U.S. DEPARTMENT OF ENERGY | Office of Science

Congratulations!
SSRL 50th Anniversary

April 20, 2023

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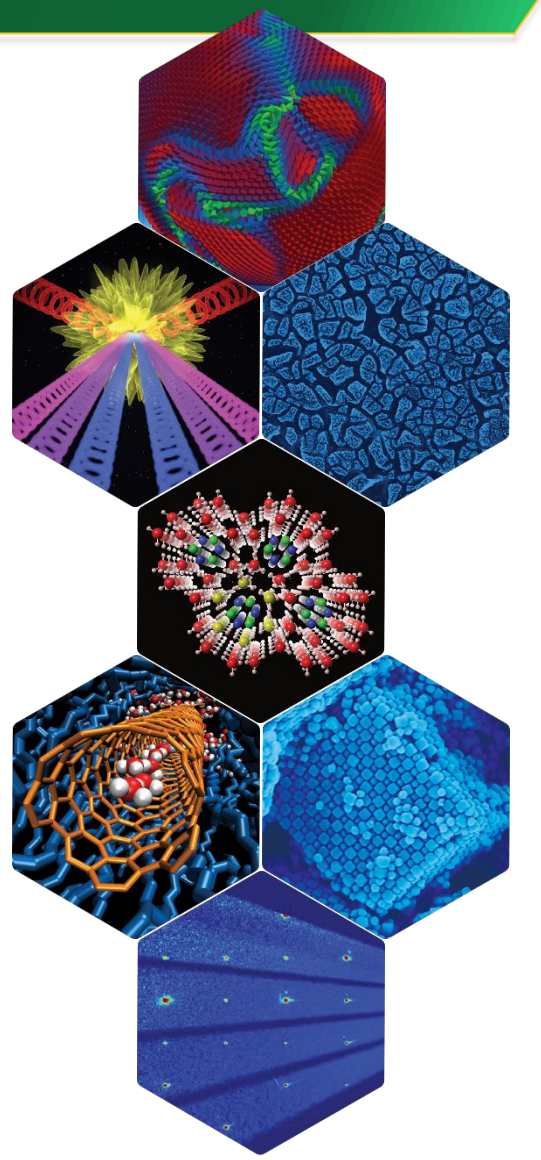
Associate Director for Science for Basic Energy Sciences

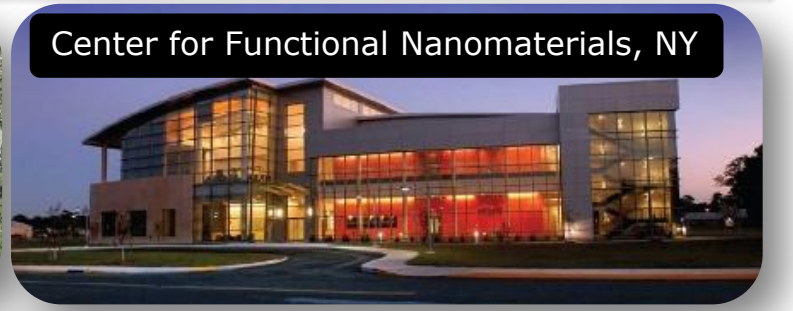
DOE's Office of Basic Energy Sciences Focuses on Understanding Matter and Energy at Electronic, Atomic, and Molecular Levels

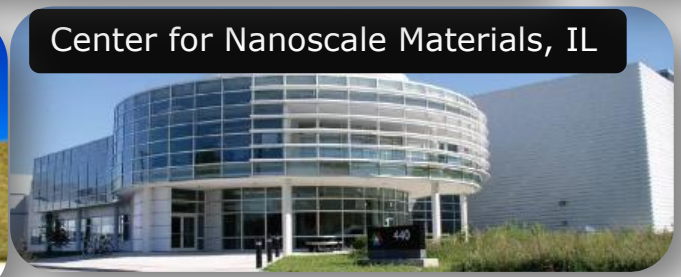
BES fulfills its mission through:

