NSLS-II, Photon Science Division Beamline Engineering Group Portfolio Photon Delivery System Examples

Beamline Engineering Meeting at BNL

25 March 2019

U.S. DEPARTMENT OF ENERGY | Office of Science

BROOKHAVEN NATIONAL LABORATORY

NSLS-II Beamline Engineering Group

Steve Hulbert
- Group Leader (interim)

Daniel Bacescu
- EPoC for Soft X-ray Scattering & Spectroscopy Program
- BL/ES developed: CSX, IOS, SMI, J-PLS (in progress)

Christopher Eng
- BL/ES developed: FIS/MET, IOS (in progress)

Lukas Lienhard
- EPoC for Expt. Development Program
- BL/ES developed: CMS, QAS, FIS/MET

Steve O'Hara
- Structural and thermal analysis, esp. finite element
- Front end engineering and analysis (NSLS-II and APS)

Steve Antonelli
- EPoC for Structural Biology Program
- BL/ES developed: ARI R&D (in progress)

Scott Coburn
- EPoC for Complex Scattering Program
- BL/ES developed: IXS, FXI
- WFO: APS 27-ID RIXS endstation

Ed Haas
- EPoC for Diffraction & In-Situ Scattering program
- BL/ES developed: TES, XFM, PDF

Mike Lucas
- EPoC for Hard X-ray Scattering Program
- BL/ES developed: ISR, HEX (in progress)

Yi Zhu
- EPoC for Imaging & Microscopy Program
- BL/ES developed: ESM, SIX, XFM, B-CDI (in progress)

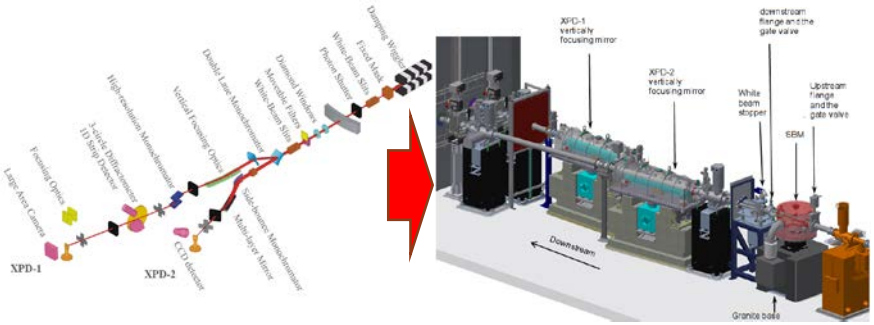
ePOC = Engineering Point of Contact
BL = beamline
ES = endstation

Photon Delivery System engineering examples

Haas: Beamline Photon Delivery Systems

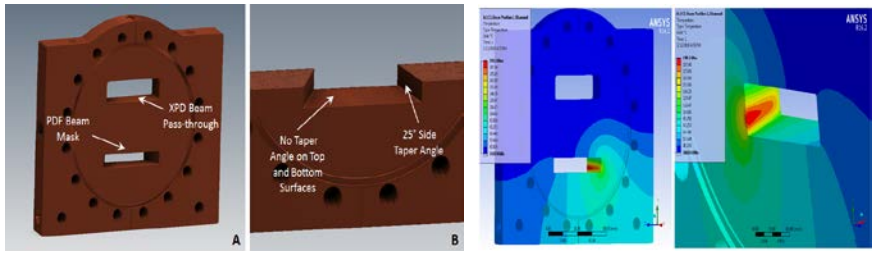
I. Beamline Design, Assy, & Instl

- Overall beamline design
- Beamline equipt instl & alignmt
- Safety & applicable code compliance



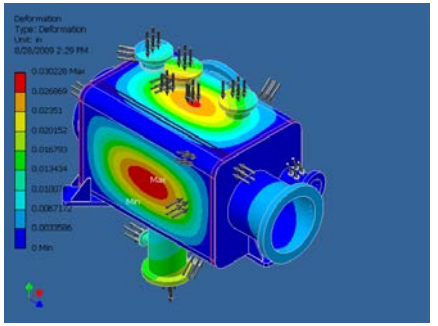
II. Ray Tracing, Shielding, and Beam Conditioning

- Radiation / Bremsstrahlung Shielding
- Photon Beam Thermal Mgmt
  - mask/slits/filter design



III. New Equipment Design, Development, Analysis & Integration

- Custom equipment design & integration



- Structural & Thermal analyses
- Cooling & Fluid Flow
- Procurement, Fabrication, Assy, Instl, & Alignmt Oversight

IV. Beamline Optics

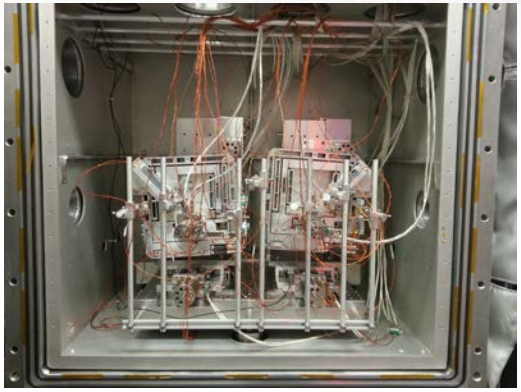
- Specification/SOW Development
  - Mirrors
  - Monochromators

