SSRL Welcome!

SSRL 50th Anniversary Celebration

Paul McIntyre

April 20, 2023

U.S. DEPARTMENT OF ENERGY | Stanford University

SLAC NATIONAL ACCELERATOR LABORATORY

SSRL-50th Celebration April 20/21

- Symposium today
- Experimental Floor – Beam Line Tours
  - Open 10 am to 1 pm tomorrow
  - Sign up now!

AGENDA

8:30 AM - 8:45 AM
SSRL Welcome
Paul McIntyre, SSRL Director

8:45 AM - 9:00 AM
SLAC and Stanford University Welcome
Stephen Streiffer, Interim SLAC Director

9:00 AM - 9:15 AM
DOE Welcome
Asmeret Asefaw Berhe, Director, Office of Science

9:15 AM - 9:45 AM
From SSRP to SSRL, 1972 - 1998
Artie Bienenstock

9:45 AM - 10:15 AM
The SSRL Structural Biology Program & SSRL and the Early SPEAR3 Era
Keith Hodgson

10:15 AM - 10:45 AM
Coffee Break

10:45 AM - 11:15 AM
VUV and Soft X-Ray Science at SSRL
Z. X. Shen

11:15 AM - 11:45 AM
Molecular Environmental Science at SSRL
Gordon Brown

11:45 AM - 12:15 PM
Structural Studies of Viral Pathogenesis Enabled by Synchrotron Radiation
Erica Ollmann-Sapphire

12:15 PM - 1:30 PM
Non-hosted Lunch and Group Photo

1:30 PM - 2:00 PM
A Perspective from the Funding Agencies - Virtual Presentations
Linda Horton, Associate Director of Science for Basic Energy Sciences
Amy Swain, Program Manager of Biological and Environmental Research
Dorothy Beckett, Director of NIGMS Division of Biophysics, Biomedical Technology, and Computational Biosciences

2:00 PM - 2:30 PM
Road to SPEAR3 and Beyond
Bob Hettel

2:30 PM - 3:00 PM
Energy Materials Science
Johanna Nelson-Weker

3:00 PM - 3:30 PM
Coffee Break

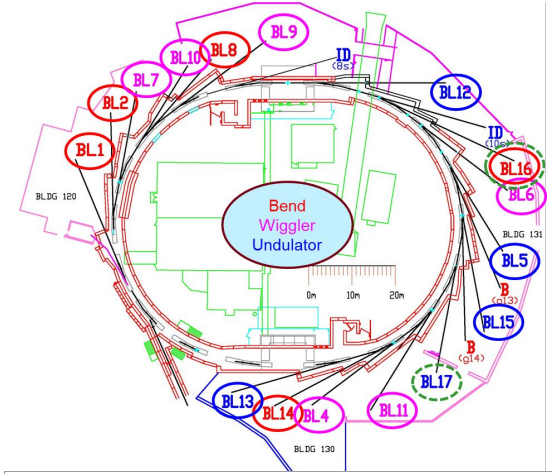
3:30 PM - 4:00 PM
Chemical Sciences
Ryan Hadt

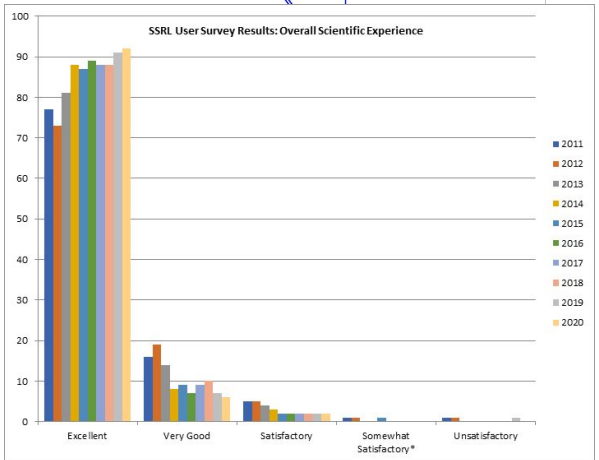
4:00 PM - 4:05 PM
SSRL as the "Birthplace of Photon Science"
Seb Doniach

