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VELA and CLARA Access: Useful Information

This document, which should be read in conjunction with the 'Mechanism for Access to the VELA and CLARA Accelerators for Science and Technology Research' document, sets out the expectations both users and beamtime access providers can expect during any allocated time. It is evident that during any given experimental run there are certain standards of delivery, which include minimum beam parameters and operational support levels which users should be able to count on. In the same sense there are expectations from the users in terms of their readiness for the experiments and provision of any additional non-standard equipment which the accelerator staff should also be able to expect. By establishing these conditions it will help to maximise the probability that an experimental run will be successful and deliver the results desired.

It should be noted that beamtime on both VELA and CLARA is provided on a 'best efforts' basis. By this we mean that the staff in charge of providing the beam will make every practical effort to provide the beamtime during the allocated slot and in the event of breakdowns or other failure to try to find an alternative slot for the experiment within contingency. If scheduled beamtime is lost during an allocation period, the users are not automatically entitled to have that beamtime rescheduled at a future date. Any possible reallocation of beamtime during a running period will be allocated at the discretion of the VELA and CLARA Exploitation Leader. In addition, the STFC will not provide any financial remuneration for lost expenses associated with an experiment which cannot be run for any reason.

User Expectations

Allocations –

Users will receive notification of allocated beamtime at least a month before the start of that time. In the event that the allocated beamtime cannot be provided by the accelerator staff notification will be sent to the users as soon as is practicably possible. The accelerator staff will attempt to find an alternative time slot within contingency to run the allocation and discuss this with the users at the earliest possible opportunity. The beamtime allocation will be for a specified number of shifts. Users should expect to receive the number of shifts allocated or as near to this number as is reasonably practicable. Where there is any doubt towards the availability of the beam for any part of the allocated time users will be informed at the earliest possible moment.

Shifts –

A standard shift is 8 hours and the machine typically operates Monday through to Friday. During each shift, the users should expect a reasonable amount of time for beam set-up and re-optimisation. Typically this will be of the order of one hour when the beam is initially established and 15 to 30 minutes for re-optimisation which is likely to be required every 3 to 4 hours. Any change in beam parameters requested by the users may also require significant additional set-up time.

Beam Parameters –

The achievable beam parameters in the accelerator hall (as shown in Fig.1) and in the Beam Area 1 (as shown in Fig.3) are given in Appendix A. As noted in the appendix, not all values are simultaneously obtainable so prospective users should consult accelerator staff (in the first instance the Technical Co-ordinator) prior to making an application to confirm that the parameters they need can be provided. Where particular beam requirements are critical to the experiment it is especially important to make this clear on the application form. The successful delivery of a shift on the part of the accelerator staff will be gauged by the ability to provide the agreed parameters for a substantial part of that shift.

Experimental Areas -

The accelerator hall itself can be used to carry out experiments with the electron beam by mounting some experimental apparatus or device for testing into the beamline or replacing some part of the existing infrastructure with a new system to test. Previous experiments in the accelerator hall have included Ultra-fast Electron Diffraction (UED) and characterisation of new accelerator beam diagnostics. Beam Area 1 houses a dedicated end station primarily aimed at alternative acceleration research. There is a large evacuated vessel where user's equipment can be mounted with some in-situ diagnostics for alignment and characterisation and a down-stream spectrometer line for momentum and momentum spread measurements. Previous work has included both Terahertz and laser-plasma wake field experiments. ***From 2019 the shield wall between the accelerator hall and Beam Area 1 will be removed so that from a radiation perspective they will form a single area.*** However, a replacement non-radiation hard wall will be installed to allow Beam Area 1 to be separately searched and isolated for TW laser alignment work. Beam Area 2 will not be available for experimental work during the coming exploitation period. Appendix A contains further details of the Accelerator Hall and Beam Area 1 where experiments can be carried out.

Local Contact -

Each user group will be provided with a Local Contact, who will act as the user support scientist during the experimental run. They will act as the principal interface between the User group and the accelerator staff and will be available for consultation during the experiment (or provide a suitable deputy). They will provide advice, expertise and support prior to and during the experimental beamtime. Obviously, user groups should also feel free to discuss aspects of their experiment with any other member of the accelerator team as appropriate during their run.

