# Access to the Central Laser Facility - Artemis

*Beamtime application for the period December 2023 – June 2024*

Applications are now invited for access to the Artemis laser facility at the Central Laser Facility (CLF) (Science and Technology Facilities Council (STFC) Rutherford Appleton Laboratory), during the period December 2023 - June 2024. A total of fourteen weeks' access is available on the facility. We are offering access to both the 1-kHz and 100-kHz laser systems.

The fourteen weeks available include up to four weeks funded by Laserlab-Europe. The remaining weeks will be funded by STFC. Laserlab-Europe funding requires that the principal investigator and the majority of other investigators be located outside the UK. STFC funding, by contrast, applies to proposals in which at least one co-investigator is a permanent member of staff at a UK academic institution.

Applications will be reviewed and prioritised by the Artemis Facility Access Panel. **The deadline for applications is 12th July 2023, at 17:00 British Summer Time**. Please talk to facility staff before you submit your proposal, to ensure that it is feasible.

Please also read the information below before applying.

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## Facilities available

### 1-kHz laser system

In this call period, Artemis will offer ultrashort laser and extreme ultraviolet (XUV) pulses at 1-kHz repetition rate, with end-stations for any of the following:

- time-resolved spectroscopy in gases, using an electron time-of-flight spectrometer or velocity-map imaging detector;
- coherent XUV imaging;
- XUV spectroscopy
- angle-resolved photoemission spectroscopy (ARPES) using a SPECS Phoibos 100 hemispherical analyser and/or a Fermiologics FeSuMa analyser.

The laser and XUV pulses are generated from a Ti:sapphire laser system with twin outputs, each producing 8-mJ, 30-fs, 780-nm pulses at a 1-kHz repetition rate. One output can be used to pump an optical parametric amplifier (OPA) system providing tuneable pulses in the spectral range of 235 nm – 15 μm, with up to 1 mJ per pulse at 1300 nm in a 40-fs pulse. The OPA output at 1700 nm can be further compressed to ~ 12 fs with ~ 0.4 mJ per pulse.

Any of the Artemis laser outputs can be used to generate XUV pulses through high harmonic generation (HHG). Two XUV beamlines are available: one with a monochromator for photoelectron spectroscopy, and the other a high-flux XUV beamline for HHG spectroscopy and imaging.

Photoelectron spectroscopy

The monochromatised XUV beamline contains:

- HHG chamber with differentially pumped continuous nozzle;
- Monochromator to select a single XUV harmonic in the spectral range 12 eV – 80 eV while preserving the pulse length. The photon flux is ~ $2x10^{10}$ photons/s at 30 eV, but drops at energies above 45 eV. Best XUV energy resolution is 120 meV;
- absolutely calibrated XUV photodiode to measure XUV flux; and
- relay imaging chamber with toroidal mirror and optics to enable laser and XUV pulses to be recombined for pump-probe experiments.

The end-stations available on this beamline for time-resolved spectroscopy are:

- atomic and molecular physics end-station with velocity-map imaging detector or time-of-flight electron spectrometer, a pulsed gas source, and differential pumping. The chamber can be reconfigured with different gas sources.
- ultrahigh-vacuum (UHV) end-station for time- and angle-resolved photoemission spectroscopy (tr-ARPES) from the solid state. This is equipped with a SPECS Phoibos 100 hemispherical analyser, a Fermiologics FeSuMa analyser, a five-axis cryo-manipulator, a preparation chamber, and a fast load lock for sample transfer.

Spectroscopy and imaging

This high-flux XUV beamline contains:

- HHG chamber with differentially pumped continuous nozzle;
- XUV flat-field spectrometer, which can be used for HHG spectroscopy or HHG optimisation experiments; and
- Coherent XUV imaging chamber with multilayer focusing mirrors and sample positioning (filters and XUV multilayer mirrors are available for 29 nm, 17.5 nm and 13 nm).

## 100-kHz laser system

In this call period, we offer laser and XUV pulses at 100 kHz derived from our infrared OPCPA system, with a new XUV beamline and flat-field spectrometer, and end-station for time- and angle-resolved photoemission spectroscopy from the solid state.

In this period, we will offer the following outputs from the light source:

- 170 µJ, 50 fs pulses at 1750 nm. This output, or its second harmonic, can be used for high harmonic generation
- XUV photons in the 17 - 41 eV range, with ~ $10^{10}$ photons/sec at 32 eV.
- Pump pulses at 440 nm (1 µJ, 50 fs), 875 nm (5 µJ, 50 fs), 1750 nm (20 µJ, 50 fs), and 2500 nm (50 µJ, <150 fs).
- Pump pulses at ~600 nm and ~750 nm (1 µJ, 50 fs) (under development).

