

National Synchrotron Light Source



Accessing BNL User Facilities -- Ron Pindak, *NSLS*

Center for Functional Nanomaterials



VUV Storage Ring:

51 m circumference

$E = 0.808 \text{ GeV}$

$I = 1.0 \text{ A}$

7 bunches

Orbital Period = 170 ns

Pulse Width = 320 ps

X-Ray Storage Ring:

170 m circumference

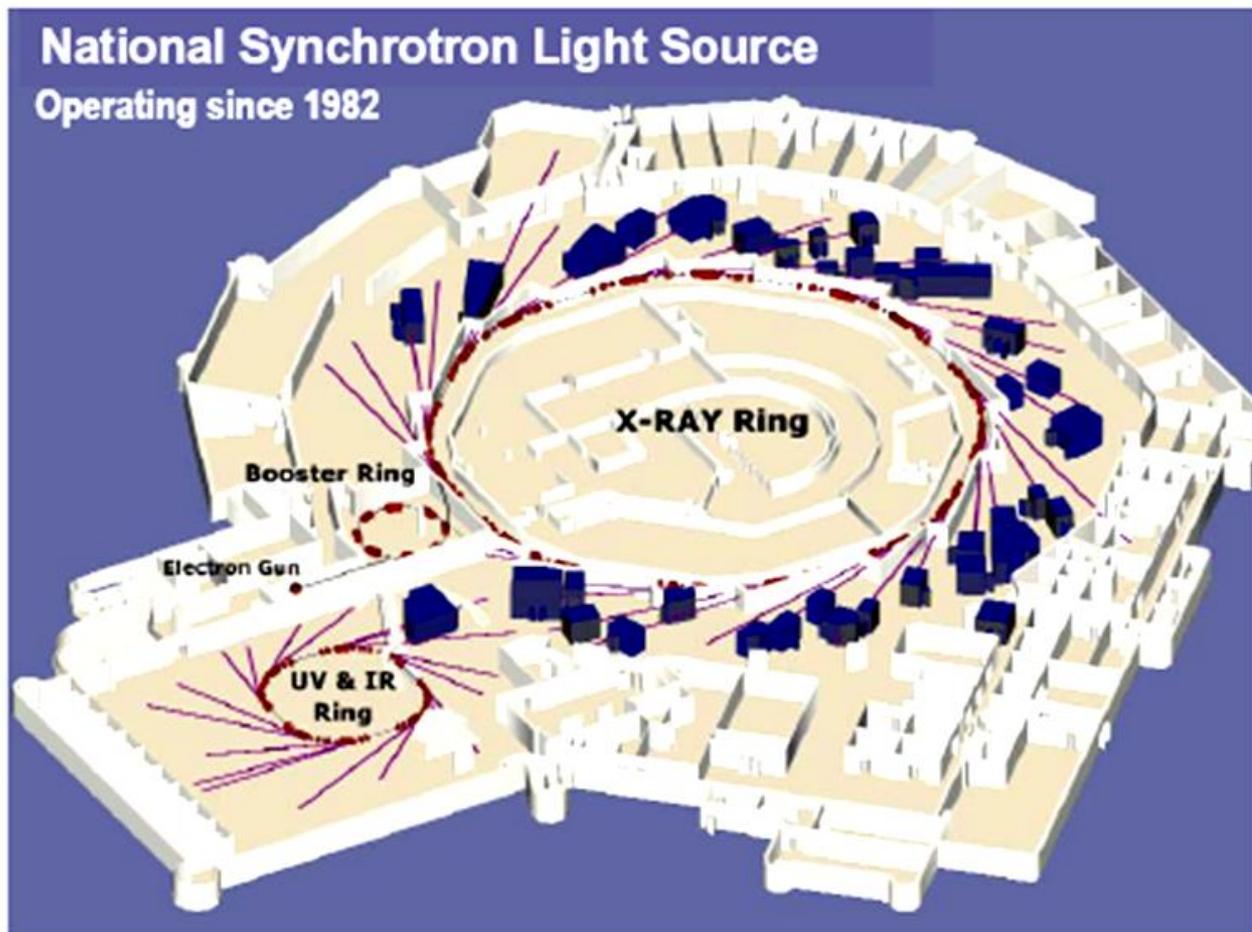
$E = 2.8 \text{ GeV}$

$I = 280 \text{ mA}$

25 bunches

Orbital Period = 567 ns

Pulse Width = 290 ps



- Facility operates 24 hours/day, 7 days/week, ~10 months/year
- 65 operational beamlines available (>2100 users per year, ~1/3 are new users).
- ~ 60% of the beam time is available to users at no cost via peer-reviewed proposals.

Useful Web Sites

- Background information on synchrotron techniques as well as descriptions of capabilities, workshops, courses from synchrotron facilities worldwide:

<http://www.lightsources.org/>

- Information specifically about the NSLS

<http://www.nsls.bnl.gov/>

- [NSLS staff web pages](http://www.nsls.bnl.gov/organization/) – <http://www.nsls.bnl.gov/organization/>
- NSLS science highlights – <http://www.nsls.bnl.gov/newsroom/science/>
- NSLS user access – <http://www.nsls.bnl.gov/access/>
- NSLS beamline descriptions – <http://www.nsls.bnl.gov/beamlines/>

- Information specifically about the CFN

<http://www.bnl.gov/cfn/>

- [CFN staff web pages](http://www.bnl.gov/cfn/research/) – <http://www.bnl.gov/cfn/research/>
- CFN facilities – <http://www.bnl.gov/cfn/facilities/>

NSLS Physical & Chemical Sciences Division

Division Head



Ron Pindak, Physicist
Soft Condensed Matter Systems & Interfaces