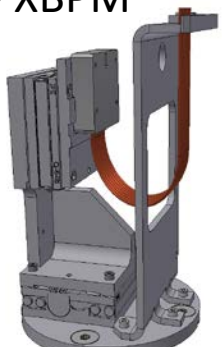
V. Common Components

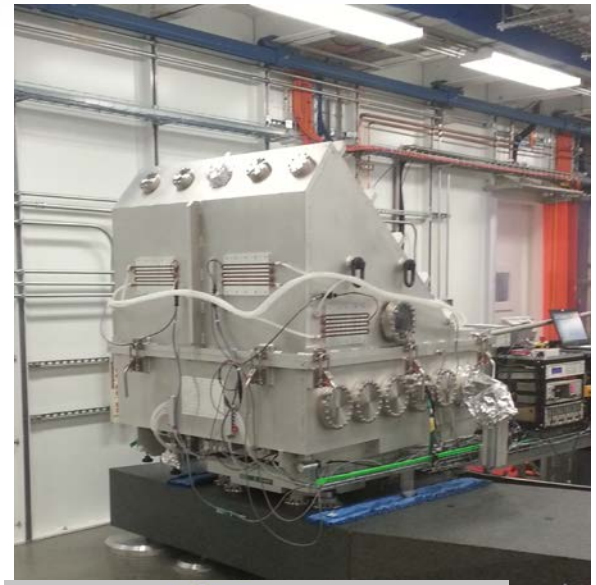
- Photon Shutters
- Hutches

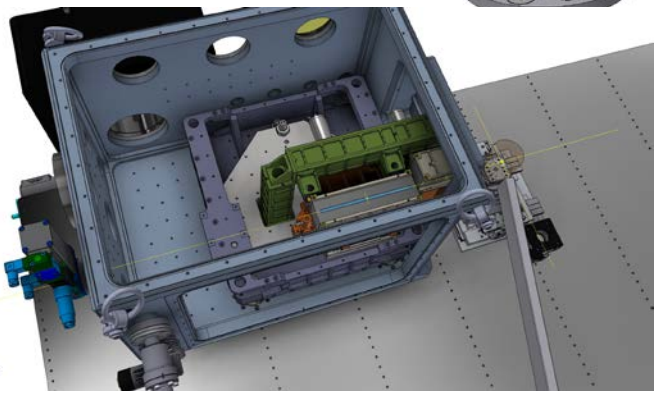
Coburn: Beamline Optics

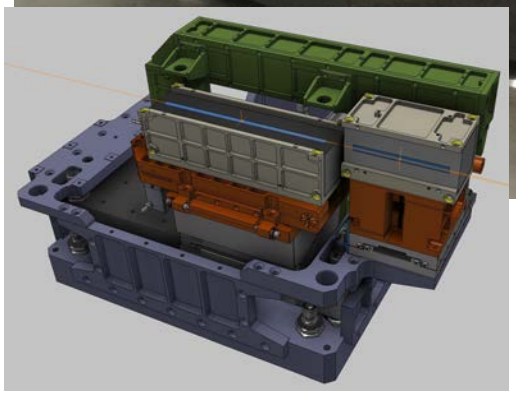
- IXS (10-ID) R&D Optics
- IXS (10-ID) Beamline High-Resolution Monochromator and Analyzer
- SRX (5-ID) Beamline KB Mirror
- SMI (12-ID) Beamline XBPM





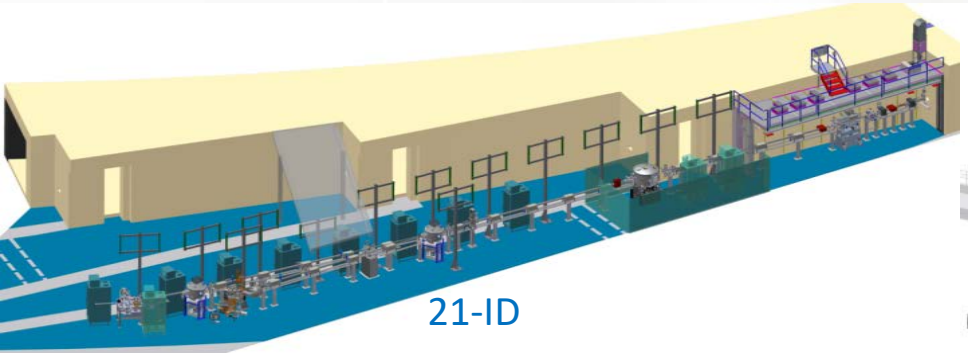






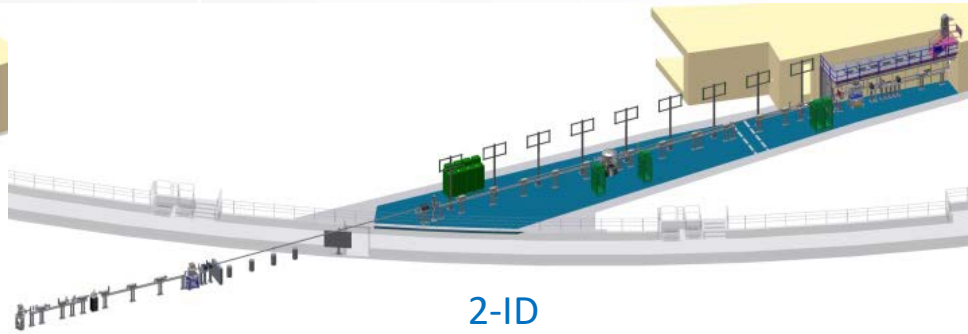
Zhu: Soft and Hard X-ray Photon Delivery Systems

