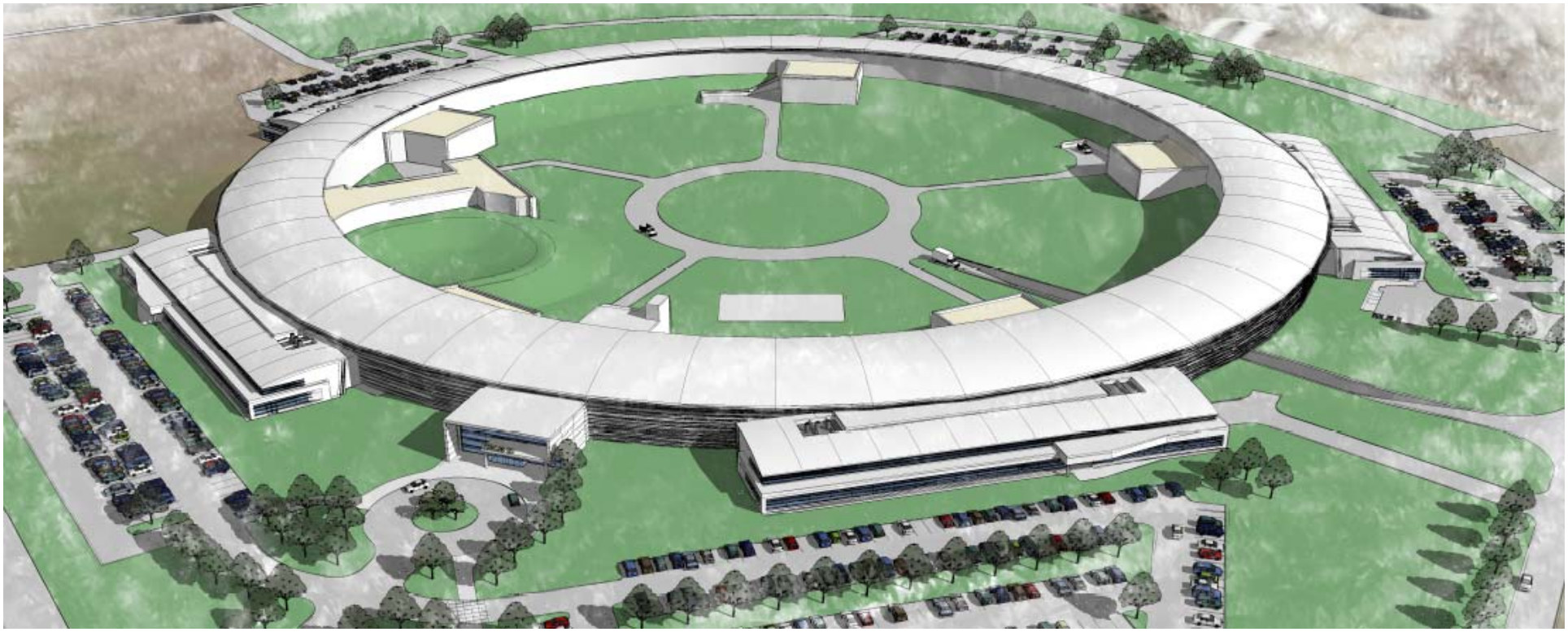
NSLS-II Update



Steve Dierker
Associate Laboratory Director for Light Sources
NSLS-II Project Director
NSLS/CFN Users Meeting
May 20, 2008

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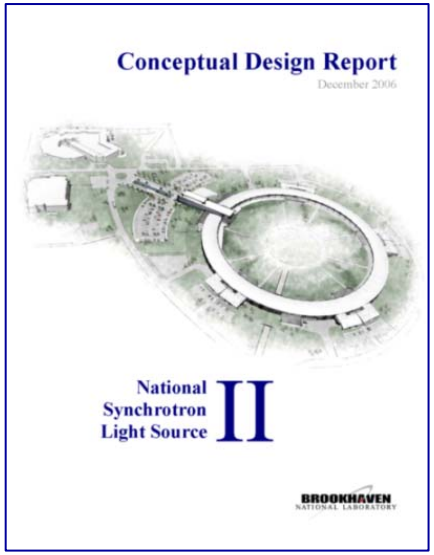
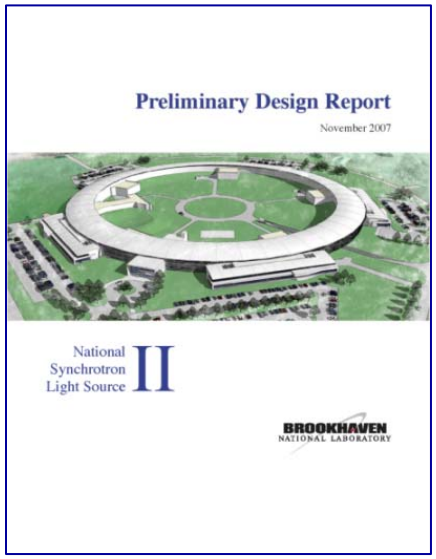
Key Project Milestones

