

PHYSICS REQUIREMENT DOCUMENT (PRD)	Doc. No. SP-391-000-23 R1	LUSI SUB-SYSTEM DCO, CXI, XPP
Physics Requirements for the LUSI Pulse Picker System		
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Revision	Date	Description of Changes	Approved
R0	03DEC07	Initial release	
R1	19JUN08	Deleted Obsolete Beam Parameters, Reduced the clear aperture requirement, Rephrased a vacuum requirement, Split the safety requirement in two requirements	7/8/2008

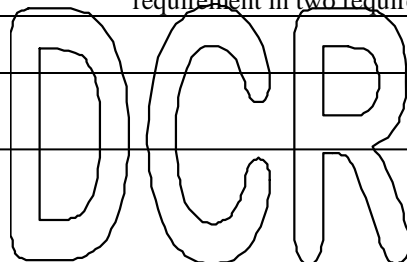


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1. Overview

The LUSI instruments require the ability to reduce the repetition rate of the LCLS pulse train. This document describes the requirements of a system to perform this task.

The coordinate system is defined in Design Standards Supplement DS-391-000-36.

2. Performance Requirements

- 2.1.** The pulse picker system will have the capability of reducing the repetition rate of the LCLS X-ray pulse train to any frequency less than or equal to 10 Hz.
- 2.2.** The pulse picker shall have an opening and closing time of 3 msec or less.
- 2.3.** The pulse picker shall have to ability to perform an open and close cycle in less than 8 msec.
- 2.4.** The pulse picker shall have to ability to remain open for as long as desired.
- 2.5.** The pulse picker must withstand the full LCLS flux (white beam) at all locations downstream of and including NEH Hutch 2, across the 2-25 keV spectral range without degradation due to radiation damage. The beam parameters in Hutch 2 can be calculated from the parameters listed in LCLS PRD# 1.1-014.
- 2.6.** The transmission through the pulse picker should be no more than 10^{-11} throughout the entire spectral range of 2-25 keV.
- 2.7.** No reflection of the beam off the pulse picker shall be allowed to propagate down the beamline.

3. Size Requirement

- 3.1.** A clear aperture of 3.5 mm must be present for the LCLS beam when the shutter is in the open position.

4. Positioning Requirements

- 4.1.** Two operating positions shall exist for the pulse picker: “Open” or “Closed”.
- 4.2.** When in the ‘Open’ position, the LCLS beam shall propagate through the center of the opening to within 2% of the opening size
- 4.3.** The accuracy and repeatability of the positioning of the pulse picker opening shall be 2% of the opening size.

5. Vacuum Requirements

- 5.1.** The pulse picker will reside in a 10^{-7} Torr pressure environment and the appropriate vacuum practice for the design, manufacturing, and installation of the system components shall be implemented.
- 5.2.** The pulse picker design shall allow for visual inspection in the field.

6. Controls Requirements

- 6.1.** The pulse picker system is required to change state remotely via the instrument control system.
- 6.2.** The state of the pulse picker shall be recorded in the experimental metadata.
- 6.3.** Remote inspection of the pulse picker state, consistent with requirement 5.2, shall be implemented and the image shall be displayed at the instrument control console when desired by the user at a frame rate of 30 Hz.

7. Safety Requirements

- 7.1.** Any radiation produced by the interaction of the LCLS beam with the pulse picker shall be absorbed with the use of slits or shields so that it does not propagate down the beamline.
- 7.2.** Reflections of the LCLS off the pulse picker shall not be allowed to hit the walls of the vacuum enclosure at any point downstream of the pulse picker.

Appendix A – Revision 1 Primary Changes Affected Sections

2. Performance Requirements

- 2.1 No change
- 2.2 No change
- 2.3 No change
- 2.4 No change
- 2.5 (was) The pulse picker must withstand the full LCLS flux in NEH Hutch 3, where the x-ray spot size is 220 μm FWHM and energy per pulse is 1 mJ, across the 2-25 keV spectral range without degradation due to radiation damage.
- 2.6 No change
- 2.7 No change

3. Size Requirement

- 3.1 Changed 4mm to 3.5 mm

5. Vacuum Requirements

- 5.1 No change
- 5.2 (was) The pulse picker design shall allow for direct viewing of the beam stopping part of the pulse picker during operation.

7. Safety Requirements

- 7.1 (was) Any radiation produced by the interaction of the LCLS beam with the pulse picker shall be absorbed with the use of slits or shields so that it does not propagate down the beamline and have the possibility of hitting the vacuum pipe downstream.
- 7.2 Added this requirement