I. Electron Spectro-Microscopy (ESM, 21-ID)



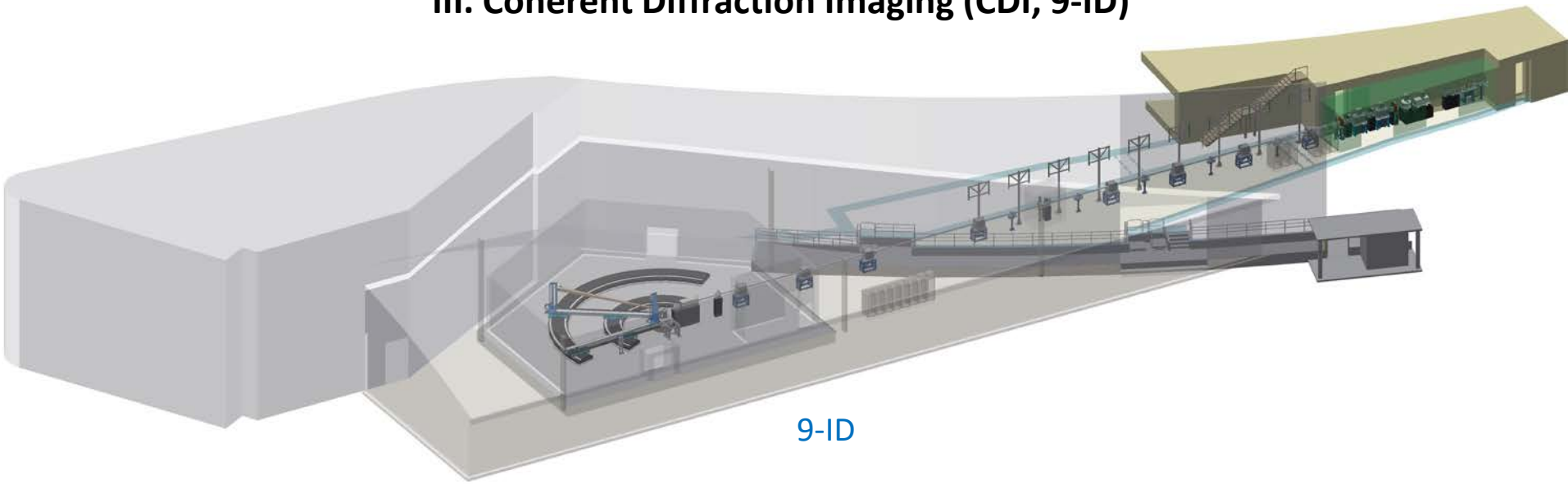
21-ID

II. Soft Inelastic X-ray Scattering (SIX, 2-ID)



2-ID

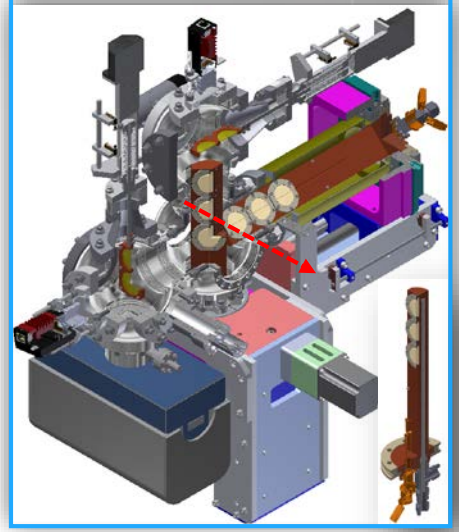
III. Coherent Diffraction Imaging (CDI, 9-ID)



