

Purchase Order 78931

SLAC National Accelerator Laboratory
 2575 Sand Hill Road M/S 1
 Menlo Park CA 94025
 Fax: (650) 926-2000

Purchase Order	Date	Revision	Page
SLAC - 78931	03/12/2009		1
Payment Terms	Freight Terms	Ship Via	
Net 30	FOB Destination	UPS BROWN	
Buyer Lam, Carol		Currency	USD
PHONE: 650/926-5051	E-Mail: clam@slac.stanford.edu		

Confirming Order

PEGASUS DESIGN
 608 MAIN STREET
 STE: D
 PLEASANTON CA 94566
 United States
 Fax: 925/426-9806

PHONE: 925/426-2386

Vendor: 0000015738
Ship To: SLAC National Accelerator Laboratory
 2575 Sand Hill Road
 Menlo Park CA 94025

Bill To: SLAC National Accelerator Laboratory
 Accounts Payable
 2575 Sand Hill Rd M/S85
 Menlo Park CA 94025
 Fax: 650 926 4248

Line-Schd	Item	Description	Quantity	UOM	PO Price	EPLS	Verified on 3/12/2009	Extended Amt	Due Date
1 - 1		Mechanical design services to generate a 3D models and fabrication drawings of the Detector Stage to be used in the CXI instrument at LCLS.	1.00	JOB	62,400.00			62,400.00	05/01/2009
Schedule Total								<u>62,400.00</u>	

Mfg ID

Schedule Total 62,400.00

This purchase order is for the mechanical design services to generate the 3D models and fabrication drawings of the Detector Stage to be used in the CXI instrument at LCLS. Vendor is required to present the design at each design phase as specified in the Statement of Work, Doc. No. SP-391-001-68 R0, dated February 20, 2009. The mechanical design shall meet specifications contained in the Engineering Specification, Doc. No. SP-391-000-70-R0, dated February 13, 2009.

Item Total 62,400.00

All shipments, shipping papers, invoices, and correspondence must be identified with the SLAC P.O. Number. PURCHASE ORDER NUMBER MUST APPEAR ON THE OUTSIDE OF THE PACKAGE. All Shippers and/or Invoices accompanying the items shipped shall state the Export Control Classification Number (ECCN) on the document. Overshipments will not be accepted unless authorized by Buyer prior to shipment.

RECEIVING HOURS: 7:00am - 11:45am 12:30pm - 4:00pm Phone Number: 650-926-4247

Order Placed With: Pegasus Design

SLAC National Accelerator Laboratory Terms and Conditions for Commercial Supplies and Services, M366 (Rev. 09Jan09), are attached hereto and incorporated by reference.

Two copies of all invoices shall be addressed to the University Contract Administrator as identified in section F of Article 1 -- Scope of Work/General Information and mailed to the following address

Stanford Linear Accelerator Center
 Purchasing Department MS-01
 2575 Sand Hill Road
 Menlo Park, CA 94025

Milestone Payment Schedule

Payment will be authorized based on the percentage of completion. Delay in delivery or non-delivery will result in non-payment. Payment will be based on the following payment milestone schedule:

- #1 - Present the current design state at periodic meetings throughout the design phase - 20% payment = \$12,480.00
- #2 - Present the design at the Preliminary Design Review - 20% payment = \$12,480.00
- #3 - Present the design at the Final Design Review - 20% payment = \$12,480.00
- #4 - Deliver all CAD files for the designed system & all detailed calculations performed during the design phase - 20% payment = \$12,480.00
- #5 - Transfer any simulation or Finite-element Analysis input files in a format to be agreed upon with SLAC (if applicable) - 20% payment = \$12,480.00

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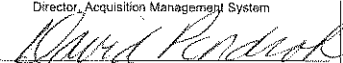
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Tax Exempt? Y	Tax Exempt ID: SRGH26-001337	Inspection Required? Y	EPLS	Verified on 3/12/2009			
Line-Schd	Item	Description	Quantity	UOM	PO Price	Extended Amt	Due Date

Total of five (5) milestone payments = \$62,400.00

Total PO Amount 62,400.00

Acceptance of this Purchase Order implies the acceptance of all terms and conditions contained therein, and also all specifications, drawings, and additional terms and conditions referred to herein and/or attached hereto. Seller will invoice separately for each purchase order number. Send one (1) copy of invoice. This purchase is for resale to the U.S. Government under DOE Contract DE-AC02-76SF00515 and is exempt from any sales or use tax.

STANFORD UNIVERSITY
 SLAC National Accelerator Laboratory
 Barry Miller
 Director, Acquisition Management System
 By 

SLAC NATIONAL ACCELERATOR LABORATORY

Terms and Conditions for Commercial Supplies and Services

1. DEFINITIONS

As used in this Purchase Order, the term:

- a. "Item" means the commercial item or commercial component, as defined in FAR 52.202-1, ordered under the Purchase Order.
- b. "Buyer" means the Board of Trustees of the Leland Stanford Jr. University, or any duly authorized representative thereof.
- c. "Government" means the Government of the United States of America.
- d. "DOE" means the United States Department of Energy.
- e. "Seller" means the firm (individual person and/or entity) supplying the materials, equipment or services called for under this order.
- f. "Commercial item" means

1. Any item, other than real property, that is of a type customarily used by the general public or by non-governmental entities for purposes other than governmental purposes, and –
 - (a) Has been sold, leased, or licensed to the general public; or
 - (b) Has been offered for sale, or license to the general public;
2. Services of a type offered and sold competitively in substantial quantities in the commercial marketplace based on established catalog or market prices for specific tasks performed or specific outcomes to be achieved and under standard commercial terms and conditions. This does not include services that are sold based on hourly rates without an established catalog or market price for a specific service performed or a specific outcome to be achieved. For purposes of these services-
 - (a) "Catalog price" means a price included in a catalog, price list, schedule, or other form that is regularly maintained by the manufacturer or vendor, is either published or otherwise available for inspection by customers, and states prices at which sales are currently, or were last, made to a significant number of buyers constituting the general public; and
 - (b) "Market prices" means current prices that are established in the course of ordinary trade between buyers and sellers free to bargain and that can be substantiated through competition or from sources independent of the offerors.

2. ACCEPTANCE - CONTRACT TERMS

- a. The Buyer agrees that, unless otherwise provided herein, the Seller may accept this order by performance hereof or in writing at the option of the Seller.
- b. Seller, by accepting this order, agrees that (i) this order as written by the Buyer sets forth the entire order between the Buyer and the Seller and (ii) no form or document supplied by the Seller shall constitute a part of this order unless specifically accepted in writing by the Buyer.

3. PUBLICITY

Seller agrees not to release any advertising copy mentioning Buyer or quoting the opinion of any of Buyer's employees unless such copy is approved by Buyer before release.

4. ASSIGNMENT

Neither this Purchase Order nor any interest therein nor claim thereunder shall be assigned or transferred by the Seller except as expressly authorized in writing by the Buyer; provided, that the Seller or its assignee's rights to be paid amounts due as a result of performance of this purchase order may be assigned to a bank, trust company or other financing institution, including any Federal lending institution. Payments to an assignee shall be subject to setoff or recoupment for any present or future claims of Buyer against Seller.

5. PERMITS AND LICENSES

Except as otherwise directed by the Buyer, the Seller shall procure all necessary permits or licenses and abide by all applicable laws, regulations, and ordinances of the United States and of the State, territory and political subdivision in which the work under this order is performed.