Aug 2005	CD-0, Approve Mission Need	(Complete)
Jul 2007	CD-1, Approve Alternative Selection and Cost Range	(Complete)
Jan 2008	CD-2, Approve Performance Baseline (Defines scope, costs, and schedule)	(Complete)
Dec 2008	CD-3, Approve Start of Construction	
Feb 2009	Contract Award for Ring Building	
Feb 2012	Beneficial Occupancy of Experimental Floor	
Oct 2013	Start Accelerator Commissioning	
Jun 2014	Early Project Completion; Ring Available to Beamlines	
Jun 2015	CD-4, Approve Start of Operations	





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Project Scope

Accelerator Systems

- Storage Ring (~ ½ mile in circumference)
- Linac and Booster Injection System

Conventional Facilities

- Ring Building w/ Operations Center and service buildings
- Laboratory/Office Buildings (LOBs) to house beamline staff & users
- Reuse of existing NSLS office/lab space for NSLS-II staff

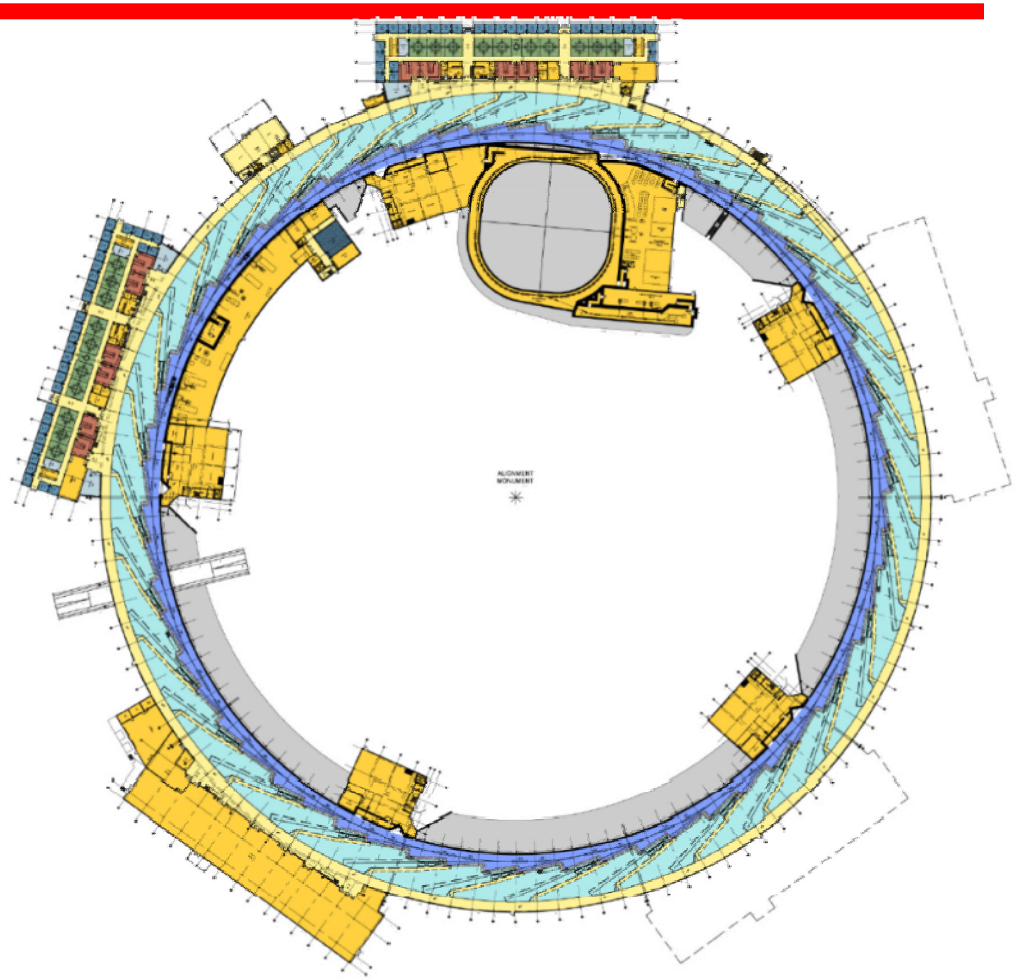
Experimental Facilities

- Initial suite of 6 insertion device beamlines and instruments
- Capable of hosting at least 58 beamlines

R&D

- Advanced optics for achieving 1 nm and 0.1 meV
- Nanopositioning and mirror metrology
- Advanced insertion devices

NSLS-II Design Features



Design Parameters

- 3 GeV, 500 mA, top-off injection
- Circumference 791.5 m
- 30 cell, Double Bend Achromat
  - 15 long straights (9.3 m)
  - 15 short straights (6.6 m)

Novel design features:

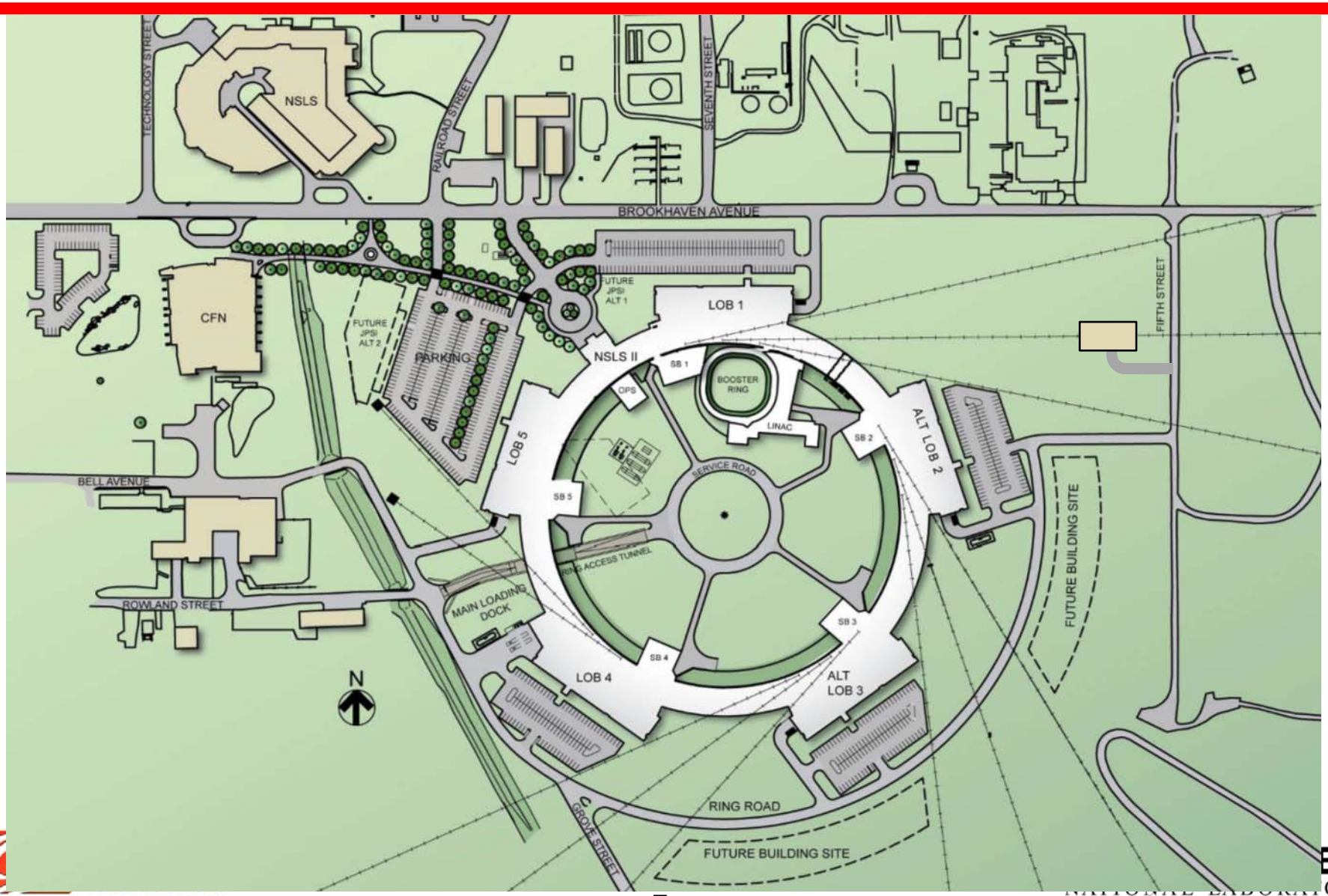
- Damping wigglers
- Soft bend magnets
- Three pole wigglers
- Large gap IR dipoles