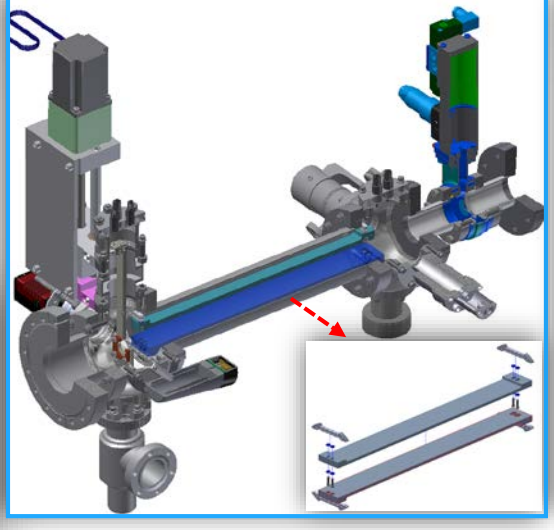
9-ID

Zhu: Photon Delivery System Components

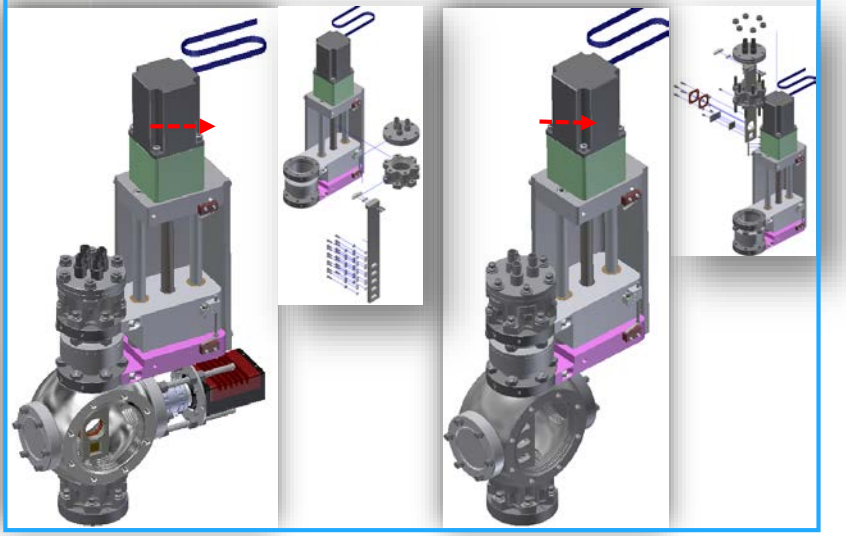
I. DiagOn



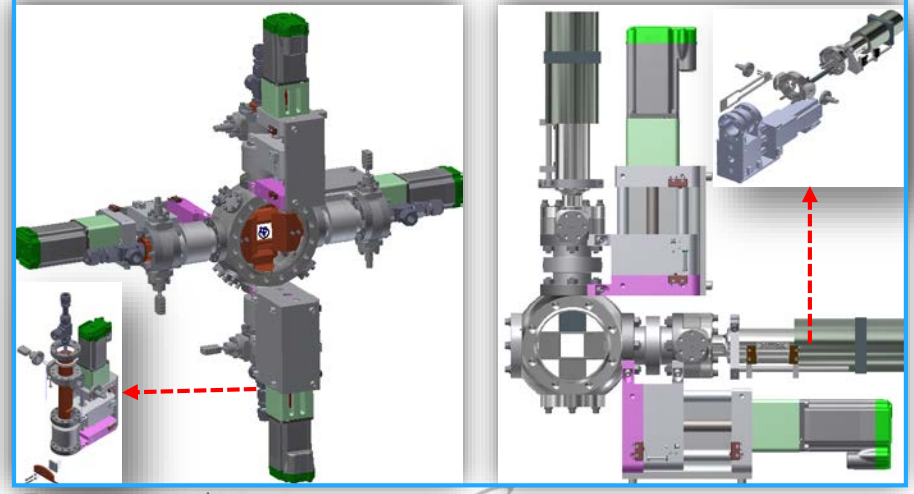
II. Gas Cell



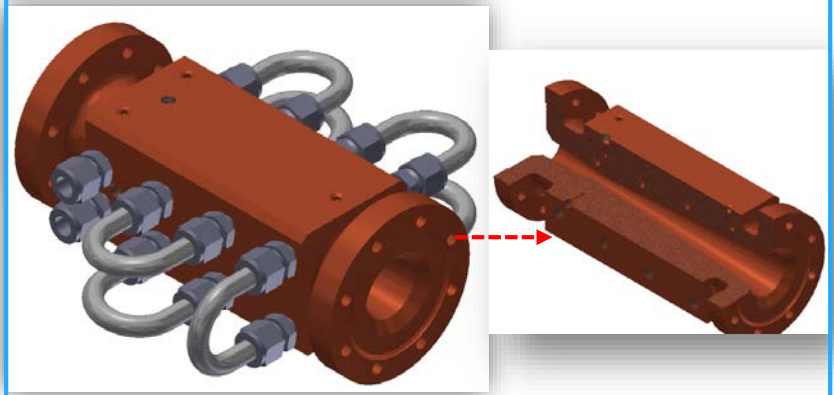
III. Diagnostic Units



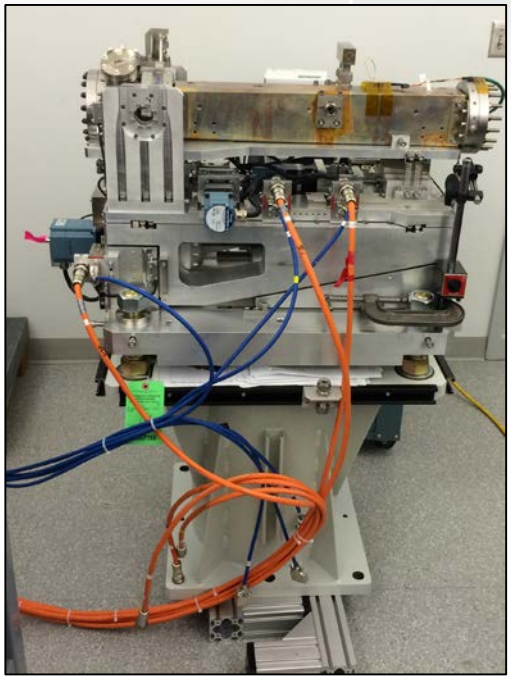
IV. Aperture/Slit Diagnostic Units



V. White Beam Mask

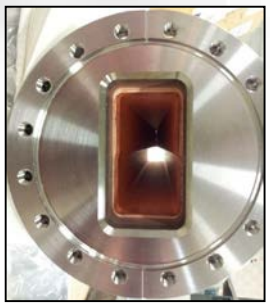


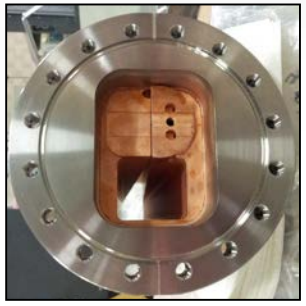
Antonelli: Front End WB and HHL systems

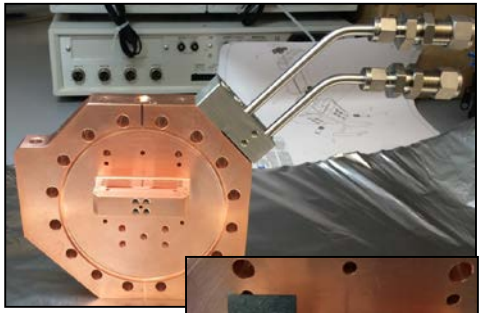


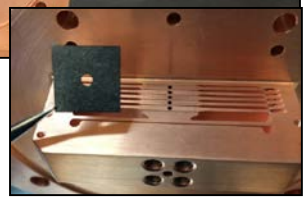
Case Study – IXS WB CRL system

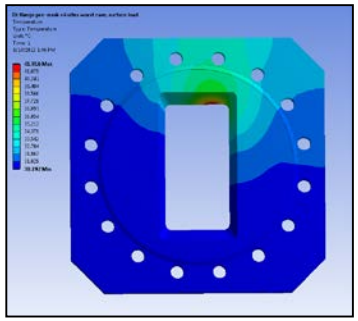
- HHL FEA analysis
- Mask / filter design
- Thermal management
- Optics integration
- High-stability support
- Precision stage design
- Assembly, testing, installation