6. TITLE AND RESPONSIBILITY

- a. Title to the material and supplies purchased hereunder shall pass to the Government at the point of delivery to the Buyer; and, if purchased F.O.B. Shipping Point, delivery to the carrier by the Seller shall be deemed delivery to the Buyer. No insurance charges will be allowed unless specifically authorized in the order.
- b. Except as otherwise provided in this order (i) the Seller shall be responsible for the supplies covered by this order until they are delivered at the designated delivery point, regardless of the point of inspection; (ii) the Seller shall bear all risks as to rejected supplies after notice of rejection, except that the Buyer shall be responsible for the loss, or destruction of, or damage to, the supplies if loss, destruction or damage results from the gross negligence of officers, agents, or employees of the Buyer acting within the scope of their employment.
- c. The actual total transportation charges paid to the carrier(s) by the consignor or consignee shall be reimbursed by the Seller

7. TAXES

- a. Except as may be otherwise provided in this order, the selling price includes all applicable Federal taxes in effect on the date of this order but does not include any State or local sales, use, or other tax directly applicable to the completed supplies or services covered by this order nor any other tax from which the Seller or this transaction is exempt. Upon request of the Seller, the Buyer shall furnish, unless no legal basis exists therefore, a tax exemption certificate or similar evidence of exemption with respect to any such tax not included in the Seller's price pursuant to this article.
- b. Tax Withholding:

The University will automatically deduct 1099 withholdings from any invoice paid to independent contractors/consultants based on the following criteria

1. Payable to U.S. California Residents - no tax withholding but will be reported to IRS and California State Franchise Tax Board for 1099 tax reporting.
2. Payable to U.S. Non-California Residents (for work performed in California) – The University will withhold 7% California State Tax if the vendor is paid over \$1,500.00 in a calendar year.

SLAC NATIONAL ACCELERATOR LABORATORY

Terms and Conditions for Commercial Supplies and Services

3. Payable to U.S. Non-California Residents (for work performed outside of California) – no tax withholding but will be reported to California State Franchise Tax Board for 1099 tax reporting.
4. Payable to Non-U.S. Residents (for work performed outside of California) – The University will withhold 30% Federal Tax. In addition, the University will withhold 7% State Tax if the independent contractor is paid over \$1,500.00 in a calendar year.
5. Payable to Non-U.S. Residents (for work performed outside the U.S.) – no reporting or withholding.
6. Invoices submitted for payment, as a result of this purchase order, must clearly specify any and all hours worked in the State of California and worked outside of the State of California.

8. EXTRAS

Except as otherwise provided in this order, no payment for extras shall be made unless such extras and the price therefore have been authorized in writing by the Buyer.

9. CHANGES

Changes in the terms and conditions of the Purchase Order may be made only by the written agreement of the parties.

10. INSTRUCTIONS FOR PACKAGING

Packing and packaging shall be adequate to prevent damage when shipped by common carrier or method utilized. Any damage resulting from improper packaging, containerizing, or lack thereof shall be the liability of the Seller. The Seller shall indicate the Purchase Order number on each container or package. An itemized packing list shall be affixed to the outermost cover of each container or package. The use of biodegradable packaging materials is encouraged.

11. QUALITY OF ITEMS

All item(s), including any materials and supplies furnished by the Seller in performance of any services, shall as a minimum: (1) be new or reconditioned and so identified and warranted as new and not of such age or so deteriorated as to impair their usefulness or safety; (2) be as warranted; and (3) not contain any counterfeit or suspect materials, parts, or components. The furnishing of reconditioned items must be specified in the Purchase Order or approved by the Buyer's Purchasing Representative. Types of materials, parts, and components known to have been counterfeit or suspect include, but are not limited to: electrical components, piping, fittings, flanges, and fasteners. The Buyer will not accept any items or any services involving the furnishing of materials or supplies found by the Buyer to not conform to these minimum requirements, notwithstanding any inspection or acceptance of delivery by the Buyer, unless such conditions specifically approved in writing by the Buyer's Purchasing representative.

12. INSPECTION

- a. The Buyer reserves the right to inspect all and every part of the items under this Purchase Order, during and after completion of performance. The Buyer shall not be obligated to inspect the items, and neither the inspection nor the lack of inspection by the Buyer shall relieve the Seller of its responsibility for providing the items in accordance with the terms and conditions of this Purchase Order. The inspection or use of or payment for an item under this Purchase Order, either wholly or in part, shall not be construed as acceptance.
- b. If any item or any part of it is not in accordance with the terms and conditions of this Purchase Order, the Buyer shall notify the Seller that the item is rejected.

Thereupon, the Seller shall, at its own expense, take the necessary corrective action. The Buyer shall reject performance or revoke its acceptance of an item: (1) within a reasonable time after a defect is discovered or should have been discovered; and (2) before any substantial change occurs in the condition of the item, unless the change is due to a defect in the item.

13. WARRANTY

The Seller warrants that all services, supplies and equipment delivered hereunder shall be free from all defects in materials and workmanship and shall comply with all the requirements of this order. The warranty shall begin upon acceptance and extend for a period of (1) the manufacturer's warranty period or six months, whichever is longer, if Seller is not the manufacturer and has not modified the item or (2) one year or the manufacturer's warranty period, whichever is longer, if Seller is the manufacturer of the item or has modified it. Any defective supplies or equipment shall be promptly repaired or replaced during the warranty period at no cost to Buyer. All expenses of return shipment and reshipment to Buyer shall be borne by Seller.

14. LIMITATION OF LIABILITY

Except as otherwise provided by an express or implied warranty, the Seller will not be liable to the Buyer for consequential damages resulting from any defect or deficiencies in accepted items.

15. EXCUSABLE DELAYS

The Seller shall be liable for default unless nonperformance is caused by an occurrence beyond the reasonable control of the Seller and without its fault or negligence, such as acts of God or the public enemy, acts of the Government in either its sovereign or contractual capacity, fires, flood, epidemics, quarantine, restrictions, strikes, unusually severe weather, and delays of common carriers. The Seller shall notify the Buyer in writing as soon as reasonably possible after commencement of any excusable delay, setting forth the full particulars in connection therewith, shall remedy such occurrence with all reasonable dispatch, and shall promptly give the University written notice of the cessation of such occurrence.

16. TERMINATION FOR THE CONVENIENCE OF BUYER

The Buyer reserves the right to terminate this Purchase Order, or any part hereof, for its sole convenience. In the event of such termination, Seller shall immediately stop all work terminated and shall immediately cause any and all of its affected suppliers and subcontractors to cease work. Subject to the terms of this Purchase Order, Seller shall be paid a percentage of the price reflecting the percentage of the work performed prior to the notice of termination, plus reasonable charges that Seller can demonstrate to the satisfaction of Buyer using its standard record keeping system, have resulted from the termination. Seller shall not be required to comply with the federal cost accounting standards or federal contract cost principles for this purpose. This article does not give the Buyer any right to audit Seller's records. Seller shall not be paid for any work performed or costs incurred which reasonably could have been avoided.

17. TERMINATION FOR CAUSE

The Buyer may terminate this Agreement for default, in whole or in part, for cause in the event of any default by the Seller, or if the Seller fails to comply with any purchase order term or condition, or fails to provide the Buyer, upon request, with adequate assurances of future performance. In the event of termination for cause, the Buyer shall not be liable to the Seller for any amount for supplies or services not accepted, and the Seller shall be liable to the Buyer for any and all rights and remedies provided by law. If it is determined that the Buyer improperly terminated this

SLAC NATIONAL ACCELERATOR LABORATORY

Terms and Conditions for Commercial Supplies and Services

contract for default, such termination shall be deemed a termination for convenience

18. INVOICES AND PAYMENTS

Except as otherwise provided in this order, the Seller shall be paid, upon the submission of invoices or vouchers in a form satisfactory to the Buyer, the prices stipulated herein for supplies or equipment delivered and accepted or for services rendered and accepted, less deductions if any, as herein provided. Unless otherwise specified, partial payments will not be made. This, however, should not be construed to mean payments for partial shipments of complete items (as distinguished from components) will not be made. It shall be understood that the cash discount period to Buyer will date from the date of receipt of merchandise or the invoice, whichever is later, and not from the date of invoice. Payments shall be made by check.

