PHYSICS REQUIREMENT DOCUMENT (PRD)	Doc. No. SP-391-000-10 R1	LUSI SUB-SYSTEM CXI, XCS, XPP

Physics Requirements for the LUSI Attenuator System

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Revision	Date	Description of Changes	Approved
R0	28NOV07	Initial Release	
R1	02JUL08	Deleted Obsolete Beam Parameters	7/8/2008

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Table of Contents

1. Overview

An attenuator system is required for the XPP, CXI and XCS instruments to control the incident x-ray intensity. This document describes the requirements of this system.

The coordinate system is defined in Design Standards Supplement DS31100036.

2. Performance Requirements

2.1. The attenuator system should provide greater than 10^8 attenuation with at least 3-steps-per decade incremental attenuation at a photon energy of 8.3 keV.

2.2. The attenuator system should provide greater than 10^4 attenuation with at least 3-steps-per decade incremental attenuation at a photon energy of 24.9 keV (**XPP and XCS only**).

2.3. The filters must not damage or degrade when exposed to the full unfocused LCLS flux in the NEH Hutch 3 across the 4 -25 keV spectral range. The LCLS flux can be calculated from parameters listed in LCLS PRD# 1.1-014. Use of the XTOD attenuators is permitted to achieve this requirement.

2.4. The attenuators shall preserve the transverse coherence of the FEL radiation to the highest extent achievable.

3. Size Requirement

3.1. The filters in the attenuator system shall have a clear aperture of 1 cm.

4. Positioning Requirements

4.1. Two operating positions are required for each attenuator: 'In' and 'Out'.

4.2. The attenuator system state should have the ability to be changed in ~ 1 second.

4.3. When in the 'In' position, the LCLS beam shall transmit through the center of the filter to within 10% of the filter size and the surface normal of each filter shall be aligned to the z-axis of the LCLS coordinate system to within ±1°. This can be achieved manually.

4.4. A minimum stay clear radius of 0.5" will be maintained when the attenuators are in the 'Out' position.

4.5. A translational repeatability of 100 microns and a rotational repeatability (tilt and yaw) of 0.1º shall be maintained when the attenuator is placed in the 'In' position.

4.6. The attenuators shall default to the 'In' position in the event of a system fault.

4.7. A mechanism to manually place the filters in the 'Out' position should be provided in the case of a system fault.

5. Vacuum Requirements

5.1. The attenuator system 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 attenuator system should have direct visual evidence of the state of each attenuator (for example a viewport or an indicator on an actuator).

6. Controls Requirements

6.1. The attenuator system is required to change state remotely via the instrument control system.

6.2. A status signal that indicates the current state of each filter is required. The status of each attenuator shall be recorded in the experimental metadata.

Appendix A – Revision 1 Primary Changes Affected Sections

2. Revision 1 Performance Requirements

2.1. The attenuator system should provide up to a 10^8 factor in attenuation with a maximum incremental attenuation of 3-steps-per decade at a photon energy of 8.3 keV.

2.2. The attenuator system should provide up to a 10^5 factor in attenuation with a maximum incremental attenuation of 3-steps-per decade at a photon energy of 24.9 keV (XPP and XCS only)

2.3. (was) If multiple attenuating materials (filters) are implemented, each filter must not damage or degrade when exposed to the full LCLS flux in the NEH Hutch 3, where the x-ray spot size is 220μm FWHM and energy per pulse is 1 mJ, across the 6-25 keV spectral range.

2.4. (no change)

5. Vacuum Requirements

5.1. (no change)

5.2. The attenuator system should allow for direct viewing of the filters during operation.