

ENGINEERING SPECIFICATION DOCUMENT (ESD)	Doc. No. SP-391-001-13 R0	LUSI SUB-SYSTEM CXI
Engineering Specifications for the CXI Instrument Controls		
Perry Anthony Author	_____	_____
	Signature	Date
Gunther Haller PCDS Manager	_____	_____
	Signature	Date
Sebastien Boutet Instrument Physicist	_____	_____
	Signature	Date
Paul Montanez Instrument Engineer	_____	_____
	Signature	Date
Darren Marsh Quality Control	_____	_____
	Signature	Date
Thomas Fornek LUSI Project Manager	_____	_____
	Signature	Date
	_____	_____

Revision	Date	Description of Changes	Approved
R0	29Jul08	Initial release	

DCR

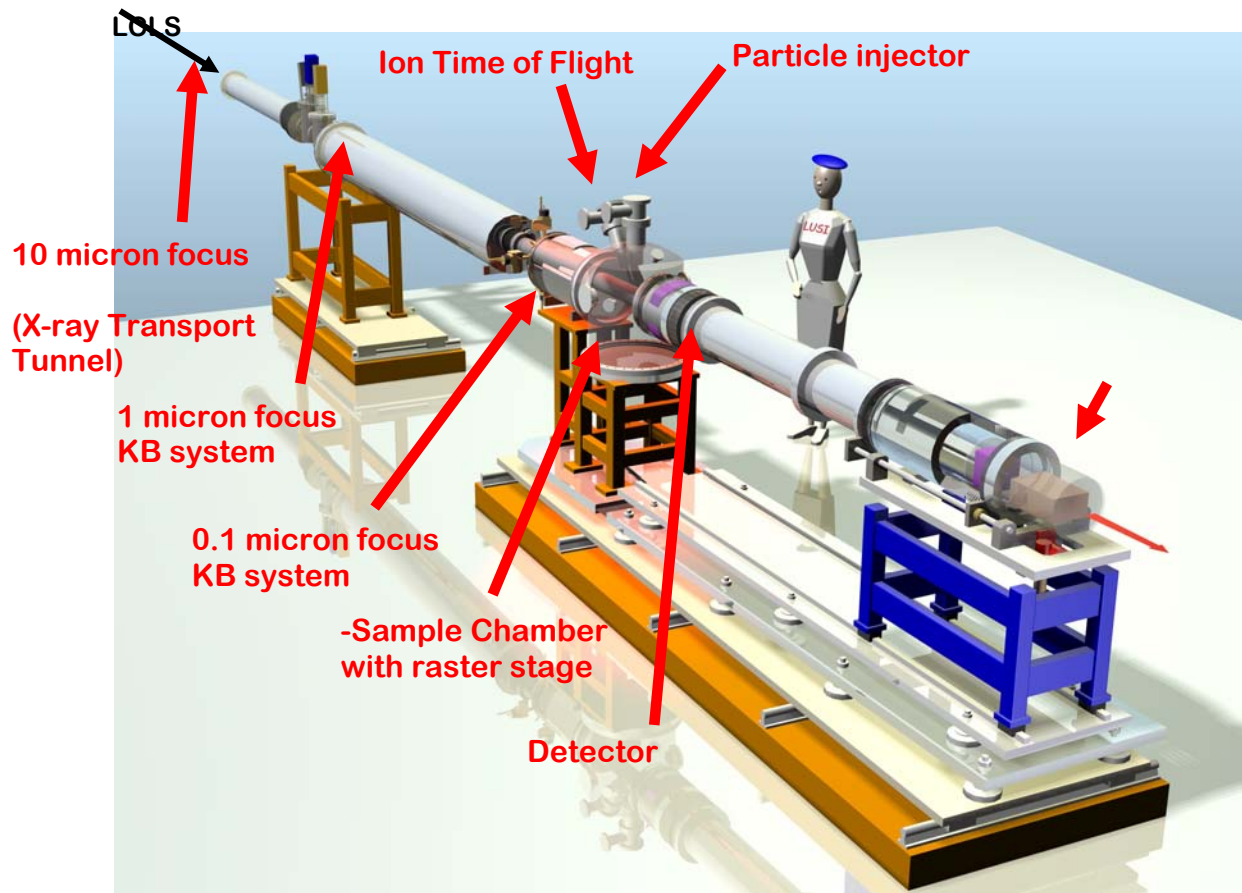
Table of Contents

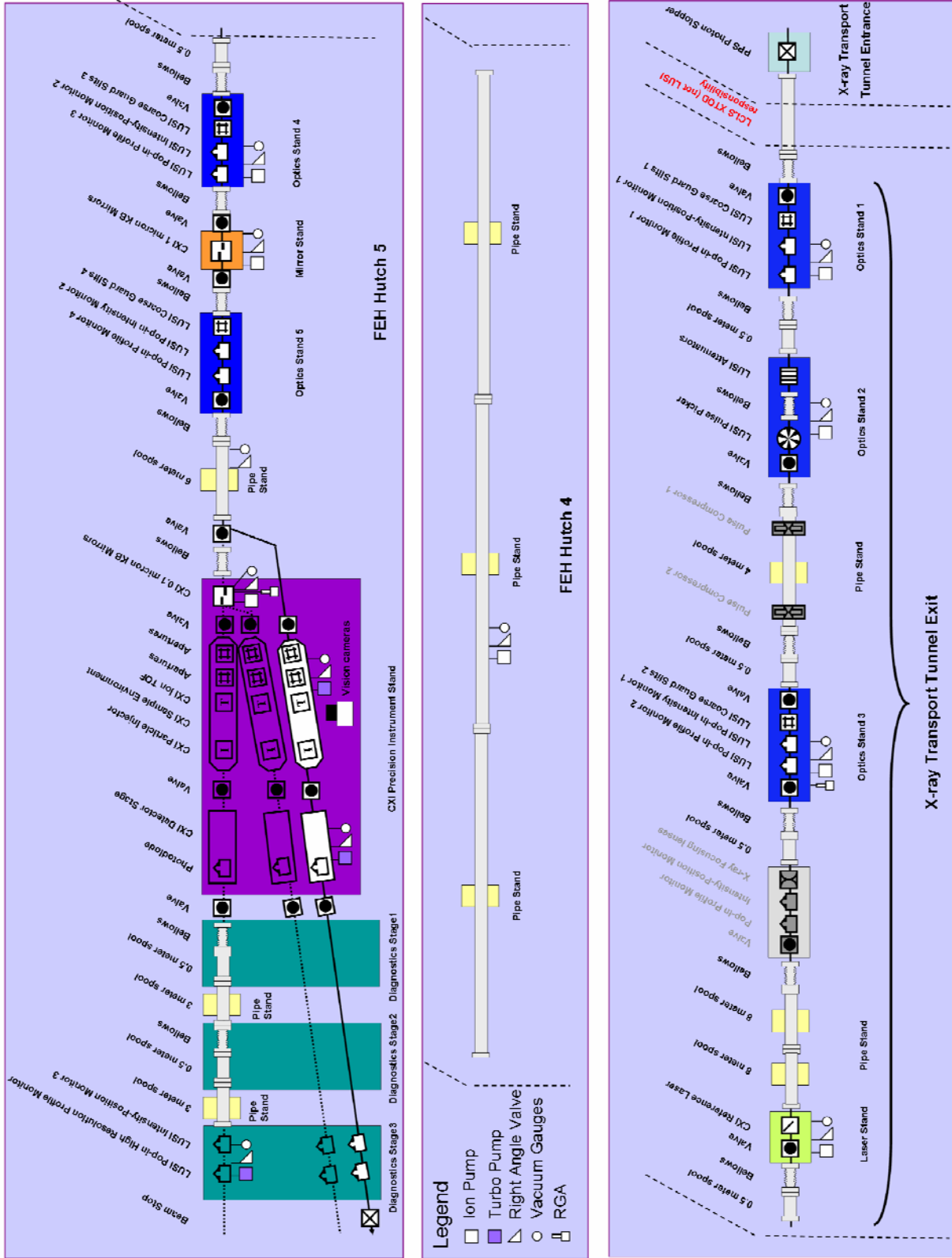
Table of Contents	2
1. Applicable Documents	2
2. Overview.....	3
3. CXI Instrument Control.....	5
4. Global Hutch Controls.....	24
5. Machine Protection System (MPS) Interface	24

1. Applicable Documents

PRD# SP-391-000-19	Physics Requirements for the CXI Instrument
PRD# SP-391-000-03	LUSI Controls and Data System
PRD# SP-391-000-20	CXI Sample Chamber
PRD# SP-391-000-21	CXI Reference Laser System
PRD# SP-391-000-23	LUSI Pulse Picker System
PRD# SP-391-000-24	CXI 0.1 micron Kirkpatrick-Baez (KB) Mirror System
PRD# SP-391-000-25	CXI 1 micron Kirkpatrick-Baez (KB) Mirror System
PRD# SP-391-000-26	CXI Particle Injector System
PRD# SP-391-000-28	CXI Detector Stage
PRD# SP-391-000-30	CXI Ion Time-Of-Flight (TOF)
PRD# SP-391-000-63	CXI Precision Instrument Stand
ESD# SP-391-001-19	LUSI Common Instruments Controls

2. Overview





This document contains the specifications for the control system for the CXI instrument components and the specifications for the data acquisition system for this instrument.