X-Ray Diffraction, Resonant & Surface XRD



Dario Arena, Physicist
Magnetism & Dynamics of Thin Films
Soft X-Ray Spectroscopy & Scatt, Time-Resolved



Larry Carr, Physicist
Dynamics of Metals, Superconductors, Semiconductors
Tz, IR spectroscopies, Magnetospect, Time-Resolved



Lars Ehm, Mineralogist
Materials at Extreme Conditions
X-Ray Powder Diff, X-Ray Total Scatt.



Christie Nelson, Physicist
Strongly Correlated Electron & Mag. Systems
X-Ray Diffraction & Resonant XRD



Cecilia Sanchez-Hanke, Physicist
Magnetic Thin Films & Devices
Soft X-Ray Spectroscopy & Scattering



Elio Vescovo, Physicist
Magnetic Surfaces, Interfaces and Multilayers
Angular- and Spin-resolved Photoemission



Syed Khalid, Physical Chemist (Sci. Assoc.)
Catalytic Systems
XAS, XANES, XRD, Q-EXAFS

NSLS Life & Environmental Sciences Division

Division Head



Lisa Miller

Biophysical Chemist
Beamline U10B
IR, XRF spectr. & imaging



Marc Allaire

Biochemist
Beamline X6A
MX



Elaine DiMasi

Physicist
Beamline X6B
X-ray scattering



Vivian Stojanoff

Physicist
Beamline X6A
x-ray scattering, MX



Lin Yang

Biophysicist
Beamline X21
X-ray scattering

NSLS Experimental Systems Division

Lonny Berman



Pete Siddons



Zhong Zhong



Ken Evans-Lutterodt



Steve Ehrlich



Joe Dvorak



Jun Wang



Experimental Systems
Hulbert (Div Head)

Beamline R&D
Berman

Carr[†], Dvorak, Ehrlich,
Evans-Lutterodt,
Nelson[†], J.Wang, Zhong

Science Assoc.
Dong, LaMarra[†]

Postdocs
Connor, Isakovic

Detectors
Siddons

Carini, Feng-Berman,
Kuczewski, Michta

Postdoc
Rumaiz

Gabriella Carini



Center for Functional Nanomaterials (CFN)

