EP 11: Planets and Small Bodies

Time: Friday 11:00–12:25 Location: KH 01.019

Invited Talk EP 11.1 Fri 11:00 KH 01.019

Iron and the search for life on Mars — •Christian Schröder — Max Planck Institute for Solar System Research, Göttingen, Germany

Iron is a major rock-forming element. Because it is redox-active, it connects the geosphere with (bio)geochemical cycles of the CHNOPS elements essential to life. Compared to Earth, Mars has accreted from a more oxidized reservoir and therefore retained more iron in its mantle. This iron remains mobile in aqueous systems because Mars' atmosphere and water have never been fully oxygenated. Iron thus plays a dominant role in the search for life on the Red Planet when assessing its habitability as well as the preservation and detection of potential biosignatures. For example: Serpentinization of iron-bearing olivine can generate organic molecules through Fisher-Tropsch type synthesis; minerals indicating iron redox cycling provide strong potential biosignatures; reactive iron mineral phases sequester and preserve organic carbon compounds as potential biosignatures over geological timescales; but iron may also hamper the detection of organic compounds with GCMS or Raman spectroscopy. This presentation will put recent results into the context of the current state of international Mars exploration.

EP 11.2 Fri 11:30 KH 01.019

Sonar Simulations of the TRIPLE Forefield Reconnaissance System with COMSOL — •Julien Leroux, Alexandros Deslis, Ömer Altug, Jan Audehm, Mia Giang Do, Lars Heuermann, Dirk Heinen, Lukas Michels, Andreas Nöll, Christopher Wiebusch, and Simon Zierke — Physics Institute IIIb, RWTH Aachen, Germany

The TRIPLE (Technologies for Rapid Ice Penetration and Subglacial Lake Exploration) project line was initiated by the German Space Agency at DLR in order to pioneer the exploration of subglacial oceans on icy moons such as Europa and Enceladus, in the search for extraterrestrial life. In TRIPLE, we explore numerous technologies to safely navigate a melting probe through the ice cover. The melting probe must be able to detect hazards such as debris or crevasses, as well as locating an anchoring point at the water-ice boundary below the glacier. For this, the TRIPLE Forefield Reconnaissance System (TRIPLE-FRS) employs a combination of radar and sonar integrated into the melting head of the probe. This system must preserve the melting head's narrow profile, high melting speed, and maximize the reconnaissance performance. For the optimization of the sonar system, we perform finite element simulations using COMSOL. We present the latest results from these studies.

EP 11.3 Fri 11:45 KH 01.019

Characterising and Evaluating Acoustic Transducers in Water for TRIPLE-FRS — •Alexandros Deslis, Ömer Altug, Jan Audehm, Mia Giang Do, Dirk Heinen, Lars Heuermann, Julien Leroux, Lukas Michels, Andreas Nöll, Christopher Wiebusch, and Simon Zierke — III. Physikalisches Institut B - RWTH Aachen University

The TRIPLE project line, initiated by the German Space Agency at DLR, aims to develop technologies for the exploration of subglacial ocean worlds on moons of the outer solar system, in the search for extraterrestrial life. TRIPLE consists of three core components: a melting probe for penetrating the ice, an autonomous underwater exploration vehicle, and an astrobiological laboratory for sample analysis. One key subsystem of the melting probe is the Forefield Reconnaissance System (FRS), which enables the detection of obstacles within the ice as well as the identification of the ice-water boundary. It includes a sonar which employs a piezoelectric tonpilz transducer to both emit and receive acoustic signals. Several transducer designs were evaluated in water in the laboratory. Here, we compare key acoustic parameters, such as sending and receiving performances, across these designs in search for the most promising setup for the mission's needs. This presentation introduces the methods and presents results of these studies.

EP 11.4 Fri 12:00 KH 01.019

Time-Variability of the Galactic Positron Annihilation Signal — •Rudi Reinhardt and Thomas Siegert — Julius-Maximilians-Universität Würzburg, Würzburg, Germany

The interactions of low-energy cosmic-rays with asteroids might lead to a measurable variable gamma-ray foreground emission within our Solar system. Siegert (2024) modeled the spatial distribution of all relevant asteroid populations (Main Belt Asteroids, Jovian and Neptunian Trojans and the Kuiper Belt) to calculate their appearances by line-of-sight integrations. The signal is expected to vary in time due to the relative motion of Earth and the asteroids. In this work we used 20 yr of INTEGRAL/SPI data to search for this time-variable foreground albedo in both, the 511 keV line and the ortho-Positronium (oPs) continuum. Since the Galaxy is bright in the bulge at 511 keV, we can determine its variability on a two year timescale, which allows us to constrain the possible contributions from all asteroid families. Our analysis shows no significant emission signal for all considered populations. However, we find a significant 511 keV signal in the vicinity of the Galactic center, which may mimic variable diffuse emission unless its time variability is taken into account. In a 20x20 deg2 region around the Galactic center, we find several point-like hotspots which coincide spatially with the distribution of globular clusters. Preliminary results of GEANT4 simulations of electromagnetic and hadronic interactions of cosmic-rays with asteroids agree with contemporaneous simulations by DeGaetano et al. (2023) using FLUKA, with fluxes being several orders of magnitude smaller than previously estimated.

Poster Pitch: EP 25 (Broer), EP 26 (Kinne)