

<b>PHYSICS REQUIREMENT DOCUMENT (PRD)</b>	<b>Doc. No. SP-391-001-16 R0</b>	<b>LUSI SUB-SYSTEM CXI</b>
<b>CXI Instrument Start-up Plan</b>		
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# 1. Introduction

The CXI instrument will be located in FEH Hutch 5 at the LCLS. The CXI instrument will predominantly use the full LCLS X-ray pulse focused to a small spot to collect the complete diffraction patterns of submicron objects in order to obtain high resolution images of the these objects.

Instrument construction and start-up occurs in two phases as follows:

- a) Construction
- b) Commissioning

Construction is funded by the applicable portion of the LUSI M.I.E. project and provides design, procurement, construction, installation, testing without beam, a commissioning plan and operating procedures. Construction completion is confirmed by an Instrument Readiness Review and resolution of all pre-startup (required before receiving beam) issues generated by the review.

Commissioning starts immediately after construction is complete and includes testing and calibration with X-ray beam and implementation of adjustments needed for effective usage by users.

As stated in the LUSI Project Execution Plan (PEP) and repeated below, the CXI portion of the project will be complete upon meeting the technical baseline specifications given in Table 5.1 of the PEP. Funding for commissioning and user operations activities is provided by LCLS Facility operations.

*“The LUSI project scope comprises designing, building, and installing three instruments. It does not include commissioning with beam which occurs as part of LCLS operations. Technical scope is defined in Table 5.1, Essential parameters for LUSI Instruments to achieve their respective Critical Decision (CD)-4. Although it is not possible to directly measure the parameters listed in Table 5.1 without beam, the capability of an instrument to eventually achieve these parameters will be demonstrated as part of the CD-4 process for each device using results of acceptance tests and/or calculations. Using this approach, CD-4 approval for each LUSI instrument is based on: demonstrating the capability to achieve the technical parameters shown below, either by acceptance testing, calculations, or some combination of testing and calculation, and successful completion of an Instrument Readiness Review (IRR).*

*Upon completion of CD-4 for each instrument, the LCLS operations organization will assume ownership of the instrument and will support the full cost of commissioning and operating. All LUSI project funding for the instrument/system ceases with acceptance at CD-4. With this well defined LUSI project completion milestone, there is no period of time when dual ownership of an instrument occurs.”*

## 2. Validation of Technical Specifications

Completion of the CXI instrument and component physics requirements (PRD) will be verified per the Inspection, Test and Commissioning section of the CXI Instrument Engineering Specifications Document (SP-391-000-85) and the Acceptance Testing Requirements section of the CXI Instrument Physics Requirements Document (SP-391-000-19). This acceptance testing includes:

- verification that the CD-4 technical parameters can be obtained,
- certification that all radiological shielding is expected to provide the required performance (measurement of radiation levels is not possible without beam)
- certification of proper operation of all safety systems
- verification that appropriate as-built documentation has been provided
- operation of all equipment (without beam) in a manner that simulates performing intended experiments.

Where not possible to verify shielding performance or CD-4 technical parameters without testing with beam, they will be validated by acceptance testing, calculations, or some combination of testing and calculation.

The project team will certify this completion by completing the signoff checklist required by the LCLS Instrument Completion Procedure (TBD).

The project team will obtain operational approval for beam commissioning per a LCLS Operations Procedure (TBD).

## 3. Instrument Start-Up

Commissioning will consist of:

- Verification that radiation shielding performance meets the SLAC safety limits by performing surveys while operating with beam
- X-ray flux, resolution, detector performance and other testing while operating with beam
- Providing fixes needed for effective user operation
- Generating operating/maintenance procedures and personnel training for user operation,
- Conducting an IRR for user operation

Shielding surveys will be performed by SLAC radiation protection personnel. Once the radiation survey has been completed, authorization will be given to allow shutter operation without the presence of SLAC radiation protection staff.

These surveys are performed routinely on new instruments and when configurations change. Based on experience with equivalent measurements at other beam lines, this is expected to require several days.

Testing to confirm the instrument performance with beam will be conducted in accordance with the Commissioning Plan that will be generated by the project and approved by the IRR for commissioning.