Soft & Biological Materials

Oleg Gang, **Group Leader**
Biomimetic systems



William Sherman, Physicist
DNA nanostructures



Mircea Cotlet, Phys. Chemist
Energy & electron transfer



D. Nykypanchuk, Polymer Sci.
Self-assembly of soft matter



Electronic Materials

Chuck Black, **Group Leader**
Nanostructured photovoltaics



John Warren, Materials Sci.
Nanofabrication



Aaron Stein, Physicist
Nanofabrication



Weiqiang Han, Mat.Sci.
Synthesis nanomaterials



Center for Functional Nanomaterials (CFN)

Interface Science & Catalysis

Peter Sutter, **Group Leader**

Interfacial nanoscience / catalysis



Jerek Sadowski, Physicist

XPEEM / LEEM surf. analysis



David Starr, Physicist

Nanocatalysts



Percy Zahl, Physicist

Surface science



Electron Microscopy

Yimei Zhu **Group Leader**

EM Structure of adv. materials



Eli Sutter, Physicist

EM of nanostructures



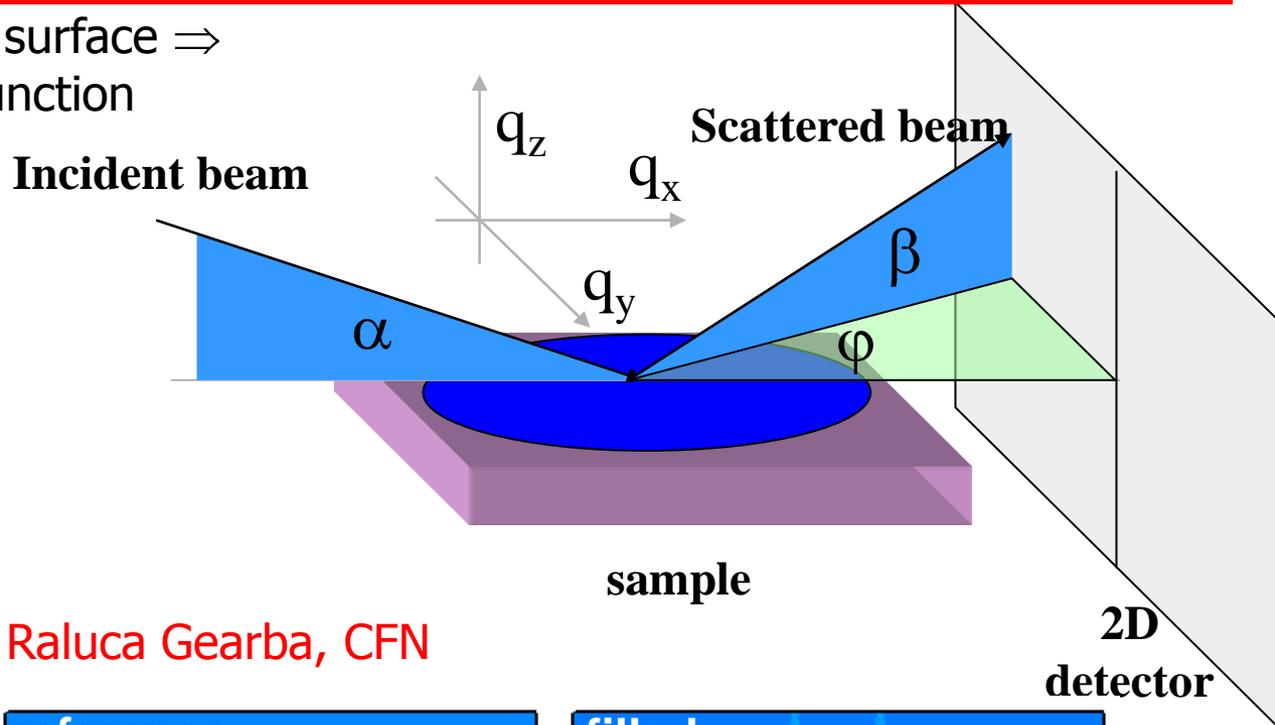
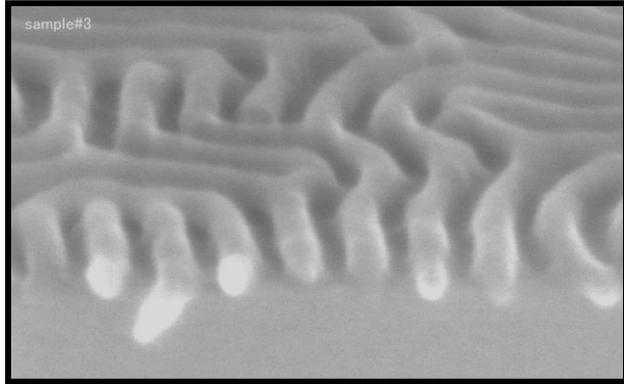
Lihua Zhang, Mat Sci.