3. CXI Instrument Control

3.1. Instrument Components

The CXI is composed of various photon beam-line components. Each component is detailed below, with CXI instrument packages, made up of these components, are summarized later in this section.

EPICS control system will allow the user to select system to view summary status of components and to select individual components for detailed control.

3.1.1. LUSI Common Optics and Diagnostics (*PRDs SP-391-000-04, 08, 09, 10, 14, 15, 23, ESDs SP-391-000-54, 60, 66, 89, 91, 92*)

LUSI common optics and diagnostic instruments are used to define, measure and monitor the beam. CXI directly controls these instruments located in the X-Ray Tunnel (XRT) and FEH Hutch 5. In addition, CXI will require information from and an interface to control XPP installed LUSI common diagnostic instruments in NEH Hutch 2.

LUSI common diagnostic instruments located in XRT include:

- LUSI Coarse Guard Slit System: qt. 2
- LUSI Intensity-Position Monitor: qty. 1
- LUSI Pop-in Profile Monitor: qty. 2
- LUSI Pop-in Intensity Monitor: qty. 1
- LUSI Attenuator: qty. 1
- LUSI Pulse Picker: qty. 1

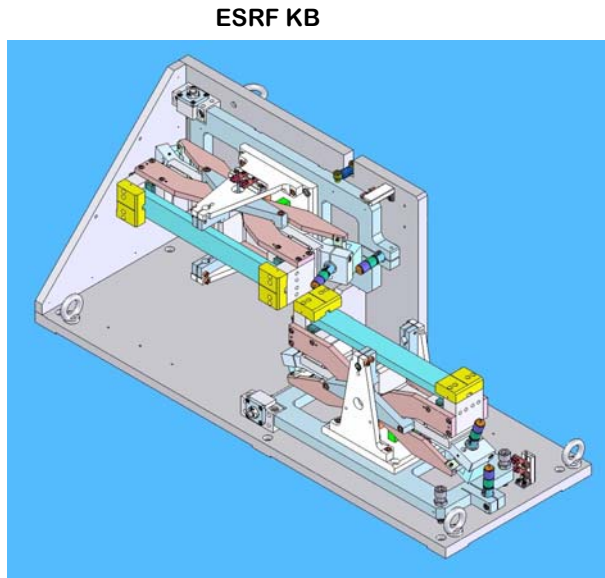
LUSI common diagnostic instruments located in FEH Hutch 5 include:

- LUSI Coarse Guard Slit System: qt. 2
- LUSI Intensity-Position Monitor: qty. 2
- LUSI Pop-in Profile Monitor: qty. 2
- LUSI Pop-in High Resolution Profile Monitor: qty. 1
- LUSI Pop-in Intensity Monitor: qty. 1

The EPICS control system will implement all controls and calibrations for these devices as defined in the LUSI Common Diagnostics Controls ESD #SP-391-001-19.

