CSX HOLOGRAPHY END-STATION
Equipment Readiness Review (ERR)

Wen Hu - Beamline Scientist

Daniel M Bacescu - Mechanical Engineer

September 25, 2018

OUTLINE

- Beamline layout overview
  - Self identified pre- and post-start findings
  - Primary capability
  - Holography End Station Overview
  - Holography setup – In-Vacuum Electro-Magnet
  - Holography setup – Sample Holder & Manipulator
  - Holography setup – fCCD, Beam Stop & Cold Finger
  - Holography setup – fCCD X-Y-Z Motion Module
- Pillar I: Documentation:

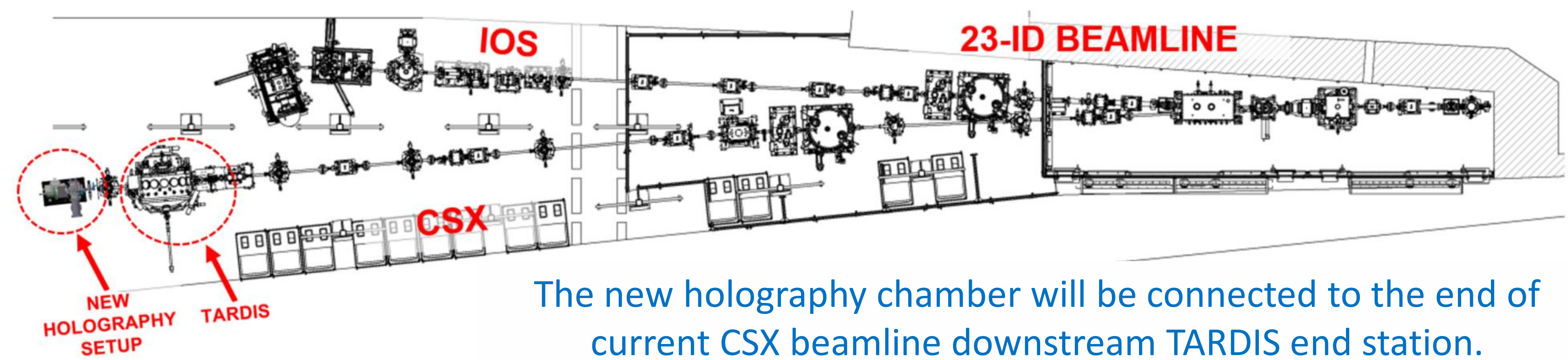
  RSC review, Hazard Identification and Mitigation, ESR and PASS
- Pillar II: Hardware

  PPS, Utilities, EPS, Controls
- Pillar III: Personnel

  Beamline Staff

fCCD: fast CCD camera

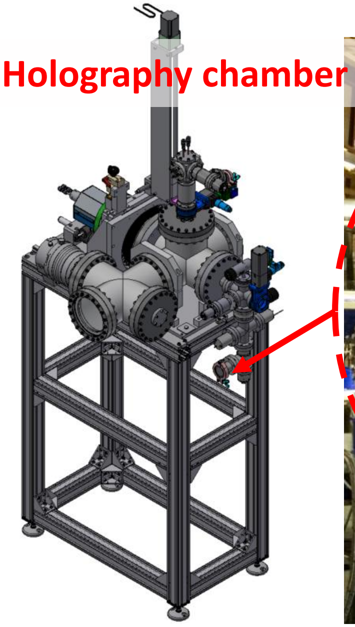
BEAMLINE LAYOUT OVERVIEW

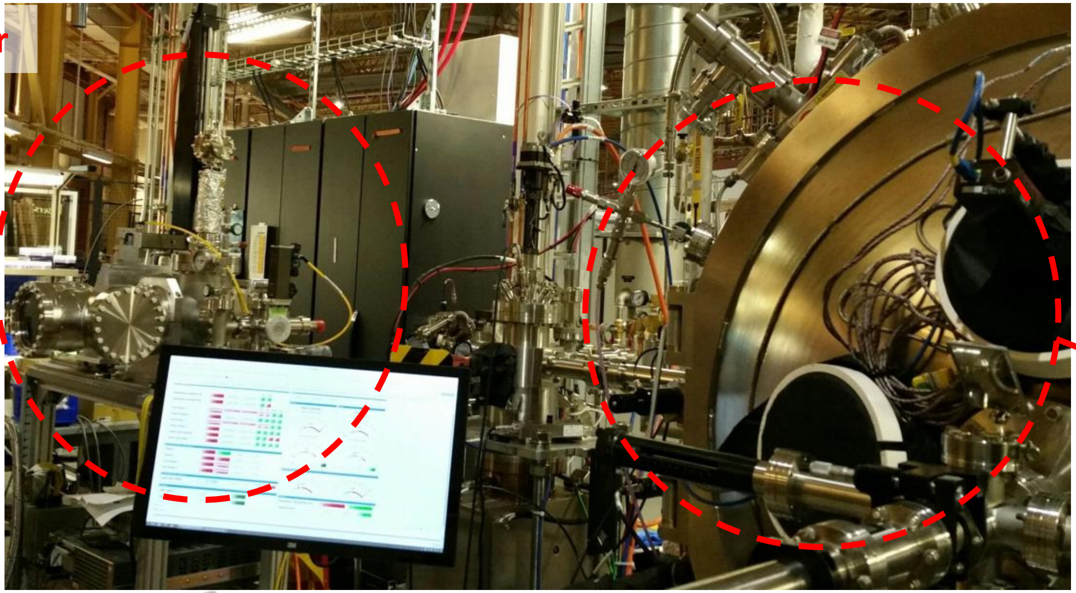


The new holography chamber will be connected to the end of current CSX beamline downstream TARDIS end station.

