Software developments in Gemini

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Introduction

The Gemini laser system software consists of a network of distributed applications used to control sections of the laser, and monitor a large number of parameters both on-shot and continuously.

Over the last year there has been a significant update to the facility-wide metrology system, and an application introduced to allow remote adjustment of the timing of the pump lasers for Amplifier 3 by Gemini operators. These developments are described below.

Gemini Metrology System

Nearly 100 parameters (and rising) are used monitor the beam and environment of the laser areas. These parameters include laser outputs, chamber pressures, gas system pressures and gas types, enclosure temperatures, room humidities, oscillator temperature, noise levels, light levels, and the ISIS trigger for external synchronisation.

We have extended our use of the Experimental Physics and Industrial Control System (EPICS), originally developed at Los Alamos National Laboratory. All instruments taking metrology measurements are now "EPICS enabled" via a .NET server or EPICS Input/Output Controller (IOC) running on the main server or a Raspberry Pi.

Each metrology parameter is associated with an EPICS Process Variable (PV) broadcast every few seconds, all of which can be accessed by any EPICS-enabled application on that network. Chief amongst these is the application that saves data to the eCAT data analysis software, but the PVs can also be monitored by software collecting diagnostics in the Target Areas. This has already proven extremely useful when a group of users monitoring the gas system diagnosed issues with a sticking valve before it adversely affected the experiment.

The move from a considerable number of read/display/save software programs to a simpler read/broadcast server model has also improved reliability. If a data channel goes down, it is more usually because the instrument has failed or been powered-off than because the software has crashed.

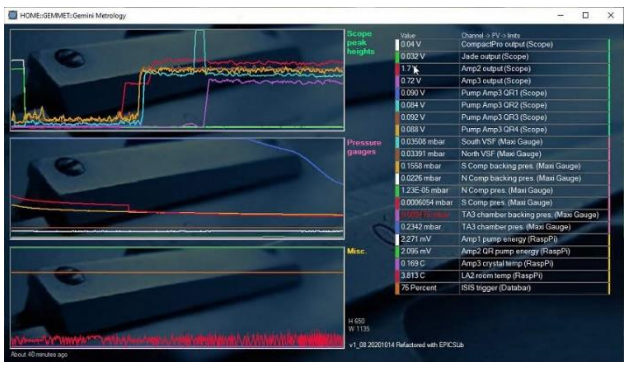

Figure 1. The Gemini Metrology application (formerly Mon&Cont). There was a spike on Amp3 output as the system was brought up, the TA3 Target Chamber is being pumped-down, and the ISIS trigger is holding steady.

Remote operations, DG535 and beam-dump control

At the start of lockdown in March 2020, we discussed the possibility of running the laser remotely from offices and/or from home. Clearly this would not be appropriate or safe for all operational tasks, but a couple of improvements were implemented.

Stanford DG535 delay box control: One action that the operators need to take every day when setting up the laser is to temporarily reduce the laser power by changing the timing of the Amp3 pump lasers by a microsecond. The associated delay box was put on the network, and an application written to allow remote control of the delays. This worked well, although there was some initial confusion over which button to click on the instrument to allow the operator in the area to resume physical control. A button was added to the software interface to enable a 30-second physical over-ride.

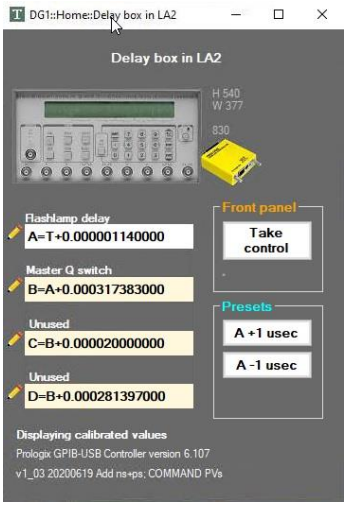

Figure 2. Screenshot of the DG535 control software showing the settings of the four channels (only two of which are in use), preset timing adjustment buttons, and physical control over-ride button.

Amp3 beam-dump control: Most of the sliders in LA2 are controlled via both physical buttons on the digital/analogue control crates next to the main Control System, and by virtual buttons on the main Control System interface. For historical reasons however, the two beam-dumps in Amp3 were controlled only by the physical buttons. It was a straightforward process to update the interface of the main Control System to include virtual buttons, but there was an issue in doing so because there are no micro- or magnetic switches to confirm the positions of the beam dumps. A webcam set up on a nearby PC allows the remote operator (and the code developer) a view of Amp3 and the beam dumps. The in-built microphone also allows someone in the area to communicate with a remote user, although it is a very noisy link. The installation of magnetic switches to indicate the positions of the beam dumps has been added to the list of engineering tasks.