User Support -

The User Support Scientist and other members of the operations team will endeavour to assist the User group via the provision of both general and more specialised support. For the majority of experiments it is planned that a larger team of beam delivery personnel and technical experts will be put together to assist with each experiment. Daresbury has access to extensive specialist expertise (i.e. mechanical, electrical, controls, riggers etc.) and every effort will be made to make these services available to Users where required. This is a limited resource, and prior planning of User requirements is essential to minimise disruption to the beamtime. Any extended use of specialist support (e.g. design and fabrication of experimental hardware) will need to be costed into the proposal for beamtime.

Facility Expectations

Allocations –

Users should be well prepared before putting in an application, since for example new research equipment often has long delivery times. Where users become aware that they may not be in a position to use their allocated beamtime they should notify accelerator staff via their Local Contact at the earliest possible time. This will allow rescheduling of the beamtime to other users and could increase the likelihood of contingency time being available.

Experimental Team Leader –

Each beamtime application will have a Principal Investigator who leads the proposal, but it is recognised that in some cases this individual may not be present during the whole experimental run. Each team should nominate an Experimental Team Leader (which could be the Principal Investigator) who will be the main point of contact for the experimental team and should be available during the whole run. The Experimental Team Leader should have an excellent understanding of the precise details of the aims and objectives of the experiment and what will be required to successfully achieve them.

Team Members -

Users must endeavour to provide a sufficient number of team members from their own or collaborating groups to provide cover for each shift of the experimental run. Typically, this will mean a minimum of two people. Team members should be sufficiently knowledgeable to contribute to the experiment, where appropriate requiring experience in the necessary equipment which could include electrical equipment, vacuum equipment and or laser systems. Team members should have received sufficient Health and Safety training at their host institutions to allow them to carry out any required operation safely. In addition, members will be required to carry out Induction Training once on-site at Daresbury and as required more specific 'Tool-Box Training' to use particular sub-systems or equipment.

Safety –

Along with the Induction Training, team members are expected to be aware of the 'CLARA/VELA Safety Handbook' and' Local Rules' and if appropriate 'Standing Orders' for any laser system they are using. In addition, a suitable 'Risk Assessment' and in many cases 'Method Statement' must be provided for each experiment. Users must abide by STFC Health and Safety rules at all times whilst on site.

Equipment Loan –

Where users need to borrow specific equipment from the laboratory they should make enquiries well in advance of the allocated time and in the case of critical equipment, potentially before making the beamtime application. These enquiries should be made on each run where such equipment is required rather than assuming that previously borrowed equipment is still available.

Summary

This document aims to set out the expectations of VELA/CLARA users and staff to facilitate the smooth operation of access time. The document sets out defined channels of communication between users and staff and highlights the importance of sharing information at the earliest possible time to minimise inefficient use of time. It also reinforces the need for users to discuss their experiments with accelerator staff before the beamtime and preferably before the application is made to make sure that the beam parameters required are achievable and that any additional equipment or other resource will be available. By taking into account these things it is hoped that the various experiments carried out by external users on the VELA and CLARA accelerators will have the maximum chance of success, gaining high quality data which will lead to many scientific publications, reflecting well on both the user groups and the accelerators and staff.

Appendix A

VELA/CLARA layout overview

The Versatile Electron Linear Accelerator (VELA) and Compact Linear Accelerator for Research and Applications (CLARA) consist of the Accelerator Hall and Beam Area 1 (BA1), a straight on beam transport line as shown in Fig.1. ***In the coming exploitation period there will be no shielding between the Accelerator Hall and Beam Area 1 meaning that they will form single area from a radiation perspective*.** However, a light tight wall will be installed to allow laser alignment work in Beam Area 1 while the Accelerator Hall is open access. Both the Accelerator Hall and Beam Area 1 need to be vacated and searched before the beam can be set up. Beam Area 2 will not be available for experiments during this exploitation period.

Within the Accelerator Hall there are several positions where experimental equipment can be mounted. There is a dedicated station for electron diffraction experiments where samples can be introduced into the beam. There is the straight on position from the CLARA gun and the first linac where a Faraday cup is currently mounted. The Faraday cup is separated from the accelerator vacuum tube by a beryllium window. It is possible to install an experiment at this location without breaking the accelerator vacuum.

For the coming beam allocation period the High Repetition Rate Gun (HRRG) on the VELA beam line will be under commissioning, so beam from this gun and the use of beam diagnostics in first section of VELA beam line (e.g. the TDC) will not be available.