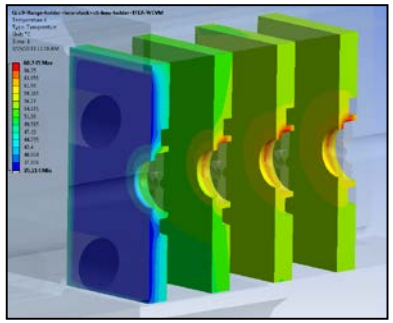


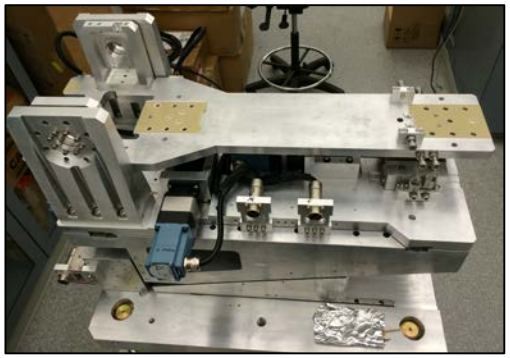


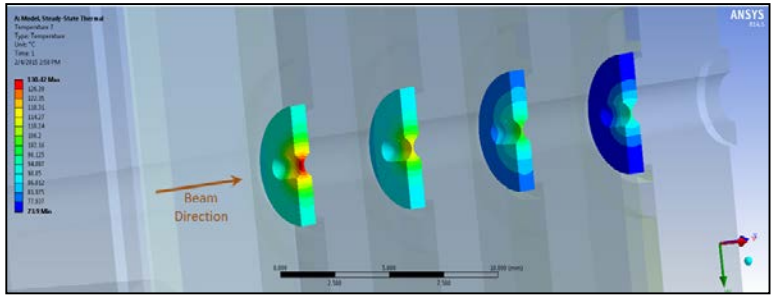


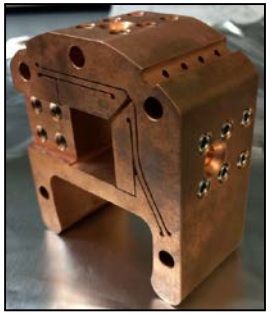








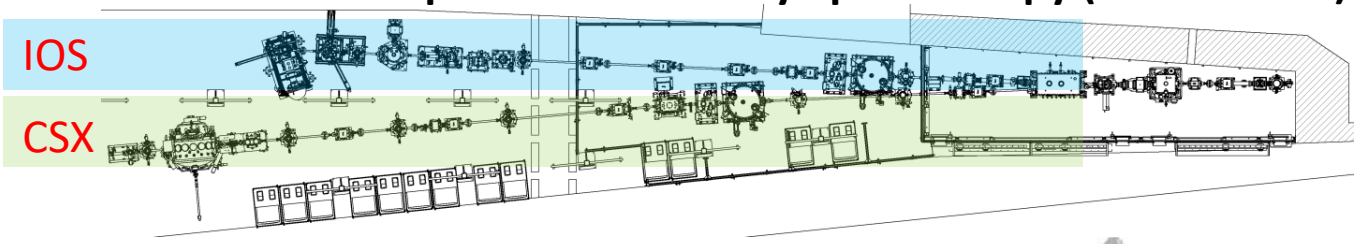




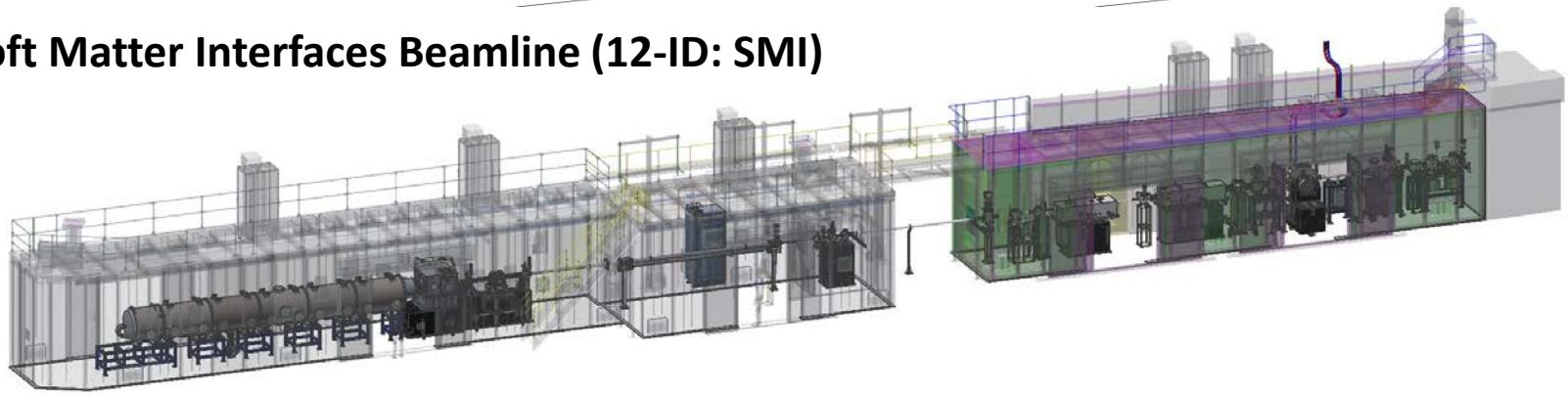
Bacescu: Soft & Hard X-ray Beam Delivery Systems