In-situ TEM of nanostructures



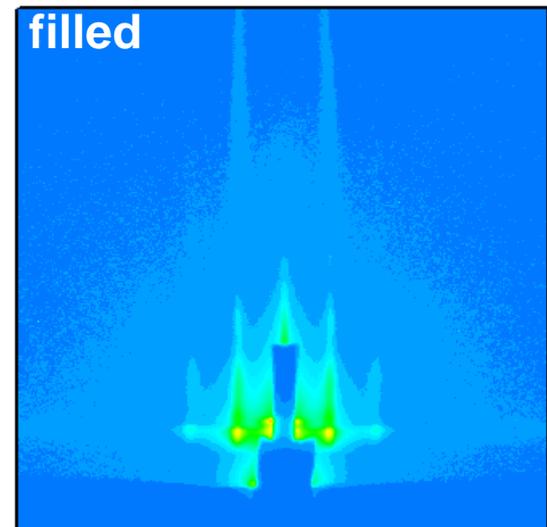
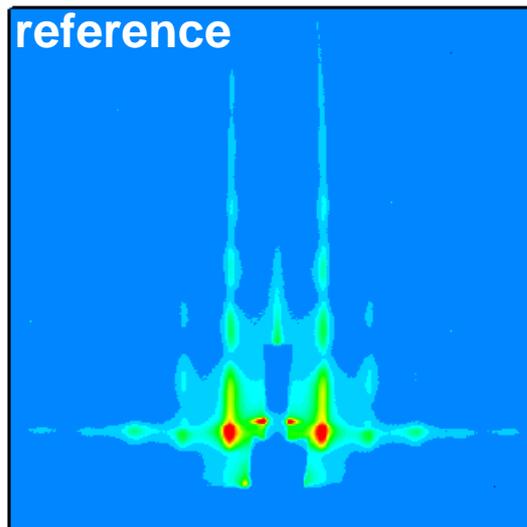
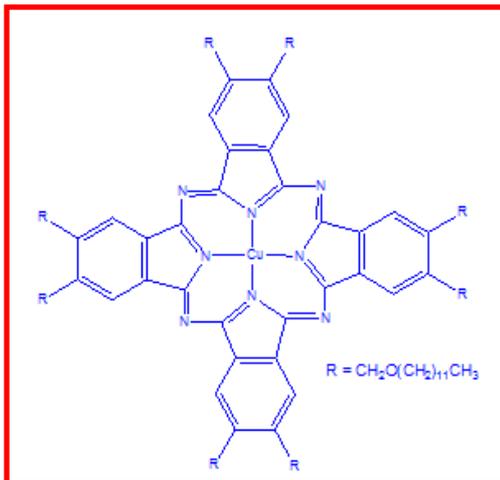
Grazing Incidence Diffraction (GID)