- **Beam Parameters Available**
  Because of recent changes to the photoinjector laser, simulations of the beam parameters need to be repeated. Preliminary experimental characterisation of the beam will be carried out after establishing beam before start of the exploitation period. Beam parameters strongly depend upon the bunch charge and vary along the beam line. The beam pipe ID is 35mm in most of the beam line. Depending upon the location of the experiment, beam line settings may be optimised to deliver the required transverse and longitudinal beam parameters. If you have particular requirements, you are strongly recommended to contact accelerator staff.

	Accelerator Hall (Fig.1)	Beam Area 1(Fig.3)
Beam Momentum	Up to 40.0 MeV/c	Up to 40.0 MeV/c
Bunch Charge	20 - 100 pC	20 - 100 pC
Bunch length (σ_t, rms)	~ 2 - 3 ps straight on ~ 0.3 - 5 ps through dogleg	~ 0.3 - 5 ps
Normalised emittance (x,y)	3 - 30 mm mrad*	3 - 30 mm mrad*
Beam size ($\sigma_{x,y}$, rms)	> 100 µm	> 100 µm
Momentum spread (σ_e, rms)	0.05 - 2.0 %	0.05 - 2.0 %
Bunch repetition rate	10 Hz	10 Hz

* Emittance is highly dependent on other parameters such as bunch charge. It is hoped that from 2020 onwards lower emittances might be possible due to improvements in laser transverse pulse shaping and other changes to 10 Hz gun.

Note that not all combinations of the above parameters are achievable simultaneously (e.g. short bunch lengths require larger energy spread and lower beam momentum)

- **Diagnostics available**

The available diagnostics include beam position monitors (and steerers) along both VELA and CLARA lines to correct beam orbit, insertable YAG screens, a dipole spectrometer line for momentum and momentum spread measurement and a Wall Current Monitor, Integrated Current Transformer and several Faraday cups at different locations to measure charge. From 2020 onwards, it is also hoped that a dedicated bunch compression monitor will be included on a last YAG station in the accelerator hall. For further information on the available diagnostics and how they might be used in specific experiments please contact accelerator staff.