19. TRAVEL

When travel is included as part of the performance under the purchase order and is set forth as a specific cost/price element in the purchase order, the following requirements shall apply:

- Expenses for Domestic travel, lodging, meals, and incidental expenses shall be considered reasonable and allowable only to the extent that they do not exceed the maximum per diem rate in effect at the time of travel as set forth in the Federal Travel Regulations for the area of travel covered by this Purchase Order/Subcontract. The Seller/Subcontractor shall submit with its invoice, receipts or ticket stubs for items in excess of \$25 for fares, lodging, parking fees, toll charges, automobile rentals, etc.
- Any Foreign travel, if required, under this Purchase Order/Subcontract shall be conducted pursuant to the requirements contained in DOE Order 551.1, "Official Foreign Travel" or any subsequent version of the order in effect at the time of award. Note: All Foreign travel requests must be entered into the DOE Foreign Travel Management System (FTMS) within 60 calendar days before the proposed departure date. For the convenience of the traveler, the form "Request for Approval of Foreign Travel" (RAFT) is available at <http://www-group.slac.stanford.edu/bsd/travel/default.htm>

The RAFT must be completed and transmitted to the Buyer/Contract Specialist no later than 60 calendar days prior to the proposed departure date. Upon receipt of the Request for Approval for Foreign Travel, the Buyer/Contract Specialist shall coordinate through the UTR and SLAC Travel Office the submission of the RAFT to the DOE FTMS for review and approval.

Note: No Foreign travel shall be taken until a DOE FTMS Foreign Travel Approval Number has been obtained from the SLAC Travel Office and transmitted to the Seller/Subcontractor. Reimbursement for Foreign travel incurred without a FTMS Approval Number will not be allowed. The SLAC Travel Office may be contacted at Phone 650-926-4346.

20. CLAUSES INCORPORATED BY REFERENCE

The FAR and DEAR clauses listed below, which are located in Chapters 1 and 9, respectively, of Title 48 of the Code of Federal Regulations, are incorporated by this reference as a part of the University's Purchase Order or Subcontract (hereinafter "Subcontract") as prescribed below. As used in the clauses, the term "contract" shall mean the Subcontract; the term "Contractor" shall mean the entity (hereinafter "Subcontractor") who entered into the

Subcontract with the University; the term "subcontractor" shall mean the Subcontractor's subcontractor; and the terms "Government" and "Contracting Officer" shall mean the University, except in FAR clauses 52.227-1, 52.227-2, 52.227-3, 52.227-14, and 52.227-19, and DEAR clauses 970.5232-3, and 970.5245-1, in which clauses "Government" shall mean the U. S. Government and "Contracting Officer" shall mean the DOE Contracting Officer for Prime Contract DE-AC02-76SF00515 with the University. The Subcontractor shall include the listed clauses in its subcontracts at any tier, to the extent applicable.

FAR 52.203-6	RESTRICTIONS ON SUBCONTRACTOR SALES TO THE GOVERNMENT (SEP 2006), with Alternate 1 (OCT 1995). Use this clause if the Subcontract exceeds \$100,000
FAR 52.203-10	PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997), if the Subcontract exceeds \$100,000.
FAR 52.203-12	LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (SEP 2005), if the Subcontract exceeds \$100,000.
FAR 52.219-8	UTILIZATION OF SMALL BUSINESS CONCERNS (MAY 2004), if the Subcontract exceeds \$100,000.
FAR 52.219-9	SMALL BUSINESS SUBCONTRACTING PLAN (SEP 2006), if the Subcontract exceeds \$550,000, unless the Subcontractor is a small business or there are no subcontracting possibilities.
FAR 52.222-21	PROHIBITION OF SEGREGATED FACILITIES (FEB 1999), if the Subcontract exceeds \$10,000.
FAR 52.222-26	EQUAL OPPORTUNITY (APR 2002) (Note: Download the EEO Poster at: http://www.dol.gov/esa/ ; select "Posters" then "Equal Employment Opportunity Act")
FAR 52.222-35	EQUAL OPPORTUNITY FOR SPECIAL DISABLED VETERANS, VETERANS OF THE VIETNAM ERA, AND OTHER ELIGIBLE VETERANS (SEP 2006), if the Subcontract value is \$100,000 or greater.
FAR 52.222-36	AFFIRMATIVE ACTION FOR WORKERS WITH DISABILITIES (JUN 1998), if the Subcontract exceeds \$10,000.
FAR 52.222-37	EMPLOYMENT REPORTS ON SPECIAL DISABLED VETERANS, VETERANS OF THE VIETNAM ERA, AND OTHER ELIGIBLE VETERANS (SEP 2006), if the Subcontract value is \$100,000 or greater.

SLAC NATIONAL ACCELERATOR LABORATORY

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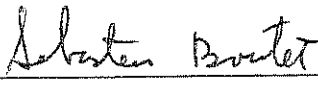

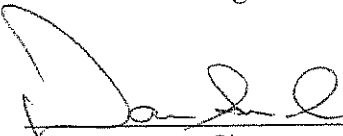
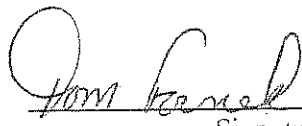
FAR 52.222-39	NOTIFICATION OF EMPLOYEE RIGHTS CONCERNING PAYMENT OF UNION DUES OR FEES (DEC 2004), if the Subcontract exceeds \$100,000.	information or evaluation, or for emergency repair or overhaul work by such government.
FAR 52.222-41	SERVICE CONTRACT ACT OF 1965, AS AMENDED (JUL 2005), if the Subcontract is principally for the furnishing of services through the use of "service employees" and if the subcontract exceeds \$2,500 UNLESS the Subcontract qualifies for class deviation under Section 4(b) of the McNamara-O'Hara Service Contract Act.	FAR 52.227-19 COMMERCIAL COMPUTER SOFTWARE-RESTRICTED RIGHTS (JUN 1987), if the Subcontract involves the acquisition of commercially available computer software & a GSA/Subcontractor Multiple Award Federal Supply Schedule Contract is not applicable.
FAR 52.222-44	FAIR LABOR STANDARDS ACT AND SERVICE CONTRACT ACT -- PRICE ADJUSTMENT (FEB 2002), if FAR clause 52.222-41 applies.	FAR 52.229-3 FEDERAL, STATE AND LOCAL TAXES (APR 2003), if the Subcontract exceeds \$100,000.
FAR 52.225-1	BUY AMERICAN ACT -- SUPPLIES (JUN 2003)	FAR 52.244-6 SUBCONTRACTS FOR COMMERCIAL ITEMS (SEP 2006), if Subcontract value exceeds \$550,000.
FAR 52.225-13	RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (FEB 2006)	FAR 52.245-4 GOVERNMENT FURNISHED PROPERTY (SHORT FORM) (JUN 2003), if the Subcontract is \$100,000 or less.
DEAR 952.204-71	SENSITIVE FOREIGN NATIONS CONTROLS (APR 1994)	FAR 52.249-2 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED PRICE) (APR 1984)
FAR 52.227-1	AUTHORIZATION AND CONSENT (JUL 1995) if the Subcontract exceeds \$100,000.	DEAR 952.203-70 WHISTLEBLOWER PROTECTION FOR CONTRACTOR EMPLOYEES (DEC 2000), if the Subcontract involves any work at a DOE-owned or leased facility.
FAR 52.227-2	NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT INFRINGEMENT (AUG 1996), if the Subcontract exceeds \$100,000.	DEAR 970.5223-4 WORKPLACE SUBSTANCE ABUSE PROGRAMS AT DOE SITES (DEC 2000), if the Subcontract is \$25,000 or over, and if it involves any of the hazardous activities stipulated in 10 CFR 707.2.
FAR 52.227-3	PATENT INDEMNITY (APR 1984), if the Subcontract exceeds \$100,000.	DEAR 970.5223-2 AFFIRMATIVE PROCUREMENT PROGRAM (MAR 2003)
DEAR 952.227-9	REFUND OF ROYALTIES (FEB 1995), if "royalties" are paid under the Subcontract by the Subcontractor, or by a subcontractor at any tier.	DEAR 970.5245-1 PROPERTY (DEC 2000)
FAR 52.227-14	RIGHTS IN DATA-GENERAL (JUN 1987), with Alternate V, and DEAR 927.409 paragraphs (a) and (d)(3). If delivery of Restricted Computer Software is required, then add Alternate III. If delivery of Limited Rights Data is required, then add Alternate II with the following five purposes to be added at the end of paragraph (a) of the clause: 1. Use (except for manufacture) by other contractors; 2. Evaluation by non-government evaluators; 3. Use (except for manufacture) by other contractors participating in the Government's program of which the specific subcontracts is a part, for information and use in connection with the work performed under each subcontracts; 4. Emergency repair or overhaul work; and 5. Release to a foreign government, or instrumentality thereof, as the interests of the United States Government may require, for	