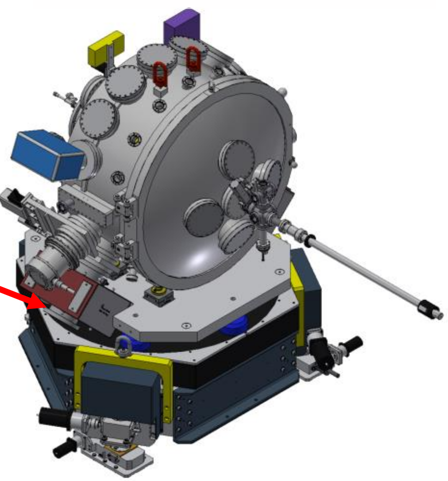
Beam can be focused in TARDIS or HOLOGRAPHY chamber (4 m along beamline).

Holography chamber





TARDIS chamber



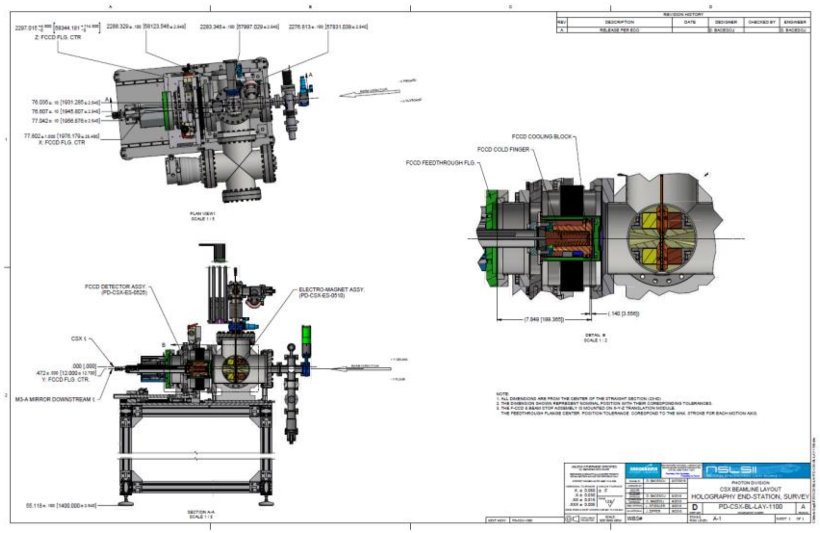
SELF IDENTIFIED PRE- and POST-START FINDINGS

- Pre-start findings:

  None

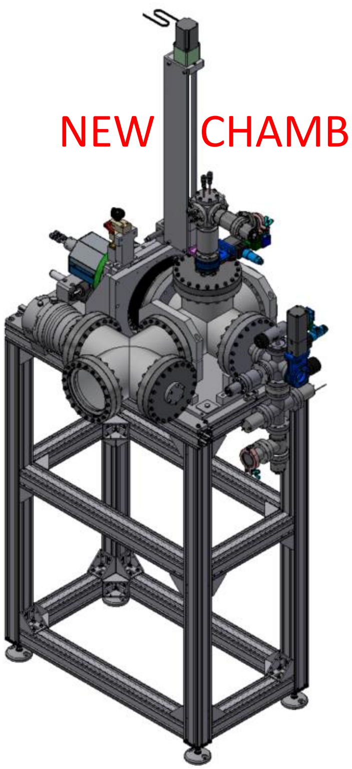
- Post-start findings:

  A1 drawing to be approved and released



PRIMARY CAPABILITIES

➢Establish world-leading time-resolved x-ray holographic imaging capability at the beamline CSX, NSLS-II.



Requirement:

- Study magnetic materials as a function of temperature and magnetic field.
- 2D detector for imaging.
- Flexible detector-sample distance.

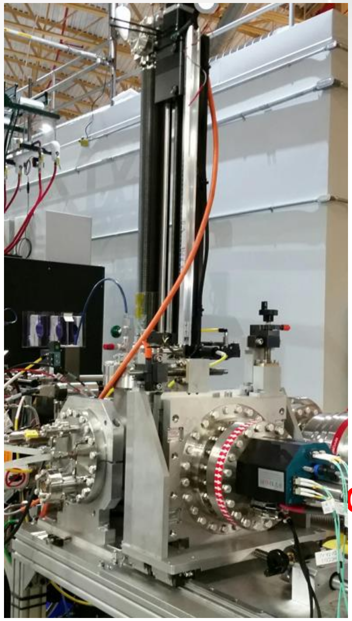
In-situ experimental condition:

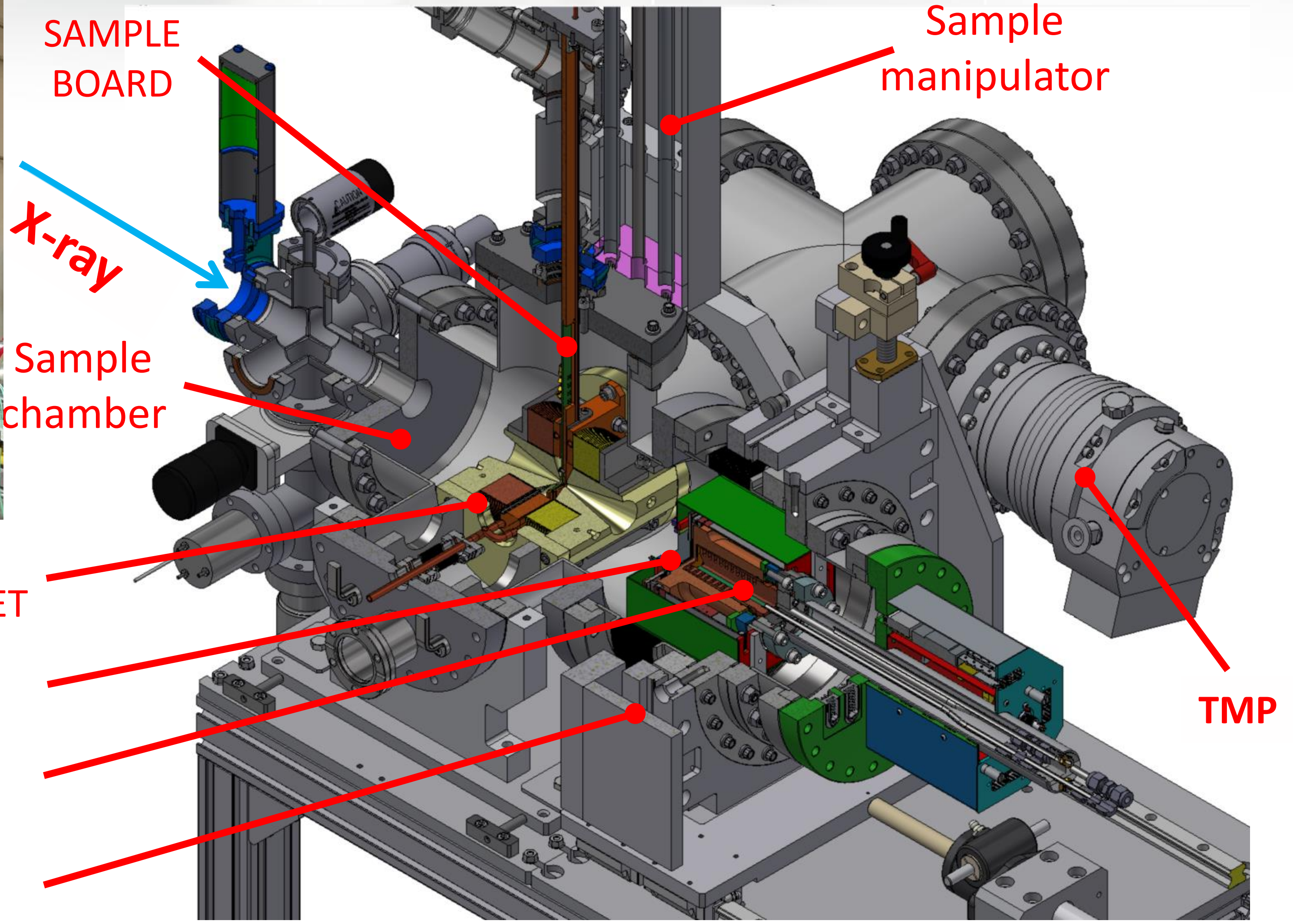
i. In-vacuum electro-magnet
ii. fCCD detector
iii. Translation motions of detector

More (excluded from ERR):

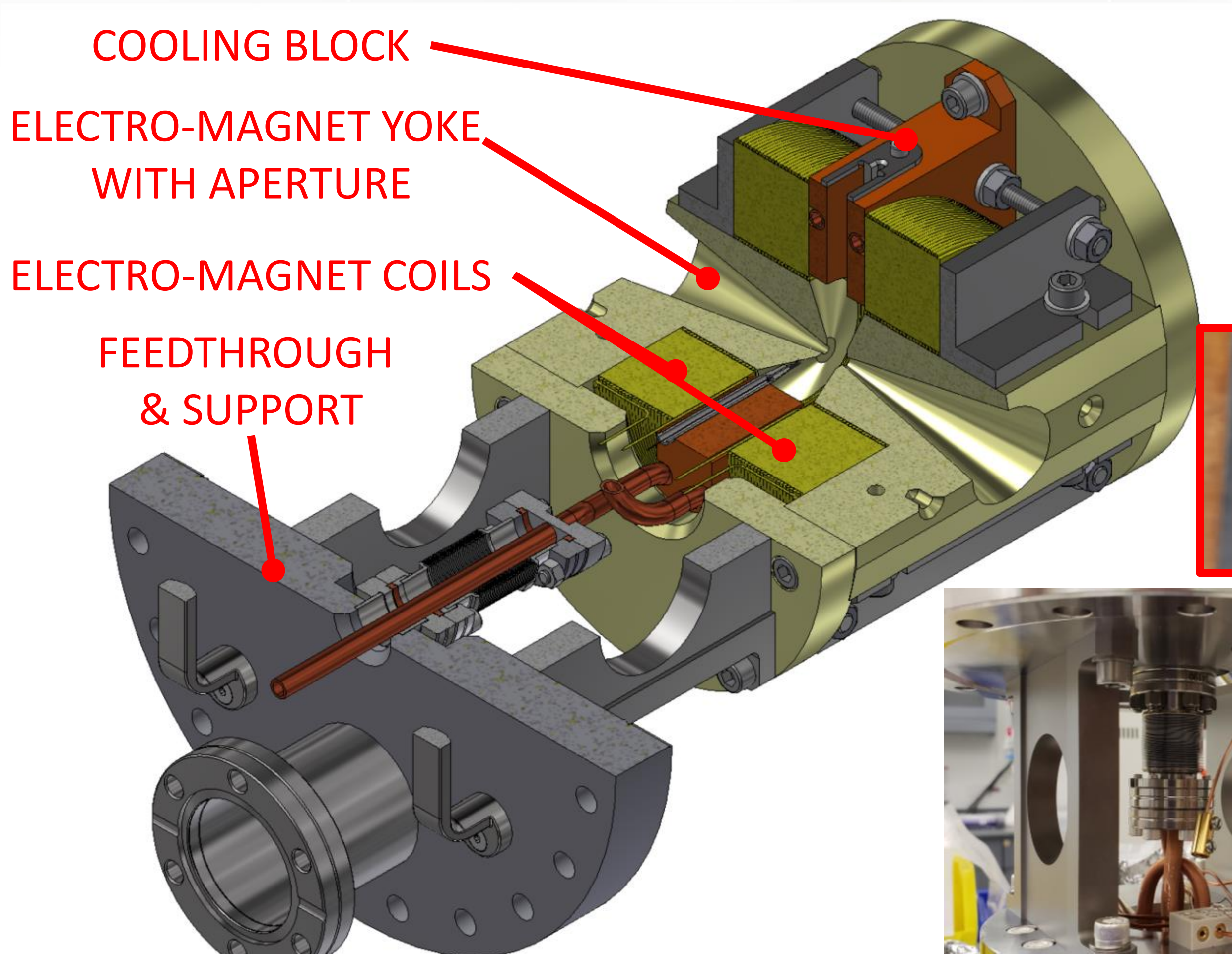
i. high frequency electrical field (~ns)
ii. Multiple samples at a time
iii. Temperature control on sample board