Ultra-low emittance

- ε_x, ε_y = 0.6, 0.008 nm-rad
- Diffraction limited in vertical at 10 keV
- Small beam size: σ_y = 2.6 μm, σ_x = 28 μm, σ'_y = 3.2 μrad, σ'_x = 19 μrad

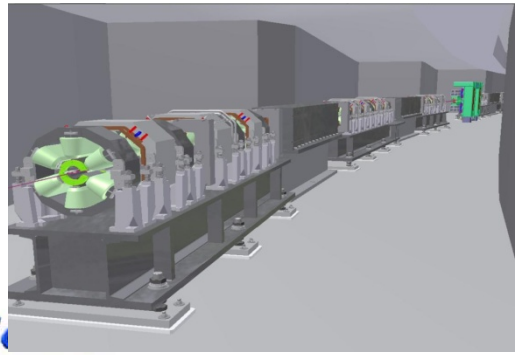
Pulse Length (rms) ~ 15 psec

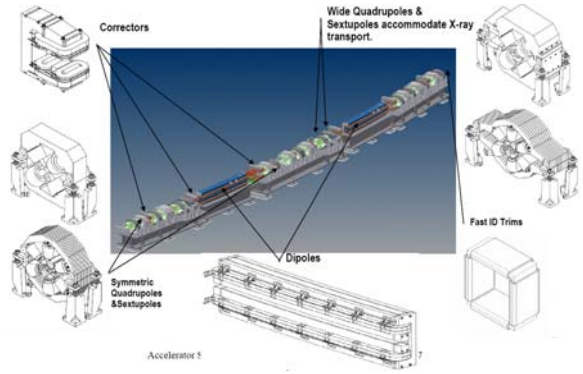
Site Plan


NSLS
TECHNOLOGY STREET
RAILROAD STREET
SEVENTH STREET
BROOKHAVEN AVENUE
FIFTH STREET
CFN
FUTURE JPSI ALT 2
PARKING
FUTURE JPSI ALT 1
LOB 1
NSLS II
SB 1
BOOSTER RING
OPS
LINAC
SB 2
ALT LOB 2
LOB 5
SB 5
SERVICE ROAD
BELL AVENUE
ROWLAND STREET
MAIN LOADING DOCK
RING ACCESS TUNNEL
SB 3
SB 4
LOB 4
ALT LOB 3
N
FUTURE BUILDING SITE
RING ROAD
GROVE STREET
FUTURE BUILDING SITE

Design Progress

- Working to finalize design required for start of construction
- Conventional facilities final design schedule is the most critical project activity and design decisions are made to keep this design work on schedule
- Accelerator systems design schedule ensures that interfaces with conventional facilities are adequately defined
- Beamline Access Team formation underway for project beamlines





