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

Action number: CA21126

Grantee name: Arun Subramani

Details of the STSM

Title: Velocity map imaging of polycyclic aromatic hydrocarbons anions

Start and end data : 13th April – 29th April, 2026

Description of the work carried out during the STSM

The main aim of this STSM was to develop a working experience with Velocity map imaging (VMI) spectrometers which would then be very useful in getting the new VMI system working at DESIREE. To this end, VMI experiments using the PASTA instrument were carried out with different systems. Initial measurements were done on fully deuteurated acetonitrile, CD2CN-. These measurements are complementary to the measurements that were carried out earlier on normal CH2CN- and would help understand the effects of deuteration on detachment processes. In addition to this, we also attempted to record photodetachment spectra near the detachment threshold but we could not find good enough signal in this region. We then moved on to indenyl anions, C9H7-. Velocity map images were recorded at different wavelengths above threshold. The anisotropy of the images seem to be a function of the wavelength of the excitation, indicating the role of vibrational states in the detachment process.

After a few days of measurement, the plasma from the ion source could not be sustained long enough for further measurement. Thus we opened up the system to thoroughly clean the electrodes, as it was suspected that the soot deposited onto the electrodes made them partially conducting. After which, we put it back together and tested it again to ensure it was working. Then we continued measuring VMI images for indenyl.

Apart from the experiments, Dr. Bull is also involved in many projects at DESIREE. We were able to finalize the molecular dynamic simulations that is required to model the RF rate coefficient for a few of our previous DESIREE investigations. We also discussed the methodology through which these calculations are setup in great detail so that similar calculations could be performed at our home laboratory.

[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 Grant Holder Manager to verify the grant documents compliance and proceed with the payment.

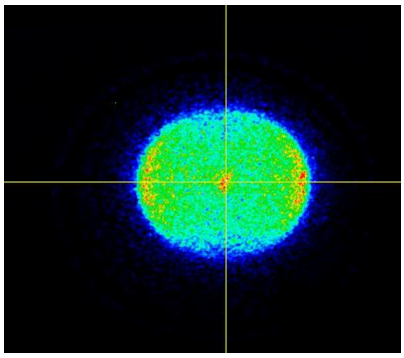


Figure 1: VMI of indenyl anion at 430 nm

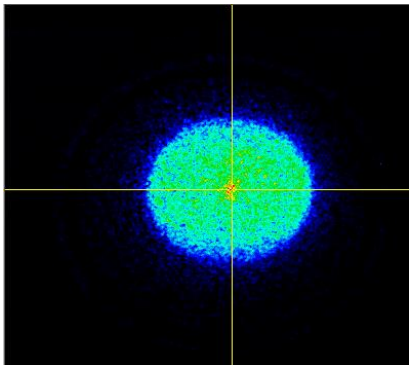


Figure 2: VMI of indenyl anion at 450 nm

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

The PASTA instrument is a versatile system capable of performing both detachment and VMI measurements simultaneously. As a home-built instrument, it allows straightforward access for maintenance and modification. This enabled valuable hands-on experience, through which I gained practical insight into the operation of a VMI spectrometer. These skills are directly transferable to the DESIREE VMI spectrometer, which has only recently been commissioned. In this sense, a key achievement of this STSM is the development of experimental expertise that supports NanoSpace's goal of enabling young researchers to participate in collaborative research and knowledge exchange across institutions.

During the visit, we also prepared a proposal for a follow-up experiment at DESIREE using the same indenyl system, aimed at providing complementary time-dependent measurements to the high-resolution spectrum obtained here. Together, these results would help constrain the likelihood of detecting indenyl anions in space. This proposal is expected to initiate a joint effort between the experimental teams at DESIREE and UEA, alongside continued theoretical support from Dr. Bull.

The VMI spectrometer at DESIREE represents a recent development to expand its capabilities for studying anions, and its performance remains to be fully characterised. Unlike conventional VMI setups, it is coupled to the storage ring, meaning that electrode voltage settings optimised for electron imaging can adversely affect ion trajectories. Its operation therefore requires a careful balance between resolution and ion storage. The experience gained with PASTA's VMI provides a strong foundation for testing and optimising this system, contributing directly to its characterisation. In this way, the present STSM supports NanoSpace's capacity-building objective of improving access to research infrastructures and strengthening collaboration through shared expertise.