4:05 PM - 5:00 PM
Panel Discussion
Joel Brock, Cornell University
Graham George, University of Saskatchewan
Junko Yano, LBNL
Francesco Sette, ESRF
Susannah Scott, UC Santa Barbara
Kelly Gaffney, SLAC

5:00 PM
Concluding Remarks
Paul McIntyre

Stanford Synchrotron Radiation Lightsource Facts





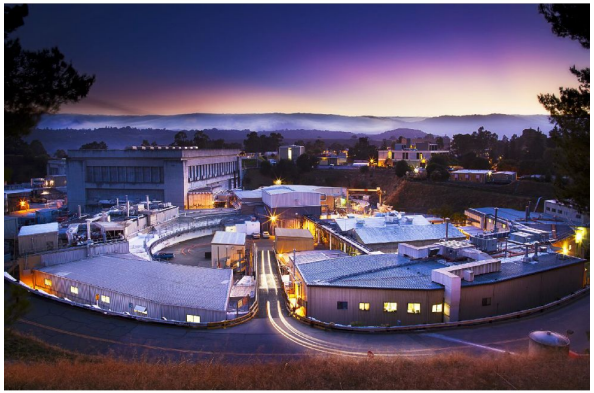
- SPEAR3
  - 3 GeV, 500 mA
  - Top-off injection every 5 minutes
  - Highly reliable
  - 9.8 nm-rad emittance □ 7 nm-rad
- ***FY22:*** SSRL operated 27 BL with 33 stations at the end of run
- ***In a typical year***, SSRL supports ~1,700 users
- ~600 journal pubs/yr ~ 21% high-impact
- ~120 theses per year

Science First Approach to Cost Effective Research & User Support

Stanford Synchrotron Radiation Lightsource

Strategic Plan: 2021-2025

Meeting the Scientific Challenges of the Future



March 2021

SLAC NATIONAL ACCELERATOR LABORATORY

Three Scientific Foci

- **Accelerating Materials Design**
- **Understanding Catalytic Function & Interfacial Reactions with Atomic Precision**
- **Identifying How Collective Function Emerges from Constituent Interactions**

Strategy development:

- *Outreach & collaboration with User, SLAC, and Stanford communities*
- *Engagement with and responsiveness to BES & Office of Science planning*
- *Review and feedback from SSRL SAC & UEC*

Science First Approach to Cost Effective Research & User Support

Stanford Synchrotron Radiation Lightsource

Strategic Plan:
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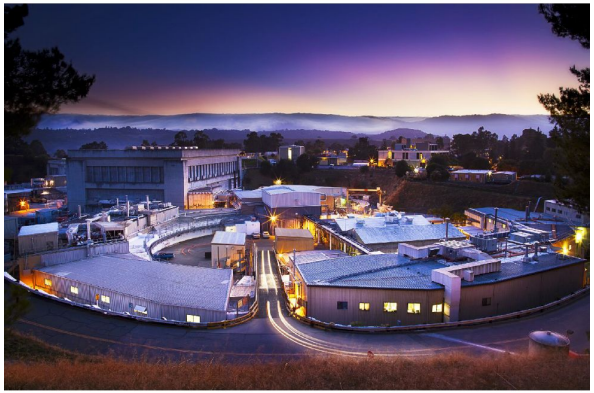

March 2021

SLAC NATIONAL ACCELERATOR LABORATORY

New Use-Inspired Opportunities:

- **Quantum information science**
- **Microelectronics – materials, metrology**
- **Designing sustainable catalysts**
- **Advanced manufacturing**
- **Biological approaches to sustainability**

Strategy development:

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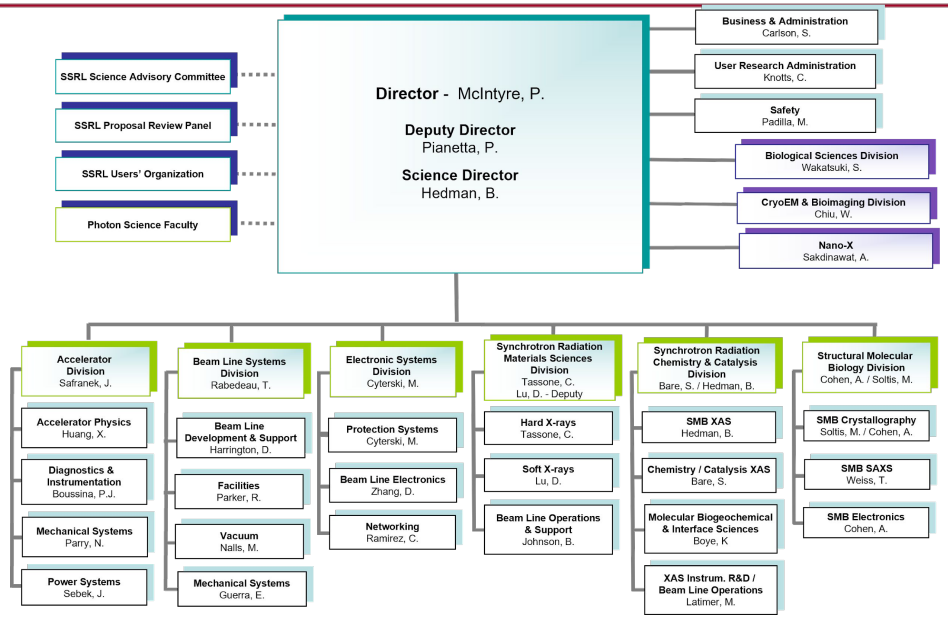
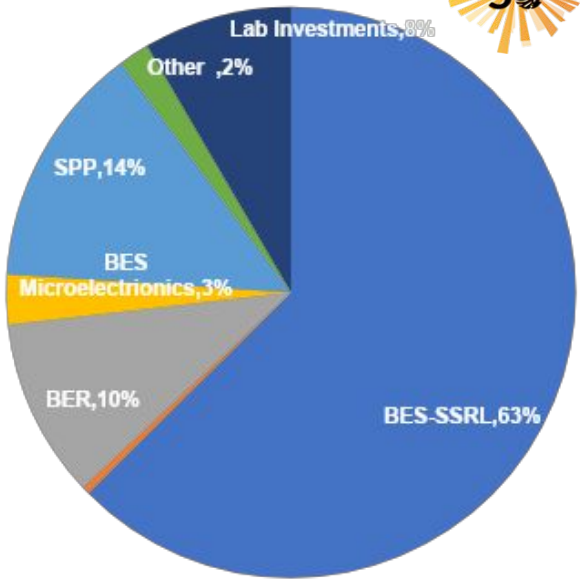
SSRL Organization and Funding