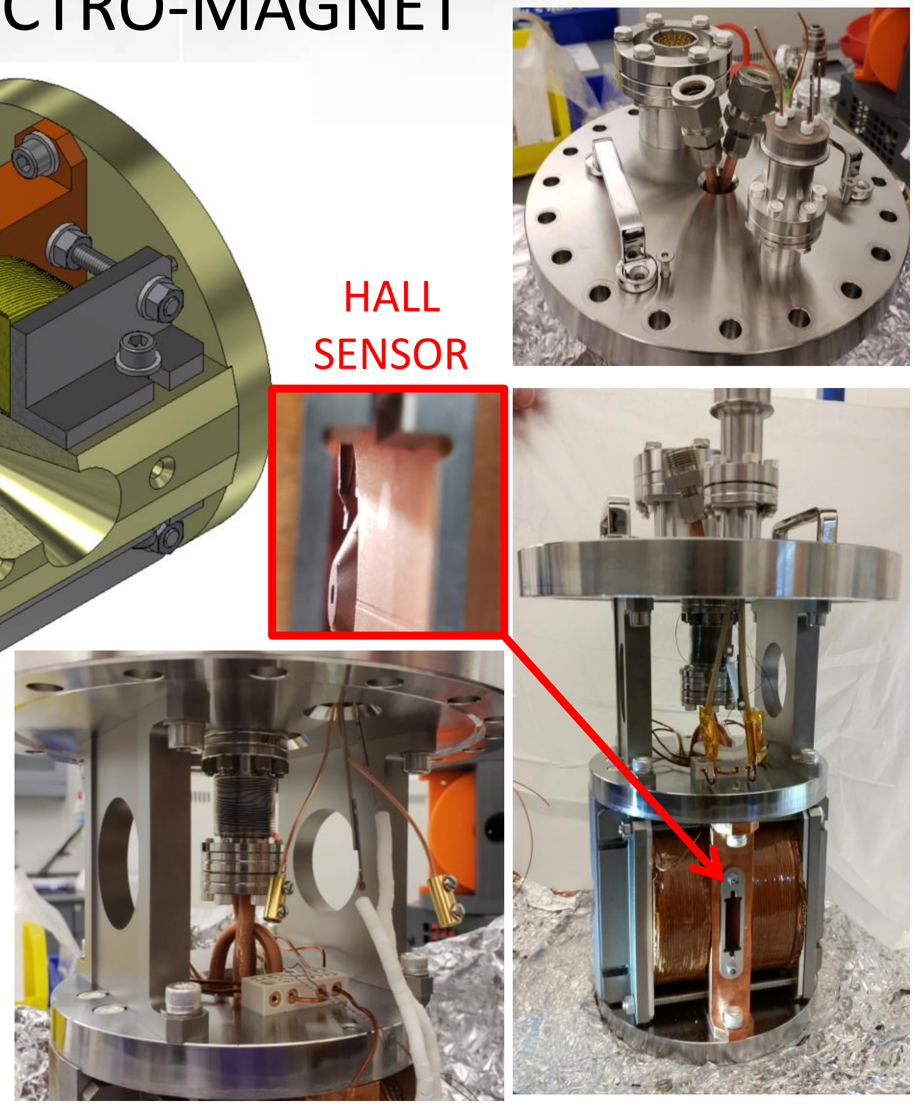
HOLOGRAPHY END STATION OVERVIEW





HOLOGRAPHY SETUP
IN VACUUM ELECTRO-MAGNET

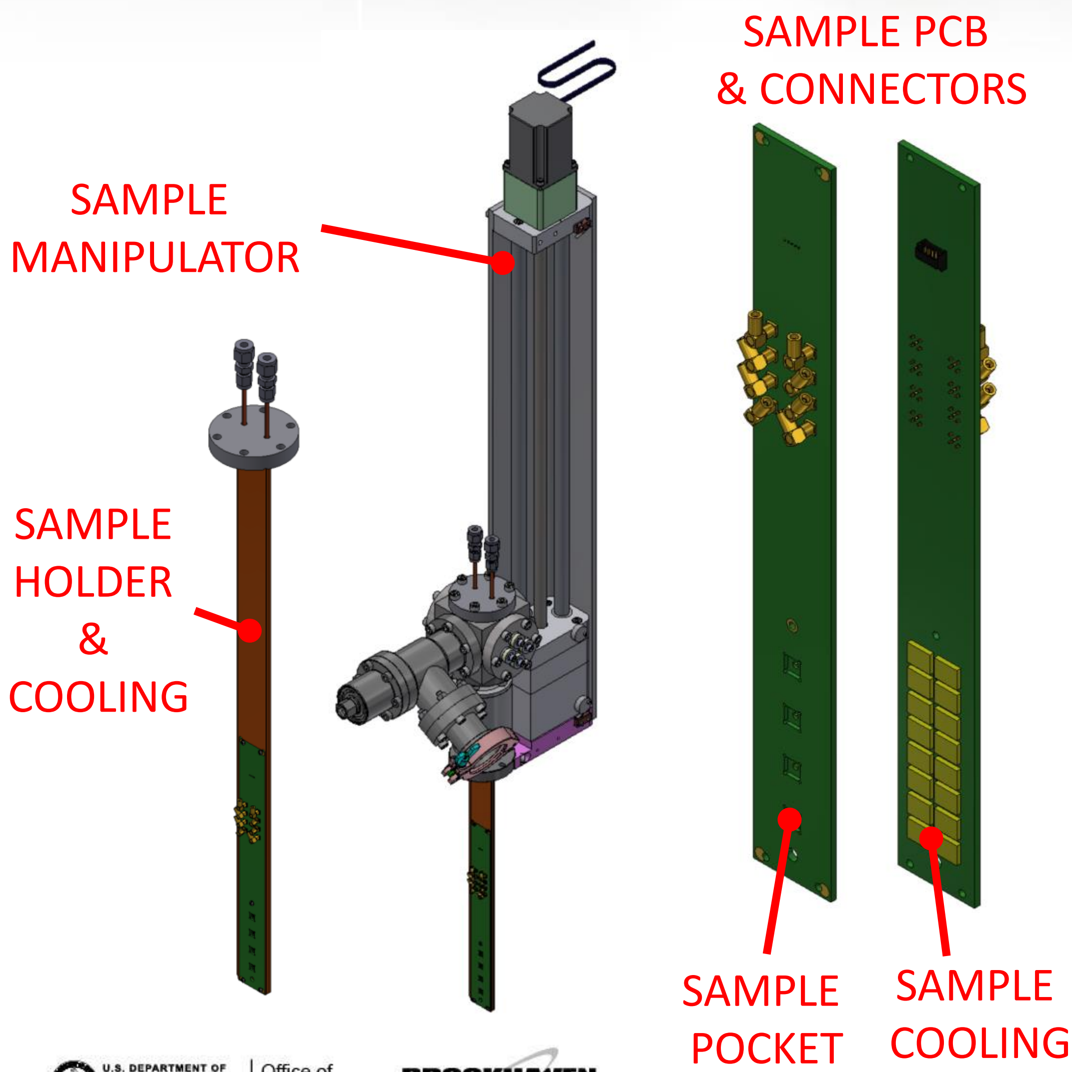




