Report on the outcomes of a Short-Term Scientific Mission[1]

Action number: CA21126

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Details of the STSM

Title: Production and characterization of cosmic dust grains for experimental campaign at FELIX

Start and end date: 26/11/2025 to 01/12/2025

Description of the work carried out during the STSM

The STSM was conducted at the Friedrich-Schiller University Jena under the supervision of PD Dr. Jäger. The goal of the visit was to acquire hands-on experience with the experimental setup for producing carbonaceous and siliceous refractory dust grains, the Dust Production Machine, and produce high-quality dust analogs required for upcoming experiments at FELIX in December 2025.

The first part of the visit consisted of an introduction to, and familiarization with, the experimental setup for dust synthesis. This included training in operating the dust production setup, with particular emphasis on target material selection, establishing optimal quenching gas conditions, and adjusting laser power and targeting parameters to ensure stable ablation. Additional training was also provided on routine maintenance and cleaning procedures between depositions to secure reproducibility in the dust production rate and to minimize contamination during successive experiments.

A central objective of the visit was the production of dust analogs for subsequent IR-induced ice–dust interaction studies at FELIX. Two dust samples were successfully synthesized and prepared for shipment to Nijmegen, where they will be used in the upcoming beamtime. Because these samples were intended for reflection FTIR studies, but the Jena setup is optimized for transmission measurements, the dust was also deposited onto KBr substrates. This approach was used to enable characterization of the samples both immediately following deposition and after controlled exposure to atmospheric conditions, to assess contamination effects. However, the FTIR spectrometer integrated into the experimental setup was unable to detect the deposited layers. As a result, in-situ characterization could not be performed as planned.

Instead of using the FTIR integrated into the experimental setup, post-air-exposure spectral characterization was conducted using a more sensitive bench-top FTIR spectrometer at the Friedrich-Schiller University Jena with the assistance of Dr. Gaël Rouillé. These measurements successfully

[1] This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarded grant. The Grant Awarding Coordinator coordinates the evaluation of this report on behalf of the Action MC and instructs the GH for payment of the Grant.

confirmed the presence of absorption features of the deposited dust and provided an estimate of the level of surface contamination following air exposure.

Beyond the experimental work, the visit enabled extensive scientific discussions on dust formation processes, the design principles of dust production systems, and strategies for implementing this knowledge into the new ice-dust experimental system at Leiden. The visit also included planning activities for the upcoming FELIX beamtime, during which the samples produced in Jena will be used for IR irradiation studies to explore ice–dust interaction pathways under astrophysical conditions.

Description of the STSM main achievements and planned follow-up activities

The STSM successfully fulfilled its planned objectives and yielded the expected scientific and training outcomes. During the visit, two dust analog samples were produced and prepared for transport to Nijmegen, where they will be used in the FELIX beamtime scheduled for December 2025. In addition to these experimental results, the visit provided substantial hands-on experience in operating a dust production system. The training included all stages of the synthesis process, including laser ablation, gas-quenching conditions, substrate collection, and system maintenance, and will be directly applicable to ongoing and future laboratory work at Leiden Observatory. The visit therefore significantly strengthened the experimental competence necessary for the commissioning of the new dust production setup at Leiden.

The STSM also facilitated productive scientific exchanges between the Leiden and Jena groups, allowing for detailed discussions on dust formation processes, technical considerations for the implementation of dust synthesis capabilities, and strategies for integrating dust analog production with ice-deposition and irradiation experiments. These outcomes support the Action MoU Research Coordination Objective RCO4 by contributing to the development of new laboratory experiments targeting the formation, spectroscopy, and reactivity of nano-carbonaceous materials within WG2. At the same time, the skills acquired and the knowledge transferred during the visit advance the Capacity-building Objectives CBO1 and CBO3 by fostering expertise in the production and study of astrophysical dust analogs relevant to WG3.

Looking ahead, several follow-up activities have been planned. The dust samples produced during the STSM will be used in the upcoming FELIX experiments on IR-induced ice–dust interactions. Moreover, the insights gained during the visit will directly support the finalization and commissioning of the new experimental setup in Leiden, where dust production capabilities will play a central role in future research on dust–ice chemistry. Continued collaboration with the Jena group is anticipated, particularly regarding refinement of dust synthesis protocols, improvement of characterization techniques, and joint planning of subsequent experimental campaigns. The STSM thus represents a successful start for a long-term scientific partnership that will contribute to the objectives of WG2 and WG3 and is expected to lead to future joint research outputs.

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