Gemini TA3 Call for Access – P2 2025/26

The following information provides guidance for the Gemini TA3 experimental area for the 2025/26 proposal calls. It is recommended that you discuss your laser and experimental requirements with CLF personnel prior to submission of your proposal. Please contact the Experimental Operations manager (dan.symes@stfc.ac.uk) for more information, and to clarify any questions about your proposal.

Overview

Gemini offers flexible beam and diagnostic configurations to accommodate user requests. Where possible, we co-ordinate experiment design to allow common set-ups to install and test the majority of the apparatus. Experiments with similar layouts will then be scheduled consecutively with a short break between to allow facility access for changeover.

Ideally, proposed experiments should be based on one of layouts described below. Significant deviations from these layouts must be agreed with the Experimental Operations manager prior to submission.

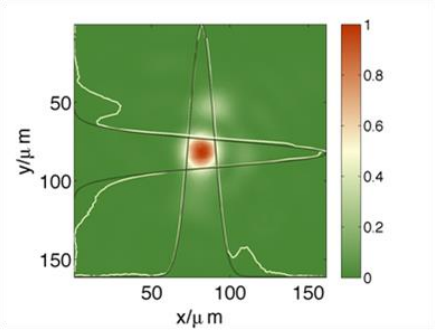
Current Gemini specifications

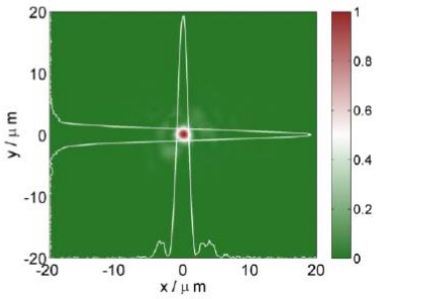
Main Beams: North and South available

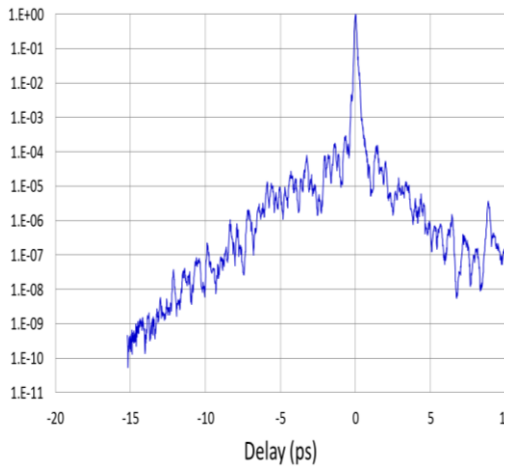
a. Energy: ~12 J on South
   ~ 12 J on North
b. Pulse length: 40-45 fs,
c. Beam diameter: 15 cm diameter
d. Focal spot $1/e^2$ radius: (using adaptive optics-images on the right)
   F/20: 16.7µm
   F/2: 1.6 µm
e. A close-in contrast scan is shown below.

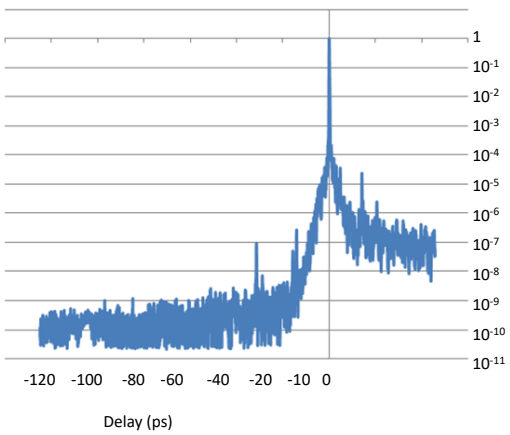
The contrast parameters are:

$<10^{-10}$ ASE level (ns)
$<10^{-7}$ prepulse contrast (ps)
$< 10^{-4}$ at 1ps









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a. The experimental access slot will be preceded by a set-up period to allow CLF staff to build up the optical layout and carry out diagnostic testing as far as possible in the time available.
b. All non-standard diagnostics and potential hazards must be discussed and agreed with the Experimental Operations manager prior to proposal submission.
c. Equipment that is brought to RAL by the user group must be delivered to site in good time, to ensure adequate time for safety assessments and integration into the experiment.
d. To ensure reliability of the system, we may require up to 50% of a day each week (preferably Mondays) to carry out maintenance and optimise performance. All lost hours will be compensated by providing operational support during out-of-office hours.

