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Mechanical Interface between the 2D Pixel Array Detector and the CXI Detector stage

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Brief Summary:

This document presents the mechanical interface between the Cornell 2D Pixel Array Detector in LCLS WBS 2.06.05.02 & 2.06.02.08 and the CXI Instrument in LUSI described by WBS section 1.03.

Change History Log

Rev Number	Revision Date	Sections Affected	Description of Change
0	Nov 17, 2008	All	Initial Version

Supporting Documents

1. ID-391-522-30: CXI Detector chamber interface drawing.
2. LCLS PRD 1.6-002 r1: Physics Requirements for the 2D X-Ray Detector.
3. LCLS ICD 1.1-514 r0: PCD (Photon Controls & Data) systems.
4. LUSI PRD SP-391-000-28 r0: Physics Requirements for the CXI Detector Stage.
5. LUSI PRD SP-391-001-42 r0: Physics Requirements for the CXI 1 μm Precision Instrument Stand.
6. LUSI ESD SP-391-001-18 r0: Data Acquisition Specification for the CXI Experiment.
7. LUSI DS-391-000-36 r0: Mechanical Design Standards Supplement.
8. LCLS ICD 1.1-302: LCLS vacuum requirements

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1. Introduction

The LCLS X-ray Endstation System group will develop a prototype x-ray detector (2D-PAD) in collaboration with Cornell to be used in the LUSI Coherent X-ray Imaging (CXI) experiment. The detector consists of a sensor diode bump-bonded to two pixelated readout ASICs. The CXI experiment requires a tiled detector to cover a larger area and a variable hole size in the center to accommodate the diverging beam when moving the detector along the LCLS beam.

This document describes the interfaces between the CXI detector assembly, holding multiple 2D-PAD detectors, and the CXI Instrument.

1. Acronyms

2D-PAD: two dimensional pixel array detector

2. Coordinate System

See document LUSI DS-391-000-36 r0.

2. Interface Definition

The interfaces between the LUSI CXI instrument and the LCLS x-ray detector described in this document are mainly mechanical. For details about the interface between the x-ray detector and the LCLS Photon Controls & Data systems we refer to document LCLS ICD 1.1-514.

1. Mechanical Requirements

The detector shall meet the mechanical envelope, interface, and center of gravity requirements as specified in Ref [1], the mechanical interface drawing.

The not-to-exceed (NTE) weight of the entire detector assembly shall be 11 kg (25 pounds).

The center of gravity along the Z-axis shall not exceed ***3" (76.2 mm)*** from the interface plane on the back of the detector package. The center of gravity of the detector assembly must be within 0.25" (6.4 mm), radially, of the center. See ID-391-522-30.

The stayclear volume is ***11.25" (286 mm)*** diameter by ***6" (152.4 mm)*** long envelope. All cables, cooling, and other services must exit the detector assembly off the back flange. An additional 3" (76 mm) in Z is available off the back end of the detector to allow for connectors and cable routing to either route the services in Z or radially. The diameter of the sample chamber flange should be 11.75" or larger. See ID-391-522-30.

All alignment of the detector will be accomplished by features in the CXI chamber. No bulk alignment capability is needed within the detector with respect to the interface described in this document.

2. Detector Stability

The CXI Detector Stage and Precision Instrument Stand will contribute to the overall stability of the detector w.r.t. the sample or beam. These stability numbers are assumed to be uncorrelated and added in quadrature. The CXI Detector Stage shall hold the detector stable on the end of its cantilever to ±10 μm with respect to the Precision Instrument Stand.

3. Thermal & cooling interface

The power allocation is 48 W for the complete CXI detector assembly, with power cycling.

The cantilever interface mount temperature shall be stable to ± 5 °C over 12 hours.

The detector will supply any over-temperature protection needed.

Water cooling requires air-guards to prevent water to vacuum interfaces.

The CXI chamber will supply water at a temperature of 20 ± 1 °C.

The CXI chamber will supply water at a minimum rate of 0.3 gpm and maximum pressure of 100 psi.

The water flow rate shall be manually adjustable and include a manually read flow meter. Valve and flow meter shall be outside the chamber and supplied by LUSI.

4. Vacuum Requirements

The x-ray detector operates in a 10^{-7} Torr vacuum of the CXI sample chamber. All the detector materials (including cables) shall be vacuum compatible with 10^{-7} Torr.

All materials, components, and assemblies shall be processed and cleaned according to LCLS handling practices [8]. After cleaning, all materials, components, and assemblies used in the detector assembly or fixturing shall be stored, handled, and used in accordance with LCLS vacuum practices [8].

5. Electrical interface

The CXI chamber will provide electrical signal and power cables and vacuum feedthroughs. The cables (signal, power, etc.) shall be connected to the LCLS PCD systems via the detector FE-board outside the CXI chamber. The maximum length of the cables is determined by the distances between the detector & feedthroughs and feedthroughs & FE-board.

For the detector raft wiring 9 pin sub connectors will be used and the wires will be twisted pair. The data cable on the detector side has crimp sockets for 28 awg wire Positronic part number SND9F12S500G, the detector stage side (FE board) has crimp pins for 28 awg wire Positronic part number SND9M1200E2G. The power cable is required to carry 3 amps per pin where the detector side has crimp sockets for 24 awg wire Positronic part number SND9M1S500G. The detector stage side (FE-board) has crimp pins for 24 awg wire Positronic part number SND9F100E2G.

The motor cable for motor control (and sensor wires) has on the detector side a 15 pin male, part number SDD15M0000G.

Pin #	Data cable	Power cable
1	Clk	12 vdc rail 1
2	Clk	12 rtn rail 1 (ground)
3	Data	12 vdc rail 1
4	Data	12 rtn rail 1
5	-	-
6	Data	12 vdc rail 2
7	Data	12 rtn rail 2
8	Data	12 vdc rail 2
9	Data	12 rtn rail 2

6. Power Requirements

All moving parts, and actuators shall be fail-safe from sudden loss of power.

The high voltage power (120-200 V) to bias the sensor and the low voltage power for the readout electronics are provided by the CXI detector. The CXI detector needs an isolated (clean) ground.