Slit Systems, Intensity-Position Monitors, and the Attenuator all generate BLD headers for the DAQ system.

3.1.2. CXI 0.1 and 1.0 micron KB Mirrors (PRDs SP-391-000-24, 25, ESDs SP-391-000-64, 65)



Each KB mirror system is comprised of two mirrors. Each mirror is movable in x, y, pitch, yaw, and roll. Motion precision requirements are given in the below table.

Motion	Nominal Position	Range	Resolution	Repeatability	Stability
x	0	$-10 \text{ mm} < x < 2 \text{ mm}$	4 μm	4 μm	1 μm
y	0	$-5 \text{ mm} < y < 5 \text{ mm}$	4 μm	4 μm	1 μm
Grazing angle (θ)	3.4 – 5 mrad	$0 \text{ mrad} < \theta < 10 \text{ mrad}$	1 μrad	1 μrad	0.01 μrad
In-plane rotation (ψ)	0	$-10 \text{ mrad} < \psi < 10 \text{ mrad}$	15 μrad	15 μrad	1 μrad
Perpendicularity (ϕ)	0	$-10 \text{ mrad} < \phi < 10 \text{ mrad}$	40 μrad	40 μrad	1 μrad

Mirror motors are inside the vacuum chamber. Each axis will have two limit switches and an encoder. The two mirror assembly will have 10 motors, 10 encoders, and 20 limit switches.

The mirror assembly is movable as a unit along two axes. In X, the entire assembly can be removed from beam. Movable in X and Y to approximately center on beam.

EPICS system will provide control, display, and archiving of position settings. EPICS will also provide for active feedback on each axis at 1 Hz based on data from diagnostics instruments.

Interlock between KB mirror systems so than only one may be used at a time.

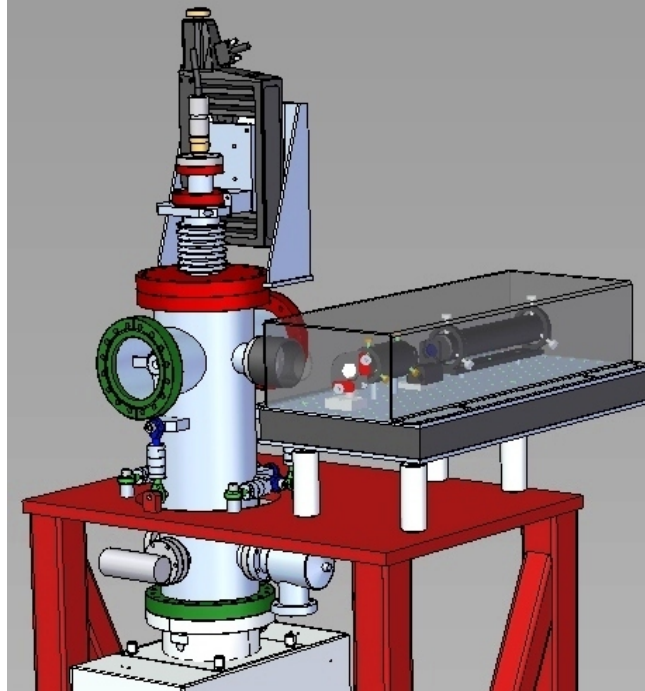
Lockout when positions set.

Scan mode for mirrors with feed back from CXI High-Resolution Profile Monitor at 1 Hz. Scan mode to be defined.

Provides BLD header information on which KB is in use and position of mirrors to data stream.

Component	Device	Model Number	Quantity	Interface Type
0.1 KB Mirrors	Mirror fine position motors with encoders	JTEC TBD	10	TBD
	Limit switches		20	
	Stage movement, X, Y, Yaw, Pitch	Mdrive Plus (smart motor) TBD	4	serial
	Encoders	TBD	4	TBD
	AutoCollimator (TBD)	JTEC JM1000-AC (TBD)	1	PC-Board (needs driver development) TBD
1.0 KB Mirrors	Mirror fine position motors with encoders	JTEC TBD	10	TBD
	Limit switches		20	
	Stage movement, X, Y, Yaw, Pitch	Mdrive Plus (smart motor) TBD	4	serial
	Encoders	TBD	4	TBD
	AutoCollimator (TBD)	JTEC JM1000-AC (TBD)	1	PC-Board (needs driver development) TBD