I. Coherent Soft X-ray Scattering (23-ID-1: CSX)

II. In Situ and Operando Soft X-ray Spectroscopy (23-ID-2: IOS)

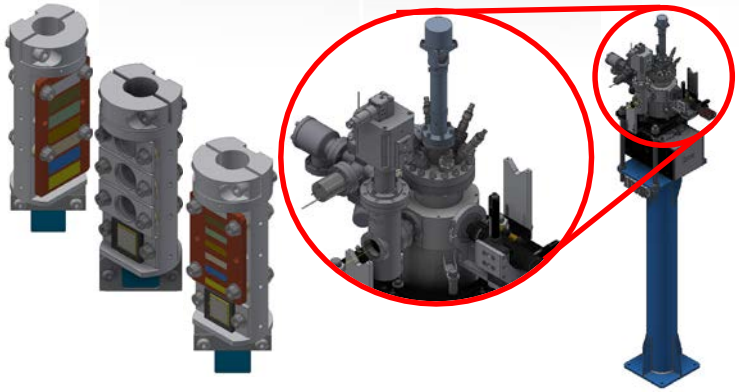


III. Soft Matter Interfaces Beamline (12-ID: SMI)

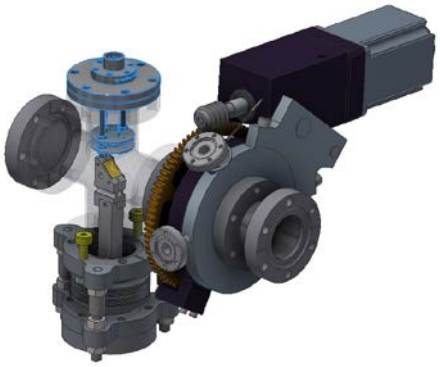


Bacescu: Beamline Instrumentation

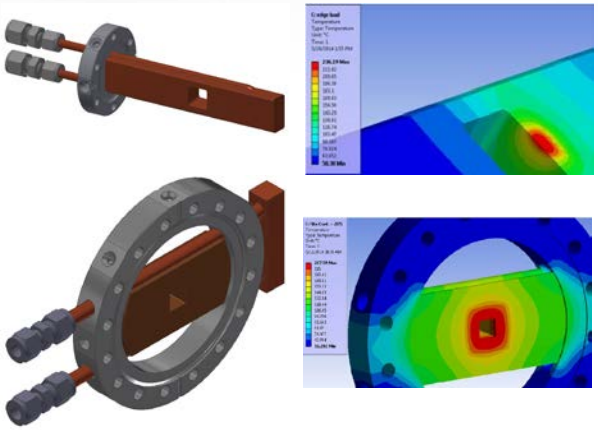
I. Beam diagnostic



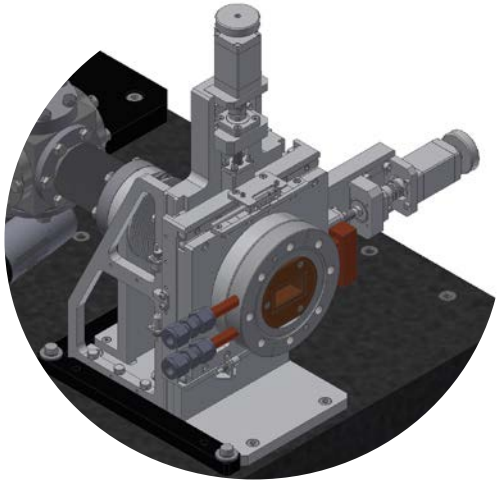
II. Polarization diagnostic



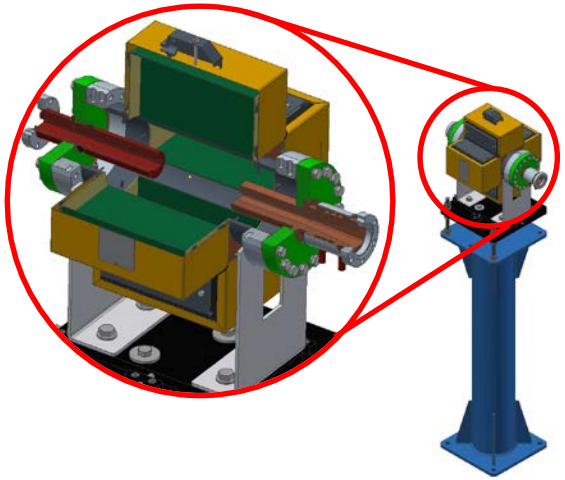
