Software developments in Gemini

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Background

Part of the commissioning process for the EPAC (Extreme Photonics Applications Centre) laser facility requires the development and testing of new laser diagnostics and characterisation of various optics to test their resilience to laser-induced damage. It is desirable to be able to do this with a laser operating at a repetition rate close to that of EPAC and as independently as possible from the rest of the facility so that long testing runs do not interfere with on-going experiments and other development work.

The original Astra laser Target Area next to what is now TA2 was ideally suited for this purpose so was brought back into service as TA1 (Target Area 1).

Various adjustments were made to the fabric of the room including reopening the wall shutter between TA1 and the laser area, re-routing part of the beam through it, installing cabling for the laser network and updating the safety interlock system. A new TA1 Control System was also developed (see Figure 1) and integrated with the existing main Gemini Control System.

TA1 Control System

The laser pulses delivered into TA1 have a relatively low energy of about 6 mJ, but the high repetition rate and accessibility make them well-suited to the development and prototyping necessary for delivering EPAC. The various EPAC testing regimes typically require pulses in long runs of half an hour or more ("continuous mode") in addition to shorter bursts of a specified number of pulses to check alignment and diagnostics ("pulses on demand").

The TA1 Control System interface for these two modes of operation was straightforward to implement but a complication arose when integrating the TA1 Control System with the main Gemini Control System.

The Gemini laser runs at 10 Hz, alternating pulses between Target Areas TA2 and TA3 such that each Target Area receives pulses at 5 Hz ("alternating mode") matching their respective compressors. TA1 receives pulses at 10 Hz but can use only alternate pulses because the others are of the "wrong" stretch for TA1. If TA1 is the only area in operation, however, then the laser can be configured to send all pulses to it with the same stretch characteristic ("non-alternating mode") and so reduce the time required to perform particularly lengthy runs.

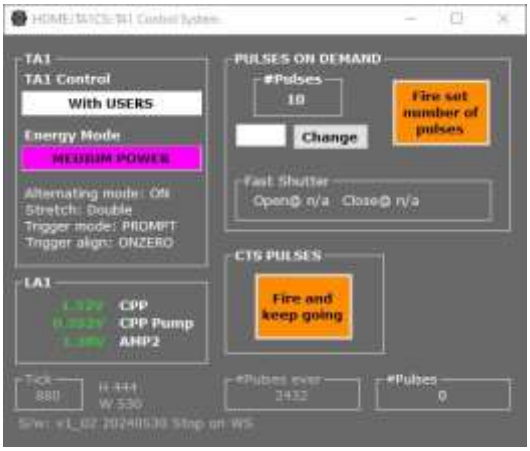

Figure 1: Screenshot of TA1 Control System interface

Two additional features were added for trigger management. Cameras and other devices can be triggered on even- or odd-numbered pulses depending on the settings of the main system, or they can be triggered on the previous pulse if downstream devices require longer arming time. (Delay boxes are used to finesse these timings.)

Finally, as with many EPICS[1]-enabled software across the facility, an EPICS PV (Process Variable) is exposed to permit a certain level of remote control of the application. The Gemini system of shot numbers was impractical at 10 Hz so instead TA1 uses a total pulse count and applies a timestamp to each sequence (long or short) of pulses. These numbers are also made available as PVs which can be utilised by remote control software to determine when a sequence finishes, make any necessary adjustments to the diagnostics, then initiate another sequence.

References

[1] https://epics.anl.gov/index.php