3.1.3. CXI Reference Laser System (PRD SP-391-000-21, ESD SP-391-000-73)

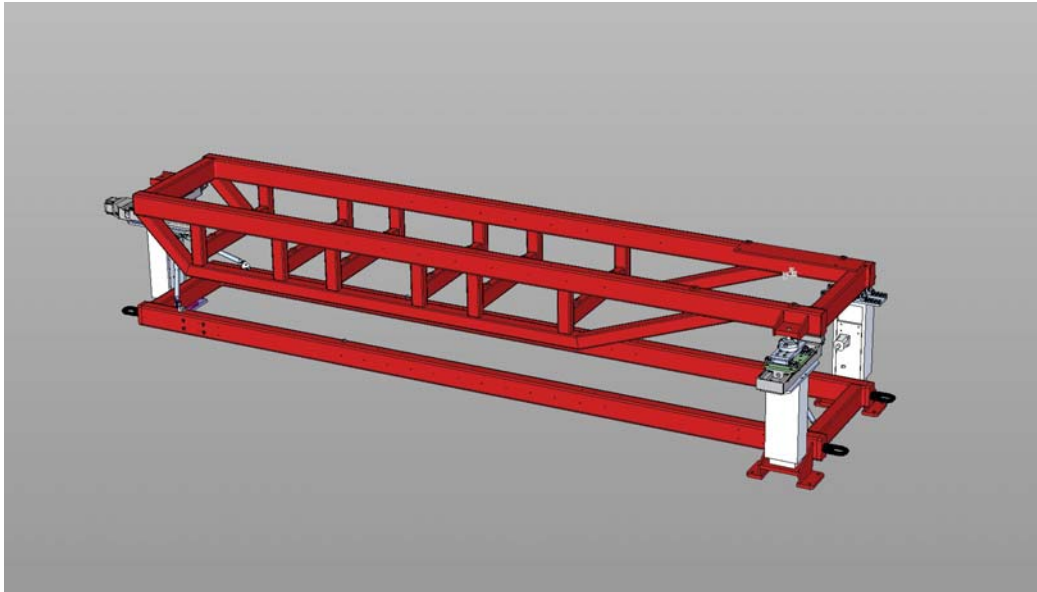


A mirror will be positioned to reflect the reference laser light for alignment of CXI instrument. This must be interlocked with the Photon Stopper to prevent damage to the mirror. A stepper motor will be used to insert the mirror, with four pico-motors for fine alignment of the mirror.

EPICS control system will be used to position mirror, display position, and archive the data.

Component	Device	Model Number	Quantity	Interface Type
Reference Laser	Y	MDC #678044 with Mdrive Plus (smart motor) TBD	1	serial
	Pitch, Yaw	TBD	2	TBD
	Limit switches		3	
	Encoders		3	
	Laser power on/off	TBD	1	TBD
	Attenuator on/off	TBD	1	TTL, TBD

3.1.4. CXI Precision Instrument Stand (PRD SP-391-000-63, ESD SP-391-000-69)



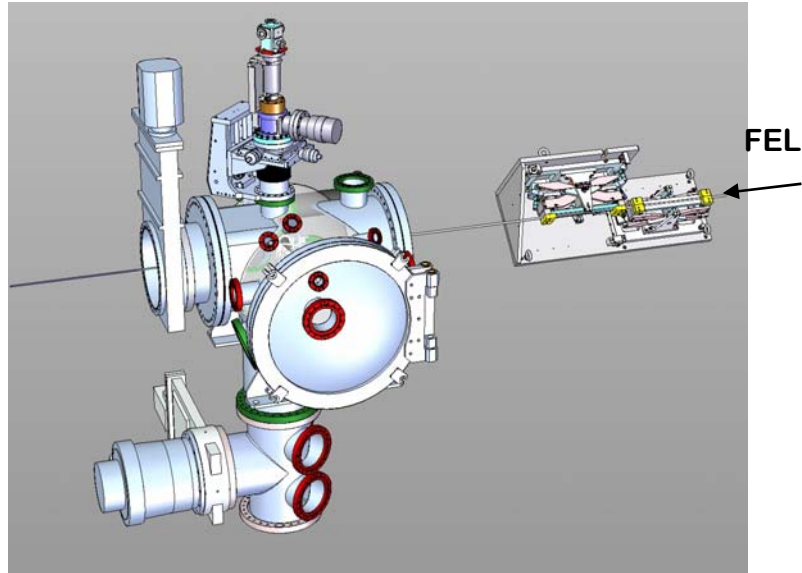
The sample chamber and detector chamber will be supported by movable instrument stand with 6 axis of motion, X, Y and Z at each of the 3 legs (only 6 of the 9 stages are motorized). Motion will be used to align the sample and detector chambers with the beam scattered off the KB Mirrors.

Motion	Range	Nominal Position	Resolution	Repeatability	Stability
X position	0 mm < x < 150 mm	0 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	0 mm < x < 20 mm	0 mm	50 μm	50 μm	0.1 μm
Yaw	-1° < yaw < 2°	0°	30 μrad	30 μrad	5 μrad

EPICS will control, display and archive the motor positions. EPICS control program will translate desired appropriate X,Y and Z positions into angular settings.

Component	Device	Model Number	Quantity	Interface Type
Precision Instrument Stand	Stepper Motors, X ,Y, Z, 3 locations (6 axis)	Mdrive Plus (smart motor) TBD	6	serial
	Limit switches		12	
	Encoders		6	

3.1.5. CXI Sample Chamber (PRD SP-391-000-20, ESD SP-391-000-67)



The sample environment contains 21 in vacuum motors for positioning various apertures and samples in the beam. Absolute position information will be required for each motion. Sample environment will be used in three configurations: Fixed Targets, Injected Particles, and Time Delay.

Motion	Nom. Position	Range	Resolution	Repeatability	Vacuum
First aperture x position	0 mm	-10 mm < x < 10 mm	≤ 0.1 μm	≤ 0.3 μm	≤ 10 ⁻⁷ Torr
First aperture y position	0 mm	-10 mm < y < 10 mm	≤ 0.1 μm	≤ 0.3 μm	≤ 10 ⁻⁷ Torr
Second aperture x position	0 mm	-10 mm < x < 10 mm	≤ 0.1 μm	≤ 0.3 μm	≤ 10 ⁻⁷ Torr
Second aperture y position	0 mm	-10 mm < y < 10 mm	≤ 0.1 μm	≤ 0.3 μm	≤ 10 ⁻⁷ Torr
Third aperture x position	0 mm	-10 mm < x < 160 mm	≤ 0.1 μm	≤ 0.3 μm	≤ 10 ⁻⁷ Torr
Third aperture y position	0 mm	-10 mm < y < 10 mm	≤ 0.1 μm	≤ 0.3 μm	≤ 10 ⁻⁷ Torr
Third aperture z position	-25 mm	-35 mm < z < -15 mm	≤ 0.1 μm	≤ 0.3 μm	≤ 10 ⁻⁷ Torr
Sample x position	0 mm	-10 mm < x < 160 mm	≤ 0.1 μm	≤ 0.3 μm	≤ 10 ⁻⁷ Torr
Sample y position	0 mm	-10 mm < y < 10 mm	≤ 0.1 μm	≤ 0.3 μm	≤ 10 ⁻⁷ Torr
Sample z position	0 mm	-10 mm < z < 10 mm	≤ 0.1 μm	≤ 0.3 μm	≤ 10 ⁻⁷ Torr
Sample Yaw					
Sample Pitch (coarse)					
Sample Pitch (fine)					
Particle aperture x position	0 mm	-10 mm < x < 10 mm	10 μm	10 μm	≤ 10 ⁻⁷ Torr