- Supporting **basic research** to discover new materials and design new chemical processes that underpin a broad range of energy technologies
  - Critical role in clean energy research
  - Supports foundational grand challenge and use-inspired science
- Expanding research in **underrepresented communities**
  - DOE Established Program to Stimulate Competitive Research (EPSCoR), Reaching a New Energy Sciences Workforce (RENEW), & Funding for Accelerated, Inclusive Research (FAIR)
- Operating **world-class scientific user facilities** in x-ray, neutron, and electron beam scattering as well as in nanoscale research
- Managing **construction and upgrade projects** to maintain **world-leading** scientific user facilities



BES User Facilities: Synchrotron/FEL X-ray, Neutrons, and Nanoscale Science, Complementary Instrumentation for Research





SSRL – First Impressions....

- 1996-97 Birgeneau-Shen BES Advisory Committee Assessment
  - "SSRL was the first storage-ring based source for x-ray science in the Nation, developed the first wiggler insertion devices for x-ray science on storage rings, and developed the first undulators which have become the basis for third generation synchrotron radiation sources throughout the world."
  - "Graduate education has been an integral part of SSRL's program since the Laboratory's beginning." "SSRL has paid enormous attention to the education of graduate students. Students trained here have taken leadership roles at national labs, industry and academia."
  - Impressions:
    - Busy experimental floor... Materials, physics, chemistry, and biology…..
    - Users were able to easily push the boundaries for new experiments and were engaged with the leadership of the facility....
    - Place to learn, collaborate, start new science directions….

History --BES Provided Support for SSRL beginning in ~1984

- First support was from NSF "Stanford Synchrotron Radiation Project"
- 1984 funding from DOE was $700K, growing to $1.1M in 1985 (Art Bienenstock was the Director of SSRL and the lead PI)

Ground Breaking for the 1977 SSRL Expansion Program
(L to R) S. Doniach, R. Gould, W. Spicer, S. Hagström, W. Oosterhuis, A. Bienenstock, A. Sessler, W. Miller, H. Winick, W.K.H. Panofsky, S. Stamp and G. Pimentel

At the time of the 1st Protein X-ray Crystallography Experiments on Beam Line 1-4 at SSRL
M. Bernheim, K. Hodgson, A. Wlodawer, J. Phillips

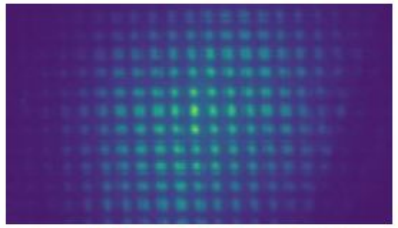
SSRL User Community has more than doubled since FY 2000!


Stanford Synchrotron Radiation Lightsource, CA

SSRL Today – Science Across the Breadth of National Priorities

Leading-edge multi-disciplinary science with wide ranging applications.
Partnership with LCLS!

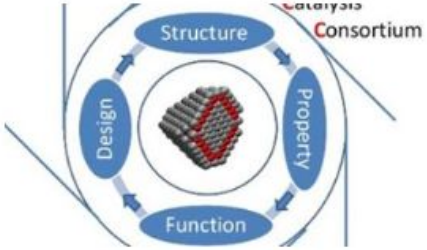
Advanced Instrumentation



New X-Ray Camera Achieves New Heights of Precision and Accuracy for Better Experiments

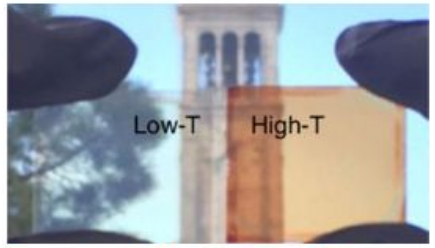
An X-ray image taken with a novel X-ray wavefront imager results in high precision measurements of intensity and direction of the X-ray beam.

Energy!



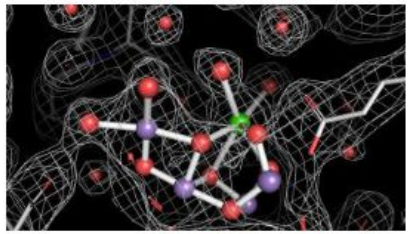
Improving Catalysis Science with Synchrotrons

The Synchrotron Catalysis Consortium (SCC) celebrates 10 years of helping scientists.



