| Engineering specification Document (ESD) | Doc. No. SP-391-001-44 R0 | LUSI SUB-SYSTEM CXI Instrument |
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# CXI 1 micron Precision Instrument Stand

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| Revision | Date | Description of Changes | Approved |
|---|---|---|---|
| R0 | 15May2008 | Initial release | |
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# Table of Contents

# 1. Applicable documents

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|---|---|
| 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 |

# 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 will 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 will be designed to carry the load of both the sample environment elements the detector chamber assembly.

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

5.3. The precision instrument stand will provide for all alternate positions of the detector stage assembly relative to the sample chamber as described in SP-391-000-70

# 6. Mechanical concepts

6.1. The precision stage will be made of 2 rectangular, welded tubular frames, linked by a set of linear stages and spherical bearings.

6.2. It will be able to move the sample chamber and detector assembly in all 6 degrees of motion; X, Y, Z, pitch, roll and yaw

6.3. The 6 axes of motion will be provided by the combination of 6 motorized linear stages, 3 free guiding stages and 3 spherical bearings configured as shown in Figure 1

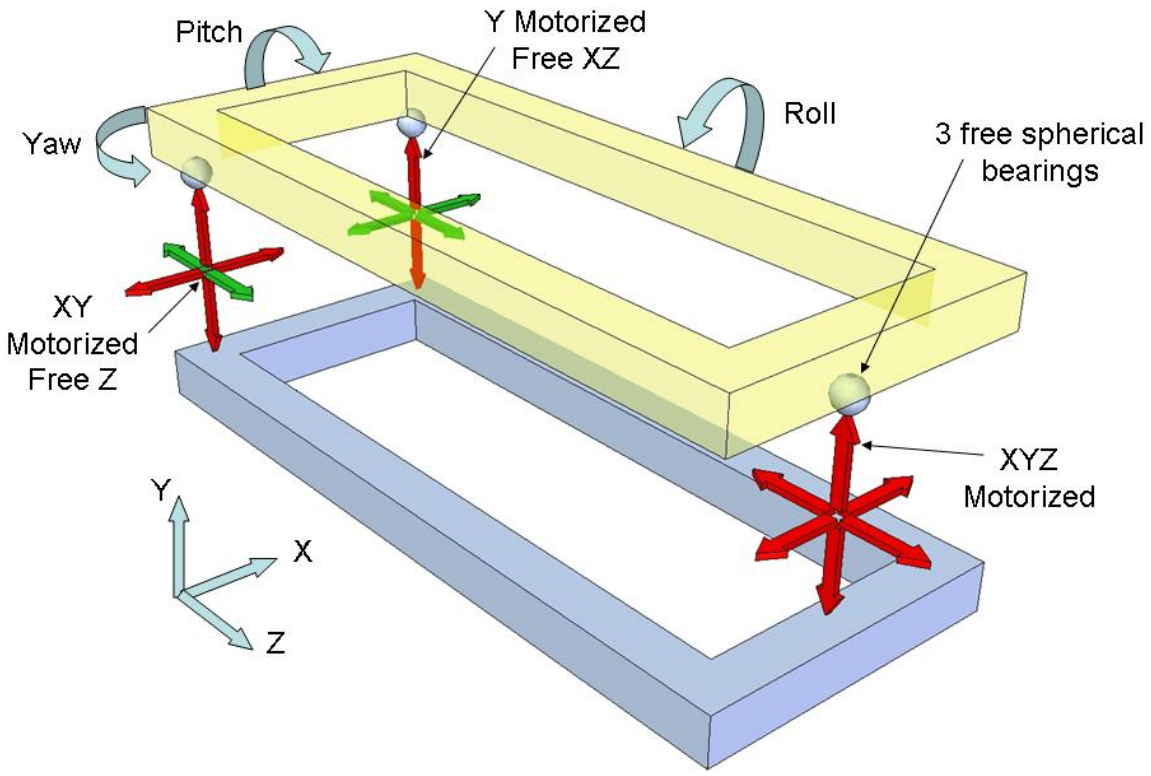


**Figure 1: Schematic of CXI 1 micron Precision Instrument Stand kinematic mounting principle**

# 7. Positioning and performance requirements

7.1. The Precision Instrument Stand will 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.

7.2. The precision stand will provide an induced rotation of the sample chamber around a vertical axis positioned at the current KB position. The combination of linear motions will 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 2.

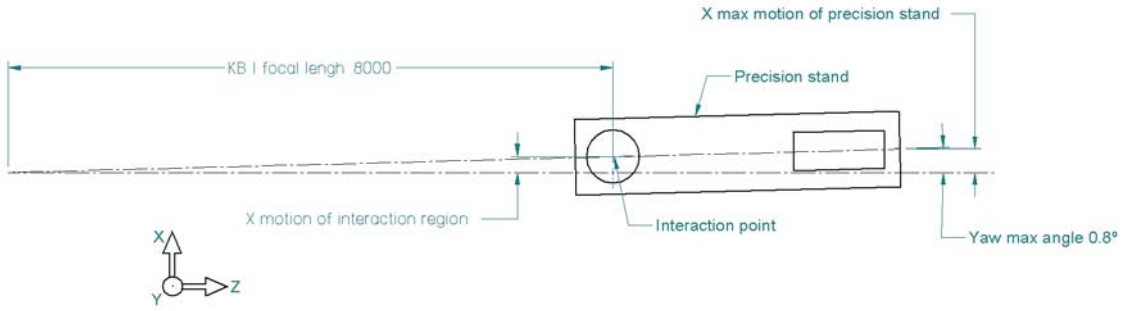


**Figure 2: jsdfjklkljjafkj**

7.3. With the KB system of 1 micron focal spot anticipated at a focal distance of 8m, and a 0.8º maximum yaw deflection angle; the maximum movements foreseen of the interaction region and the motion accuracy are listed in Table 1.

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

| Motion | Range | Nominal Position | Resolution | Repeatability | Stability |
|---|---|---|---|---|---|
| x position | -55 mm < x < 55 mm | 55 mm | 50 µm | 50 µm | 0.1 µm |
| y position | -10 mm < x < 10 mm | 0 mm | 50 µm | 50 µm | 0.1 µm |
| z position | -5 mm < x < 20 mm | 0 mm | 50 µm | 50 µm | 0.1 µm |
| Yaw | -0.4° < yaw < 0.4° | 0.4° | 30 µrad | 30 µrad | 5 µrad |

**Table 1: Motion requirements for the 0.1 micron Precision Instrument Stand**

The maximum "X" motion of the precision stand (see Figure 1) in this configuration is estimated at 165mm

## 8. Mechanical Interfaces

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

8.2. The upper frame of the precision stand will have all the necessary anchoring points to attach the Detector Stage in all its different optional positions. If necessary, extra supports will be provided to relieve stress on the spacer spools that accommodate for the different positions of the detector stage.

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

## 9. Cyclic Requirements

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

## 10. 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.) will be determined jointly with the controls group

## 11. 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.

11.1. Remote operation of all the positioners will be implemented via the instrument control system.

11.2. Password protection will 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.

11.3. Limit switches will be used to confine the precision stand motion range.

11.4. Mechanical "hard-stops" will be employed to prevent accidental over-travel

## 12. Earthquake requirements

The precision stand anchoring to the floor and the moving frame with its positioners will be able to withstand earthquakes accelerations within the specifications defined in SLAC's document I-720-0A24E-002.