EP 4: Planets and Small bodies

Time: Tuesday 14:00–15:35 Location: EP-H1

Invited Talk EP 4.1 Tue 14:00 EP-H1

Exploration of the Jupiter system with a small submillimetre wave telescope onboard the JUICE satellite — •Paul Hartogh — Justus-von-Liebig-Weg 3, 37077 Göttingen, Germany

JUICE - JUpiter ICy moons Explorer it the first large class mission of ESA's Cosmic Vision 2015 - 2025 program. The JUICE satellite is planned to be launched in 2023 and will arrive in 2032. The primary mission in the Jupiter system will take about three years. The focus of the mission is Jupiter itself and the Galilean satellites, their internal oceans and potential habitability. Recent ground-based observations of Europa and Ganymede showed water vapor plumes, probably related to geysers on their surfaces. JUICE intends to identify the geysers, monitor their potential activity and molecular and isotopic composition in order to constrain satellite formation models and development processes (of chemical, physical and potentially biologic nature) in the interior of their oceans. Jupiter itself is seen as an archetype of a gas giant. A better understanding of its atmospheric processes will be a baseline for a better understanding of gas giants outside our solar system. JUICE will characterize the general circulation of Jupiter's atmosphere, its meteorology, chemistry and structure between the upper cloud deck and the ionosphere and magnetosphere. The Submillimetre Wave Instrument (SWI) is part of the JUICE science payload. SWI covers two spectral bands between 530 and 1275 GHz. The SWI functionalities and specifications as well as required technology developments during the last decades and how the unique capabilities of SWI will help to answer JUICE key science questions will be presented.

EP 4.2 Tue 14:30 EP-H1

A PE-based radio propagation simulation for glaciers and ice moons with depth-dependent permittivity profiles — •Gianluca Boccarella, Alex Kyriacou, and Pia Friend — Bergische Universität Wuppertal, Gaußstraße 20, 42119 Wuppertal

Enceladus Explorer (EnEx) is an initiative from the DLR to develop a melting probe that can reach a near surface water pocket on the ice moon Enceladus to search for microbial life. To find the water pocket a radar imaging system is needed, but the unknown permittivity of the surface ice will affect the accuracy of the measurements. We present an ice layering model of Enceladus including dielectric properties for the different types of ice layers, derived from Cassini data. We introduce a simulation which utilises Parabolic Equations (PE) to model radio propagation through inhomogeneous dielectric media such as ice environments on terrestrial glaciers or ice moons. Target objects embedded in the ice can be identified together with further reflections from the interface layers in the time-domain spectrum. By extracting the time of flight of respective reflected signals one can calculate the distance from the antennae to the target. Radar images, which would be obtained if a transmitter and receiver were placed on the melting probe moving vertically downwards through the ice, can be simulated and compared to each other for different permittivity profiles and targets. *This project is funded by the Enceladus Explorer Initiative of the DLR Space Administration

EP 4.3 Tue 14:45 EP-H1

On the Subsurface Exploration of Ocean Worlds in the Outer Solar System with the TRIPLE project — •Mia Giang Do[1], Jan Audehm[1], Dirk Heinen[1], Johanna Hermannsgabner[1], Sharif El Mentawi[1], Andreas Nöll[1], Shreyans Sakhare[1], Christopher Wiebusch[1], Yuting Ye[1], Simon Zierke[1], Clemens Espe[2], Marco Feldmann[2], and Gero Francke[2] for the TRIPLE-nanoAUV-Collaboration — [1]RWTH Aachen University - Physics Institute III B, Aachen, Germany — [2]GSI - Gesellschaft für Systementwicklung und Instrumentierung mbH, Aachen, Germany

In search of extraterrestrial life, the icy moons in the solar system are prime targets as they are suspected to harbor a subsurface ocean of liquid water. Future space missions to explore these subsurface ocean worlds are of great interest. A mission scenario includes landing on the surface, penetrating through the massive ice shell with a probe, and diving into the ocean with an underwater vehicle that is collecting samples for identifying potential habitats. Within TRIPLE (Technologies for Rapid Ice Penetration and subglacial Lake Exploration), a system containing three components: a melting probe, a miniaturized autonomous underwater vehicle and an in-situ astrobiological laboratory, is in development. Aiming for a mission to Jupiter's moon Europa, the system will be tested in an analogue environment in Antarctica. The talk will give an overview of the TRIPLE project with a focus on the technological challenges of the melting probe and the latest status of the system. TRIPLE is a project line that has been initiated by the German Space Agency at DLR.

