EP 3: Planets and Small bodies

Time: Tuesday 11:00–13:00 Location: EP-H1

Invited Talk EP 3.1 Tue 11:00 EP-H1

A new era of Venus exploration - seen Venus in a new light — •Jörn Helbert[1], Melinda Darby Dyar[2], Giulia Alemanno[1], Alessandro Maturilli[1], Nils Müller[1], Doris Breuer[1], VEM on VERTIAS team[1], and VenSpec on Envision team[1] — [1]Institute for Planetary Research, DLR, Berlin, Germany — [2]Mount Holyoke College, USA

Venus is our next-door planet. It is almost identical in size to Earth and yet we know so little about it. Recently three new mission have been selected to study Venus - the ESA EnVision and the NASA VERITAS and DAVINCI missions. The new interest in Venus has partly come through discussions with the exoplanet community about why their models always lean towards Earth-like planets. They have asked for fundamental parameters for Venus to improve their models, like the surface composition of Venus, and we just do not have the answers currently. This led to the realisation that we need to find out more about this planet that has evolved in such a different way from the Earth in order to understand how habitable planets evolve in general.

All three recently selected Venus missions include in their payload instruments focused on the 1 micron region. The NASA VERITAS and ESA EnVision missions use the DLR build Venus Emissivity Mapper (VEM) as a multi-spectral imaging system. The DAVINCI mission has a 1 micron descent imager. These new instruments have been made possible in part by a dedicated effort to set up a new Venus high temperature spectroscopy laboratory at DLR to routinely obtain VNIR emissivity spectra at relevant Venus surface temperatures.

EP 3.2 Tue 11:30 EP-H1

The impact of large solar particle events on the chemical composition of the Martian atmosphere — •Miriam Sinnhuber[1], John Lee Grenfell[2], Konstantin Herbst[3], and Fabian Wunderlich[2] — [1]Karlsruher Institute für Technologie, Karlsruhe, Germany — [2]DLR Institut für Planetenforschung, Berlin, Germany — [3]Universität Kiel, Kiel, Germany

Large solar coronal mass ejections are known to have a large impact on the chemical composition of the high-latitude atmosphere of Earth. Collision of the incident protons and resulting secondary electrons with the most abundant atmospheric constituents leads to dissociation, ionization, and dissociative ionization of these substances; in the Earth's atmosphere, these are N_2 and O_2, and the main products are nitrogen radicals and nitrogen oxides (NOx: N, NO, NO_2) as well as hydrogen oxides (HOx: OH, HO_2) from the uptake of water vapor into large cluster ions. Both NOx and HOx species contribute to catalytic ozone loss, and very rapid loss of ozone in the terrestrial polar stratosphere and mesosphere is well-documented. However, not much is known about the impact of these events on other planets. Here, we present results from model experiments for the atmosphere of Mars, considering three different solar particle events: a ground-level event (1956), the Carrington white light flare (1859), and one of the largest ground-level events found in the paleo-record so far, the AD774/775 event. The analysis focuses on the different responses of the thin Martian atmosphere with its low amounts of nitrogen and high CO_2 mixing ratio.

EP 3.3 Tue 11:45 EP-H1

The interaction of the Martian with the solar wind as observed by MAVEN — •Lukas Maes and Markus Fraenz — Max Planck Institute for Solar System Research, Göttingen, Germany

The Mars Atmosphere and Volatile EvolutioN (MAVEN) mission was launched in 2013 to study the atmosphere and ionosphere of Mars, its interaction with the solar wind, and the consequences for the erosion of the Martian atmosphere. With a comprehensive and complementary set of plasma and neutral gas instruments, it has offered higher resolution data than ever before, with a dataset of over 6 years now. In this talk we will look at a some results about the plasma physical processes in and around the Martian ionosphere observed by the MAVEN satellite and discuss them in the context of Mars' atmospheric evolution, the effect of Mars' crustal magnetic fields, and what we can learn from it about other planets.