Particle aperture y position	0 mm	-10 mm < y < 10 mm	10 μm	10 μm	≤ 10 ⁻⁷ Torr
Sample viewer mirror x position	0 mm	-10 mm < x < 10 mm	≤ 0.1 μm	≤ 0.3 μm	≤ 10 ⁻⁷ Torr
Sample viewer mirror y position	0 mm	-10 mm < y < 10 mm	≤ 0.1 μm	≤ 0.3 μm	≤ 10 ⁻⁷ Torr
Sample viewer mirror pitch	0 degree	±10°	1 mrad	1 mrad	≤ 10 ⁻⁷ Torr
Sample viewer mirror yaw	0 degree	±10°	1 mrad	1 mrad	≤ 10 ⁻⁷ Torr
Sample viewer mirror gimble					
Sample/Aperture 3 coarse positioning					

In addition to the above motions, a telescope on a 2 axis stage will be mounted on the environment chamber. The telescope will have an integrated motorized zoom/focus.

Two motorized zoom lenses will also be mounted on the chamber.

Three cameras will be used to view sample, not synced with beam, 30Hz.

EPICS will control, monitor, and archive all positions. EPICS will allow viewing, with occasional archiving of camera data.

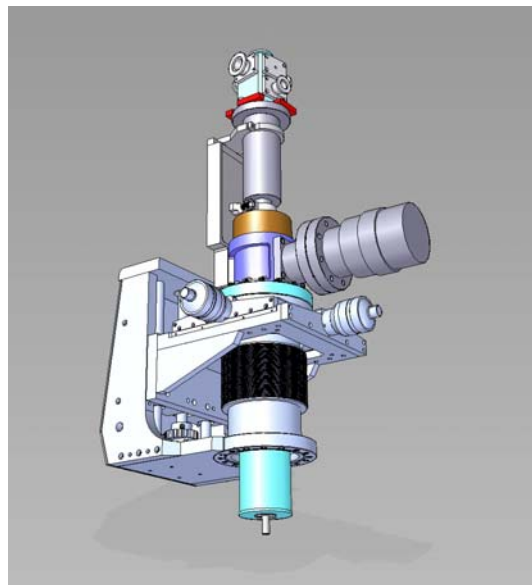
EPICS will have provision for selecting the mode of operation (Fixed Target, Injected Particles, or Time Delay). Depending on mode selected, appropriate devices in the sample environment will be presented for control.

Provides BLD as appropriate including mode of operation.

Component	Device	Model Number	Quantity	Interface Type
Sample Environment	Aperture Stage 1	Physik Instrumente Piezo	6	Serial
	Aperture Stage 2	Stage M663 with C866 controller		
	Particle Beam Aperture Stage	Physik Instrumente Piezo	8	serial
	Aperture Stage 3	Stage M361 with E361.1A1 controller		
	Multimode stage	New Focus Picomotor	5	serial
	Sample Viewer Stage	8301-UHV and 8766-kit controller		
	Sample Yaw	Micos Linear Stage VT-75mm with VSS-42	1	Hytec/Mdrive controller (TBD)
	Sample Pitch (file)	Phytron VSS19-	1	Hytec/Mdrive
	Sample Viewer (pitch, yaw, gimble)			
	Sample/Aperture 3 Coarse positioning			

(coarse)	VGPL 22-1		controller (TBD)
Viewing Telescope motorized focus/zoom	Questar QM1 model 83002	1	TBD
Viewing telescope stage	Questar QM1 model 83002	1	TBD
Encoders	TBD	TBD	TBD
Limit Switches	TBD	TBD	TBD
Viewing Cameras	Pulnix TM-6760CL Pulnix TM-1402CL	3	CamerLink
Zoom lens	Navitar 1-62523	2	TBD (PC board, may be able to use Hytec)
Illuminator	Edmund Optics NT55-232 with NT57-783	2	Serial

3.1.6. CXI Particle Injector System (PRD SP-391-000-26, ESD SP-391-000-75)



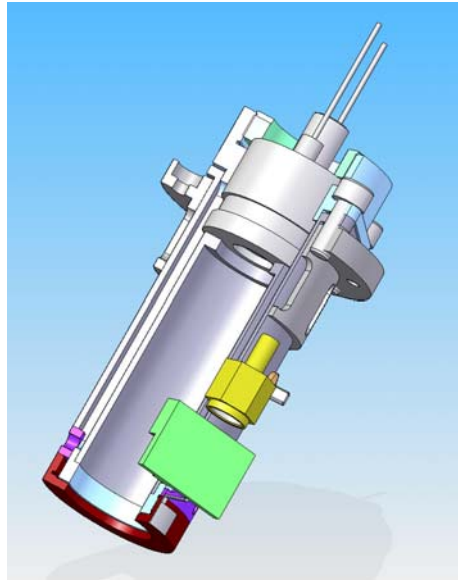
The particle injector is integrated with the sample environment chamber. It has three axes of motion for positioning the injected particle beam to intersect the FEL beam. Two charge detectors are integrated with the Particle Injector package. A waveform digitizer will be required to read out each charge detectors.

EPICS will control the operation of, and display the status of the equipment associated with generation of the particle stream, including diagnostics equipment. EPICS will also control the three axes of motion.

