that would measure the chemical and isotopic composition of Saturn's atmosphere, into the cloud-forming region of the troposphere, with the goal of better understanding the origin and evolution of this giant planet. The observations to be returned by the *Hera* mission would break new grounds in our understanding of the origin and evolution of our solar system and, by extrapolation, of exoplanetary systems.

Kathy Mandt et al. in "*Prediction for how New Horizons can constrain the source of Pluto's nitrogen and the history of atmospheric escape*" present a model for the loss of nitrogen from Pluto over geologic time considering various atmospheric escape mechanisms. They conjecture the present nitrogen isotope ratio is an indicator of the original source of nitrogen – N_2 or NH_3. There are a number of simplifying assumptions in the model such as the history of loss, resupply, and condensation of nitrogen etc. Nevertheless, the model would serve as a good starting point for understanding the origin of nitrogen on Pluto when the nitrogen isotope data from New Horizons become available.

Editor
A. Coustenis
LESIA – Observatoire de Paris, CNRS, UPMC Univ. Paris 06, Univ. Paris-Diderot, Meudon, France
E-mail address: athena.coustenis@obspm.fr

Editor
S. Atreya
Univ. Michigan, Ann Arbor, MI, USA

Editor
J. Castillo
JPL/Caltech, Pasadena, CA, USA

Editor
I. Mueller-Wodarg
Imperial College, London, UK

Editor
L. Spilker
Jet Propulsion Laboratory, Pasadena, CA, USA

Editor
G. Strazzulla
INAF-Osservatorio Astrofisico di Catania, Catania, Italy