Max: 0.7 T @ 4 A (64 W)

HOLOGRAPHY SETUP

SAMPLE, SAMPLE HOLDER & MANIPULATOR

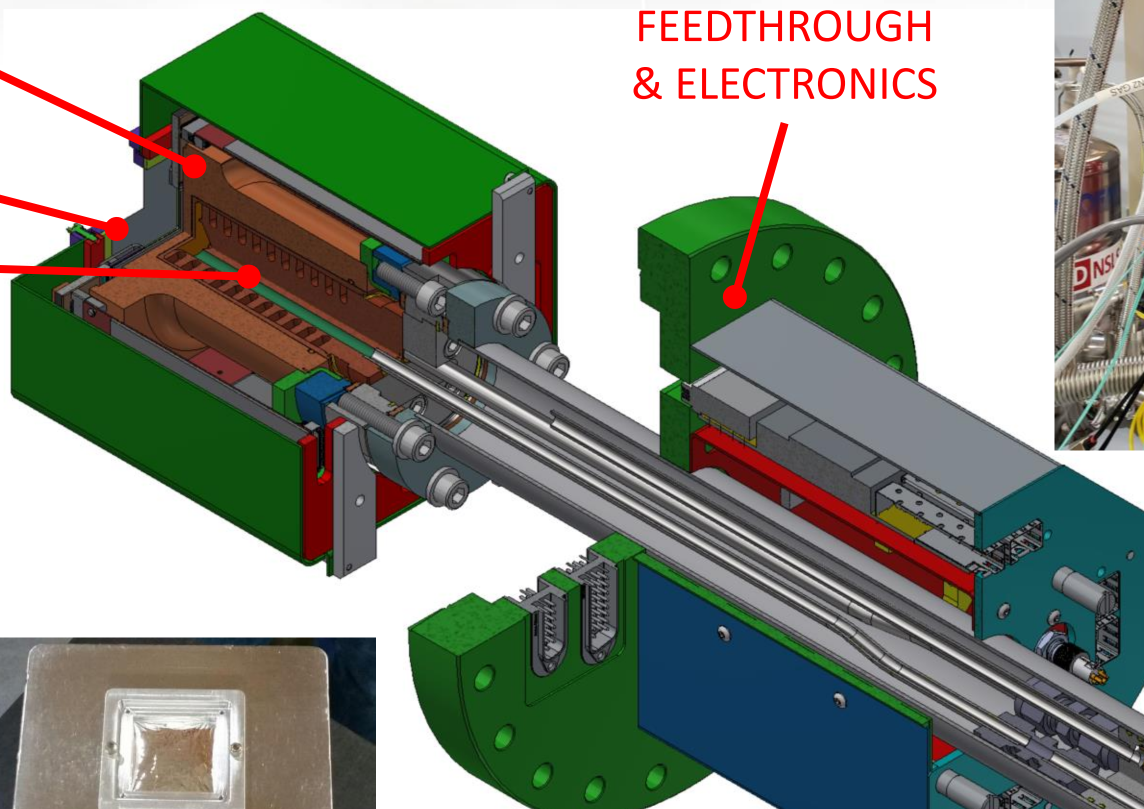


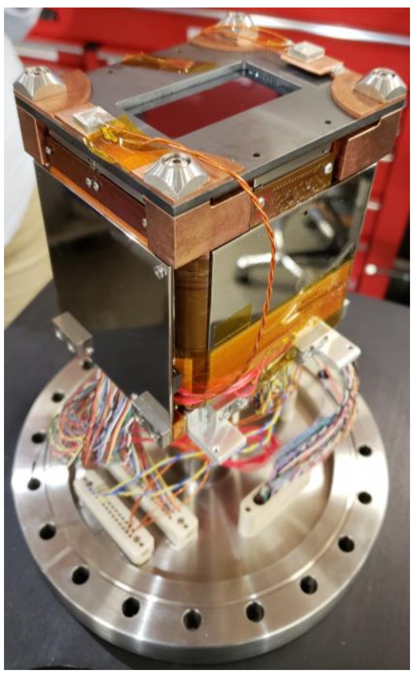
Capabilities:

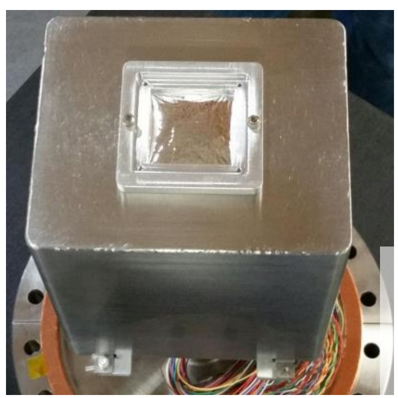
- Multiple samples at a time
- High frequency electrical field (up to 18 GHz)
- Water cooling of the sample board (not in use)
- Adjustable sample temperature (TEC on sample board)

HOLOGRAPHY SETUP

fCCD, BEAM STOP & COLD FINGER





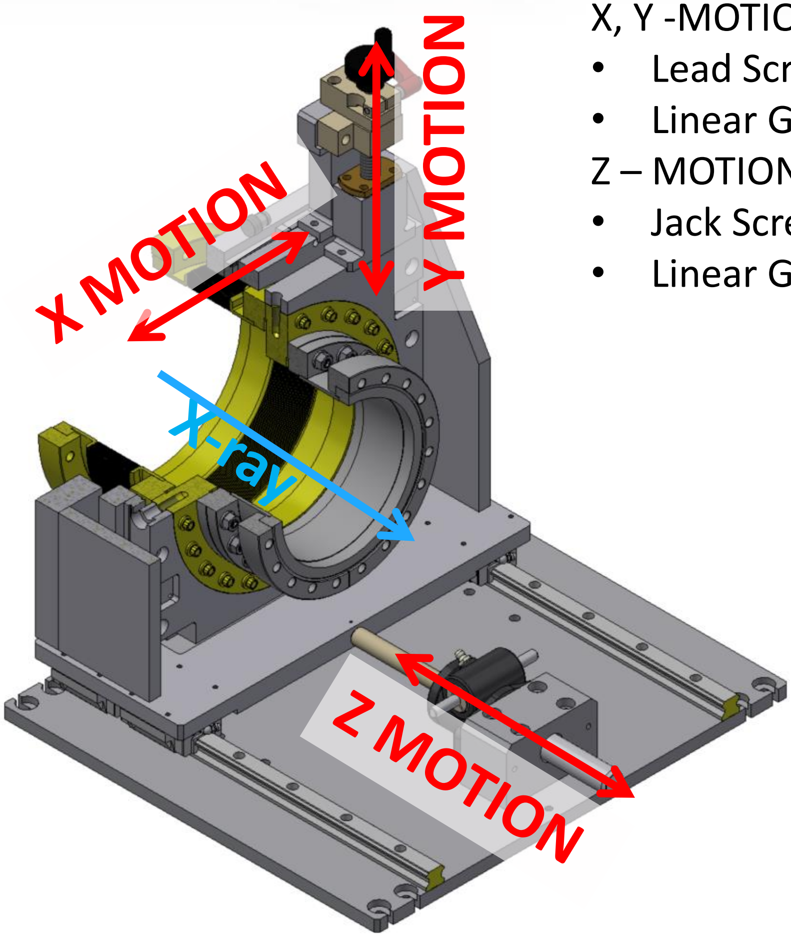


The fCCD used is identical to the one used in TARDIS. Liquid Nitrogen cooling, standard operation at CSX

U.S. DEPARTMENT OF ENERGY | Office of Science

BROOKHAVEN NATIONAL LABORATORY

HOLOGRAPHY SETUP
F-CCD X-Y-Z MOTION MODULE

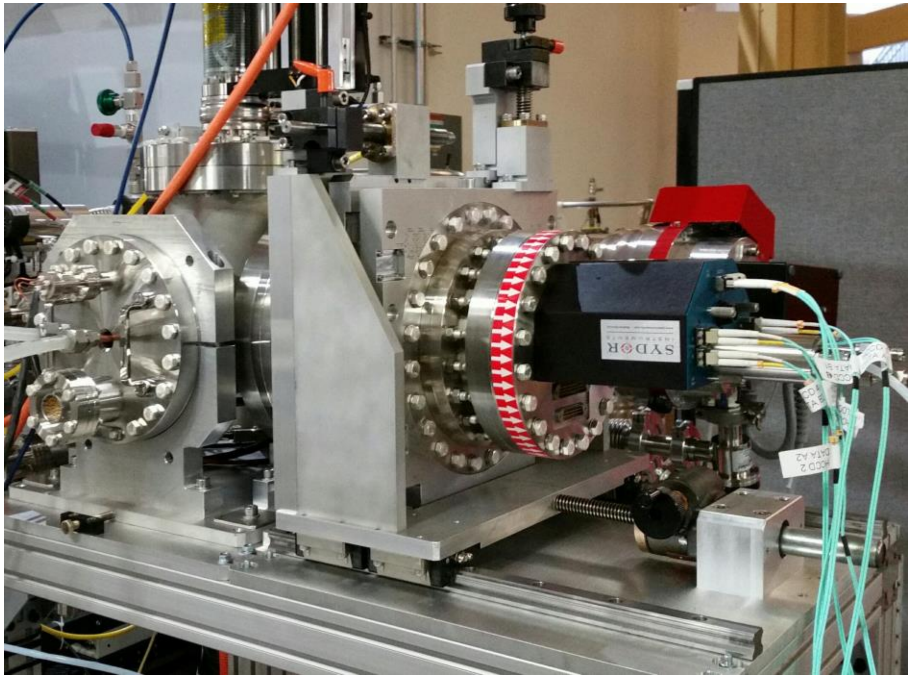


X, Y -MOTION:

- Lead Screw & nut: MISUMI MTSWK16240S44 & MTSGR16
- Linear Guides: McMaster-Carr 5708K25 & 5708K992