III. Pink beam masks



IV. Pinhole Selector

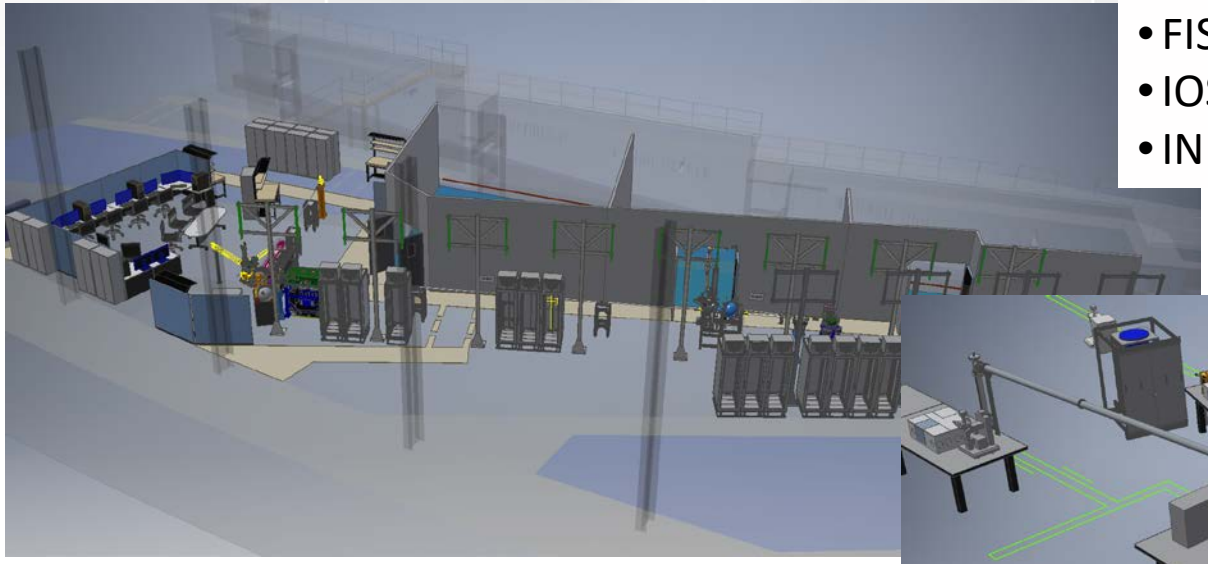


V. Differential Pump

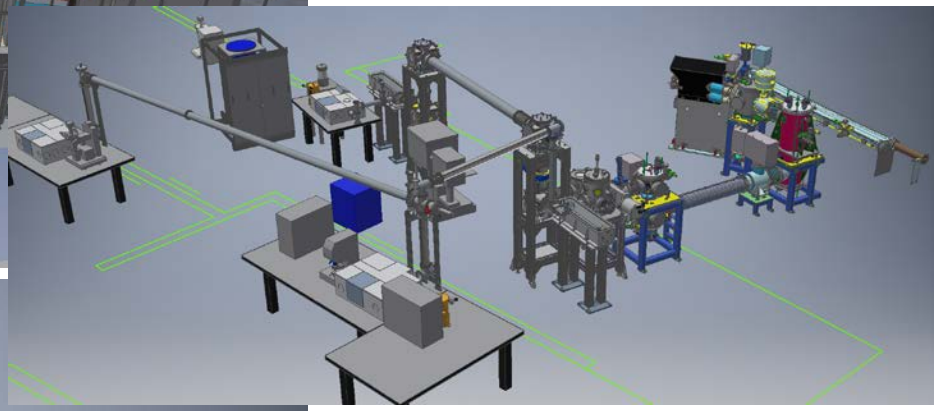


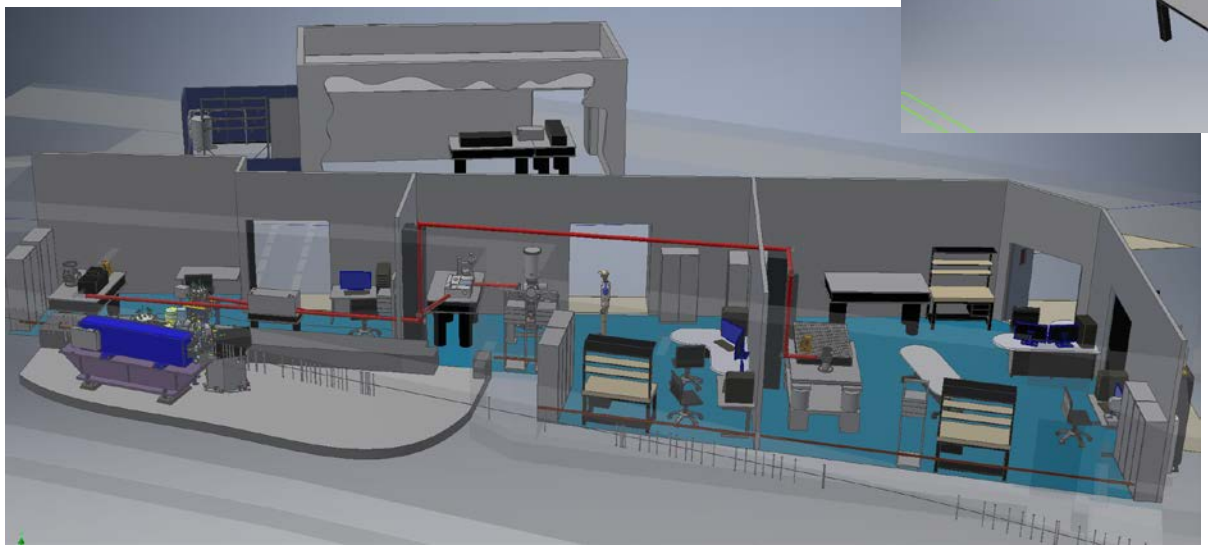
VI. BeamLine Burn through device

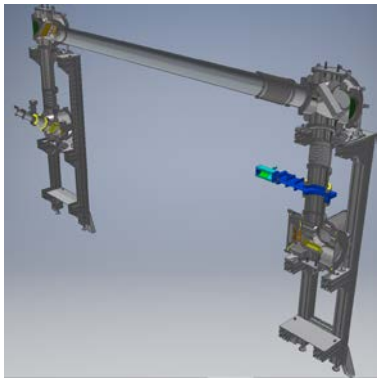
Eng: Photon Delivery Systems



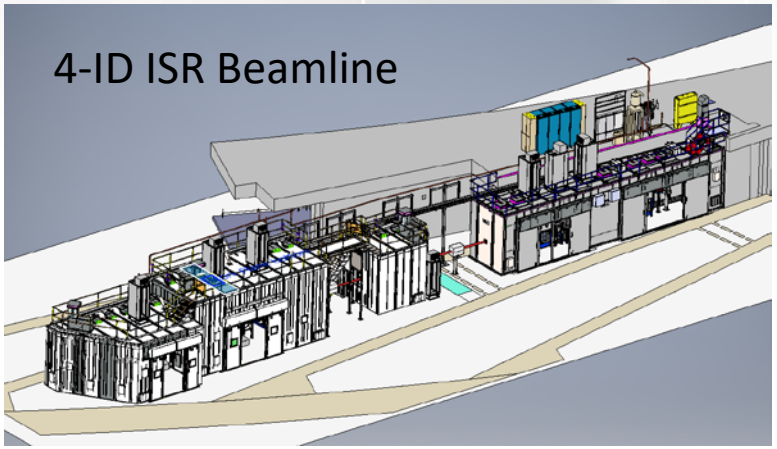
- FIS/MET Far-IR Beamlines (22-IR)
- IOS-INSPIRE upgrade (23-ID-2)
- INF Infrared Beamline (design)