21. ENTIRE AGREEMENT AND ORDER OF PRECEDENCE

This Purchase Order shall consist of the Purchase Order Signature Page, and Special Provisions, these Standard Terms and Conditions, and any other referenced and incorporated clauses, provisions, and documents, which is the entire Agreement between the parties concerning the subject matter hereof and supersedes all prior proposals, representations, negotiations, or agreements, whether written or oral.

Any inconsistencies in the terms and conditions comprising this Purchase Order shall be resolved by giving precedence in the following order: (a) the Purchase Order document (b) any Special Provisions; (c) these Standard Terms and Conditions; (d) the clauses incorporated by reference hereunder; (e) any specifications; (f) any other documents exhibits, or attachments.

(END OF TERMS AND CONDITIONS)

STATEMENT OF WORK (SOW)	Doc. No. SP-391-001-68 R0	LUSI SUB-SYSTEM CXI
Statement of Work for the Design of the CXI Detector Stage		
Prepared by: Sébastien Boutet CXI Instrument Scientist	 Signature	02/20/09 Date
Reviewed by: Paul Montanez CXI Lead Engineer	 Signature	02/25/09 Date
Reviewed by:	Signature	Date
Approved:	Signature	Date
Approved: Darren Marsh Quality Assurance Manager	 Signature	2/25/09 Date
Approved: Tom Fornek LUSI Project Manager	 Signature	2/23/2009 Date

Revision	Date	Description of Changes	Approved
R0	20FEB09	Initial release	

1. Introduction

The Coherent X-ray Imaging (CXI) instrument to be built at the Linac Coherent Light Source (LCLS) by the LCLS Ultrafast Science Instruments (LUSI) on the SLAC National Accelerator Laboratory site requires a 2D pixel array detector to be accurately placed with respect to the incident X-ray beam in order to detect X-rays scattered from a sample. This detector will be mounted inside a vacuum enclosure and the entire device is called the CXI Detector Stage.

This Detector Stage will have 5 degrees of freedom: X, Y, Z translation as well as pitch and yaw.

A vendor is sought to produce a complete design of the CXI Detector Stage and generate fabrication drawings for the device.

2. Scope

The vendor shall perform the following tasks described in SLAC document No. SP-391-000-70.

1. Preliminary Design

The vendor shall design a Detector Stage system capable of meeting the specifications contained in SLAC document No. SP-391-000-70.

2. Preliminary Design Review

When a sufficient design level has been reached, as agreed upon by SLAC and the vendor, a Preliminary Design Review shall be held at SLAC where the vendor shall present to a small committee, the status of the design and how the mechanical design meets the specifications contained in SLAC document No. SP-391-000-70.

3. Final Design

After the Preliminary Design Review, the vendor shall proceed to complete the design phase by incorporating the comments from the review and addressing the concerns raised by the committee. The final design of the vendor shall meet all the specifications contained in SLAC document No. SP-391-000-70, unless specifically agreed upon by SLAC.

4. Final Design Review

When the final design is complete, as agreed upon by SLAC and the vendor, a Final Design Review shall be held at SLAC where the vendor shall present to a small committee, the final design and how the mechanical design meets the specifications contained in SLAC document No. SP-391-000-70.

5. Drafting Phase

After successful completion of the Final Design Review, the vendor shall proceed to:

- Create detail drawings of all fabricated parts
- Write assembly instructions of all sub-assemblies and provide maintenance procedures for all sub-assemblies as well as the top-level assembly
- Create assembly drawings of all sub-assemblies and the top level assembly
- Generate a complete bill of materials

3. Applicable Documents

- SLAC document No. SP-391-000-70, "Engineering Specifications for the CXI Detector Stage"
- SLAC drawing No. DS-391-000-36, "Mechanical Design Standards Supplement"
- SLAC drawing No. SC-700-866-47, "Specification Kly & Vac Machining Fluids"
- SLAC document No. I-720-0A29Z-001, "SLAC ES&H Manual, Chapter 14, Pressure, Vacuum and Cryogenic Systems"
- SLAC document No. I-720-0A24E-001, "Seismic Design Specification for Buildings, Structures, Equipment, and Systems"

4. Requirements and Specifications

All requirements and specifications for the CXI Detector Stage are found in SLAC document No. SP-391-000-70.

4.1. Deliverables

The vendor has the following deliverables to SLAC:

- Present the current design state at periodic meetings throughout the design phase

- Present the design at the Preliminary Design Review
- Present the design at the Final Design Review
- Deliver all CAD files for the designed system
- Deliver all detailed calculations performed during the design phase
- Transfer any simulation or Finite-element Analysis input files in a format to be agreed upon with SLAC (if applicable)

4.2. Delivery times

The following duration for each phase of the work as desired:

Preliminary Design: 4 weeks

Final Design: 3 weeks

Drafting Phase: 6 weeks

Some down time is expected between each phase of the design to allow SLAC schedule design reviews and to resolve potential interface issues with other devices. During this down time, the vendor is not expected to perform any work on this project. The total duration of the project, including the down time, is expected to be 4-5 months.

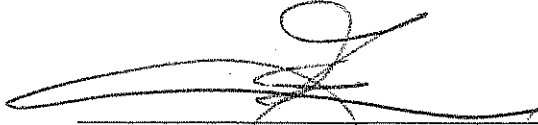
5. Quality Assurance Requirements

All drawings delivered will be checked by SLAC according to SLAC's quality assurance practices.

Engineering specification Document (ESD)	Doc. No. SP-391-000-70 R0	LUSI SUB-SYSTEM CXI instrument
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Engineering Specifications for the CXI Detector Stage

Prepared by:
Jean-Charles Castagna
Design Engineer



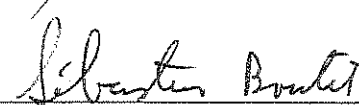
Signature Date 08-17-09

Co-authored by:
Paul Montanez
CXI Lead Engineer



Signature Date 02/13/09


Reviewed by:
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CXI Instrument Scientist



Signature Date 02/13/09

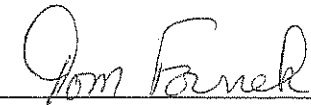
Signature Date

Approved:
Darren Marsh
Quality Assurance Manager



Signature Date 2/7/09

Approved:
Tom Fornek
LUSI Project Manager



Signature Date 2/13/2009

Revision	Date	Description of Changes	Approved
R0	13FEB09	Initial release	

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1. Overview

The 2D X-ray Detector used by the CXI instrument is described in document LCLS PRD # 1.6-002, *Physics Requirements for the 2-D X-Ray Detector*. The detector is required to be accurately placed so that the incident X-ray beam passes through the hole in the middle of the detector at various distances from the sample. The detector will be mounted in vacuum. The detector stage comprises the vacuum enclosure in which the detector is placed, the supports and motions of this vacuum enclosure and the in-vacuum mount and motion stages that hold the detector. This document describes the technical specifications of the detector stage system.