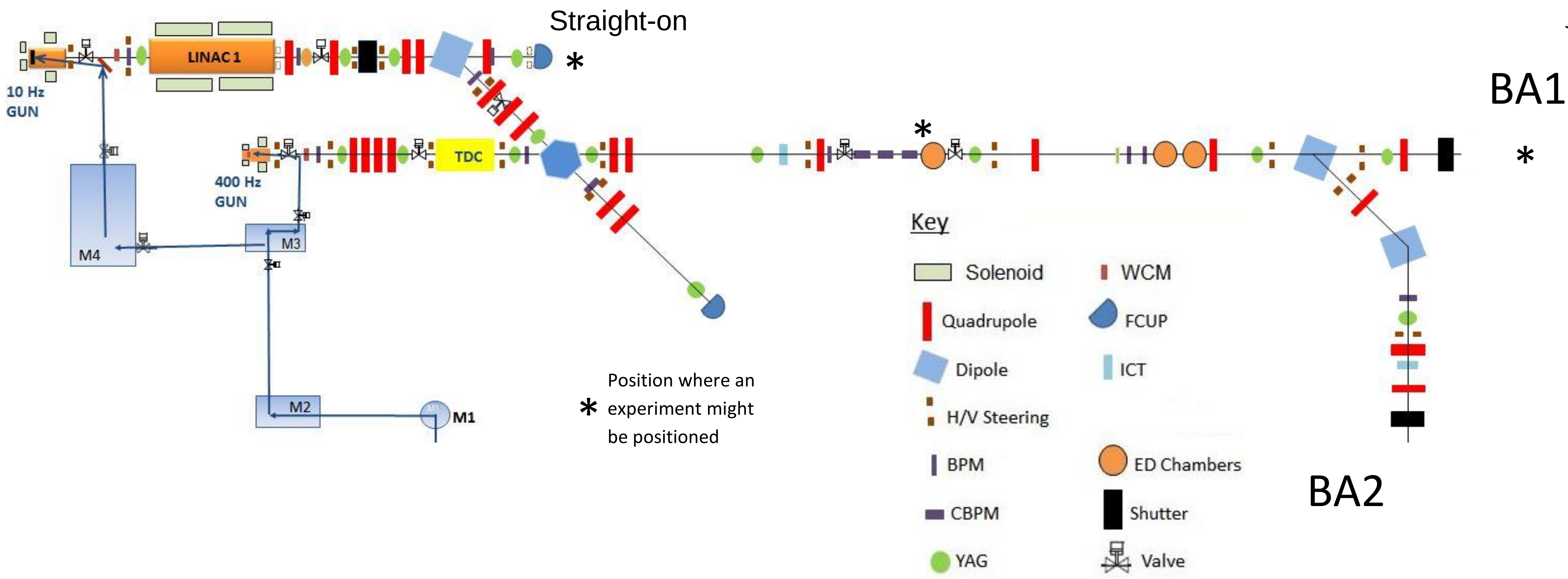

Fig.1: Schematic diagram of the VELA and CLARA accelerators. BA1 schematic is shown in Fig.3.

Beam Area 1

- **Floorplan/clearances**

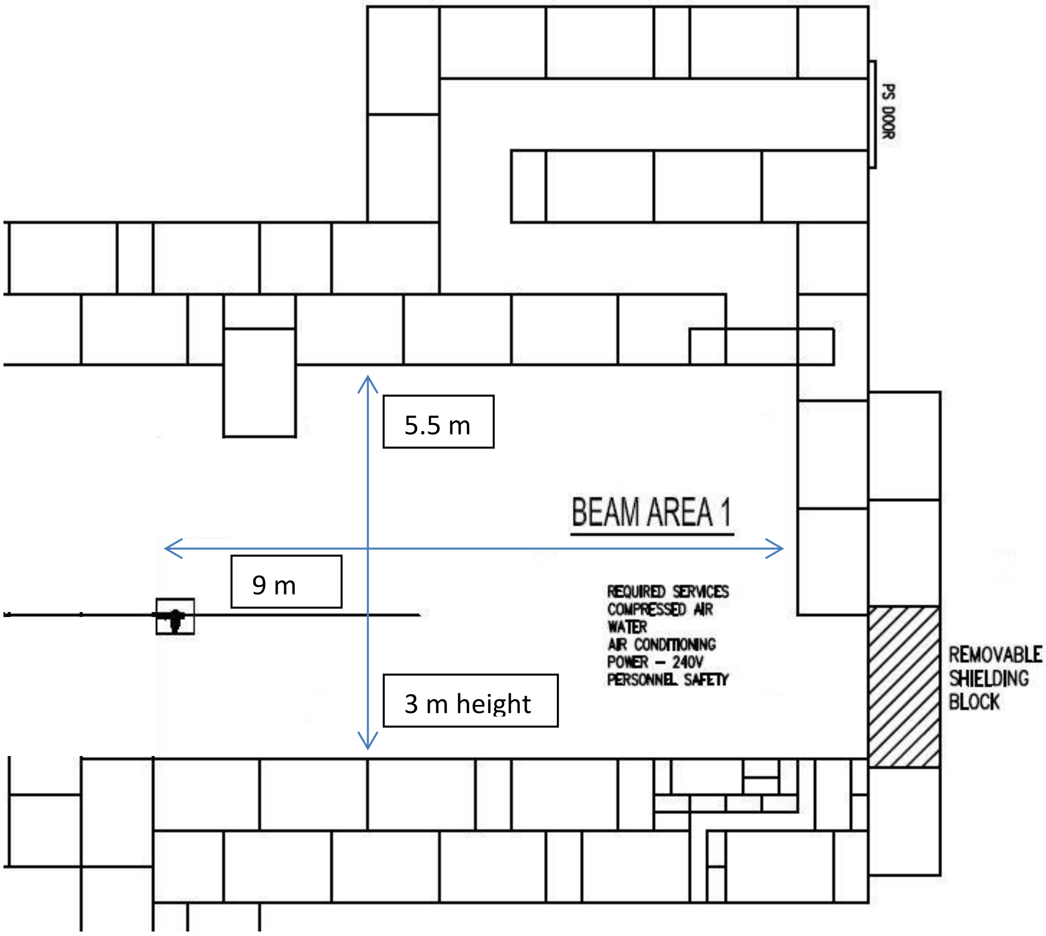

Fig.2: Floor plan and clearances in Beam Area 1

A user station with readily accessible and internally reconfigurable vacuum chamber is available with a base pressure of 10^{-7} mbar. The experimental chamber is approximately 2 metres in length, and is accessed through large hinged doors along its length. Vent and pump-down time is approximately 3 hours, allowing the option for adjustment to experimental configurations within multi-shift experiments.

