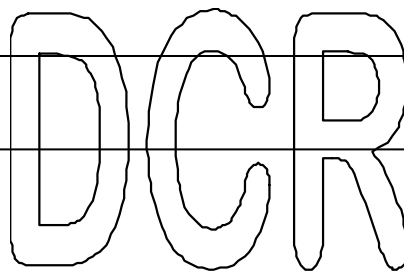


<b>PHYSICS REQUIREMENT DOCUMENT (PRD)</b>	<b>Doc. No.</b> SP-391-000-10 R1	<b>LUSI SUB-SYSTEM</b> CXI, XCS, XPP
<b>Physics Requirements for the LUSI Attenuator System</b>		
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Revision	Date	Description of Changes	Approved
R0	28NOV07	Initial Release	
R1	02JUL08	Deleted Obsolete Beam Parameters	7/8/2008



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### 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  $\sim 1$  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  $\pm 1^\circ$ . 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  $0.1^\circ$  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 220 $\mu$ m 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.