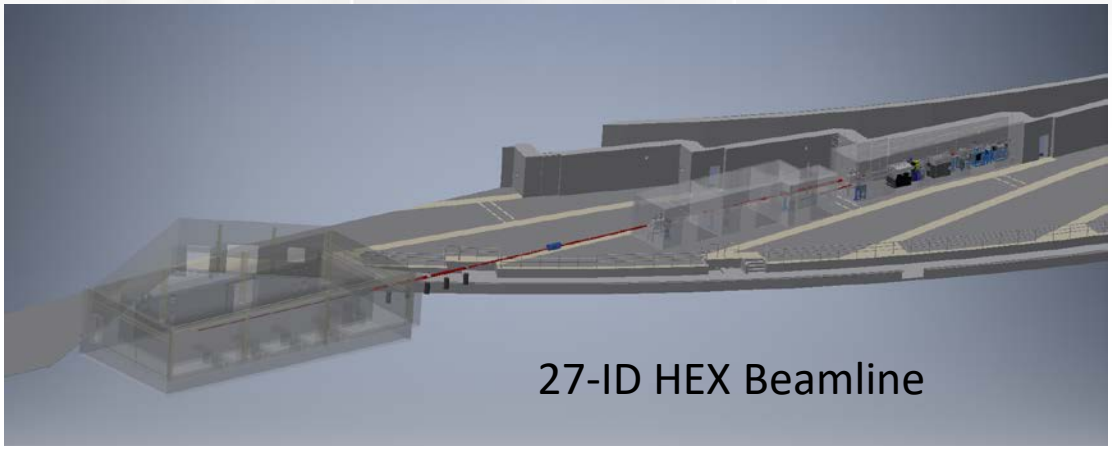




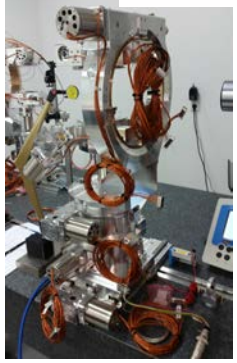


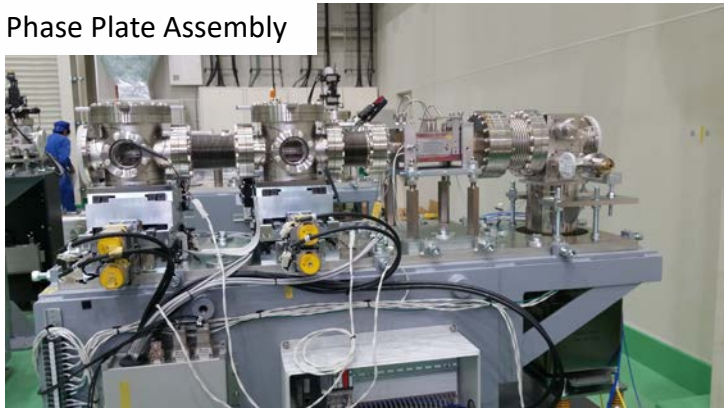
Lucas: Photon Delivery Systems

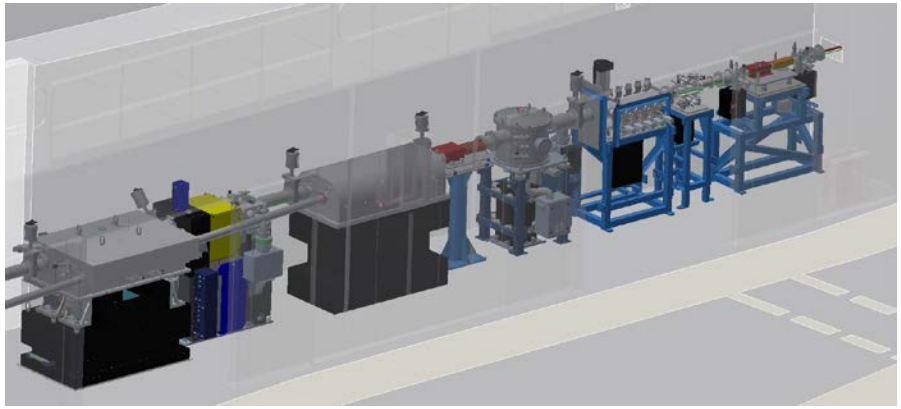


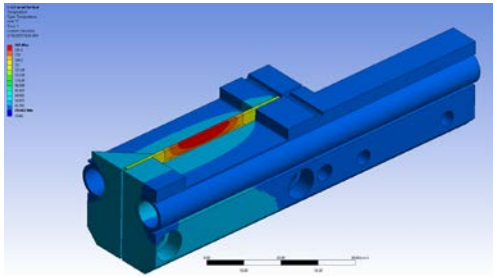


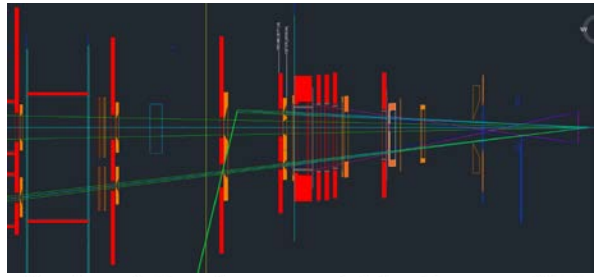
ISR Dual Phase Plate Assembly





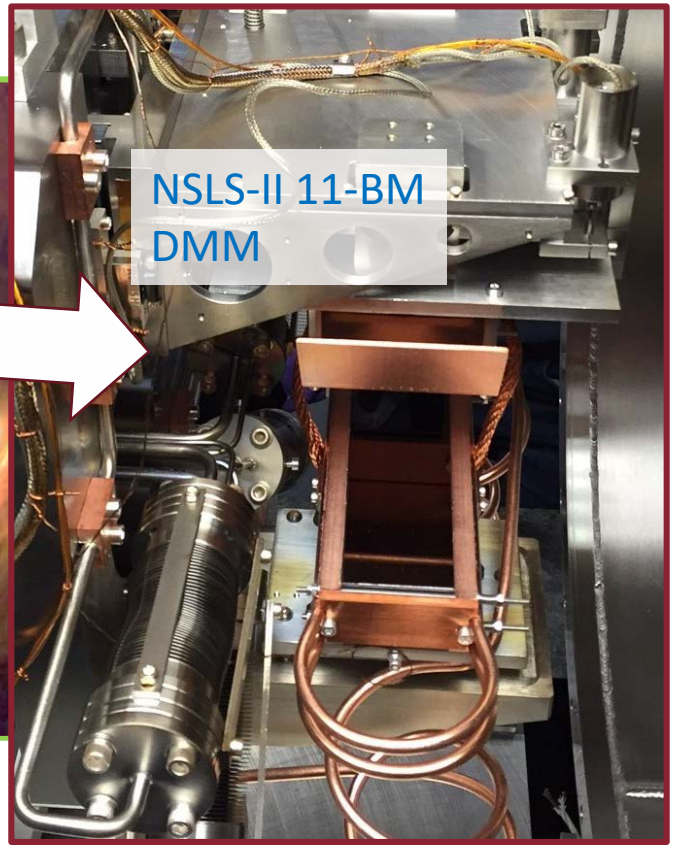






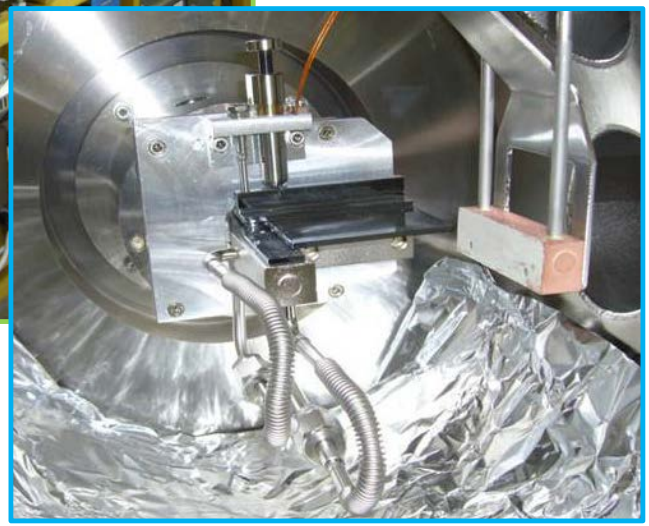
Lienhard: Hard X-Ray Photon Delivery Systems

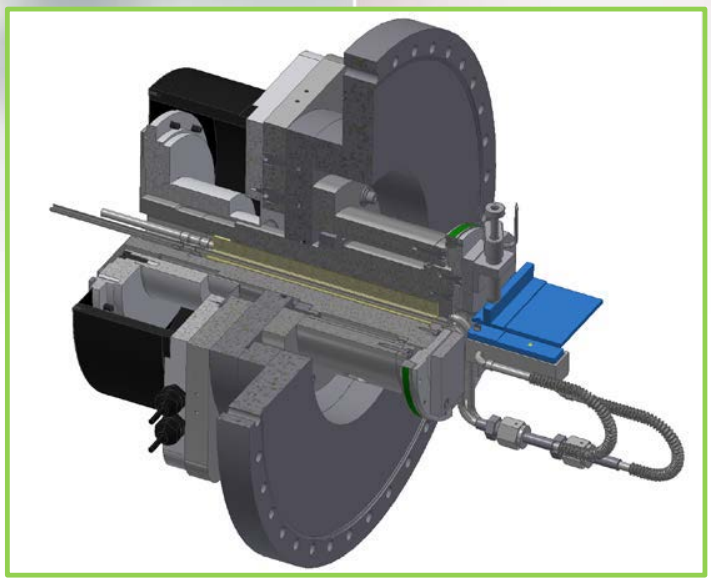
- Transfer of NSLS beamline optics to NSLS-II
- Upgrades for existing instruments
- Reverse engineering of old components
- Engineered to minimize cost & lead time



Lienhard: Hard X-Ray Photon Delivery Systems (2)

NSLS X18A DCM with cam-driven quick-scanning tangent arm





NSLS-II 7-BM quick-scanning DCM with direct drive AC servo motor

Original Design by P. Siddons

Lienhard: Infrared Beamlines & Cabins

- Conventional construction
- Cabins act as thermal & acoustic barrier from experimental floor
- Vibration sources placed outside of cabin