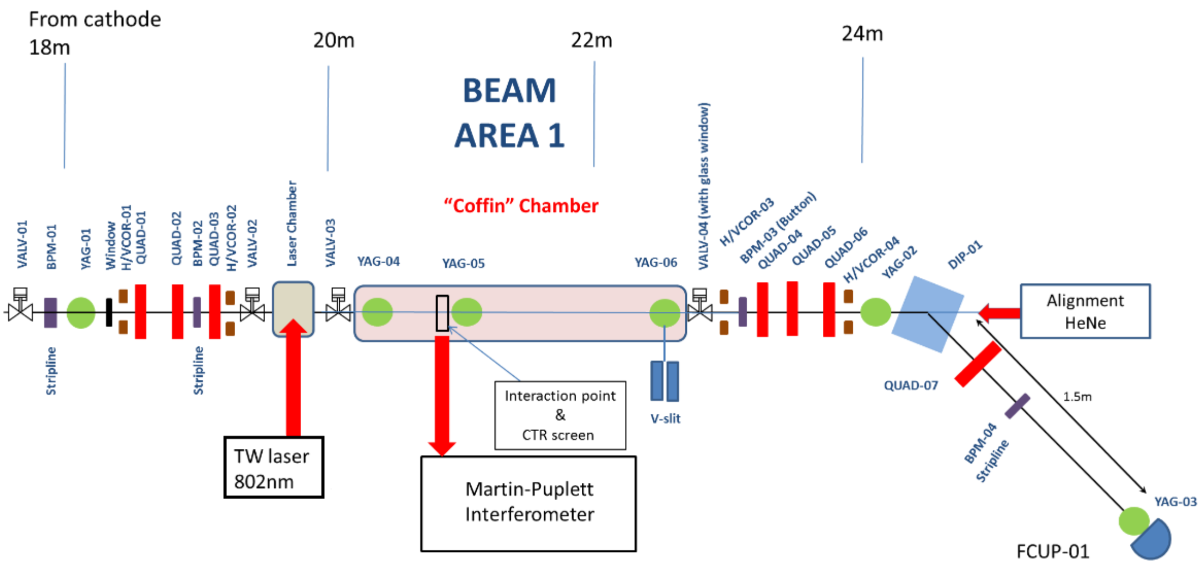

Fig.3: Schematic of Beam Area 1 beam line. The TW laser comes from adjacent "LATTE lab".

- **Laser specification**

Although not generally available under VELA/CLARA access arrangements, a TW laser from the adjacent 'LATTE lab' (**La**boratory for **T**Hz & **T**erawatt **E**xperiments in accelerator applications) can be directed into Beam Area 1 and the experimental chamber for dedicated laser-electron beam interaction programmes. Users should speak to the Femtosecond Lasers and Timing Group Leader to discuss possible use of this laser.

- **Diagnostics available**

Four quadrupoles, a dipole spectrometer line and Faraday cup follow the experimental chamber. The beamline includes YAG screens, beam position monitors and steering correctors for optimising the beam during experiments. By arrangement it is also possible to use the de-mountable Martin-Puplett Interferometer for measurements in the 'Coffin' chamber.

Beam Area 2

- **Not Available**

General Accelerator Parameters

- **Vibrational stability**

The Daresbury site was primarily chosen for its excellent geological stability, a significant factor in the design and implementation of large-scale accelerators. The VELA/CLARA accelerator is mounted on girders and stanchions designed to minimise vibration. The floors of the beam areas are solid concrete and provide an exceptionally stable platform for User experiments. A Güralp multi-axis seismometer is available (at cost) for vibrational data collection by prior arrangement.

- **Positional stability**

The entire VELA/CLARA accelerator is covered by a comprehensive network of survey datum points and laser trackers. Access to a laser tracker for accurate User equipment positioning is available (at cost) by prior arrangement.

- **Temperature stability**

The VELA/CLARA Accelerator hall is air-conditioned to provide better than ±0.1°C control of air temperature. BA1 and BA2 are not air –conditioned. The building in which the VELA/CLARA accelerator complex is located provides ±1°C control of air temperature for the entire complex.

- **Triggering/timing**

A trigger timing signal can be provided for users to allow experimental synchronisation with the beam. Typically the accuracy of this trigger will be 100 fs.

- **Services & gases**

Compressed air and dry nitrogen are available by default and other gasses may be available on special request. Users should arrange for any specialist gasses well in advance of their allocated beamtime.

Contact Details

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