EPICS will archive data on motion and particle generation equipment.

Component	Device	Model Number	Quantity	Interface Type
Particle Injector	MDC XYZ Stage	MDC Model 678044 with Mdrive Plus (smart motor)	3	Serial
	Electrospray Aerosol Generator	TSI Model 3480	1	Analog voltages, TBD
	Vision camera to look at Electrospray Aerosol Generator Taylor Cone	Pulnix TM-6760CL	1	CameraLink
	Electrospray Aerosol Generator modifications for front panel control	TBD (may be smartmotors on control knobs)	TBD	TBD (may be serial)
	Electrostatic Classifier	TSI Model 3080	1	Serial
	Condensation Particle Counter	TSI 3786	1	Serial
	Turbo Pump	Varian V81M	1	Standard Turbopump controller
	Backing pump	Varian TriScroll PTS03001UNIV	2	Remote on/off
	Flow control	TBD	2	TBD
	Charge Detector Rack-mounted low noise signal differentiator	TBD	2	TBD
	Charge Detector Rack-mounted low noise amplifier	TBD	2	TBD
	Charge Detector Rack-mounted pulse generator	TBD	1	TBD
	Charge Detector	TBD	1	TBD
	Power to front end electronics	TBD	1	TBD
	Faraday Cup	TBD	1	TBD
	Waveform Digitizer	TBD (Acqiris Digitizer DC282?)	2	TBD (CompactPCI?)

3.1.7. CXI Ion TOF (PRD SP-391-000-30, ESD SP-391-000-68)

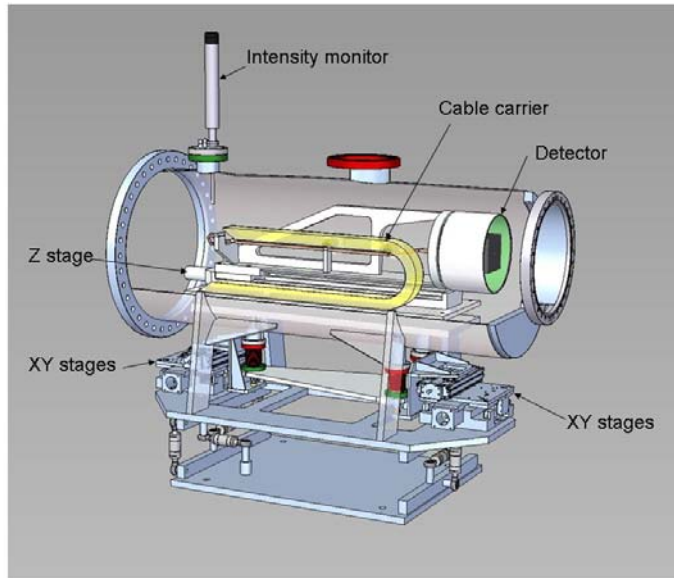


The Ion TOF will require power to the front end electronic including high voltage and bias voltages. The control system will provide for control and readout of a waveform sampling digitizer.

EPICS to provide control of the HV system.

Component	Device	Model Number	Quantity	Interface Type
Ion TOF	Quad Output DC Voltage Generators	ISEG VHS4050X_105	2	VME
	High Voltage Pulser	IXYS PVX-4140	2	Trigger from EVR
	Waveform digitizer	TBD (Acqiris?)	1	TBD (compactPCI?)

3.1.8. CXI Detector Stage (PRD SP-391-000-28, ESD SP-391-000-70)



The detector is located in vacuum. The following motions will be provided:

Motion	Nominal Position	Range	Resolution	Repeatability	Stability
In-vacuum motion of the Cornell Detector (1 axis)	0	$-5 \text{ mm} < y < 5 \text{ mm}$	10 μm	10 μm	1 μm
In-vacuum z	50 mm	$50 < z < 3000 \text{ mm}$	50 μm	50 μm	1 μm
Vacuum Enclosure x (2 locations)	0	$0 \text{ mm} < x < 150 \text{ mm}$	50 μm	50 μm	1 μm
Vacuum Enclosure y (2 locations)	0	$-10 \text{ mm} < y < 10 \text{ mm}$	50 μm	50 μm	1 μm

In addition, the control system will implement password protection for all positioners of the detector stage to protect the detector from damage by the beam in the event of an accidental move. Interlocks to the gate valve separating the detector vacuum from the sample vacuum will be provided to prevent closing of this valve when the detector is protruding through the valve.

The Detector stage package also includes a photodiode assembly to monitor intensity response. This photodiode will be movable along one axis. Photodiode will be interlocked to the photon beam stoppers to prevent insertion when the stoppers are open.

EPICS to control all motions and archive positions, on/off of power supply, monitoring of detector temperature and initiating appropriate action for over temperature and/or loss of cooling.

BLD of positions and calibration data.

Component	Device	Model Number	Quantity	Interface Type
-----------	--------	--------------	----------	----------------

Detector Stage	Cornell Detector Motion	TBD	1	TBD
	Cornell Detector Temperature Monitoring	TBD	1	TBD
	Cornell Detector Power Supply	TBD	TBD	TBD
	Cornell Detector Cooling monitor	TBD	TBD	TBD
	Detector Stage Z Motion	Micos LS 110-600	1	TBD (MDrive Controller)
	Chamber XY stages	Parker Daedal 404XR with Mdrive Plus (smart motor)	2	Serial
	Chamber XY stages	Parker Daedal ZP200 Stages with Mdrive Plus (smart motor)	2	Serial
	PhotoDiode Motion	TBD (Mdrive Plus (smart motor)?)	1	TBD (Serial?)
	PhotoDiode Power Supply	TBD	1	TBD
	Waveform digitizer	TBD (Acqiris?)	1	TBD (compactPCI?)