The proposal application must be accompanied by a completed CLF Experimental Pack for Principal Investigators, which lists the requirements for (a) laser parameters; (b) Target Fabrication; (c) experimental gases; (d) diagnostics. At the end of the document we request that you explain some details of the proposed experiment with a sketch of the required beam and diagnostic layouts. This is very useful for CLF staff to understand the technicalities that might not be included in the scientific case because of lack of space. The equipment that is available in TA3 is as follows:

Permanent beam and alignment diagnostics available:

a. Double plasma-mirror system on North beam to improve picosecond contrast to 10^{-6} at 1ps;
b. Adaptive optics on both beam lines;
c. Long working distance 50x, 20x, 10x Mitutoyo objective lenses for focal spot imaging;
d. Solid target positioning system (based on rear surface illumination);
e. Overhead imaging of interaction point;
f. Post-compression diagnostics including near-field and far-field (in laser area);
g. All relevant laser parameters displayed on eCAT on a shot-to-shot basis.

Plasma diagnostics available:

a. Thomson parabola spectrometers;
b. Electron spectrometers (MeV and GeV ranges);
c. Flat field and x-ray crystal spectrometers;
d. X-ray cameras (direct-detection and fibre-coupled scintillator detection);
e. Optical spectrometers and high dynamic range cameras;
f. Single shot Grenouille for pulse measurement after interaction.

Permanent target mounts/drives available:

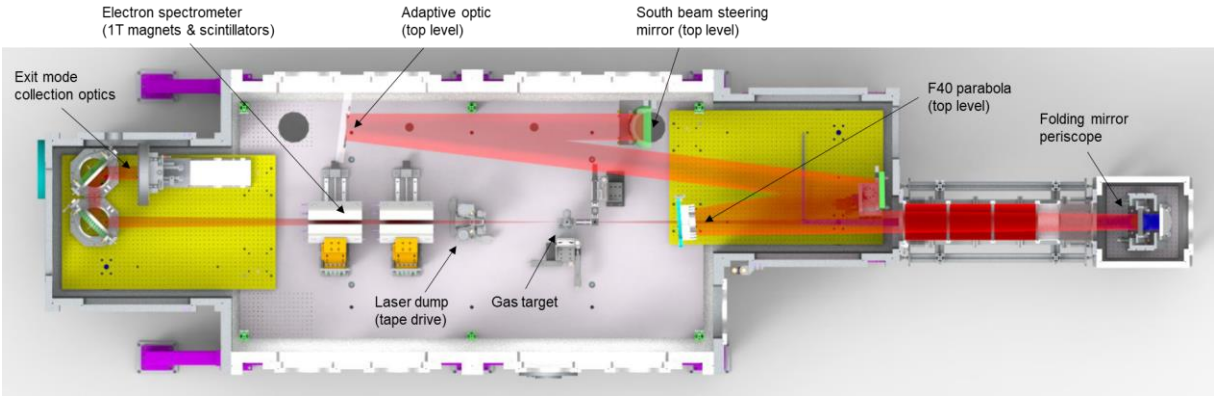
a. Wide variety of standard motorised and manual stages;
b. Standard gas jet and gas cell mounts.
c. Custom built mounts on request (subject to time and budget constraints);
d. Thick and thin film target wheels, tape drives, and array targets.

Experimental Geometries

Several standard experimental geometries are shown in the figures below. Different configurations may be considered, but must be discussed before submission of the proposal so that we can assess feasibility. Failure to agree in advance non-standard requirements could lead to the proposal being rejected on technical grounds.

