MAC: Experimental station for AMO science and Coherent Diffractive Imaging

Contact person: Maria Krikunova, email: maria.krikunova@eli-beams.eu

Scope of the call:

We invite experienced users to explore the current experimental capabilities of the MAC end-station. Possible experiments which can be performed in MAC include: Pump-probe experiments using HHG and auxiliary beams with available detectors and sample delivery systems and CDI experiments with a monochromatized HHG beam. The MAC station is also open for further suggestions. To discuss the feasibility of a project you have in mind, please contact Maria Krikunova.

Brief description of the available set up:

The MAC end station is a _M_ultipurpose end station for _A_MO (Atomic, Molecular and Optical) and _C_DI (Coherent Diffractive Imaging) science using the ELI Beamlines HHG source [1,2]. The design of the MAC vacuum chamber is similar to that of the LAMP chamber in the AMO station at LCLS and the CAMP chamber now located at FLASH, DESY with a DN400CF central cylinder (stainless steel 316LN ESR) and a large number of ports for mounting equipment.

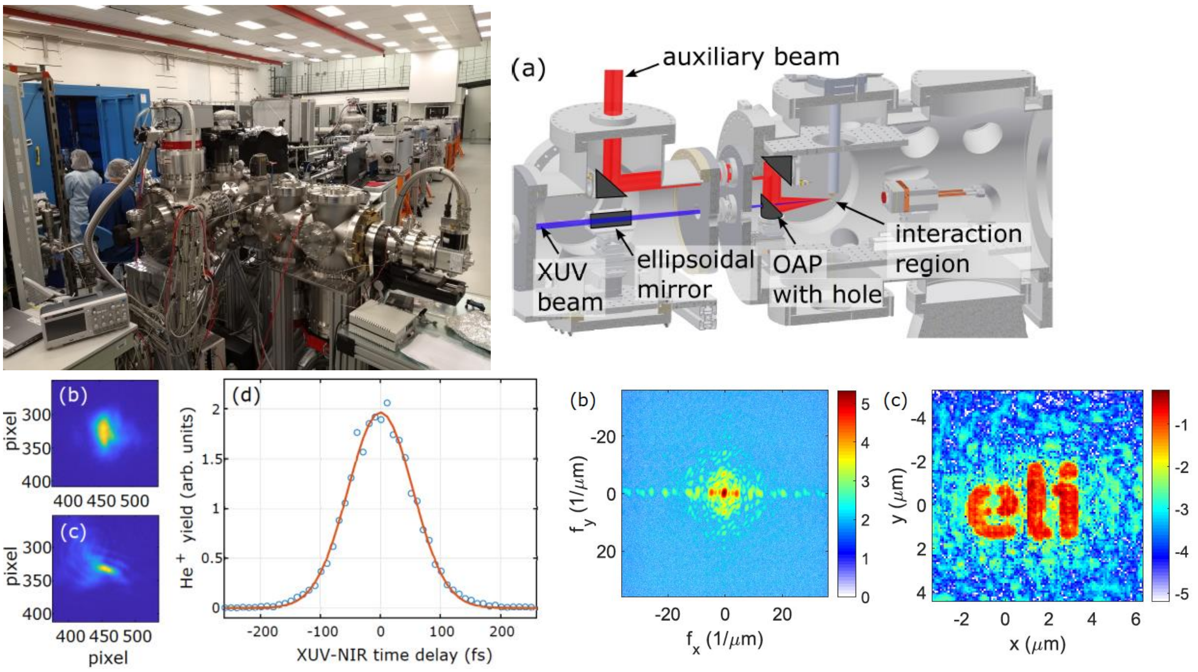

Fig. 1: (Top left) The MAC end station with cryo-cooled cluster source during operation in the E1 experimental hall. (Top right) Set up for pump-probe experiments in the MAC chamber. (Bottom left) IR/XUV overlap imaged with the in-line microscope and in He gas. (Bottom right) Single harmonic diffraction patter and reconstructed image of the ELI logo.

Main experimental geometries

The MAC station offers two complementary XUV focusing geometries using either an XUV monochromator or a back focusing multi-layer coated spherical mirror with the direct beam. When using the monochromator the HHG beam is focused by an ellipsoidal mirror generating a spot size of about 70 μm x 40 μm. Alternatively the elements of the XUV monochromator are removed from the beam path and the XUV beam is refocused by a spherical mirror. Three different coatings are available: (1) centred at 21.5 eV (narrow bandwidth), (2) centrered at 26.6 eV (narrow bandwidth), (3) around 15-27.5 eV (broad bandwidth).

For pump-probe experiments the pump beam is split from the main beam in front of the HHG source and propagated in air to allow pulse modification, before it re-enters vacuum in the MAC chamber and is overlapped with the XUV beam.

Available sample delivery systems and target systems

- Cryo-cooled Even-Lavie valve, maximum repetition rate of 500 Hz
- Molecular source with an Amsterdam Piezo Valve, model ACPV2-100 with a repetition rate up to 5 kHz
- 4-axes fixed sample stage for CDI and fixed targets

Available spectrometers, detection and observation systems

- Electron and ion Time of Flight spectrometers (in house development). Up to 1 kHz shot to shot readout.
- Velocity Map Imaging (VMI 75 mm MCP with a phosphor screen imaged by a camera with 166 fps 1936 x 1216 pix Sony CMOS 1/1.2" sensor 72 dB (~ 12 bit resolution)) with ns gated imaging detector (Velocitas/Photek)
- PI MTE in vacuum XUV CCD
- Microscope for sample observation and optimization

Refs.

[1] Plasma channel formation in NIR laser-irradiated carrier gas from an aerosol nanoparticle injector Sci Rep 9, 8851, https://doi.org/10.1038/s41598-019-45120-3 (2019). E. Klimešová, *et al.*

[2] A Multipurpose End-Station for Atomic, Molecular and Optical Sciences and Coherent Diffractive Imaging at ELI Beamlines
https://arxiv.org/abs/2105.11128, E. Klimešová, *et al.*