

Report on the outcomes of a Short-Term Scientific Mission¹

Action number: CA20129

Grantee name: Elisabeth Tzouridis

Details of the STSM

Title: Dynamics of Molecular Uptake and Irradiation in Glyoxylic Acid Clusters Relevant to Atmospheric Processes

Start and end date: 05/05/2025 to 16/05/2025

Description of the work carried out during the STSM

Description of the activities carried out during the STSM. Any deviations from the initial working plan shall also be described in this section.

(max. 500 words)

During the STSM period from the 05/05/25 – 16/05/25, we investigated the ions produced by co-expanding glyoxylic acid (GA) vapours in a supersonic expansion with the experimental setup CLUB (cluster beam apparatus) in prague. We received complex spectra with insight into the different clusters that are being formed such as GA/water clusters (parent: $m/z = 74$) and double GA/water clusters (parent: $m/z = 149$).

Subsequently, we conducted pickup experiments by introducing different organic molecules—namely methanol, isoprene, 3-methyl-3-buten-1-ol (3M3BoI), and 2-methyl-3-buten-2-ol (2M3BoI)—into pure GA clusters in the mixing chamber. Isoprene was cooled to 1 °C to improve pressure control.

Initial results, particularly from single pickup experiments with methanol, were promising. However, unexpected peaks at $m/z = 76, 94, 112, 130, 148, 166, 184, 202$ etc., began to appear (parent: $m/z = 76$, rest water additions). These peaks could not be assigned to any known clusters containing argon, GA, water, or oil. Furthermore, their intensities varied inconsistently in relation to other peaks, leading to speculation that they may originate from impurities or possible decomposition or transformation of GA. To minimize possibilities of decomposition, GA was heated to temperatures below 100 °C and later switched out for a new batch of GA, but this did not yield any improvements. After the switch out for the new batch, the GA peak at $m/z = 74$ only lasted for a few spectra and the peak at $m/z = 76$ dominated after that again. Due to the overpowering peaks of $m/z = 76$ and its water series, experiments with GA were paused for now.

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.

Additionally, 2M3Bol exhibited significantly greater signal scattering compared to its isomer 3M3Bol, suggesting that the position of functional groups influences the interaction between GA and the pickup molecules.

Another recurring issue was occasional abrupt drops in pressure—once or twice per day—most clearly observed during methanol measurements. Typically, the ion gauge (mixing chamber) showed a pressure of approximately 4.3×10^{-6} mbar, but on occasion, it unexpectedly dropped to around 8.7×10^{-7} mbar. We suspect this irregularity may be due to a malfunction in the ion gauge within the mixing chamber.

Apart from these measurements I also have talked with Michail and Andrej at the Heyrovsky Institute about the best way to upgrade our cluster beam for reactivity and nucleation studies. This also includes the designing of a supersonic source to generate clusters in molecular beams that we want to incorporate into our setup.

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

Description and assessment of whether the STSM achieved its planned goals and expected outcomes, including specific contribution to Action objective and deliverables, or publications resulting from the STSM. Agreed plans for future follow-up collaborations shall also be described in this section.

(max. 500 words)

Overall, the STS was a successful and a productive experience. I significantly expanded my knowledge in the field and contributed to the discussions and developments within the host institute. Specifically, regarding the design of the new sources and to create sketches of them using SolidWorks. We intend to incorporate these sources into our cluster beam setup in the nearest future.

Although the planned experiment involving GA did not proceed as expected due to an unexpectedly high peak at $m/z = 76$ and its water series, we still gained valuable insights. As a result, the GA experiments have been paused for the time being. However, during the STSM, we discussed the possibility of a follow-up project, with the next collaboration planned for this fall. This would allow us to explore alternative approaches regarding GA and further contribute to the objectives of the Action.