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

2. Applicable documents

PRD# SP-391-000-19	Physics Requirements for the CXI Instrument
PRD# SP-391-000-20	Physics Requirements for the CXI 0.1 micron Sample Chamber
PRD# SP-391-000-28	Physics Requirements for the CXI Detector Stage
PRD# SP-391-001-41	Physics Requirements for the CXI 1 micron Sample Chamber
PRD# SP-391-001-42	Physics Requirements for the CXI 1 micron Precision Instrument Stand
PRD# SP-391-000-63	Physics Requirements for the CXI 0.1 micron Precision Instrument Stand
LCLS PRD # 1.6-002	Physics Requirements for the 2-D X-ray Detector
LCLS ICD # 1.1-529	Interface Between the 2D-PAD and CXI Instrument
ESD# SP-391-000-67	Engineering Specifications for the CXI 0.1 micron Sample Chamber
ESD# SP-391-000-69	Engineering Specifications for the CXI 0.1 micron Precision Instrument stand
ESD# SP-391-001-43	Engineering Specifications for the CXI 1 micron Sample Chamber
ESD# SP-391-001-44	Engineering Specifications for the CXI 1 micron Precision Instrument Stand

3. General Requirements

3.1. Location

The CXI Detector Stage shall be located inside the CXI hutch (hutch 5) in the far experimental hall.

3.2. Environment

The humidity and temperature are controlled in the FEH hutches, therefore no component specific temperature stabilizing system shall be provided for the instrument, unless the expected temperature stability is determined to be insufficient to meet the stability requirements.

The temperature and relative humidity in the FEH Hutch 5 will be maintained at $72^{\circ}\text{F} \pm 1^{\circ}\text{F}$ ($22.2^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$) and $45\% \pm 10\%$, respectively.

3.3. Maintenance, Accessibility and Operations

The Detector Stage will need occasionally to change its mounting location in order to appropriately select a sample to detector distance for a given experiment. There shall be lifting fixtures on the Detector Stage to allow it to be hooked up to the Hutch crane and

moved to various locations on the Precision Instrument Stands (ESD# SP-391-001-44 and ESD# SP-391-000-69). Allowances shall be made to ensure that there is adequate clearance between the Detector Stage and the adjacent beamline serving hutch 6.

3.4. Lifetime

The expected service life of the device is 10 years.

4. Performance Requirements

- 4.1.** It shall be possible to set the detector distance from the interaction region to values between 50 and 2600 mm.
- 4.2.** It shall be possible to continuously and remotely vary the detector distance from the interaction region over a range of at least 600 mm.
- 4.3.** It shall be a design goal to make it possible to mount the detector stage downstream and upstream of the 1 micron Sample Chamber. The Detector Stage shall not be mounted upstream of the 0.1 micron Sample Chamber under any circumstances.
- 4.4.** A retractable visible light photodiode shall be included behind the X-ray 2D detector to align the detector hole with the CXI Reference Laser beam (PRD SP-391-000-21). This center of the photodiode shall be positioned to within 0.5 mm from the laser beam center. This can be achieved manually.
- 4.5.** The photodiode shall be capable of measuring the intensity of the continuous laser light at a rate of 5 Hz.
- 4.6.** A retractable screen shall be included behind the X-ray 2D detector to align the detector hole with the CXI Reference Laser beam (PRD SP-391-000-21). This screen shall allow visual inspection of the reference laser profile after it passes through the X-ray 2D detector. This visual inspection shall be performed with the x-ray beam turned off and the observer shall be standing inside the hutch. The retractable system may be manual.

5. Cyclic Requirements

- 5.1.** The z translation of the Detector Stage is expected to be actuated over its full stroke on average once daily. It is also expected to be actuated over small distances (<10 mm) on average 5 times daily for 10 years, with a peak of 50 times per day.
- 5.2.** The x and y translations of the Detector Stage are expected to be actuated over small distances (<10 mm) on average 5 times daily for 10 years, with a peak of 50 times per day.

6. Mechanical Interfaces

6.1. The upstream flange of the detector stage shall connect to the downstream flange of the CXI Sample Chambers. This flange shall be a 14" non-rotatable CF flange.

6.2. The downstream flange of the detector stage shall be as large as the vacuum enclosure itself.

6.3. An adapter flange from the downstream flange down to a 6" non-rotatable CF flange shall be used to connect to the CXI beamline on the downstream end of the Detector Stage. An adapter flange is preferred over a 6" welded flange solution for possible future upgrades.

6.4. The Detector Stage shall be supported by either of the CXI Precision Instrument Stands and the baseplate of the Detector Stage shall be consistent with the mounting structures of the stands.

6.5. The CXI Detector Stage shall be occasionally mounted upstream of the CXI 1 micron Sample Chamber in order to perform time-delay experiments with the beam reflected back with an X-ray mirror. The Detector Stage shall interface with the 1 micron Sample Chamber upstream in the same manner it does downstream by rotating the Detector Stage assembly by 180 degrees. The 1 micron Precision Instrument Stand shall support the Detector Stage in this configuration.

7. Materials

7.1. All parts and materials for the device shall be new and compatible with the performance requirements of this specification. Mil source certifications, including heat number, chemical analysis for all materials used in the manufacturing of the device shall be furnished. The device will be used in a radiation environment. Use of Teflon is specifically prohibited.

7.2. All applicable material safety data sheets (MSDS) shall be provided and stored in an accessible location.

8. Size Requirement

The detector will be provided to the CXI instrument housed in a 10" diameter cylinder that is 5" deep. This is a maximum envelope which will drive many of the design decisions.

8.1. The vacuum enclosure of the detector shall be large enough to enclose the detector, its mount and the Z motion in-vacuum stage. Room will be provided for a carrier for the cables and cooling lines to follow the Z motion of the detector.

8.2. The flange of the vacuum spool attached to the sample chamber shall be large enough to allow the detector to protrude into the sample chamber.

9. Kinematics/Supports

9.1. The detector stage will be hard mounted to the Sample Chamber or the spacer spool and all will have their coarse positions set by the Precision Instrument Stand. The Detector Stage Chamber shall not be positioned independently from the Sample Chamber. The support of the

Detector Stage shall be adjustable so it can accommodate the constrained mounting to the Sample Chamber.

10. Alignment/Fiducialization

10.1. Since the position and orientation of the Detector Stage vacuum enclosure will be entirely dictated by the Sample Chamber or the spacer spools, there is no need for fiducialization of the Detector Stage.

11. Positioning Requirements

The CXI instrument will have 2 Sample Chambers. The first one, the 1 micron Sample Chamber will have to ability to use the beam focused by the 1 micron KB System (PRD SP-391-000-24) as well as the direct beam. The second sample chamber (the 0.1 micron Sample Chamber) will use the beam focused by the 0.1 micron KB System only (PRD SP-391-000-25).

In all cases, the coarse positioning of the Detector Stage shall be achieved by the Instrument Stands (PRD SP-391-000-69 and PRD SP-391-001-43) supporting the Detector Stage. Only fine motions are required to position the 2D X-ray Detector after its main axis has been aligned to the LCLS beam.

11.1. The positioning of the vacuum enclosure around the detector shall be independent of the positioning of the detector within the vacuum enclosure.

12. Detector chamber assembly positioning

12.1. The detector chamber assembly shall be attached to the same Precision Stands as the Sample Chambers as described in ESD# SP-391-000-69 and ESD# SP-391-001-44.

12.2. The Z axis of the chamber assembly shall be aligned by construction to the Z axis of the sample chamber. Both the sample chamber and the detector chamber assembly shall be positioned thru the precision stand to align their Z axis to the LCLS beam with the focusing optic in use.

12.3. The detector chamber assembly will follow all the motions of the sample chamber in x,y,z and yaw as described in ESD# SP-391-000-69 and ESD# SP-391-001-44.

12.4. Alternate positions of the detector chamber assembly on the precision stand shall be provided to cover the full range of motion of the detector. These positions will be obtained by manually moving the whole detector chamber assembly on the precision stand and inserting extension spools between the detector stage and the sample chamber, as shown on Figure 1.