Key experimental hardware includes:

- HHG chamber with differentially pumped continuous nozzle;
- XUV flat-field spectrometer, which can be used for HHG spectroscopy or HHG optimisation experiments;
- Monochromator to select a single XUV harmonic in the spectral range 17 – 41 eV;
- XUV spot down to ~20 µm diameter;

- UHV end-station for time- and angle-resolved photoemission spectroscopy (tr-ARPES). This is equipped with a SPECS Phoibos 100 hemispherical analyser, Fermiologics FeSuMa analyser, a five-axis cryo-manipulator, a preparation chamber, and a fast load lock for sample transfer.

More details of photon parameters and the UHV end-station are available at https://www.clf.stfc.ac.uk/Pages/Condensed-matter-end-stations.aspx.

## Further details and contacts

More technical specifications can be found at https://www.clf.stfc.ac.uk/Pages/Technical-Specification.aspx. We urge you to contact an appropriate Artemis staff member to discuss the requirements for your experiment prior to submitting a proposal.

After proposal submission, Artemis staff will make a technical assessment of feasibility and of potential safety issues arising from your proposed experiment. This report is passed to the access panel. Please make sure there are enough experimental details in your proposal to enable us to do this. In particular, please provide details of all samples and gases to be used.

We have very limited space for users to bring their own end-stations and breadboards. Any equipment brought to Artemis must conform to CLF safety standards.

During experiments, we recommend that four people are present each day (two of whom are experienced enough to lead the work), in order to enable you to make the most of your time. The facility is fully supported Monday – Friday during regular business hours. At evenings and weekends, the facility is operated in data collection mode with limited support.

For more detailed information please contact:

- Emma Springate, (emma.springate@stfc.ac.uk)--Artemis group leader.
- Charlotte Sanders, (charlotte.sanders@stfc.ac.uk)--condensed matter physics, 2D materials.
- Yu Zhang (yu.zhang@stfc.ac.uk)--100-kHz laser system, condensed matter physics, magnetism.
- James Thompson, (james.thompson@stfc.ac.uk)--1-kHz laser system, gas-phase experiments, XUV imaging.
- Adam Wyatt, (adam.wyatt@stfc.ac.uk)--laser diagnostics, HHG spectroscopy, XUV imaging.

## Writing your proposal

A science case of up to three pages must be included in your proposal. You should give a clear account of the aims of the experiment and set it within the broader scientific context. Keep in mind that not all review panel members will be experts in your field. If you are using samples that are not commercially available, you should indicate their source.

In your proposal, you should justify the amount of beamtime you have requested, explaining what you aim to achieve on each week of your run and estimating the data collection time. Experiments are typically allocated 2 – 4 weeks of beamtime.

## Submitting a proposal

Use the CLF online proposal system (https://proposal.isis.rl.ac.uk) to submit an electronic application. To do this:

- If this is your first proposal, register with the online proposal system by clicking on "Create a new facility user account with us". Please provide accurate contact details so that we can communicate with you.
- Ask your co-investigators to register with the proposal system and check their contact details too. All co-investigators now have to be registered before their names can be added to proposals.
- On the home page, choose "Artemis" and then create your new proposal, following the online instructions. For technical support with the online proposal application site, contact FacilitiesBusinessSystem@stfc.ac.uk.
- Step 3 of the form asks for information on your research grants and links to industry. Please list the sources of funding for the people and equipment on this project, including UKRI and EU grants, other national funders, and industry funding. If you have funding support from UKRI, you should also describe how the proposal connects with this research.
- Upload your science case of up to three pages.

Please make sure you read the terms and conditions of access before you submit. These have been recently updated to confirm the requirements for open-access publication and open data. Note also that the title and abstract of each accepted proposal will now be published online.

To apply for Laserlab-Europe funding (which you will need to do if the PI and most of the co-investigators are located outside the UK), please:

- Check you meet the eligibility criteria at https://www.laserlab-europe.eu/transnational-access/how-to-apply-for-access/criteria-of-eligibility-for-transnational-access.
- At Step #2 of the CLF proposal form, select 'Direct access' route and answer 'yes' when asked 'Are you applying through Laserlab?'
- Download a pdf copy of your application and submit it through the Laserlab online proposal system at https://apply.laserlab-europe.eu/.

## Review criteria

Applications for time on Artemis are reviewed and prioritised by the Facility Access Panel. Your proposal will be assessed with the following criteria:

- Absolute prerequisites, without which an application will not be recommended for funding:
    - scientific excellence in the specific objectives of the project;
    - international competitiveness; and
    - strategic value within the Artemis programme.
- Supporting evidence which increases the likelihood a successful outcome:
    - productivity of investigators;
    - quality of leadership and management; and
    - suitability of institution and group.

Additional criteria can include strategic alignment to UKRI areas (*e.g.,* grant supported), potential for economic impact, training, facility development, and impact plan.

Please note that, in making its assessment, the panel will refer to your previous track record of access to Artemis. The panel will have access to the experimental reports from your previous access periods at Artemis. Please contact emma.springate@stfc.ac.uk if you would like to update your report forms.