Engineering specification Document (ESD)	Doc. No. SP-391-001-44 R0	LUSI SUB-SYSTEM CXI Instrument

CXI 1 micron Precision Instrument Stand

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Revision	Date	Description of Changes	Approved
R0	6FEB09	Initial release	

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1. Applicable documents

PRD# SP-391-001-41	Physics Requirements for the 1 micron CXI Sample Chamber
PRD# SP-391-000-28	Physics Requirements for the CXI Detector Stage
PRD# SP-391-001-42	Physics Requirements for the 1 micron CXI Precision Instrument Stand
ESD# SP-391-000-70	CXI Detector Stage
ESD# SP-391-001-43	CXI 1 micron Sample Chamber
ESD# SP-391-000-65	Engineering Specifications for the CXI 1 micron KB System
SLAC—I-720-0A24E-001	Seismic Design Specification for Buildings, Structures, Equipment, and Systems
SLAC DS-391-000-36	Mechanical Design Standards Supplement
NEC, NFPA 70:	National Electric Code
NEC, NFPA 70E	Electrical safety in the Workplace

2. Overview

The CXI 1 micron Sample Chamber assembly, as described in SP-391-001-43, and the CXI Detector Stage assembly, as described in SP-391-000-70, both will need to accommodate their position to the various optics configurations offered on the beam line (unfocused beam, KB1). A precision stand that will support both of these assemblies will provide all necessary motion to align the instrument with the incoming X-ray beam.

This document describes the technical specifications of the Precision Instrument Stand.

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

3. Location

The CXI 1 micron Precision Instrument Stand shall be located inside the CXI hutch, hutch #5 in the Far Experimental Hall. It shall be anchored to the floor, downstream of the 1 micron KB system.

4. Environment

The humidity and temperature are controlled in the FEH hutches, therefore no component specific temperature stabilizing system will be provided for the stand unless a more stringent temperature control is required to meet the stability requirements.

5. Size and load requirement

5.1. The precision stand shall be designed to carry the load of both the sample environment elements and the Detector Stage assembly.

5.2. The precision instrument stand shall be of sufficient length to accommodate the positioning of the detector at 2.6m from the interaction region.

5.3. The precision instrument stand shall provide for all alternate positions of the detector stage assembly relative to the sample chamber as described in SP-391-000-70, including the detector mounted upstream of the Sample Chamber.

6. Positioning and performance requirements

6.1. The Precision Instrument Stand shall provide all necessary motions to align the instrument with the incoming X-ray beam for each of the optics configurations, i.e. unfocused beam and KB 1.

6.2. The precision stand shall provide an induced rotation of the sample chamber around a vertical axis and a horizontal axis positioned at the current 1 micron KB position. The combination of linear motions shall keep the axis of the chamber aligned with the X-ray beam for each of the optics configurations, i.e. unfocused beam and KB 1, see Figure 1.

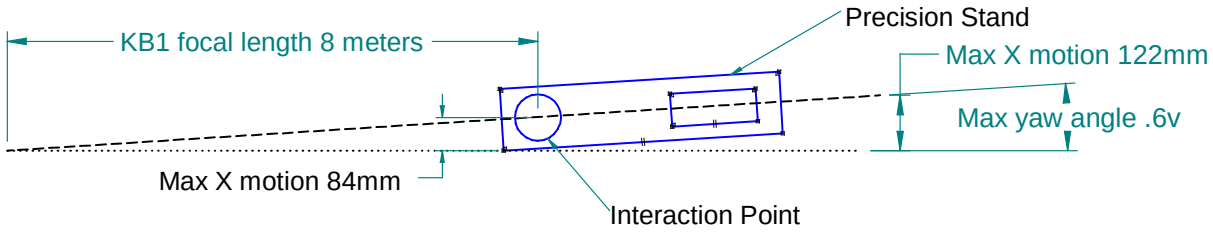

Figure 1: Motion of the Precision Stand

6.3. With the KB system of 1 micron focal spot anticipated at a focal distance of 8m, and a 0.5º maximum yaw deflection angle; the maximum movements foreseen of the interaction region and the motion accuracy are listed in Table 1.

6.4. The vibrational stability requirement in Table 1 is meant to represent stability with respect to the incident LCLS beam over a period of several seconds.

6.5. Mechanical "hard-stops" shall be employed to prevent accidental over-travel

6.6. No pinch points shall be allowed.

Motion	Range	Nominal Position	Resolution	Repeatability	Vibrational Stability	Thermal Stability
x position	-10 mm < x < 70 mm	0 mm	50 μm	50 μm	0.1 μm	20 μm
y position	-10 mm < y < 70 mm	0 mm	50 μm	50 μm	0.1 μm	20 μm
z position	-10 mm < z < 70 mm	0 mm	50 μm	50 μm	0.1 μm	20 μm
Yaw	-0.1° < yaw > 0.5°	0°	30 μrad	30 μrad	5 μrad	5 μrad
Pitch	-0.1° < pitch < 0.5°	0°	30 μrad	30 μrad	5 μrad	5 μm

Table 1: Motion requirements for the 0.1 micron Precision Instrument Stand. Translations refer to the motion of the interaction point and rotations are around the interaction point.

The maximum x and y motions of the precision stand (see Figure 1) in this configuration are estimated at 60 mm each, measured at the interaction point; 86 mm measured at the downstream end of the Precision Stand. In the eventuality of the KB mirror system being rotated by 45 degrees so that the deflection of the beam is in the horizontal plane only, then the y displacement would be zero and the x displacement would be 85 mm at the interaction point and 122 mm at the downstream end.

7. Mechanical Interfaces

7.1. The upper frame of the precision stand shall have all the necessary anchoring points to attach the 1 micron Sample Chamber.

7.2. The upper frame of the Precision Instrument Stand shall have all the necessary anchoring points to attach the Detector Stage in all its operational positions. If necessary, extra supports shall be provided to relieve stress on the spacer spools that accommodate for the different positions of the detector stage.

7.3. The Precision Instrument Stand shall allow for the Detector Stage to be mounted upstream of the 1 micron Sample Chamber, preferably with a detachable structure.

7.4. The lower frame of the precision stand shall have all the necessary anchoring points to attach the instrument to the floor.

7.5. The Precision Instrument Stand shall support a long distance microscope for visual inspection of the sample in two different locations.

8. Cyclic Requirements

The precision stand shall move on the order of 10 times daily for small adjustments or scanning motions of a few millimeters in XYZ.

9. Electrical Requirements

All the necessary power supplies and control cables shall be provided by the controls group.
The interface from the control racks to the precision stand (cable trays and routing, connector supports, etc.) shall be determined jointly with the controls group

10. Controls Requirements

The controls and data acquisition associated with the precision stand shall be consistent with the requirements outlined in the documents PRD SP-391-000-03, Physics Requirements for the LUSI Controls and Data System and PRD SP-391-000-06, Physics Requirements for the LUSI Data Management. Requirements specific to the precision stand are described below.

10.1. Remote operation of all the positioners shall be implemented via the instrument control system.

10.2. Password protection shall be implemented for all the positioners of the precision stand to protect the upstream and down stream bellows in the event of an accidental move.

10.3. Limit switches shall be used to confine the precision stand motion range.

11. Seismic requirements

The precision stand anchoring to the floor and the moving frame with its positioners shall be able to withstand seismic accelerations within the specifications defined in the latest revision of SLAC document I-720-0A24E-001.