LCLS-II Timing Pattern Generator Configuration GUIs

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Abstract

The LINAC Coherent Light Source II (LCLS-II) is an upgrade of the SLAC National Accelerator Laboratory LCLS facility to a superconducting LINAC with multiple destinations at different power levels. The challenge in delivering timing to a superconducting LINAC is dictated by the stability requirements for the beam power and the 1MHz rate. A timing generator will produce patterns instead of events because of the large number of event codes required. The poster explains how the stability requirements are addressed by the design of two Graphical User Interfaces (GUI). The Allow Table GUI filters the timing pattern requests respecting the Machine Protection System (MPS) defined Power Class and the electron beam dump capacities. The Timing Pattern Generator (TPG) programs Sequence Engines to deliver the beam rate configuration requested by the user. The low level program, the TPG generates the patterns, which contains the timing information propagated to the Timing Pattern Receiver (TPR). Both are implemented with an FPGA solution and configured by EPICS. The poster shows an overall design of the high-level software solutions that meet the physics requirements for LCLS-II timing.

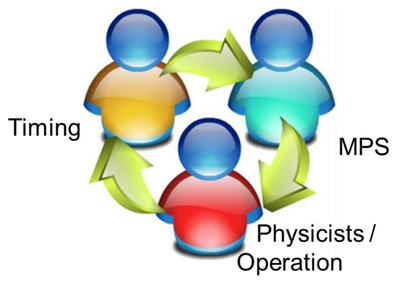
Introduction

LCLS II Timing System requires 3 GUIs to meet specifications. (see Figure 1)

The timing team, MPS team and physicists worked out together the specification for those applications.

1. Timing Pattern Generator
2. Allow Table Program
3. Actual Rates Display

Figure 1: TPG GUIs list.



Summary

The Timing System GUIs development has its focus on the flexibility required by the system.
The user interface have, in fact, the appropriate level of complexity. As the most simple version of them is defined for EIC, where most of the requirements are reduced, increasing complexity for commissioning.

The programs and GUIs are design and developed, generating patterns that need to dynamically adapt to what MPS allows for the current condition.
The GUIs described in this poster, expose the timing system to interface with multiple systems. The user interface are designed to be friendly and intuitive.

1) Timing Pattern Generator

The Timing Pattern Generator GUI (TPGGUI) uses the PVs provided by the TPG IOC to program the Sequence Engines. The Physics requirement describes the desired function for this application. Such as: Multiple Destinations and Bunch Trains. The TPG GUI required three levels of customization: a) parametrize configuration ; b) manual bunch entry con and c) pre-configured sequences selection

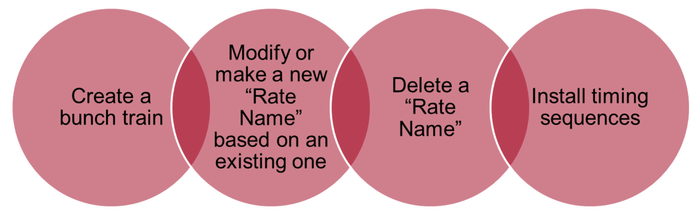


Figure 2: TPG GUI functionalities

a)

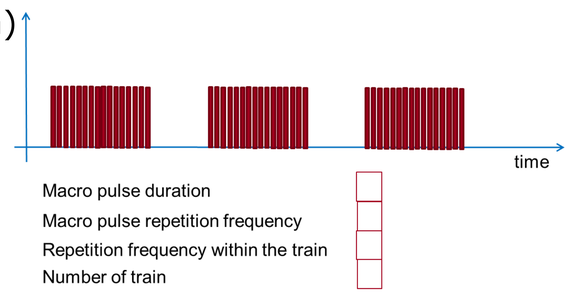


Figure 3: TPG GUI parametrize (smaller trains and fixed spacing)

b)