EP 4.4 Tue 15:00 EP-H1

TRIPLE-IceCraft - A Retrievable Melting Probe to Transport Scientific Payloads into Subglacial Lakes or Oceans — •Dirk Heinen[1], Simon Zierke[1], Jan Audehm[1], Mia Giang Do[1], Yuting Ye[1], Christopher Wiebusch[1], Marco Feldmann[2], Gero Francke[2], and Clemens Espe[2] — [1]RWTH Aachen University, III. Physikalisches Institut B, Otto-Blumenthal-Str., 52074 Aachen — [2]GSI - Gesellschaft für Systementwicklung und Instrumentierung mbH, Liebigstraße 26, 52070 Aachen

Within TRIPLE, initiated by the German Space Agency at DLR, Technologies for Rapid Ice Penetration and subglacial Lake Exploration are being researched. TRIPLE aims to explore the subglacial ocean of the Jovian moon Europa. Prior to this flight mission a technology demonstration is planned in Antarctica. For accessing the subglacial water reservoir, a drill or melting probe needs to penetrate the ice first.

The TRIPLE-IceCraft melting probe is currently in development. It is a modular bus system for transporting standardized payloads through ice. The design will be suitable for transporting a scientific payload through several hundred meters of ice, penetrating into a subglacial ocean or lake, and returning later to the surface. The TRIPLE-IceCraft will be demonstrated in an analog scenario at the Ekström Ice Shelf in Antarctica in 2023. In this talk we present the design and first results on subsystem tests of the TRIPLE-IceCraft.

EP 4.5 Tue 15:15 EP-H1

TRIPLE-IceCraft: A retrievable melting probe for transporting scientific payloads through glacial ice — •Simon Zierke[1], Dirk Heinen[1], Jan Audehm[1], Mia Giang Do[1], Yuting Ye[1], Christopher Wiebusch[1], Marco Feldmann[2], Gero Francke[2], and Clemens Espe[2] — [1]RWTH Aachen University - Physics Institute III B, Aachen, Germany — [2]GSI - Gesellschaft für Systementwicklung und Instrumentierung mbH, Aachen, Germany

The exploration of subglacial worlds is one of the greatest technological challenges for both space science and terrestrial glaciology. Within TRIPLE, initiated by the German Space Agency at DLR, technologies are being developed to address these challenges. One of the projects within TRIPLE is TRIPLE-IceCraft. Its goal is the development of an electrothermal drill as a terrestrial demonstrator for transporting payloads through an ice sheet of several hundred meters at a drilling velocity of several meters per hour. The same-named drill, TRIPLE-IceCraft, is a modular system including a cable which can be coiled and uncoiled into a dedicated compartment. The cable bears the weight of the drill and is used for communication and power. This allows the refreezing of the melt hole including the cable, so it can be operated even in cold glacial ice. The demonstration of the TRIPLE-IceCraft is planned close to the Antarctic research station Neumayer III located on the Ekström Ice Shelf in 2023. In this poster, we focus on the technical design of the TRIPLE-IceCraft.

EP 4.6 Tue 15:25 EP-H1

The In-Ice Sonar System for the TRIPLE Forefield Reconnaissance System — •Jan Audehm, Ben Burgmann, Mia Giang Do, Sharif El Mentawi, Dirk Heinen, Johanna Hermannsgabner, Andreas Nöll, Shreyans Sakhare, Christopher Wiebusch, Yuting Ye, and Simon Zierke — RWTH Aachen University - Physics Institute III B, Aachen, Germany

The icy moons Europa and Enceladus belong to the most interesting sites for the search of extra-terrestrial life in the solar system. It is assumed that in the oceans beneath their thick ice crusts preconditions for the emergence of life are fulfilled.

In the TRIPLE-project Technologies for Rapid Ice Penetration and subglacial Lake Exploration are developed to enable future exploration missions to the subsurface oceans of icy moons. These technologies will be demonstrated in a terrestrial analog scenario in Antarctica. Here, a melting probe will transport a small autonomous underwater vehicle

(TRIPLE-nanoAUV) through the ice to an underlying water reservoir.

For this mission it is of great importance that the probe avoids obstacles on the path through the ice and can detect the transition between ice and water to anchor there. This task is addressed by TRIPLE-FRS being a Forefield Reconnaissance System using a hybrid system consisting of a radar, a sonar, and a permittivity sensor. Combining the complementary techniques assures a high performance of the FRS in ice as well as in water. This poster presents our concept for the sonar system and simulations of the acoustic transducer characteristics.