EPN 2024 RI

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Project Co-ordinator: Prof Nigel Mason, University of Kent

Executive Summary / Abstract:

Despite the impact of COVID-19 causing minor delays in recruitment and training, the six tasks that are part of JRA1 are on schedule. One Task is complete (4.2.2) and the new capability has been used in an initial TA visit. Four method development tasks are making substantial progress and are currently on schedule to deliver new capabilities by the end of 2021 as planned. Task 4.2.6 involves training and knowledge transfer from ETH Zurich to ISOTOPTECH in Hungary and could potentially suffer delays in the future should strict COVID-19 lock downs continue until the late summer.

1. **Nature:** R = Report, P = Prototype, D = Demonstrator, O = Other
2. **Dissemination level:**

PU	PP	RE	CO
Public	Restricted to other programme participants (including the Commission Service)	Restricted to a group specified by the consortium (including the Commission Services)	Confidential, only for members of the consortium (excluding the Commission Services)

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Deliverable

1. Explanation of work & Overview of progress

JRA 1 comprises six specific tasks involving eleven research institutes and three industrial partners. The six tasks are planned to be completed within the first two years of the project to deliver the improved capabilities for TA calls in the final two years of the project.

The management of the JRA is coordinated by the TA Sub-Committee (VUA NHM, DLR and AU) and supported by the TA office at the VUA that also provides the secretarial support.

1.1 Objectives

JRA1 aims to develop five world-leading TA2 facilities to beyond the current state-of-the-art by providing improved analytical (4) and experimental capabilities (1) relevant to the planning, implementation and scientific exploitation phases of current and forthcoming missions to Mercury, Mars, asteroids, comets and the icy moons of Jupiter. The expanded capabilities will be offered for TA access in Years 3 & 4 of EPN-2024-RI. An additional goal of two tasks is knowledge transfer to two active facilities in under-represented states (URS), one involving the joint development of new capabilities, the second direct training at a facility recognised as the world leader in the field. The specific scientific and methodological goals of the JRA reflect the overall EPN-2024-RI TA strategy:
i) expansion in European capabilities to study icy surfaces in preparation for the JUICE mission;
ii) non-destructive/minimally invasive sample characterisation/analysis
iii) the overall project objectives of building closer ties to industry and developing capacity in URS.

1.2 Explanation of the work carried in WP

Task 4.2.1 Delivering a cryogenic reflectance spectroscopy under vacuum conditions for outer planets exploration. Led by DLR, but involves researchers at CNRS-IPAG (Grenoble), Aarhus University (AU) and University of Stirling (STIR). The researcher at STIR has re-located to Department of Computer Science, Electrical and Space Engineering, Luleå University of Technology, Sweden (LTU) from January 2021, but remains involved in the project.

All test measurements have been performed to verify the parameters required for the setup. This was achieved before DLR went into a second COVID lockdown. Several industrial providers have been contacted to build the vacuum chamber and the integrated cooling system. Detailed discussions have been undertaken with a company that would 3D print the complete system. If this solution can be implemented it would lead to significantly improved performance, reduced need for maintenance and faster implementation. It would also be a trailblazer for future setups. Due to the COVID-19 situation, discussions with companies are challenging but it still appears probable that the system will be functional on schedule at the end of 2021.

Task 4.2.2 Upgrading an astronomical ice-spectroscopy UHV chamber with UV/Vis and mass spectroscopy extensions for improving its TA potential. Led by Atomki in collaboration with University of Kent (UniKent).

This task has been completed. A UHV chamber was supplied by a collaborating institute enabling the facility to be upgraded and made operational ahead of schedule. The first TA visit was started in November 2020.
Five days of beamtime out of ten was provided between 30th November and 4th December for the TA project: *A Systematic Study of Sulfur Ion Radiolysis of Simple Oxide Ices.* Zuzana Kanuchova and Duncan V. Mifsud were present at the facility. Due to an instrument failure the TA visit was not completed in the assigned week and a second visit to complete the work is scheduled for early 2021. Presentation of the results of this work are expected at EPSC 2021.

Task 4.2.3 New capabilities for icy jet simulation at Aarhus wind tunnel. Led by Aarhus University and involving researchers at the University of Stirling (STIR) and the Open University (OU). The researcher at STIR re-located to LTU in January 2021 but remains involved in the project.