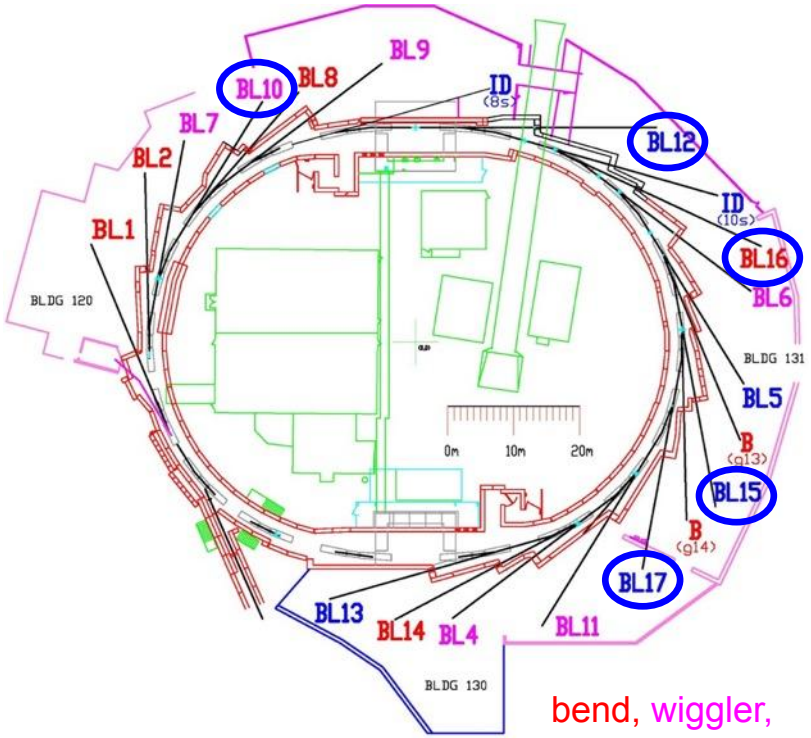
- SSRL organized in 6 divisions for R&D and operations
- Additional divisions in SSRL Directorate at SLAC devoted to biology and nanofabrication
- Teamwork within and between divisions

- Base funding from DOE-BES
- SPP/BES-Other is research funding
- Lab Investment is LDRD/PD

Total SSRL funding in FY22 was $71M from all sources

SSRL New Beam Line Development

- BL17-2 materials scattering
  - Commissioning in FY22 run
  - In operation in FY23
- BL15-2 advanced spectroscopy
- BL12-1 crystallography
- BL10-2 (XAS/XRD)
  - Co-ACCESS rear/XRD front
  - Optics upgrade ongoing
- BL16 metrology
  - BL 16-1: Commissioning
  - BL 16-2: In operation

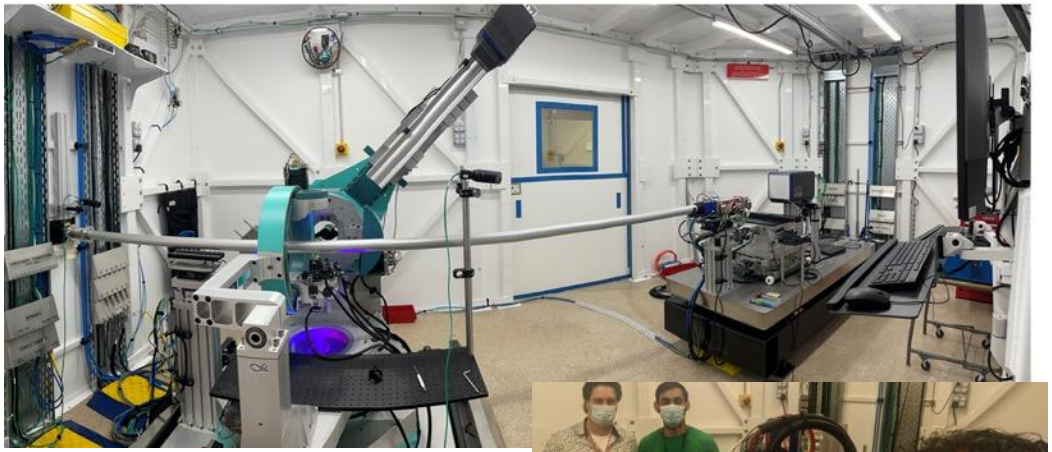


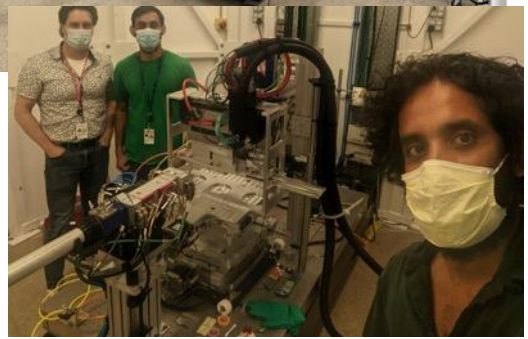
bend, wiggler, undulator

BL17-2 Energy Science Scattering

- High–repetition rate, pump-probe, time-resolved diffraction studies of model systems relevant to energy and quantum materials