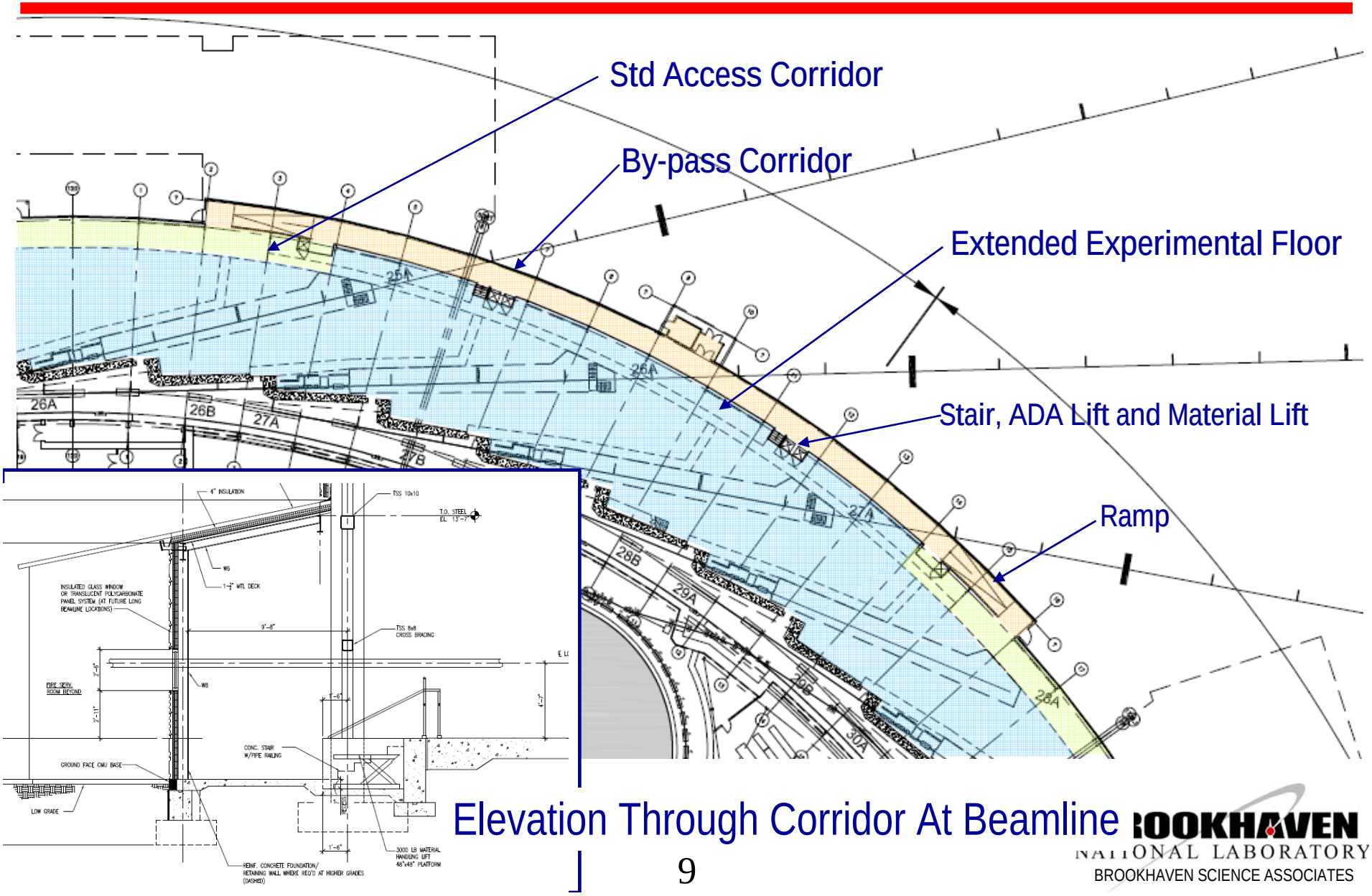
Recent Design Changes

- Beam height in tunnel increased from 1.0 m to 1.2 m to allow more room for insertion devices (beam height on floor still 1.4 m)
- Tunnel height increased from 2.75 m to 3.2 m to enhance radiation shielding and provide more room for tunnel HVAC ductwork
- Experimental Floor radial width (from ratchet wall to aisle) increased from 11.6 m to 14.6 m, increasing maximum beamline length from 60 m to 66 m and providing increased transverse experimental floor space
- Bypass corridor for long beamlines redesigned for easier access
- LOB final design deferred to FY10 in order to maximize flexibility in design
  - Doesn't delay construction of LOBs, which was always scheduled for FY11

Benefits of Ring Building Width Increase

- Canted beamlines and multiple endstations can fit on single straight without serious compromises
- Enables 1:1 focusing optics for undulator beamlines
- Accommodates complex endstations
- Avoids compromises on BM beamlines
- Provides sufficient space for users on experimental floor
- Responds to user feedback at workshops