Z – MOTION

- Jack Screw: DUFF-NORTON TM-2625-4
- Linear Guides: THK HSR20A-2-QZ-420



OUTLINE

- Beamline layout overview
  - Self identified pre- and post-start findings
  - Primary capability
  - Holography End Station Overview
  - Holography setup – In-Vacuum Electro-Magnet
  - Holography setup – Sample Holder & Manipulator
  - Holography setup – fCCD, Beam Stop & Cold Finger
  - Holography setup – fCCD X-Y-Z Motion Module
- Pillar I: Documentation:

  RSC review, Hazard Identification and Mitigation, ESR and PASS
- Pillar II: Hardware

  PPS, Utilities, EPS, Controls
- Pillar III: Personnel

  Beamline Staff

fCCD: fast CCD camera

RSC REVIEW & RADIATION SAFETY MEMO

National Synchrotron Light Source

BROOKHAVEN NATIONAL LABORATORY

Building 743, National Synchrotron Light Source
Brookhaven National Laboratory
Upton, NY 11973-5000
Phone 631 344-2117
Fax 631 344-3238
zhong@bnl.gov

managed by Brookhaven Science Associates
for the U.S. Department of Energy

Memo

Date: September 19, 2018
To: Wen Hu, Stuart Wilkins, and Paul Zschack
From: Zhong Zhong (chair), Photon Science Radiation Safety Committee
Subject: Review of the radiation safety configuration of the new CSX holography endstation at the CSX beamline

Dear Wen, Stuart, and Paul

The Photon Science Radiation Safety Committee (RSC) reviewed the design of the new CSX holography endstation (to be installed at the CSX beamline) on July 17. Subjects reviewed include synchrotron radiation shielding analysis, design and configuration control of the new synchrotron beamstop.

Written documents

The following documents and drawings were reviewed:

1. Presentation "CSX- Holography Chamber", by Wen Hu, Claudio Mazzoli and D.M. Bacescu, dated July 17, 2018.
2. Memo from Mo. Benmerrouche dated July 17 to the RSC chair describing the shielding calculation of the holography chamber beamstop.

Oral Presentation

Attendance: Daniel Bacescu, Andi Barbour, Mo Benmerrouche, Sunil Chitra, Wen Hu, Steve Hulbert, Wah-Keat Lee, Chuck Schaefer, Chris Stelmach, Lutz Wiegart, Emil Zitvogel, and Joe Zipper

Wen Hu gave the presentation entitled "CSX- Holography Chamber ". Following the guideline from the memo by Paul Zschack to the RSC on May 29, 2014, the following were discussed:

1. CSX beamline has been reviewed by the RSC before in 2014. The beamline has been in safe operation for about 4 years. Currently the beamline terminates at the TARDIS chamber which receives synchrotron soft x-rays. Being a soft x-ray beamline, current beamstop is a 2.75-inch blank conflat flange.
2. The RSC recommended approval of the beamline as a soft x-ray beamline. Thus, adding an extra experimental end chamber into the existing monochromatic section on the experimental floor is largely covered by our prior review.
3. The new Holography chamber will be attached to the end of the TARDIS chamber. The chamber wall thickness is sufficient for shielding against scattered soft x-rays.
4. The beamstop for the holography chamber can be either a FCCD detector or a blank flange (when the FCCD is not installed). Both are adequate for shielding the direct synchrotron soft x-rays entering the chamber, as demonstrated by Mo's memo.
5. The holography chamber will have dual vacuum switches that turns off the beam when the chamber is vented. These will be integrated into the existing PPS system at the CSX beamline.
6. Configuration control of the FCCD detector is discussed.

Notes

1. In a follow-up meeting, the RSC chair met with the CSX holography team, the safety team, and NSLS-II management to further discuss strategy for configuration control of the beamstop.
2. Since the risk of radiation exposure is extremely low, we note that the commissioning survey of the chamber can be performed at normal ring current.

Recommendations

There are no recommendations from the RSC at this time.

Conclusions

Based on our assessment of the CSX chamber configuration, and simulation results, the RSC finds that the new CSX holography chamber design meets the NSLS-II shielding policy. Subject to experimental verification by radiation survey, we believe the installed chamber and beamstop will provide adequate personnel protection for normal operation and against failures of synchrotron orbit.

New CSX holography chamber design meets the NSLS-II shielding policy.

End of the beamline flange:

- CSX has been in safe operation for > 3 years.
- Configuration control: a blank flange or a fCCD detector
- New vacuum switches (PPS)

RSC REVIEW & RADIATION SAFETY MEMO

Radiation Safety Memo

To: Robert Lee, NSLS-II ESH Manager
Claudio Mazzoli, Lead Beamline Scientist, 23ID Beamline
Stewart Wilkins, Program Manager, Soft X-ray Scattering and Spectroscopy
Zhong Zhong, NSLS-II RSC Chair

Cc: Sunil Chitra, Associate Radiation Physicist
Wen Hu, Assistant Physicist, 23ID (CSX)
Steve Moss, NSLS-II Authorization Basis Manager

From: Mo Benmerrouche, Radiation Health Physicist

Subject: Dose rates on contact with the New Beam Stop inside the Holography Chamber at 23ID-1 (CSX) Beamline

Date: July 17, 2018

This note describes the radiation analysis of the new monochromatic beam stop that is planned to be installed as part of the new holography chamber at 23ID-1 (CSX) beamline. The following storage ring and insertion device parameters [1] are used for the calculations herein:

- Electron Energy: 3 GeV
- Stored beam Current: 500 mA
- Elliptically Polarized Undulator Source:
  - Number of periods: 76
  - Period Length: 49.2 mm
  - Maximum Magnetic Field: 0.97 T

The analytical code STAC8 v. 2.3 [2] is used to estimate the dose rates on contact with copper beam stop. The monochromatic beam directly striking the monochromatic beam stop is conservatively simulated as a zero-order beam generated by a 3-mirror configuration (gold coated mirrors at 1.17 degrees angle of incidence) [1]. The current 23ID-1 beamline is equipped with a 2.75" diameter blank flange which acts as a monochromatic beam stop. The new holography chamber will be connected directly to 23ID-1 beamline by removing this blank flange and connecting to an upstream beam pipe with bellows. The fast CCD camera of the new chamber will be the new monochromatic beam stop for 23ID-1 and the monochromatic beam is completely stopped by the camera detector. There is a minimum of 3.56 mm thick Cu block covering the camera in addition to a thick cold finger made of copper just downstream of it [3].