3.2. Instrument packages

3.2.1. Optics Stand 1 in XRT

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

- LUSI Coarse Guard Slit System
- LUSI In-Situ Intensity-Position Monitor
- LUSI Pop-in Profile Monitor

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	Mdrive Plus (smart motor)	8	Serial/ combined with power supply in custom chassis
Power	Power supply for Intensity-Position Monitor Front End Electronics	12 Volt supply	1	NA
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Camera	12 Volt supply	1	NA

Vision	Camera	Pulnix TM-1402CL	1	CameraLink
Vision	Zoom lens (Navitar 1-62523)	SLAC Profile Monitor Controller (TBD)	1	VME w/Acromag IP-445
DAQ	Camera	CameraLink	1	120Hz DAQ Readout
DAQ	Intensity-Position Monitor	SLAC built	1	Serial

3.2.2. Optics Stand 2 in XRT

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

- LUSI Attenuator System
- LUSI Pulse Picker

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	Mdrive Plus (smart motor)	2	Serial/ combined with power supply in custom chassis
Motion	Pneumatic positioners	SLAC Solenoid Controller SD-385-001	2	Digital IO to IP digital IO boards on VME cpu
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Pulse Picker	TTL Pulser	1	EVR

3.2.3. Optics Stand 3 in XRT

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

- LUSI Coarse Guard Slit System
- LUSI Pop-in Intensity Monitor
- LUSI Pop-in Profile Monitor

Summary of EPICS control elements:

EPICS Control	Device	Model Number	Quantity	Interface Type
---------------	--------	--------------	----------	----------------

Group				
Motion	Stepper Motor	Mdrive Plus (smart motor)	6	Serial/ combined with power supply in custom chassis
Power	Power supply for Intensity Monitor Front End Electronics	12 Volt supply	1	NA
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Camera	12 Volt supply	1	NA
Vision	Camera	Pulnix TM-1402CL	1	CameraLink
Vision	Zoom lens (Navitar 1-62523)	SLAC Profile Monitor Controller (TBD)	1	VME w/Acromag IP-445
DAQ	Camera	CameraLink	1	120Hz DAQ Readout
DAQ	Intensity Monitor	SLAC built	1	Serial

3.2.4. Laser Stand in XRT

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

CXI Reference Laser

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	Mdrive Plus (smart motor)	1	Serial/ combined with power supply in custom chassis
Motion	Picomotors (TBD)	TBD	2	Serial (TBD)
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis

3.2.5. Optics Stand 4 in FEH Hutch 5

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

- LUSI Coarse Guard Slit System
- LUSI In-Situ Intensity-Position Monitor
- LUSI Pop-in Profile Monitor

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	Mdrive Plus (smart motor)	8	Serial/ combined with power supply in custom chassis
Power	Power supply for Intensity-Position Monitor Front End Electronics	12 Volt supply	1	NA
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Camera	12 Volt supply	1	NA
Vision	Camera	Pulnix TM-1402CL	1	CameraLink
Vision	Zoom lens (Navitar 1-62523)	SLAC Profile Monitor Controller (TBD)	1	VME w/Acromag IP-445
DAQ	Camera	CameraLink	1	120Hz DAQ Readout
DAQ	Intensity-Position Monitor	SLAC built	1	Serial

3.2.6. Mirror Stand in FEH Hutch 5

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

- CXI 1 Micron KB Mirrors

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
---------------------	--------	--------------	----------	----------------

Motion	Stepper Motor (stage)	Mdrive Plus (smart motor)	5	Serial/ combined with power supply in custom chassis
Motion	PicoMotors (mirror alignment)	JTEC TBD	10	Serial (TBD)
Motion	Autocollimator	JTEC JM1000-AC	1	Serial (TBD)
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis

3.2.7. Optics Stand 5 in FEH Hutch 5

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

- LUSI Coarse Guard Slit System
- LUSI Pop-in Intensity Monitor
- LUSI Pop-in Profile Monitor

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	Mdrive Plus (smart motor)	6	Serial/ combined with power supply in custom chassis
Power	Power supply for Intensity Monitor Front End Electronics	12 Volt supply	1	NA
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Camera	12 Volt supply	1	NA
Vision	Camera	Pulnix TM-1402CL	1	CameraLink
Vision	Zoom lens (Navitar 1-62523)	SLAC Profile Monitor Controller (TBD)	1	VME w/Acromag IP-445
DAQ	Camera	CameraLink	1	120Hz DAQ Readout

DAQ	Intensity Monitor	SLAC built	1	Serial
-----	-------------------	------------	---	--------

3.2.8. CXI Precision Instrument Stand in FEH Hutch 5

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

- CXI Precision Instrument Stand
- CXI 0.1 Micron KB Mirrors
- CXI Sample Chamber
- CXI Particle Injector System
- CXI Ion TOF
- CXI Detector Stage

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	Mdrive Plus (smart motor)	20 + 1 controller only	Serial/ combined with power supply in custom chassis
Motion	Custom motors in sample chamber	Various (see 3.1.2 and 3.1.5)	32	Serial (TBD)
Power	Power supply for the stepper motors	SLAC custom built	2	Combined with Serial control interface in custom chassis
Power	ION TOF DC	ISEG VHS4050X_105	2	VME
Power	ION TOF HV Pulser	IXYS PVX-4140	2	Trigger from EVR
Power	PhotoDiode in Detector Stage	TBD	1	TBD (VME)
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Camera	12 Volt supply	1	NA
Vision	Camera	Pulnix TM-6760CL and TM-1402CL	4	CameraLink Non-DAQ

Vision	Telescope	Questar QM1	1	TBD (serial?)
Vision	Zoom lens (Navitar 1-62523)	SLAC Profile Monitor Controller (TBD)	3	VME w/Acromag IP-445
Vision	Illuminators	Edmund Optics NT55-232 with NT57-783	3	Serial
Miscellaneous	Particle Injector Components	See Sec. 3.1.6	8	Serial and TBD
	Camera	CameraLink	1	Non-DAQ readout
DAQ	Waveform Digitizer	Acqiris	4	cPCI
DAQ	Cornell Detector	SLAC built	1	Serial