Diblock copolymer patterned surface \Rightarrow
oriented bulk PV heterojunction



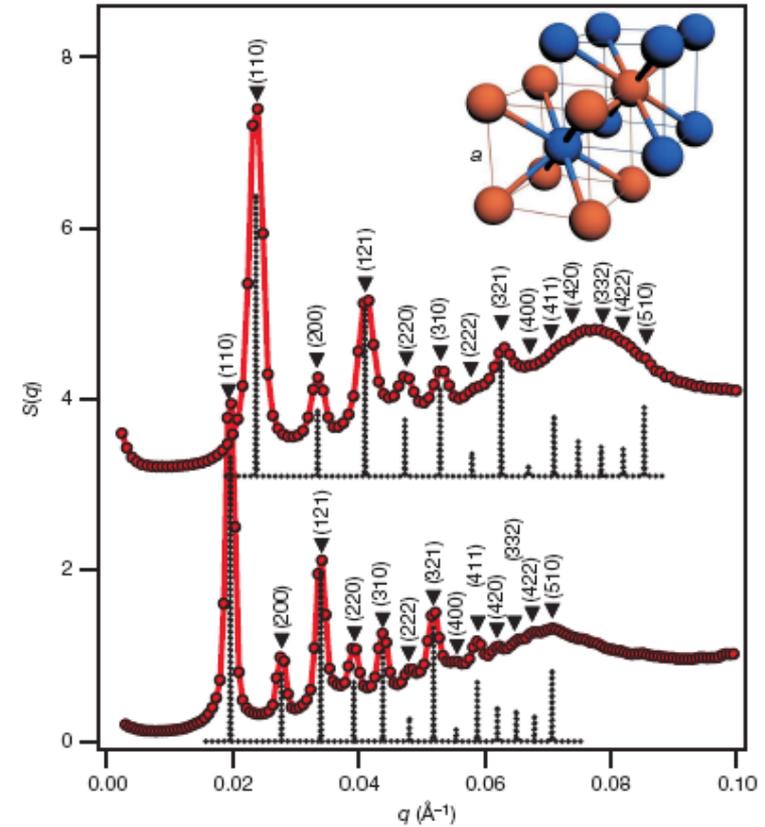
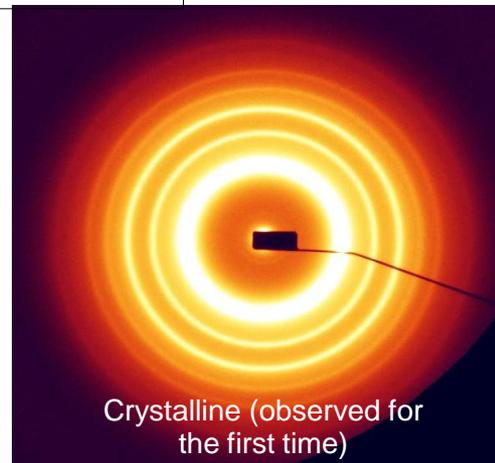
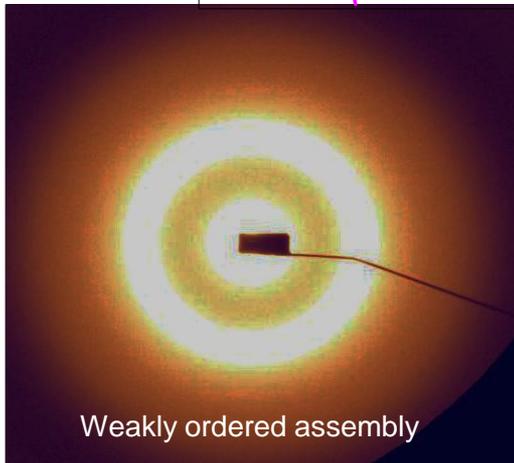
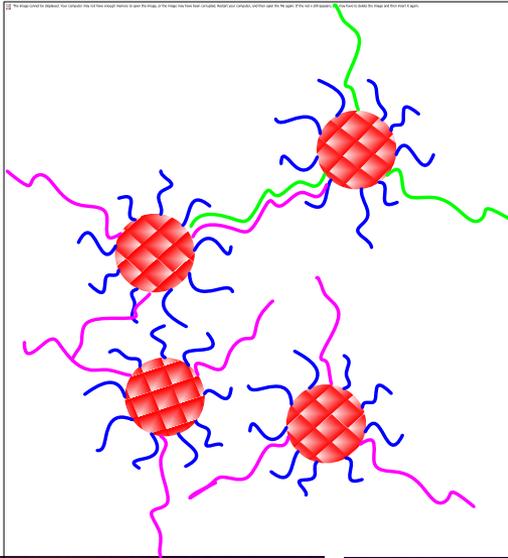
Filling material-
CuPc derivative