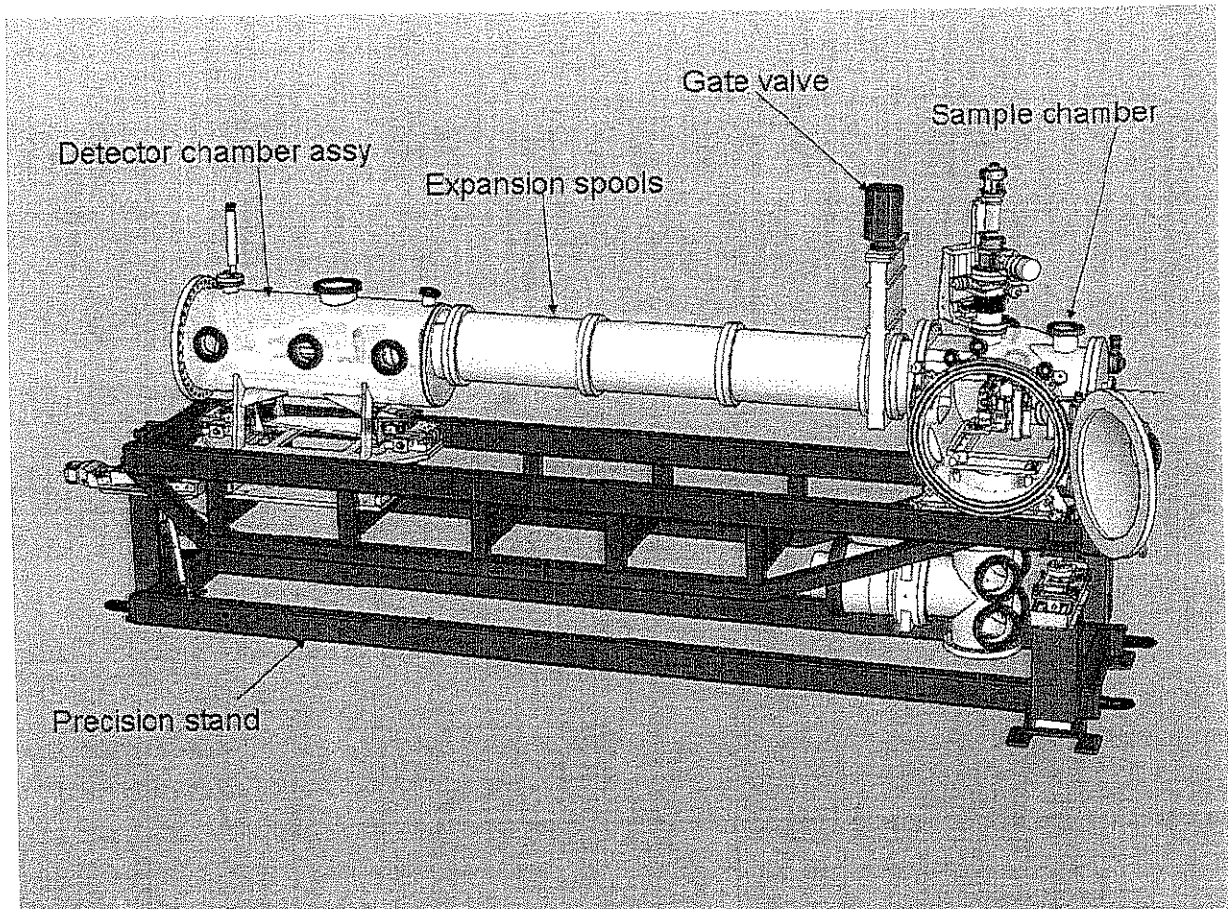


Figure 1: Detector Stage assembly shown at the downstream most location on the Precision Instrument Stand.

13. Detector Z stage axis positioning

13.1. A Z motion stage shall be provided inside the detector chamber to obtain a 600mm continuous range of the detector distance.

The Z detector stage assembly shall come as one unit that can be assembled outside of vacuum and installed in the vacuum chamber assembly. It consists of the Z linear stage, the detector with its support and cooling lines and the cable carrier. See Figure 2.

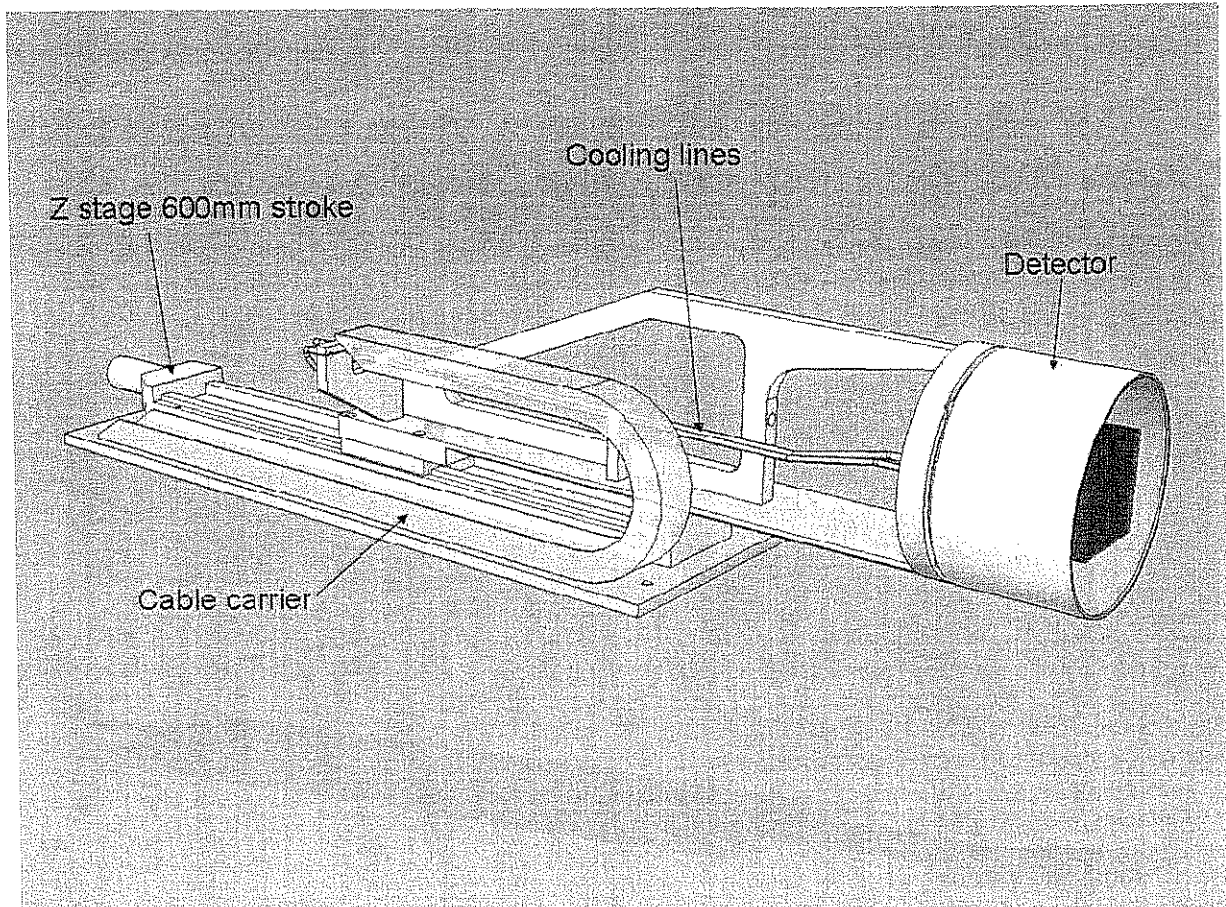


Figure 2: In-vacuum assembly of the Detector Stage controlling the Z position of the detector.