- K-B focusing optics - focus confirmed
  - 5 µm x 46 µm (v x h)
- Mono – Si(111), Si(311), Mo/B_4C multilayer
  - ML focus 5 µm x 46 µm FWHM
  - 1.1x10^{14} ph/s @ 8.9 keV
  - Positional stability ~ 2 µm over 24 hrs
- 6-axis diffractometer, area detectors EIGER 4M, 1M, 500K commissioned
- Cryostat, SAXS coming FY23
- Interleaved optics commissioning/user commissioning through end of (July)
  - Low and near ambient quantum material characterization
  - *Operando* switching of ferroelectric devices
  - *Operando* mapping of battery electrodes
  - *In-situ* thin film fabrication

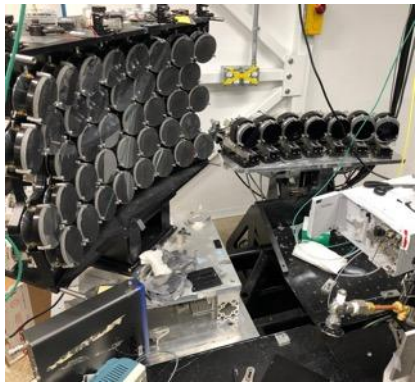




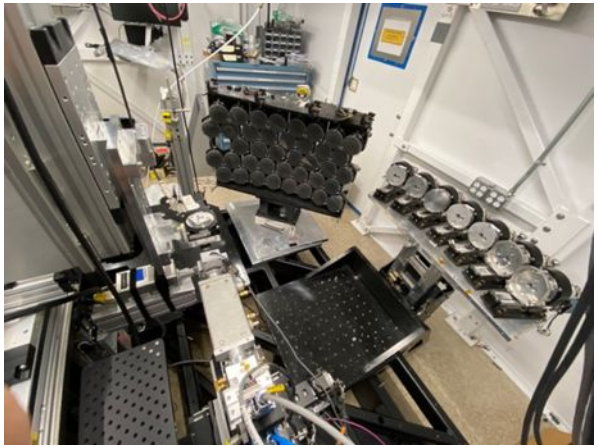
BL15-2 *Operando* and Time-resolved Advanced Spectroscopy

- XES, XRS, RIXS studies of catalysts for energy production, time-resolved pump-probe studies, enzyme and bio-inspired catalysis

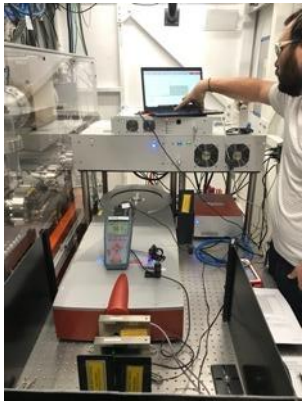
- K-B focusing optics - focus
  - 5 µm x 35 µm (v x h)
- Mono – Si(111), Si(311)
  - 4.2-18.2 keV
  - ~3x10^{13} ph/s Si(111)