Raluca Gearba, CFN



DNA-Guided Crystallization of Colloidal Nanoparticles

DNA hybridization is used to direct assembly



D. Nykypanchuk, M. Maye, D. van der Lelie, O. Gang, *Nature* **451**, 549 (2008)

Planar Refractive Lenses for Focusing X-Rays

Beamlines: X13B, X17B1, APS 8ID

NSLS Development: Kinoform type planar refractive lenses for focusing hard x-rays

Developer: Ken Evans-Lutterodt et al.

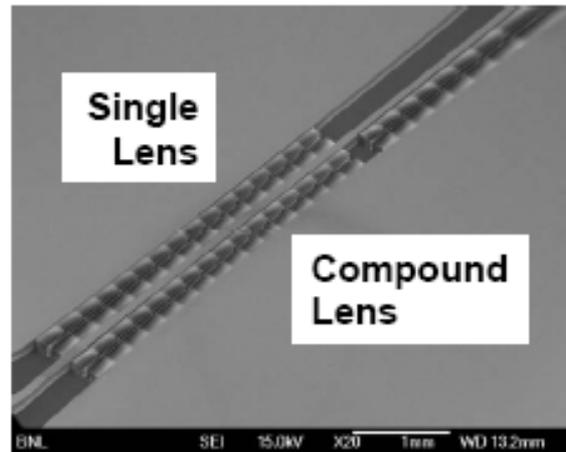
Publication: PRL 99, 134801 (2007), "Using Compound Kinoform Hard-X-Ray Lenses to Exceed the Critical Angle Limit", K. Evans-Lutterodt, A. Stein, J. M. Ablett, N. Bozovic, A. Taylor and D. M. Tennant

Significance: Kinoform x-ray lenses are one of the leading contenders for next generation x-ray focusing optics. The achievable spot size is not directly limited by the smallest physical feature size of the lens. Kinoform lenses can readily be stacked to achieve smaller spot size (compound lens), and crossed to achieve 2-dimensional focusing.

Instead of solid refractive optic:



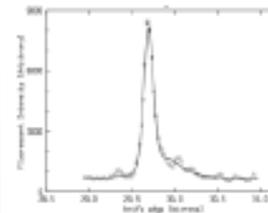
Use a kinoform:



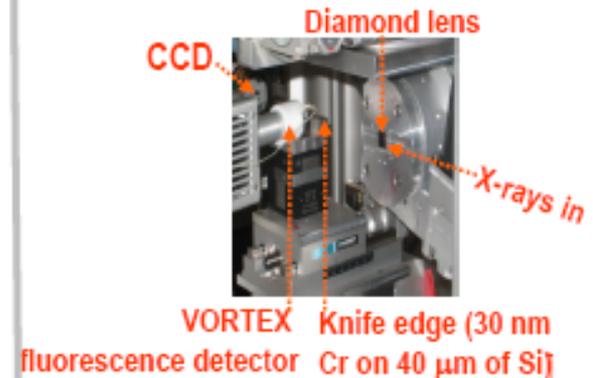
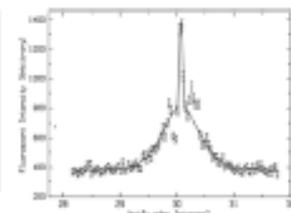
Work done at NSLS to demonstrate capability