Powering Up With a Smart Window

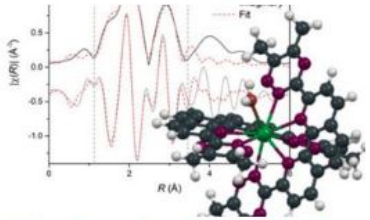
Window material repeatedly switches from being see-through to blocking the heat and converting sunlight into electricity.



Atomic Snapshots of Photosynthesis

Scientists catch details with atomic resolution, potentially helping design systems to use sunlight and water to produce fuels.

Heavy Element Science

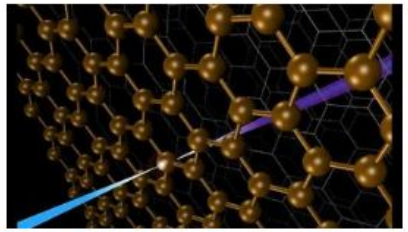


It's Not Part of the Problem, but Part of the Solution

Americium(III) is selectively and efficiently separated from europium(III) by an extractant in an ionic liquid.

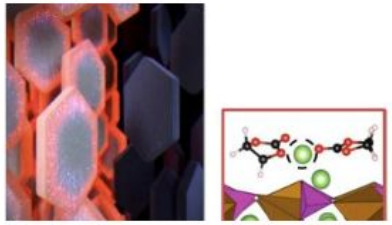
Advancing Understanding of Heavy Elements at the Edge of the Periodic Table

State-of-the-art techniques expand scientists' fundamental understanding of heavy element 99, Einsteinium.



New Probe for the Secrets of Complex Interfaces

Element-selective method reveals interfacial properties of materials used for water purification, catalysis, energy conversion, and more.



End-run Spreads Lithium Throughout Battery Electrodes

A new path is identified to keep lithium in its place during battery discharge, benefitting efforts to design better energy storage options.

Fitting a Square Peg in a Round Hole: The Surprising Structure of Uranium Bound in Hematite

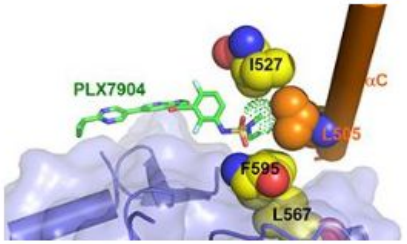
An atomic view of how toxic uranium binds to iron minerals in the environment enables better predictions of its behavior.

~17,380 Publications since 1974, 24% in high-impact journals

SSRL Today – Science Across the Breadth of National Priorities

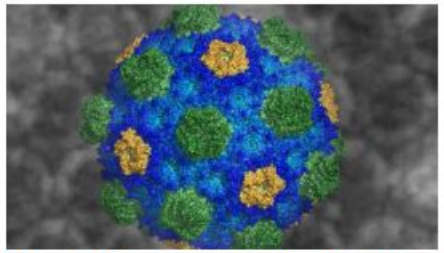
- Contributing to the understanding of COVD-19 and development of vaccines

Biological and Biomedical Sciences



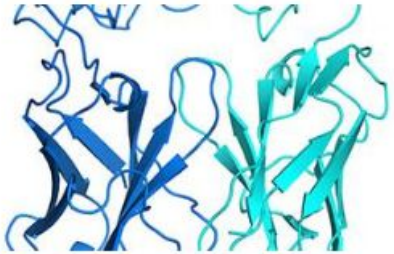
Translating Basic Biological Research to Cancer Drug Discovery

Discovery of promising next-generation inhibitors for metastatic melanoma treatment done with help from x-ray crystallography.