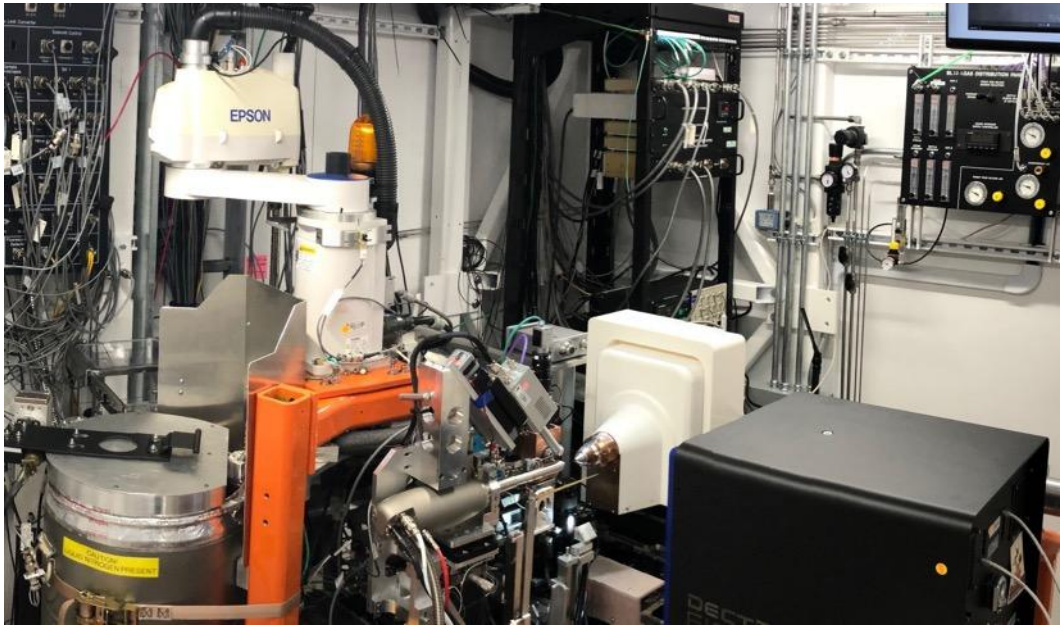
- 40-crystal XRS spectrometer
- 7-crystal XES spectrometer
- von Hamos spectrometer
- *In-situ* sample environments



- Tangerine laser
- Time-resolved capabilities with SPEAR3 lattice at 70 ps
- MHz rep rate pump probe spectroscopy



BL12-1 – Macromolecular Crystallography



Focus	Flux	Energy Range
5 µm x 50 µm (v x h)	$4x10^{12}$ @ 12.5 keV	6-18 keV

Capabilities

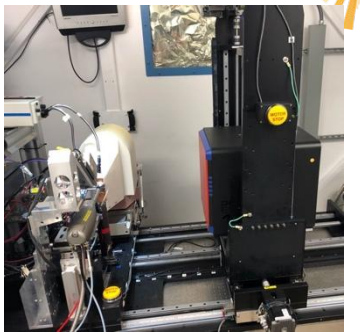
- Bright micro-beams enable collection of the most challenging samples
- Fully remote accessible with robotic sample exchange at cryogenic and controlled humidity conditions
- Time-resolved crystallography with light triggers and mixing injectors
- State-of-the-art EIGER2 XE 16M PAD – the first in the US (400 Hz continuous readout)
- Real-time data analysis and feedback

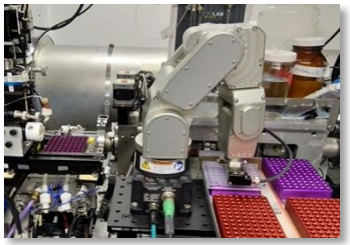
Upcoming

- **Pink Beam capability in commissioning**
- **Rapid-mixing crystal injectors**

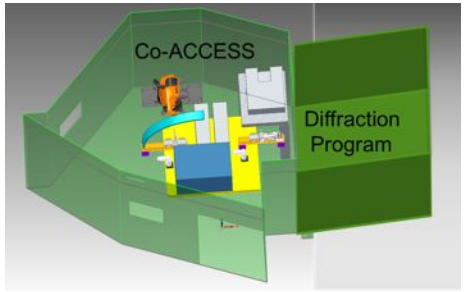
Structural Molecular Biology – Supplemental Funding