13.2. 2 pairs of additional XY stages included in the detector chamber assembly shall be provided to align the detector Z motion axis relatively to the sample chamber Z axis. The X and Y motion of the detector will be driven by linear stages outside of vacuum. The combination of movements of the XY stages will provide a pitch and yaw alignment of the Z stage of the detector, as shown on Figure 3.

13.3. The XY stages shall allow the centering of the LCLS beam to within $10\ \mu\text{m}$ of the center of the hole in the detector, provided the coarse positioning is achieved by the Precision Instrument Stand. They will also provide for any necessary realignment of the Z stage motion axis to the LCLS beam.

13.4. The detector stage shall have the motorized motions listed in Table 1.

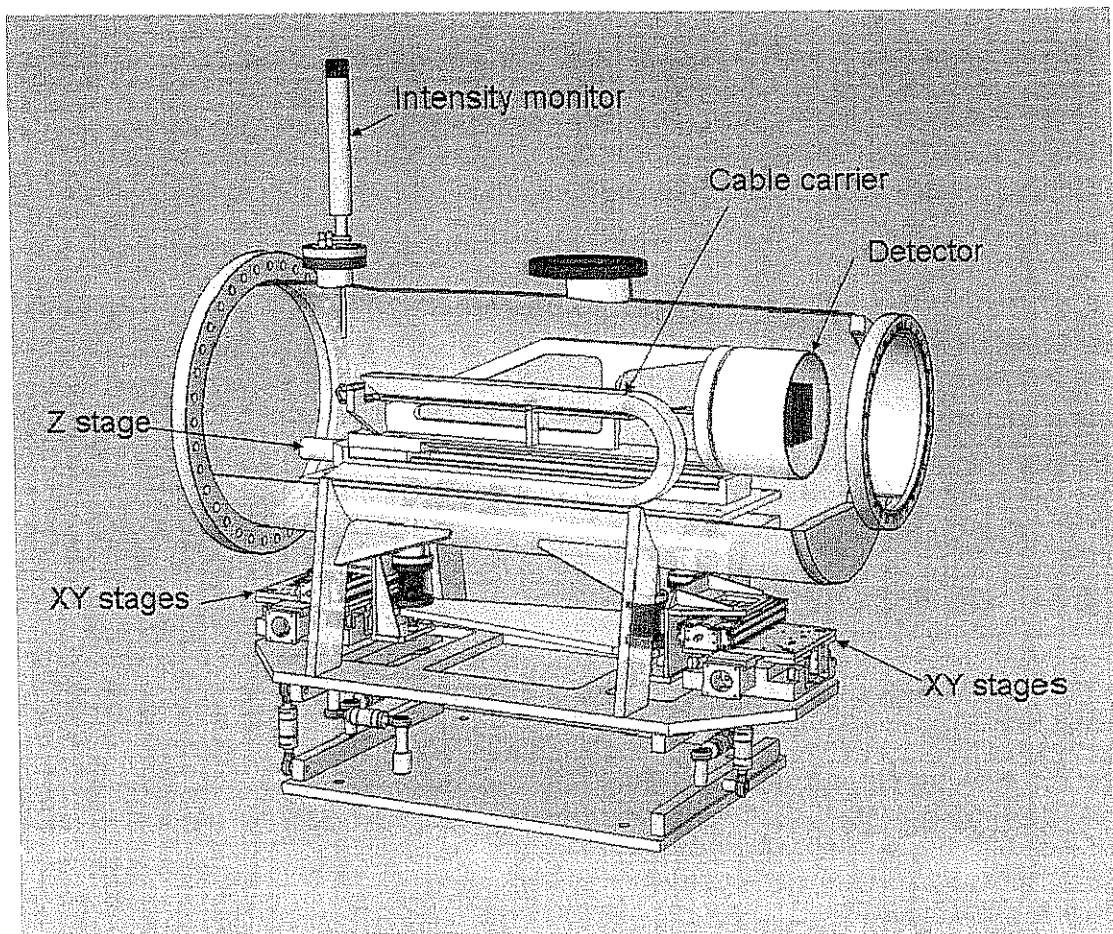
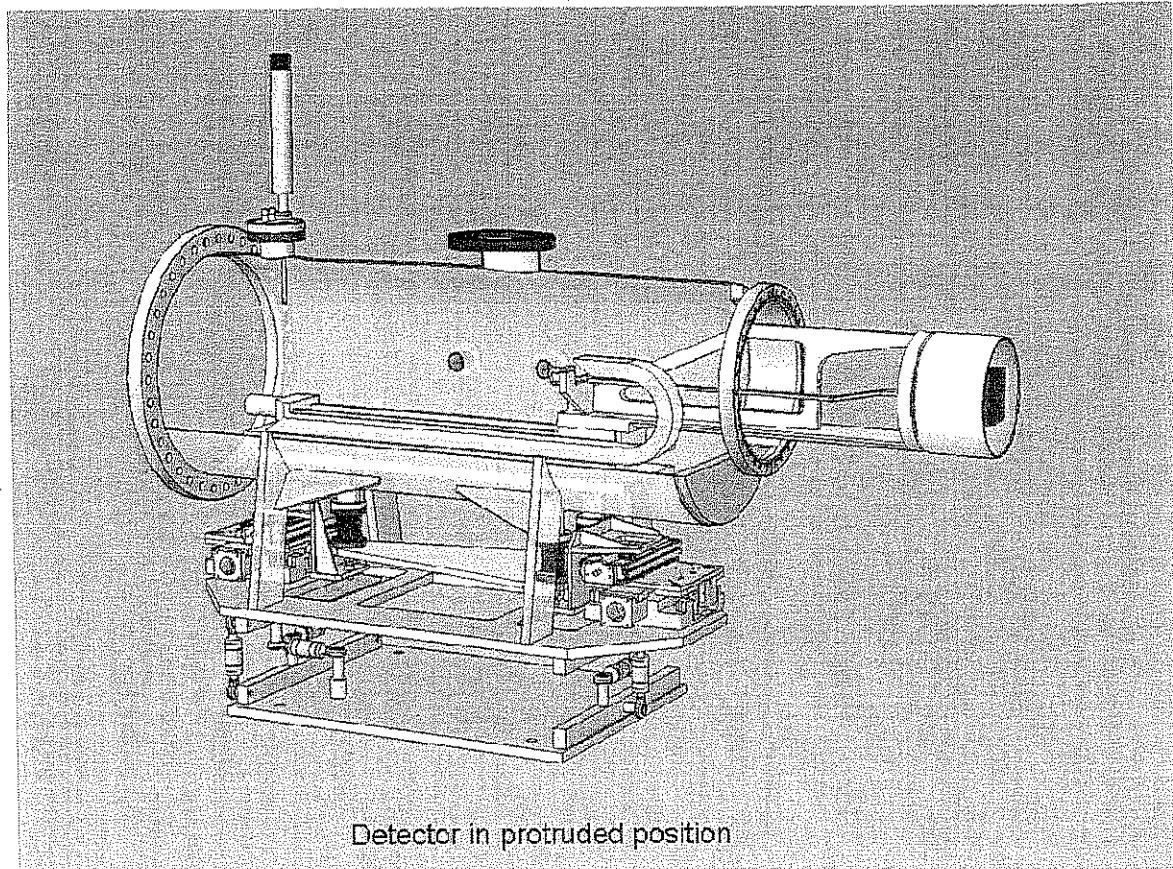


Figure 3: Detector Stage assembly showing the XY stages external to vacuum that allow the detector to be positioned transverse to the LCLS beam and also allow for pitch and yaw adjustment.

13.5. The detector shall be able to protrude out of its own chamber into the Sample Chamber and approach the sample to within 50mm, as shown on Figure 4.



Detector in protruded position

Figure 4: Detector shown in the fully protruding position.