EP 3.4 Tue 12:00 EP-H1

Dynamo models reproducing the offset dipole of Mercury's magnetic field — •Patrick Kolhey[1], Daniel Heyner[1], Johannes Wicht[2], Thomas Gastine[3], and Ferdinand Plaschke[1] — [1]Institut für Geophysik und extraterrestrische Physik, Technische Universität Braunschweig, Braunschweig, Germany — [2]Max-Planck-Institut für Sonnensystemforschung, Göttingen, Germany — [3]Institut de Physique du Globe de Paris, Université de Paris, Paris, France

Since the discovery of Mercury's peculiar magnetic field it has raised questions about the dynamo process in its fluid core. The global magnetic field at the surface is rather weak compared to other planetary magnetic fields, strongly aligned to the planet's rotation axis and its magnetic equator is shifted towards north. Especially the latter characteristic is difficult to explain using common dynamo model setups. In this study we present new direct numerical simulations of the magnetohydrodynamical dynamo problem which include a stably stratified layer on top of the outer core, which can also reproduce the shift of the magnetic equator towards north. We revisit a model configuration for Mercury's dynamo action, which successfully reproduced the magnetic field features, in which core convection is driven by thermal buoyancy as well as compositional buoyancy (double-diffusive convection). While we find that this model configuration produces Mercury-like magnetic field only in a limited parameter range (Rayleigh and Ekman number), we show that also a simple codensity model is sufficient over a wide parameter range to produce Mercury-like magnetic fields.

EP 3.5 Tue 12:15 EP-H1

Revised Modular Model of Mercury's Magnetospheric Magnetic Field — •Kristin Pump, Daniel Heyner, and Ferdinand Plaschke — Institut für Geophysik und extraterrestrische Physik, TU Braunschweig

Mercury is the smallest an innermost planet of our solar system and has a dipole-dominated internal magnetic field that is relatively weak, very axisymmetric and significantly offset towards north. Through the interaction with the solar wind, this field leads to a magnetosphere. Compared to the magnetosphere of Earth, Mercury's magnetosphere is smaller and more dynamic. To understand the magnetospheric structures and processes we use in-situ MESSENGER data to develop a semi-empiric model, which can explain the observations and help to improve the mission planning for the BepiColombo mission en-route to Mercury.

We will present this semi-empiric KTH-model, a modular model to calculate the magnetic field inside the Hermean magnetosphere. Korth et al. (2015 and 2017) published a model, which is the basis for the KTH-Model. In this new version, the calculation of the magnetic field for the neutral current sheet is restructured based on observations rather than ad-hoc assumptions so that the description is more realistic. Furthermore, a new model is added to depict the partial ring current. An analysis of the residuals shows a better visibility of the field-aligned currents. In addition, this model offers the possibility to improve the main field determination.

EP 3.6 Tue 12:30 EP-H1

BepiColombo at Mercury: First close-in magnetic field measurements from the southern hemisphere — •Daniel Heyner — TU Braunschweig

The internal magnetic field of Mercury is best described by a northward offset dipole with almost zero obliquity. Its offset, weakness, axisymmetry and lack of secular variation still poses a challenge to dynamo theory. After NASA's Mariner 10 flybys in the 1970's and MESSENGER's orbital mission in 2011-2015, BepiColombo performed a flyby at Mercury in October 2021. For the first time, magnetic field measurements are obtained from the southern hemisphere close to the planet by the fluxgate magnetometer MPO-MAG. We will present an overview of the flyby data highlighting different plasma regions and compare the new in-situ data to magnetospheric models obtained from the previous missions to the innermost terrestrial planet. Does the flyby data reveal any secular variation? Has the dipole offset changed? These are some of the questions we will discuss with this unprecedented magnetometer data. We will close with a discussion on what is to be expected from the orbital phase of BepiColombo.

EP 3.7 Tue 12:45 EP-H1

Binary main-belt comet 288P — •Jessica Agarwal[1,2] and Yoonyoung Kim[1] — [1]Institut für Geophysik und Extraterrestrische

Physik, TU Braunschweig — [2]Max-Planck-Institut für Sonnensystemforschung, Göttingen

Main-belt comets are asteroids that activate during subsequent perihelion passages, emitting dust like comets. The object 288P is currently the only known comet-like object that is also a gravitationally bound binary system. While binaries are common in the asteroid population, 288P is special even among these because of its combination of two similarly sized components and wide separation of about 100 times the object radius.

Possible formation scenarios include the likely involvement of rotational splitting, radiation-induced torques and outgassing-induced torques, but the detailed evolutionary history of the system remains to be understood. A key question in this context is whether one or both components are active.

We present data obtained with the Hubble Space Telescope in autumn 2021 that show the onset of activity in 288P as it approached perihelion.