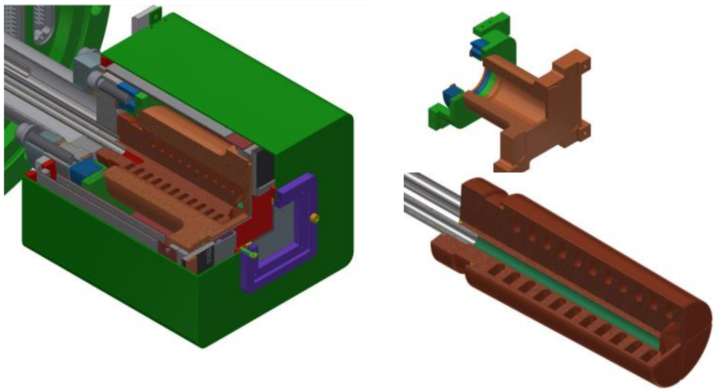
The resulting dose rates on contact with the new beam stop are negligible (< 0.001 mrem/h).

References

1. Z. Xia , "*23-ID CSX Beamline Radiation Shielding Analysis*", NSLS-II Technical Note 135, August 06 2014.
2. Y. Asano, "*A study on radiation shielding and safety analysis for a synchrotron radiation beamline,*" JAERI-Research-2001-006, March 2001. Y. Asano and N. Sasamoto, "*Development of Shielding Design Code for Synchrotron Radiation Beamline,*" Radia. Phys. Chem. 44 (1994) 133.
3. 23-ID-1 (CSX) Holography Chamber Final Design Review, PS-DRR-1067, July 17 2018

Configuration control

- Blank flange (current)
- fCCD detector (new)



The resulting does rates on contact with the new beam stop are negligible (<0.001 mrem/h).

- CSX has been in safe operation for > 3 years.

HAZARD IDENTIFICATION & Mitigation

USI (Unreviewed Safety Issue) Evaluation Negative.

Hazard	Mitigation
Radiation	Analysis shows no impact to existing configuration
Cryogenics	Handle following beamline ESR and wear required PPEs.
Pressure Safety	Burst disk installed, 1/3 psi pressure relief on gN_2 venting system
Magnetic field	5 gauss line was measured, within vacuum chamber.
Electrical	EEI, grounding, installation according to code

ESR & NSLS-II PASS

- CSX beamline (23-ID-1) ESR updated with new holography chamber, and approved within ESR system.
- CSX defined as a single resource in PASS.
- Technical commissioning proposal (#303014) and SAF (#303882) submitted and approved.

OUTLINE

- Beamline layout overview
  - Self identified pre- and post-start findings
  - Primary capability
  - Holography End Station Overview
  - Holography setup – In-Vacuum Electro-Magnet
  - Holography setup – Sample Holder & Manipulator
  - Holography setup – fCCD, Beam Stop & Cold Finger
  - Holography setup – fCCD X-Y-Z Motion Module
- Pillar I: Documentation:

  RSC review, Hazard Identification and Mitigation, ESR and PASS
- Pillar II: Hardware

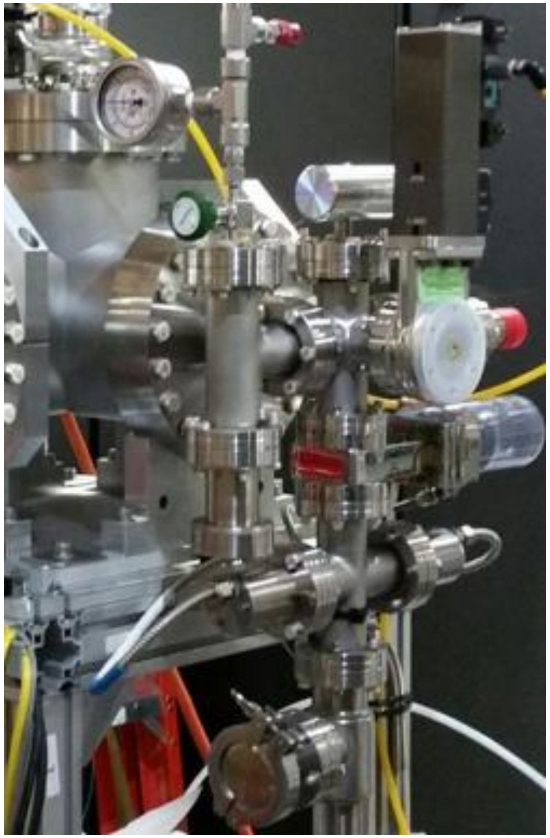
  PPS, Utilities, EPS, Controls
- Pillar III: Personnel

  Beamline Staff

fCCD: fast CCD camera

Pillar II: Hardware

- PPS: new dual vacuum switches were installed for CSX holography chamber and certified (Aug. 21-24,2018).
- Utilities: DI water integrated for cooling in-vacuum magnet (Sep. 20, 2018). Existing circuit on DI water manifold was used.
- EPS: 2 gate valve, chamber pressure, flow rate. Programming and tested by Garrett.
- Control: Single axis motor of sample manipulator. Tested and EPICS software ready.



Pillar III: Personnel

Lead Beamline Scientist	Claudio Mazzoli
Authorized Beamline Staff	Wen Hu Stuart Wilkins
Beamline Supporting Staff	Daniel Bacescu (mechanical engineer) John Sinsheimer (control engineer) Andrew Mingino (technician)

All staff members have completed required training.