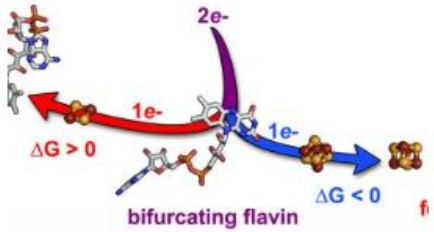
Researchers Decipher the Structure of a Bacterial Microcompartment

Understanding assembly principles may inspire new approaches for making valuable products.



On Track towards a Zika Virus Vaccine

Antibody's molecular structure reveals how it recognizes the virus.



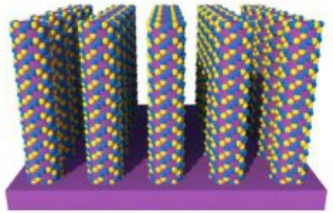
Flavins Perform Electron Magic

Researchers discover the secret behind the third way living organisms extract energy from their environment.

Semiconductors, Superconductors,….

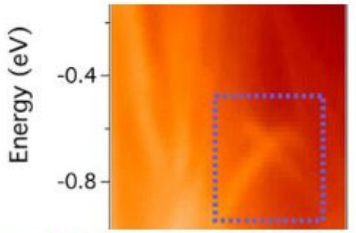
The Building Blocks for Exploring New Exotic States of Matter

Combining synthesis, characterization, and theory confirmed the exotic properties and structure of a new intrinsic ferromagnetic topological material.



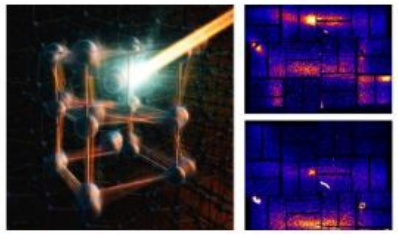
Decorating Semiconductors at the Atomic Scale

Crystals grown from layers of atoms arrange themselves on semiconductor surfaces to add new capabilities.



Spin-Polarized Surface States in Superconductors

Novel spin-polarized surface states may guide the se for materials that host Majorana fermions, unusual particles that act as their own antimatter, and could revolutionize quantum computers.



Excited Atoms Rush Independently to New Positions

Ultrafast X-rays track how associated pairs of atoms find new locations when triggered by light.

~17,380 Publications since 1974, 24% in high-impact journals

Launch of the BES User Facility Science Webinar Series To Celebrate and Communicate User Facility Impact

A BES public webinar series to enhance communication on BES User Facility science, highlighting contributions to national scientific priorities of Clean Energy, Microelectronics, Advanced Manufacturing, and Biopreparedness

Kickoff Event: Friday, January 27, 2023

Dr. Asmeret Asefaw Berhe
Director, Office of Science
Welcome Remarks

Prof. Sossina Haile
Northwestern University
Materials for batteries and hydrogen

Prof. Leora Dresselhaus-Marais
Stanford University
Low-emissions steel, additive manufacturing

Dr. Yong Chu
Brookhaven National Lab, NSLS-II
Nanoscale imaging in Microelectronics

Dr. Andrey Kovalevsky
Oak Ridge National Lab
Antiviral compounds for COVID-19

Future Topics for User Facility Webinars

- World QIS Day – April 14 included highlights of Z-X Shen's Research at the SSRL
- Microelectronics – Capabilities for advanced lithography, 2D and 3D imaging, and characterization of circuits *in situ* and *operando*
- Clean Energy – Facility research for energy storage, photovoltaics, biofuels, and carbon capture
- Bio-preparedness – structural biology for vaccines and therapeutics, materials for bio protection and sensing
- Advanced Manufacturing – *in situ* and *operando* understanding of 3D printing and alternate low-carbon steel processes

Look ahead and Questions?

- Light source facility construction reaching critical stages…
  - Dark time for construction of the upgraded ring at the APS
  - Completion of the LCLS II upgrades
- Continued evaluation of impacts of post-COVID inflation, supply chain, and other issues on facility operations budget needs and staffing (hybrid user operations)
- Workshop on Basic Research Needs for Accelerator-Based Instrumentation: Will explore the frontiers of instrumentation for large-scale scattering user facilities, focusing on needs and opportunities for research on future system components
- Looking forward to continued high impact, innovative research at the SSRL!