Motion	Nominal Position	Range	Resolution	Repeatability	Vibrational Stability	Thermal Stability
Out of vacuum y1	0	-5 mm < y < 5 mm	10 μm	10 μm	1 μm	10 μm
Out of vacuum x1	0	-5 mm < x < 5 mm	10 μm	10 μm	1 μm	10 μm
Out of vacuum y1	0	-5 mm < y < 5 mm	10 μm	10 μm	1 μm	10 μm
In-vacuum z	50 mm	50 < z < 2600 mm in steps of 600mm	50 μm	50 μm	1 μm	10 μm
Yaw (x combination)	0°	±20 mrad	100 μrad	100 μrad	10 μrad	10 μrad
Pitch (Y combination)	0°	±20 mrad	100 μrad	100 μrad	10 μrad	10 μrad

Table 1: Motion requirements for the Detector Stage. The vibrational stability represents stability over a period of a few seconds. The thermal stability represents the stability over a period of a few hours.

14. Cantilevered Detector Mount

14.1. The bracket used to mount the detector in the cantilevered configuration shown on Figure 4 shall not block the LCLS beam. That is, the LCLS beam shall pass through the hole in the center of the detector and then be allowed to propagate all the way out through the downstream end of the vacuum enclosure of the Detector Stage. A minimum 6" clear aperture shall be provided from the back of the detector all the way to the back flange of the Detector Stage.

15. Thermal Issues

15.1. The thermal stability listed in Table 1 shall be met given the temperature conditions inside the hutch described in Section 3.

16. Cooling requirements

16.1. The detector will use water cooling to remove the heat produced by the ASIC and circuit board and cooling lines shall be provided to the back plane of the detector.

16.2. These cooling lines shall follow all the motions of the detector and shall be reasonably easily disconnected and reconnected for maintenance.

16.3. The cooling lines shall not allow any water leak directly into vacuum. There shall be no in-vacuum connections on the cooling lines. The cooling lines should preferably be enclosed in a flexible bellows tube at atmospheric pressures so that any leak would be contained in this tube.

17. Vacuum Requirements

17.1. The detector shall be mounted in a 10^{-7} Torr pressure environment or better (design goal 10^{-8}) and the appropriate vacuum practice for the design, manufacturing, and installation of the system components shall be implemented. The device's vacuum sealing surfaces shall be leak tested.

17.2. All lubricants, cutting fluids, etc., used in manufacturing shall be "sulfur-free". SLAC document No. SC-700-866-47 is a compendium of SLAC approved lubricants. The use of sanding discs, abrasive paper or grinding wheels is typically prohibited. In special circumstances good vacuum practices should be followed when grinding and polishing is required. This process shall be reviewed and approved by the engineer for its vacuum compatibility.

17.3. All parts and subassemblies shall be cleaned for UHV. Once parts are cleaned for vacuum, handle only with clean latex or nitrile gloves in/on a clean room/surface. This includes all subassemblies. For storage or transportation, place in clean sealed vacuum grade plastic bag that has been back-filled with nitrogen.

17.4. It shall be possible to isolate the vacuum of the Detector Stage from the vacuum of the Sample Chamber with a gate valve, as shown on Figure 1.

17.5. The isolation gate valve shall be equipped with a view port to let the CXI Reference Laser pass through when the valve is closed.

17.6. A port for visual inspection of the front face of the detector shall be provided to the extent possible. A likely alternate option would be to include a viewport for inspection on one of the spacer spools.

17.7. The feedthrough(s) for the detector signals and power shall be located near the downstream end of the vacuum enclosure.

17.8. There shall be a feedthrough flange near the downstream end of the chamber for cooling lines.

17.9. The 2D X-ray detector housing will have an open back end. The pumping on the vacuum enclosure of the detector stage shall be designed to make any outgassing from the detector flow away from the interaction region. A suitable size turbo pump shall provide the pumping of the detector enclosure.

17.10. The turbo pump shall be located on top of the Detector Stage vacuum enclosure at the center point along the Z axis.

17.11. The downstream end of the vacuum enclosure of the detector shall allow more vacuum sections to be attached to let the beam propagate further to diagnostics devices.

17.12. 6 extra ports will be provided on the chamber for vacuum accessories and control.

17.13. The vacuum enclosure of the Detector Stage shall be made as short as possible along the Z axis. The total length can be minimized, for example, by placing the front face of the detector on the same plane as the entrance flange. Contrary to what is shown on Figure 3, there is no need to be able to retract the detector beyond the entrance flange and the overall length of the device can be reduced in this manner.

18. Alignment laser intensity monitor

18.1. The detector and its Z motion axis shall be aligned to the FEL beam by using a Reference Laser collinear to the FEL beam. This laser will emit 635 nm light (red light).

18.2. A detector diode suitable for 635 nm light shall be installed in the vacuum enclosure, downstream of the detector, to monitor the alignment of the detector with the laser beam. The diode shall measure the red laser intensity passing through the detector aperture and shall allow the user to center the detector on the laser path.

18.3. The diode shall be attached to a retractable mount to move it out of the way of the FEL beam after the alignment process is done. This diode assembly is shown on Figure 3.

18.4. Another optional configuration is to put the diode outside of vacuum and install a mirror on the feedthrough to reflect the laser to the diode via a view port.

18.5. Limit switches shall be used to ascertain that the photodiode is either in the beam path or retracted from the beam path. These limit switches shall be used as input signals for the interlock system to prevent the LCLS beam from impinging on the photodiode.

19. Lifting Features

19.1. Clearly defined lifting features and instructions shall be provided to facilitate the assembly/installation and moving the Detector Stage along the Z axis.

20. Electrical Requirements

20.1. Acquisition of unique, device specific controllers, when required, will be the responsibility of CXI; all other power supplies and control cables shall be provided by the Controls/Data Acquisition Group.

20.2. The interface from the control racks to the Detector Stage (cable trays and routing, connector supports, etc.) shall be determined jointly with the Controls/Data Acquisition Group.

21. Feedthroughs

21.1. The following vacuum feedthroughs shall be provided

- Water Supply
- Water Return
- In-vacuum Z stage
- Detector Signal and Power cables

22. Controls Requirements

The controls and data acquisition associated with the detector stage 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 detector stage are described below.

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

22.2. Password protection shall be implemented for all the positioners of the Detector Stage to protect the detector from damage due to the LCLS beam in the event of an accidental move.

22.3. Interlocks shall be implemented to prevent the gate valve separating the sample chamber from the detector vacuum spool from closing while the detector is protruding through the valve.

22.4. Interlocks shall be implemented to prevent the LCLS beam from used unless the red laser photodiode is completely removed from the beam path.

22.5. Vacuum interlocks shall prevent the valve separating the sample chamber from the detector vacuum spool from opening while the pressure is above 10^{-5} Torr.

22.6. The position of every positioner shall be recorded on every pulse for which experimental data is measured and these positions shall be embedded in the experimental metadata.

22.7. Limit switches and software interlocks shall be used to prevent the detector from colliding with the walls of the vacuum enclosure or the components inside the sample chamber.

22.8. Temperature monitoring will be provided on the detector.

23. Environmental Safety and Health Requirements

23.1. Earthquake

SLAC National Accelerator Laboratory (SLAC) is situated in an active seismic zone. All hardware exceeding a weight of 400 Lbs. and / or mounted greater than 4 feet above the floor will be reviewed by a SLAC "citizen safety committee" for seismic loading resistance. Applicable loads and structural behavior will be evaluated for compliance to the 2007 version of the California Building Code (CBC) and SLAC ES&H Division document SLAC-I-720-0A24E-001-R002: "Seismic Design Specification for Buildings, Structures, Equipment, and Systems".

23.2. Radiation Physics

No supplemental radiation shielding will be required for the Detector Stage since it shall located in a radiation hutch.

23.3. Pressure Vessel/Vacuum Vessel

The Detector Stage shall be designed for use in a High Vacuum environment with the appropriate safety factors.

Pressure relief safe guards will be provided, where appropriate, to ensure compliance with all applicable guidelines/regulations, i.e. 10CFR851.