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The Distributed Planetary Simulation and Sample Analysis Facilities

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Abstract

The Europlanet 2020 Research Infrastructure (EPN2020-RI) provides a pan-EU infrastructure that allows the multi-disciplinary European planetary science community to address the key scientific and technological challenges of modern planetary science by providing access to state-of-the-art research facilities across the European Research Area and a structure within which such research can be coordinated.

The Distributed Planetary Simulation Facility makes laboratory facilities available capable of simulating the wide range of environments encountered on planetary bodies. The Distributed Planetary Simulation Facility provides the comprehensive capability to determine isotopic and elemental compositions of planetary samples, including analyses at high spatial resolution, high precision and high sensitivity.

1. Introduction

A central part of the Europlanet 2020 RI programme is to allow any European researcher interested in pursuing planetary science research access to a comprehensive set of laboratory facilities tailored to the needs of planetary research. Access is provided by a **Transnational Access (TA)** programme that supports travel and local accommodation costs of European researchers (and of researchers from Third Countries under certain conditions) at the facility for an approved period of time to conduct their own research programme. Applications are made in response to annual calls and are subject to peer review. It should be noted that applicants must apply to use facilities outside the country in which they are employed (i.e. it is a transnational access). Applications can be made for analytical time or access to planetary simulation laboratory ranging from single days up to several weeks and up to two researchers can be fully financed in each research visit.

2. Distributed Planetary Simulation Facility

The Distributed Planetary Simulation Facility (DPSF) joins seven of the leading laboratories for planetary science into a virtual facility. Three laboratory facilities that were already part of the EU Framework Program 7 research infrastructure have introduced new infrastructure and expanded their methodologies compared to the previous RI, allowing visitors to measure samples under analogue conditions for Mercury, Venus, Mars, the Moon and near-Earth asteroids. Among the four new additions to the DPSF, the low-temperature spectroscopy laboratory will extend this capacity to comets and the icy moons of the outer planets. The added life detection techniques will support the study of extremophiles and the range of potential habitable environments in the Solar System. The new high-temperature and pressure petrology laboratory will extend our knowledge from the planetary surface to the interior.

The DPSF consists of the following facilities:

- Planetary Spectroscopy Laboratory, Germany
- Planetary Environment Facilities at Aarhus University, Denmark
- Open University Mars Chamber, UK
- High-pressure laboratory at VUA, NL
- Cold Surfaces spectroscopy, Institut de Planétologie et Astrophysique de Grenoble (IPAG), France
- Center for microbial life detection at Medical University Graz, Austria
- Petrology-Mineralogy Characterisation Facility (PMCF), Mineral and Planetary Sciences Division, Natural History Museum, London, UK

2.1 New capabilities in the DPSF

The two world-leading spectral facilities in the DPSF (DLR and IPAG Grenoble) currently have unique capabilities that attract large demand from international users. There is, however, a growing requirement from the community for more comprehensive spectral information. An upgrade program has take these two laboratories beyond the current state-of-the-art, adding new capabilities to both facilities that will maintain their premiere status and offer users unprecedented capabilities to perform experiments that are of direct relevance for the planning and implementation phases of forthcoming missions to Mercury and the outer ice moons of the giant outer planets. In addition, the upgrade program has expanded the current world-leading capabilities of the Aarhus University Planetary Simulator Facility and allows the development of new techniques for the study of planetary dust and sand transport, with a particular focus will be on Martian conditions that the ExoMars missions expect to encounter.

3. Distributed Sample Analysis Facility

The new analytical capabilities offered in isotope geochemistry and cosmochemistry by "The Distributed Sample Analysis Facility" (DSAF) play a key role in understanding the complex feed-back mechanisms involved in the formation and evolution of planetary bodies and the (bio) geochemical cycles that operate within and between different parts of these bodies. The combined DSAF infrastructure provides the comprehensive capability to determine isotopic and elemental analyses at high spatial resolution, down to ~3 nanometres (nm), high precision (down to 5 part per 1,000,000 (ppm)) and high sensitivity (sub nanogram (ng) sample sizes). DSAF will allow scientists from across the ERA to access large, state-of-the-art infrastructure and to work under the guidance of scientists with expertise in sample handling and preparation. Visitors will be able to analyse terrestrial and extra-terrestrial samples (meteorites, returned samples) in order to (i) identify the nature of stellar sources that contributed material to the Solar System (ii) determine the rates and nature of the processes that controlled planetary accretion and differentiation and the subsequent evolution and interaction between the interior surface and atmosphere, (iii) constrain the nature of the Earth's building blocks, (iv) quantify biogeochemical cycles on Earth to determine proxies that can act for the detection of life elsewhere in the Solar System.

The DSAF consists of the following facilities:

- NanoSims and Stable Isotope Analytical Facilities. The OU, Milton Keynes, United Kingdom
- Radiogenic & non-traditional stable isotopes. IfP, University of Münster, Münster, Germany
- Radiogenic and non-traditional stable isotope facility, VU University, Amsterdam, NL
- Radiogenic, non-traditional stable & rare gas isotopes, CRPG, Nancy, France

3.1 New capabilities in the DSAF

Sample return missions have the potential to be truly ground-breaking as they provide scientifically unique material for detailed analysis. An upgrade focused on "Sample Handling Protocols and Ultra-Sensitive Isotopic Analysis", which includes two leading instrument manufacturers, will allow us to make measurements that will address two key goals of planetary scientists: i) to obtain 'ground truth' and calibrate remote sensing measurements; and ii) to place absolute constraints on the nature, timing and rates of processes that have operated within and on (proto-)planets. Such data will allow a critical assessment of existing models of planetary development, including the Earth, and provide indicators for the search for life elsewhere in the Solar System. Returned samples will also help to contextualise the interpretation of the diverse samples in existing meteorite collections.

4. Application and selection

European Science Foundation (ESF) coordinates the application and peer review process and no other members of the Europlanet 2020 RI consortium are involved in the evaluation procedure.

For more details go to our website:

http://www.europlanet-2020-ri.eu/

Europlanet 2020 RI is designed to support planetary science but applications in other research disciplines are also considered based on innovation and potential scientific and technological impact to the planetary sciences field.