Long Beamlines: Sunken Access Corridor



Elevation Through Corridor At Beamline

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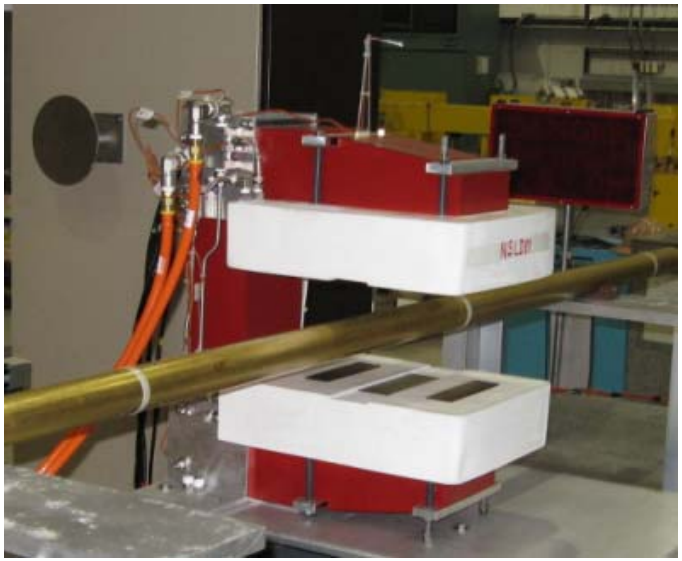
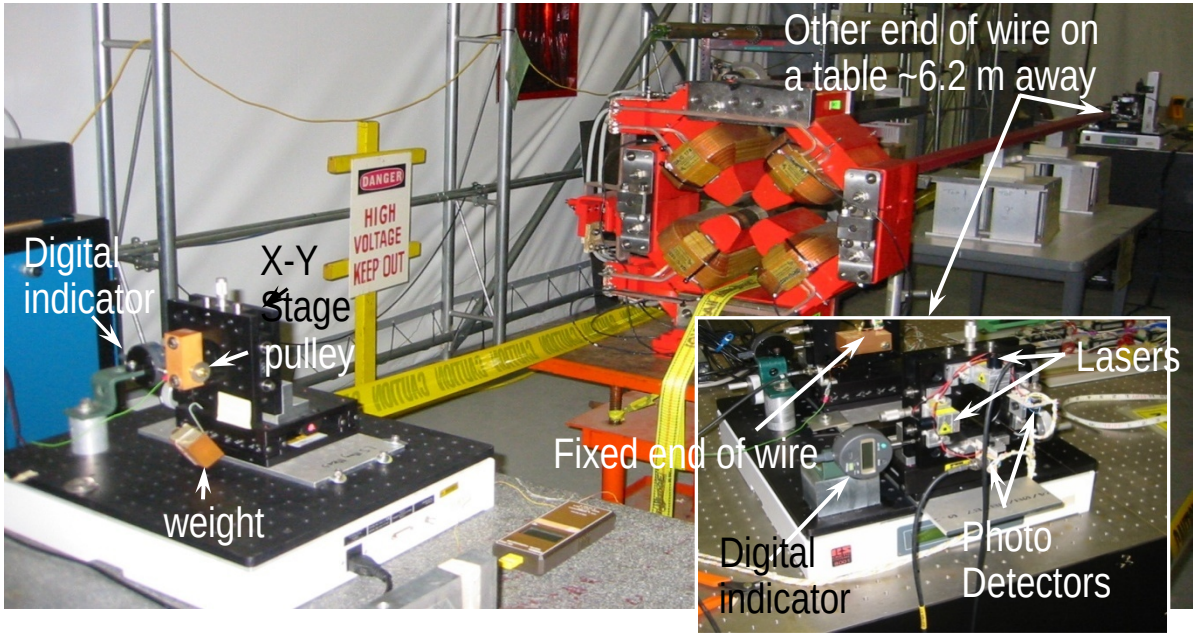
NSLS-II Magnet R&D



