EP 6: Planets and small Objects

Time: Thursday 11:00–12:15 Location: H8

Invited Talk EP 6.1 Thu 11:00 H8

The CoPhyLab: How to Study Comets in the Laboratory — •Bastian Gundlach — Institut für Geophysik und extraterrestrische Physik, Technische Universität Braunschweig, Deutschland

Comets are kilometer-sized objects, composed of different volatile and refractory species, i.e., ice and dust. They formed in the protoplanetary disc by the gravitational collapse of pebble clouds, typically consisting of mm- to cm-sized aggregates of dust and ice. After their formation, comets were scattered into the outer regions of our solar system and the bulk cometary material remained almost unaltered. Thus, comets are among the most primitive objects of our solar system. When a cometary nucleus enters the inner solar system, the cometary surface warms up and the volatile components start to sublimate. Particles, aggregates and chunks are then ejected off the cometary surface into space. This process leads to the formation of the cometary coma, the dust tail and the dust trail. However, the physical processes related to the ejection of material are still not understood. Laboratory experiments are one possible tool to investigate the activity of comets. This task is currently addressed by the CoPhyLab (Comet Physics Laboratory), an international collaboration among six Partner Institutes, with the aim to study the physical processes connected to cometary activity by various experiments and thermophysical modeling.

EP 6.2 Thu 11:30 H8

Atmospheric processes affecting methane on Mars — •John Lee Grenfell[1], Fabian Wunderlich[1,2], Miriam Sinnhuber[3], Konstantin Herbst[4], Ralph Lehmann[5], Markus Scheucher[2,6], Stefanie Gebauer[1], Gabriele Arnold[1], and Heike Rauer[1,2,7] — [1]Institut für Planetenforschung (PF), Deutsches Zentrum für Luft- und Raumfahrt (DLR), Berlin, Germany — [2]Technische Universität Berlin (TUB), Germany — [3]Karlsruhe Institute of Technology (KIT), Germany — [4]Kiel University (CAU), Germany — [5]Alfred Wegener Institute (AWI), Potsdam, Germany — [6]Now at: NASA Jet Propulsion Laboratory (JPL), Pasadena, USA — [7]Freie Universität Berlin (FUB), Germany

We investigate a range of atmospheric phenomena concerning their potential to address the Martian methane lifetime discrepancy. This refers to the over-estimate of the modelled lifetimes compared to observations by a factor of up to 600. We apply a newly developed atmospheric photochemical model where we vary in a Monte Carlo approach the chemical rate and eddy mixing coefficients within their uncertainties. Atmospheric pathways are identified and quantified in which methane is oxidized to its stable products. We also investigate the effect of air shower events due to galactic cosmic rays and solar cosmic rays. Our results suggest that the current uncertainty in chemical rates and transport together with seasonal changes in the water column and recently observed high abundances of chlorine in the Martian atmosphere can together account for a factor of 27.7 lowering (within 2-sigma) in the modelled Mars methane lifetime.

EP 6.3 Thu 11:45 H8

Magnetfeldmodellierung der Merkurmagnetosphäre mit dem KTH-Modell — •Kristin Pump und Daniel Heyner — IGEP, TU Braunschweig

Der Merkur ist der kleinste und innerste Planet unseres Sonnensystems und besitzt ein dipolartiges internes Magnetfeld. Hierdurch bildet sich eine Magnetosphäre aus, deren Strukturen Gegenstand aktueller Forschung sind. Die Magnetosphäre des Merkur ist im Vergleich zur der der Erde um ein Vielfaches kleiner, dynamischer und durch die nordwärtige Verschiebung des Dipols nicht symmetrisch in Nord-Süd-Richtung. Um die dort auffindbaren Strukturen und Prozesse zu verstehen, werden mithilfe der MESSENGER-Messdaten Modelle entwickelt, um beobachtete Signaturen erklären zu können und die anschließend dabei helfen sollen, die Magnetfeldmessungen der aktuellen BepiColombo-Mission noch genauer planen zu können.

In diesem Vortrag wird das KTH-Modell vorgestellt, ein modulares Modell, mit dem sich das Magnetfeld innerhalb der Merkurmagnetosphäre berechnen lässt. Dieses überarbeitete Modell beinhaltet zum ersten Mal ein realistisches Neutralschichtmodell, dass an den MESSENGER-Daten orientiert ist. Eine Residuenanalyse zeigt, dass mit diesem neuen Modul die Signaturen der feldparallelen Ströme und der zugehörigen Schließungsströme besser erkennbar sind. Darüber hinaus bietet das Modell Potential für eine Verbesserung der Hauptfeldbestimmung.

EP 6.4 Thu 12:00 H8

New dynamo models with a stably stratified layer as an explanation for Mercury's unique magnetic field — •Patrick Kolhey[1], Daniel Heyner[1], Johannes Wicht[2], and Karl-Heinz Glassmeier[1] — [1]Institut für Geophysik und extraterrestrische Physik, TU Braunschweig — [2]Max Planck Institute for Solar System Research, Göttingen

Since the discovery of Mercury's peculiar magnetic field it has raised questions about the dynamo process in the fluid core. The surface magnetic field is rather weak, 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. One promising model suggests a stably stratified layer right underneath the core-mantle boundary. As a consequence the magnetic field deep inside the core is efficiently damped by passing through the stably stratified layer due to a so-called skin effect. Additionally, the non-axisymmetric parts of the magnetic field are vanishing, too, such that a dipole dominated magnetic is left at the planet's surface. 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 explore a wide parameter range, varying mainly the Rayleigh and Ekman number under the aspect of a strongly stratified layer. We show which conditions are necessary to produce a Mercury-like magnetic field and give a inside about the planets interior structure.