

## **LCLS Controls Software - Requirements for High-Level Applications Packages**

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This introductory document provides a brief summary of the high-level software to be used for beam tuning in the LCLS. These high level packages in turn rely on an application software infrastructure, also briefly listed. The software “pyramid” goes down many levels to include standardized applications packages for hardware such as magnets and klystrons and control of the timing. The scope of this document is not to give a comprehensive overview of the complete controls software system, but to highlight the main accelerator physics packages that are required for commissioning the LCLS.

### **High-Level Applications Packages include**

1. Fast feedback
  - Orbit
  - Energy
  - Bunch length
2. Emittance measurement
  - 4-wire emittance reconstruction
  - profile monitor beam size measurements
  - quadrupole scan
  - beta matching
3. Power steering
  - Including lattice diagnostics
4. Linac Energy Management
5. Generic correlation plots
  - Including buffered data acquisition

These packages are built on top of the following control system capabilities:

#### **Diagnostic instrumentation inputs**

- BPMs
- Wire scanners
- Profile monitors

#### **Hardware configuration inputs**

- Magnet settings, including bends, quadrupoles, correctors
- Klystron energy, based on amplitude and phase

## Beam line online modeling

Magnet B field settings combined with beam energy values to give optics lattice “k” values

Transfer R-matrix values for all points along the beamline

Twiss parameters for all points along the beamline

Orbit fitting of measured BPM values to the beamline optics

Estimation of equivalent kick to the beam at specified location for the fitted orbit

Calculation of ideal corrector strengths to correct estimated orbit kicks