Work done at APS to optimize performance

Single lens, $\sigma = 56$ nm



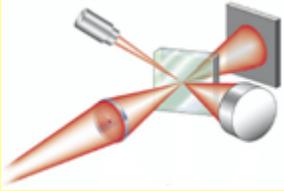
Compound lens, $\sigma = 25$ nm



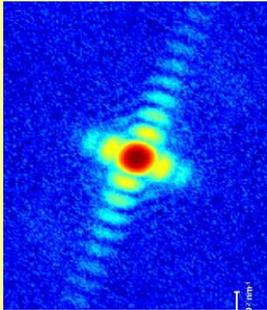
NSLS-II

The Future National Synchrotron Light Source

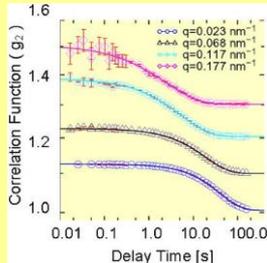
New Capabilities



Nanoprobes



Diffraction Imaging



Coherent Dynamics



Ultra-Bright Medium Energy Storage Ring

Medium Energy (3 GeV)

Large Current (500 mA)

792 m in Circumference (**>4x present NSLS x-ray ring**)

Brightness $\sim 10^{21}$ ph/s/0.1%/mm²/mrad² (**> 10⁴ x present NSLS**)

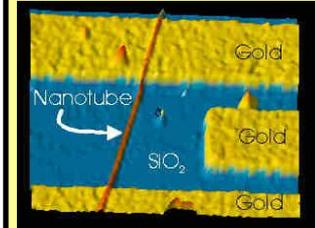
Flux $\sim 10^{16}$ ph/s/0.1% (**>20x present NSLS**)

>28 Insertion Devices (**>3x number of IDs at the present NSLS**)

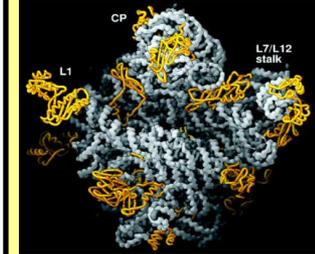
10 psec pulses (**30x shorter than present NSLS**)