- SSRL Structural Molecular Biology program has been awarded supplemental funding – jointly by NIH and DOE-BER – to prepare for assisting APS structural biology users during the APS-U shutdown, (and ALS users further out), and to enhance capabilities
- Macromolecular crystallography
  - EIGER 2 XE 16M for BL12-2 and associated compute infrastructure
  - M&S and travel support for remote-access user sample handling and training
- XAS
  - Multi-element Ge detector and electronics for SMB program at BL9-3 – replacement of 100-element detector system
  - Enhancement to BL7-2 XAS imaging system to enable micron-size beam capabilities
- BioSAXS
  - Upgrade of bioSAXS robotic system for solution scattering at BL4-2





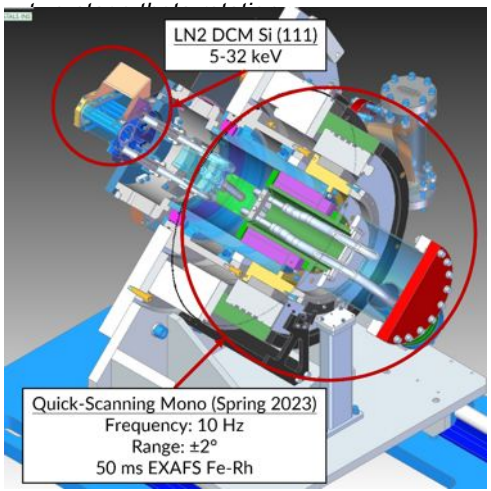
BL10-2 Upgrade for Catalysis Spectroscopy



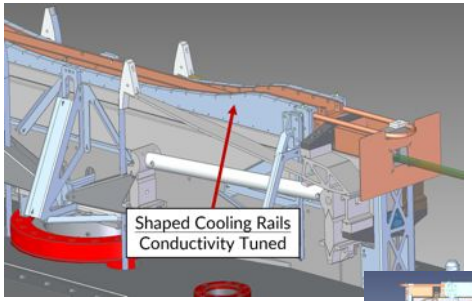
Co-ACCESS program in BL10-2 (rear); Diffraction program (front)

- New quick-scanning monochromator
- New M_0 collimating mirror
- Rebuilt M_1 focusing mirror

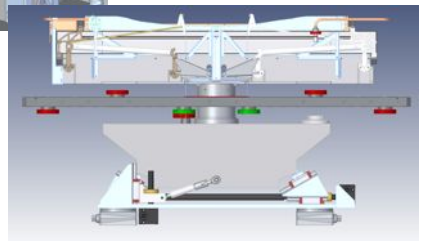
LN_2 cooled step-continuous-quick-scanning DCM mono; pseudo channel cut geometry;



BL10-2 M_0 mirror

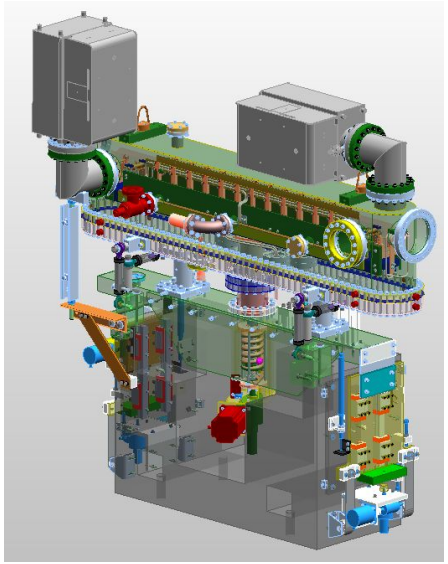


- *Improved thermal stability*
- *"Sculpted" heat transfer*
- *New positioning design*



BL10-2 M_1 mirror rebuild

- *Improved stiffness*
- *New granite pedestal*
- *Redesigned positioning system*



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- **Experimental Floor – Beam Line Tours**
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Have Fun!

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