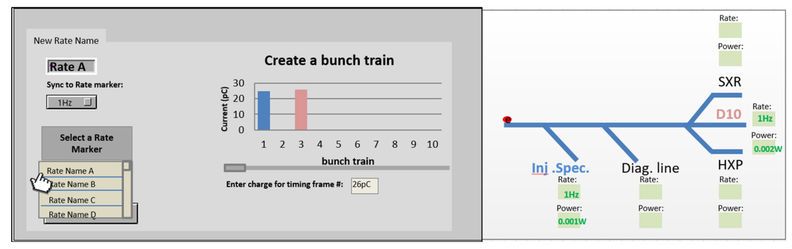


Figure 4: TPG GUI visual selection

Early Injection Commissioning

c)

Figure 5: TPG GUI for EIC

The timing system requirements to generating timing patterns for Early Injector Commission (EIC) are reduced:

- Limited set of beam rates
- max charge limited to 300pC
- one destination (GUN B)

2) Allow Table Program

The MPS system uses the timing system as a mitigation device, rate reduction.
Definitions:
Power Limit (PL): This is the maximum power authorized from MPS, communicated by the Central Node.
Allow Sequence (AS): It is the set of timing sequences allowed for a specific Power Class (PC).

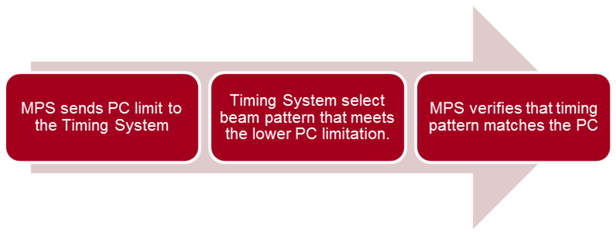


Figure 7: MPS and timing communication workflow

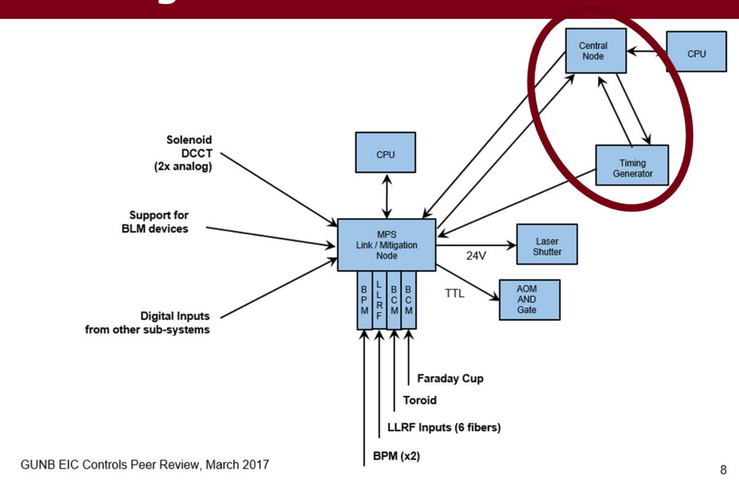


Figure 6: MPS system communication with timing generator

Early Injection Commissioning

Data input:

Timing Sequence	Charge
0Hz	300pC
1Hz	300pC
10Hz	300pC
1MHz	300pC
Burst Mode	300pC

Allow Table:

Allow Sequence	Power Class	Timing Sequence
AS2	PC2	all
AS1	PC1	10Hz,1Hz,0Hz, Burst Mode
AS0	PC0	none

MPS will choose a PC and communicate that to timing.

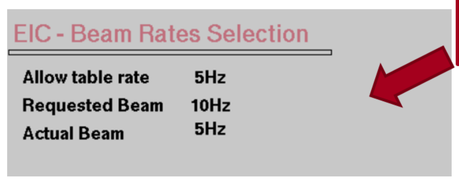
Figure 8: Allow Table for EIC

The communication between the Timing System and MPS is fundamental to calculate the Allow Table.
The Timing system is also communicating to the MPS, providing the desired charge. This way MPS can compare the actual measured charge with it and take preventive actions if required.

The requirements for EIC are reduced, assuming as max charge 300pC. This assumption allowed us to developed a static allow table

3) Actual Rate Display

For EIC the control room is going to use a unique display with the rates selection together with the "Actual Rate" compared to "Desired Rate".
For Commissioning there will be a display up in the control room showing the "Actual Rate" compared to "Desired Rate" for all destinations: Diagnostic Line, D10, SXR and HXR.



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