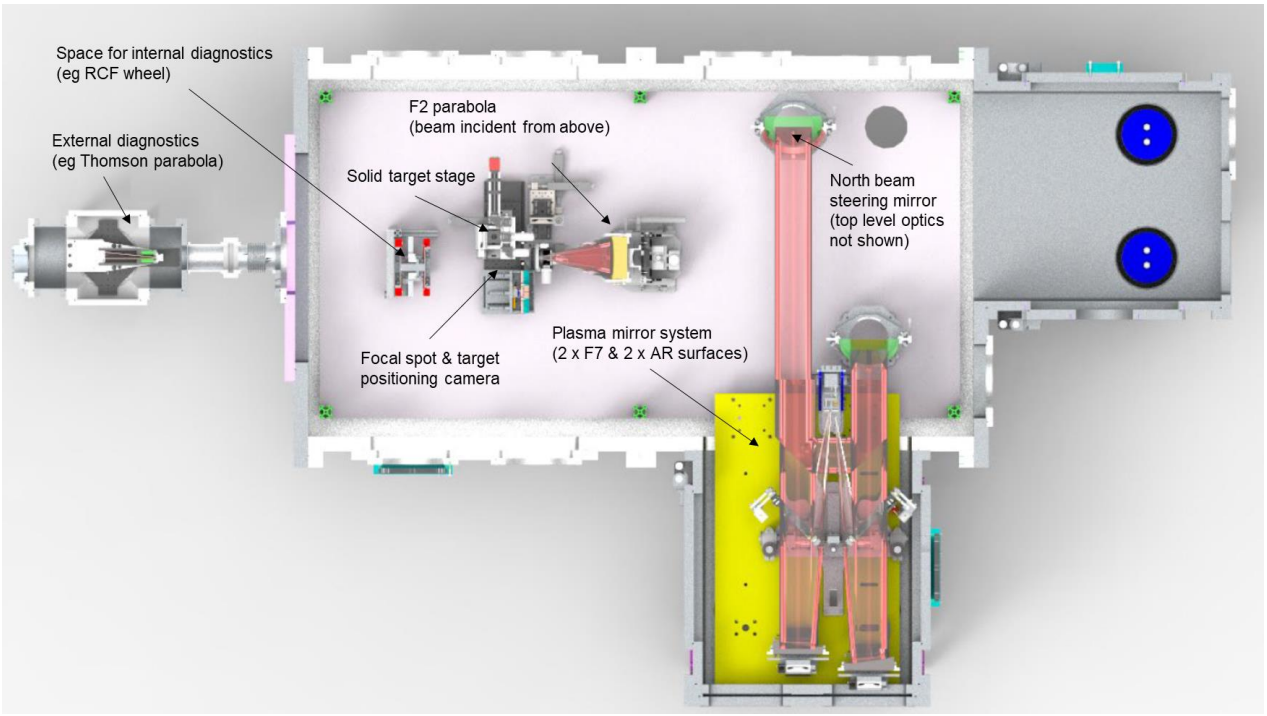
(1) Long focus (South beam):

To accommodate long focussing distance, the beam is directed to an extension chamber at the South end of the room. Two options are available – an *f*/20 (3m) parabola located in the extension, or an *f*/40 parabola reflected from a periscope located in the extension. The *f*/40 is commonly used because it produces a focus more suitable for electron acceleration, but careful design is needed to ensure the fluence remains below the damage threshold of the folding mirrors. A typical electron diagnostic layout is shown.



(2) Short focus (North beam):

Gemini uses an *f*/2 parabola to produce the highest possible intensities – typically for solid target interactions as shown here. The contrast can be enhanced using the double plasma mirror system that is situated in an extension chamber on the West side of the main chamber. The parabola is protected with a 5 µm thick pellicle. Within limits, the positions of the parabola and target can be chosen to suit diagnostic requirements.



(3) Dual beam (North and South beams):

Experiments using both beams usually use the long focus South beam combined with the short focus North beam (although other options can be delivered). An example layout is shown – here the South beam generated electrons and the North beam generated ions at 90 degrees. Different angles between the laser beams can be requested. This includes co- or counter-propagating beams using an *f*/2 parabola with a 20 mm central hole – these arrangements must be discussed before submission of the proposal.