By improving the vacuum capabilities (reducing the ultimate pressure) and allowing ice aerosol generation, the improvements planned for this activity allow improved simulation of icy moon environments. Procurement and installation of a new pump system (consisting of roots pumps and turbo pumps) has been carried out, preliminary tests have been successfully performed, final testing is scheduled for early 2021. The process of designing the new cryogenic injection/aerosilisation system has begun. This maintains the original schedule for completion of this JRA before the end of 2021.

Task 4.2.4 Non-destructive characterisation of meteorites. This project is led by Natural History Museum (NHM) and involves, UniKent and the company, Bruker Nano GmbH (Germany).

The aim of this task is to develop quantitative analysis of platinum group element (PGE) abundances using Secondary Electron Microscopy and energy dispersive x-ray spectroscopy (EDX), which is challenging because of spectral overlaps of the regions of interest. The PGEs are important elements in planetary sciences as they are depleted compared to cosmic abundances in planetary crusts and mantles, and highly enriched in planetary cores. The technique requires use of a low accelerating voltage to enable high spatial resolution that will allow analysis of submicron PGE nuggets known to be present in meteorites and in impactites. The JRA has been partly delayed due to COVID-19, as local restrictions prohibit the required in-person training in the laboratory. The job will be advertised in January 2021 with an April 1st start and we anticipate completion of project in October 2021, in time for the 3rd TA Call. Apart from recruitment, all other aspects of the project are in place and ready to proceed. Progress will be reported in a presentation at EPSC 2021.

Task 4.2.5 Improvement of analytical methodologies for the use of 10^{13} Ohm resistors in state-of-the-art analytical instrumentation is led by Vrije Universiteit, Amsterdam (VUA) and involves the company, ThermoFisher (Germany) and CNRS-CRPG (Nancy).

COVID-19 has had some impact on recruitment of junior researchers to work on this task. CRPG hired a post-doc (Xiaoyu Zhou) who started in September 2020 for one year, with partial funding from EPN 2024 RI. Training in the lab has been challenging but ultimately successful. Preliminary data are very promising and will lead to publication of an application note involving the industrial partner, ThermoFisher.

The VUA has completed the appointment process of an ESR who will start 1st February 2021, Matteo Branchetti (Italian). He will be optimising methods to analyse NdO+ to reduce still further the sample size needed to analyse planetary material. Despite the delays in recruitment, the VUA is confident that it can deliver the new capability in 2021 before the next TA call.

Task 4.2.6 An adaptation and improvement of noble gas analysis in rock and mineral samples. Led by ETH Zurich.

This task involves the training of researchers from ISOTOPTECH (Hungary) to allow them to offer a TA facility from Year 3. A detailed training schedule and exchange visits were set up. Initial training has been conducted but COVID-19 may impact the plan and require flexibility. Due to the physical

exchange and training elements of this task, it is the one part of JRA1 about which we are concerned and may suffer delays in full implementation.

1.3 Impact

The potential impact of the new technical development remains the same. The fact that the work will result in significant impact has been validated by the outreach associated with the partially completed TA visit to the completed ice-spectroscopy UHV chamber at Atomki (Task 4.2.2). In addition, the initial development work undertaken as part of the method development in using 10^{13} Ohm resistors conducted at CRPG studying the Re-Os isotope system will lead to publication of an application note by the Industrial partner, ThermoFisher.

2. Update of exploitation & dissemination plan

The exploitation and dissemination plan remains unchanged.

3. Update of data management plan

Not applicable; data management will be assessed once new methods are fully validated and the nature of standard calibrations are known; i.e. if greater data storage is required for comparative analyses.

4. Follow-up of recommendations & comments from previous review(s)

Not applicable

5. Deviations from Annex 1 (DoA)

5.1 Tasks

Despite the impact of COVID-19 causing complications with lab access and physical collaboration meetings, all the projects are roughly on schedule and expected to be able to meet deadlines for the delivery of the new capabilities unless severe lockdowns are introduced for extensive periods of time. Under such circumstances, work planned to validate the new capabilities maybe delayed (Tasks 4.2.1, 3, 4, & 5) and the training of staff uncompleted (Tasks 4.2.6).

5.2 Use of resources

No significant deviations from the plan other than some changes in starting dates.