Scheduled to begin operations in 2015

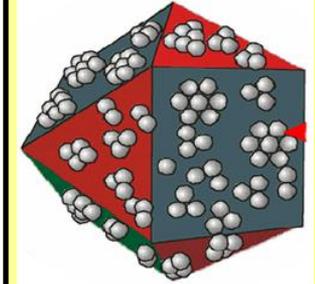
New Science



Nanoscience



Life Science



Nanocatalysis

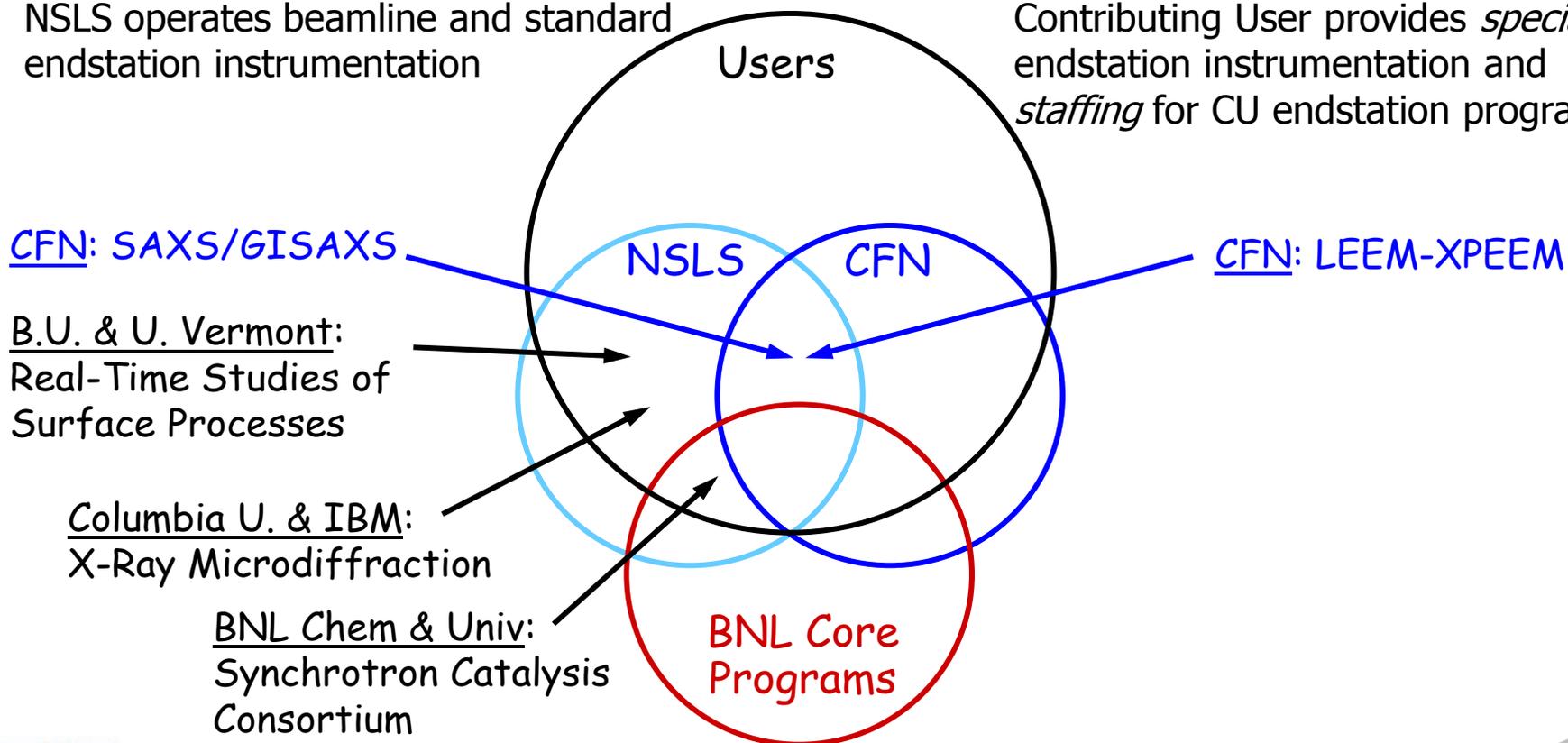
Laying a Foundation for the Transition to NSLS-II

World-Class Contributing User Programs have the potential to transition to NSLS-II

Contributing User Programs are the mechanism for coordinated research programs between the NSLS and other BNL Facilities (CFN), BNL Core Departments, and University and Industrial Users

NSLS operates beamline and standard endstation instrumentation

Contributing User provides *specialized* endstation instrumentation and *staffing* for CU endstation programs.



CFN: SAXS/GISAXS

B.U. & U. Vermont:
Real-Time Studies of
Surface Processes

Columbia U. & IBM:
X-Ray Microdiffraction

BNL Chem & Univ:
Synchrotron Catalysis
Consortium

CFN: LEEM-XPEEM

Diagnostic & Instrumentation (D&I) Beamlines

- Beamlines, which have been instrumented but because of inadequate staffing are no longer operated for general users, are being made available to Methods & Instrumentation Development Teams (MIDTs).
- MIDTs include experienced synchrotron users so require minimal NSLS staff support.
- MIDTs submit proposals for beam time for the development of beamline and endstation components/systems, including the development of new techniques, destined for transfer to NSLS-II beamlines.
- Provides researchers with the large blocks of beam time often required to develop new instrumentation or techniques.

Acknowledgements

- BNL Workshop Administration: Gretchen Cisco (lead), Mercy Baez, Corinne Messana, Kathy Nasta
- NSLS Tour Guides: Joe Dvorak, Cecilia Sanchez-Hanke, Larry Carr, Christie Nelson, Elio Vescovo, Dario Arena.
- NSLS Beamline Program Descriptions: Lin Yang, Vivian Stojanoff, Jean Jakoncic, Lars Ehm, Jaye Chernob, Daniel Fischer.
- CFN Tour Guides: Aaron Stein, Fernando Camino, Bill Sherman, Ming Lu.
- RHIC Tour Guides: Todd Satogata, Bill Christie, Debra Pettit.