3.2.9. Diagnostics Stage in FEH Hutch 5

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

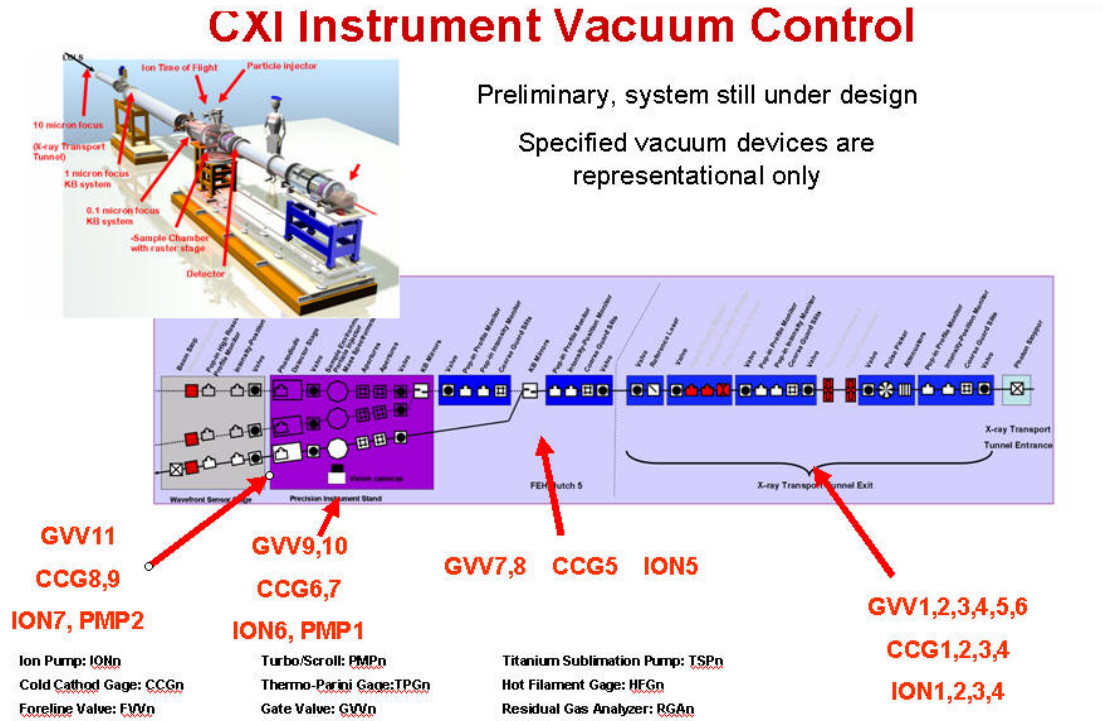
- LUSI In-Situ Intensity-Position Monitor
- LUSI Pop-in Profile Monitor with high resolution option

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	Mdrive Plus (smart motor)	5	Serial/ combined with power supply in custom chassis
Power	Power supply for Intensity-Position Monitor Front End Electronics	12 Volt supply	1	NA
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Camera	12 Volt supply	1	NA
Vision	Camera	Pulnix TM-6710CL or Imperx IPX-VGA210	1	CameraLink

DAQ	Camera	CameraLink	1	120Hz DAQ Readout
DAQ	Intensity-Position Monitor	SLAC built	1	Serial

3.3. CXI Vacuum System



The CXI instrument will have its own vacuum system controlled by a PLC based system located in FEH Hutch 5. This system will control all valves, pumps, and gauges associated with the CXI instrument components located in the X-ray Transport Tunnel and Hutch 5. This system will be interfaced to the XTOD Vacuum System, note that some sections are reused XTOD Vacuum sections under control of the XTOD Vacuum System.

EPICS control system will allow the user to select system to view summary status of components and to select individual components for detailed control.

Component	Device	Model Number	Quantity	Interface Type
X-Ray Transport Tunnel Vacuum	Gate Valve	VAT Series 108 (pneumatic controller)	5	PLC controlled
	Ion Pumps	Gamma Vacuum TiTan100L with Digitel MPS	4 pumps, 2 controllers	Serial

<u>Controller</u>				
	Cold Cathode Gauges and TBD Pirani Gauges	MKS with MKS 937A Gauge Controller	4	Serial
FEH Hutch 4	Ion Pumps	Gamma Vacuum TiTan100L with Digitel MPS Controller	1 pumps, 1 controllers	Serial
	Cold Cathode Gauges and TBD Pirani Gauges	MKS with MKS 937A Gauge Controller	1	Serial
FEH Hutch 5	Gate Valve	VAT Series 108 (pneumatic controller)	8	PLC controlled
	Ion Pumps	Gamma Vacuum TiTan100L with Digitel MPS Controller	3 pumps, 2 controllers	Serial
	Cold Cathode Gauges and TBD Pirani Gauges	MKS with MKS 937A Gauge Controller	7	Serial
	Turbo Pumps with backing pumps	Varian V551 with TriScroll 300 backing pump. Varian Turbo-V 550 controller	3	Serial
CXI Sample Chamber / Particle Injector	Turbo Pump	Varian V81M with Turbo-V 550 Controller	1	Serial
	Backing Pump	TriScroll PTS03001UNIV	2	Remote on/off

4. Global Hutch Controls

Temperature monitoring of the hutch environment will be needed. Standard timing information will be needed to sync components (e.g. cameras).

Control Requirement	Control System Implementation
LCLS pulse information/timing/triggers	EVR
Environmental controls Logging of temperature in hutch (how frequent?) Maintained by standard AC system	Temperature monitored in EPICS, sensor TBD. EPICS will display and archive information.

5. Machine Protection System (MPS) Interface

XRT and FEH Hutch 5 – Vacuum system interface to MPS.