Prototype of a Multipurpose Corrector Magnet delivered in November'07



High precision magnet alignment procedure using a vibrating wire technique

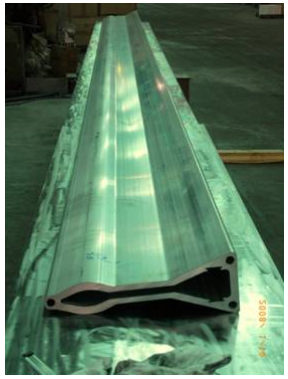
- Existence proof for 30 μm alignment tolerances achieved with this method at Cornell
- Magnet alignment precision of < 10 μm demonstrated recently by NSLS-II

NSLS-II Vacuum Chamber Test Extrusions

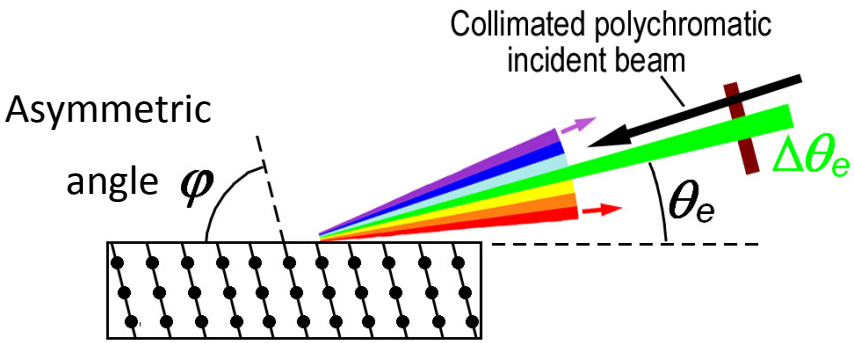
The set of extrusion dies for NSLS-II dipole chambers at Tai Lain

Test Extrusions made at Taber Comp., AR

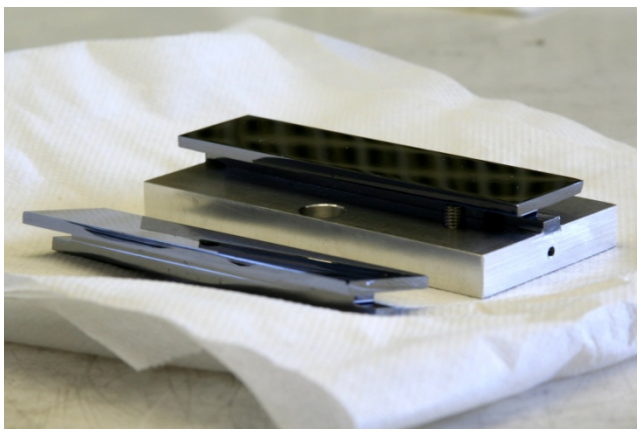
First test extrusions made in Taiwan met NSLS-II specs!



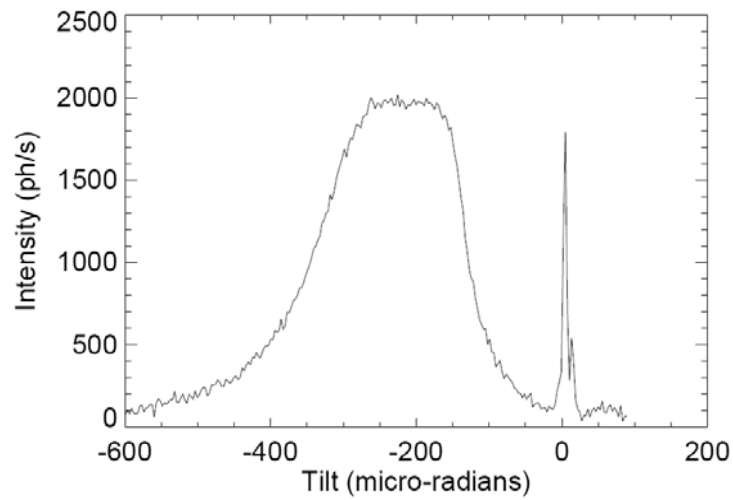
Recent results in 0.1 meV R&D



Principle is to use dispersion caused by asymmetric cuts in extreme backscattering as dispersive elements



First NSLS-II dispersive crystals



First results showing dispersive effects (reproducing Shvyd'ko's work)

Next: measure energy resolution (nominally 0.7 meV)

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Zhong, Huang, Cai, Coburn, Siddons, Cheung, …

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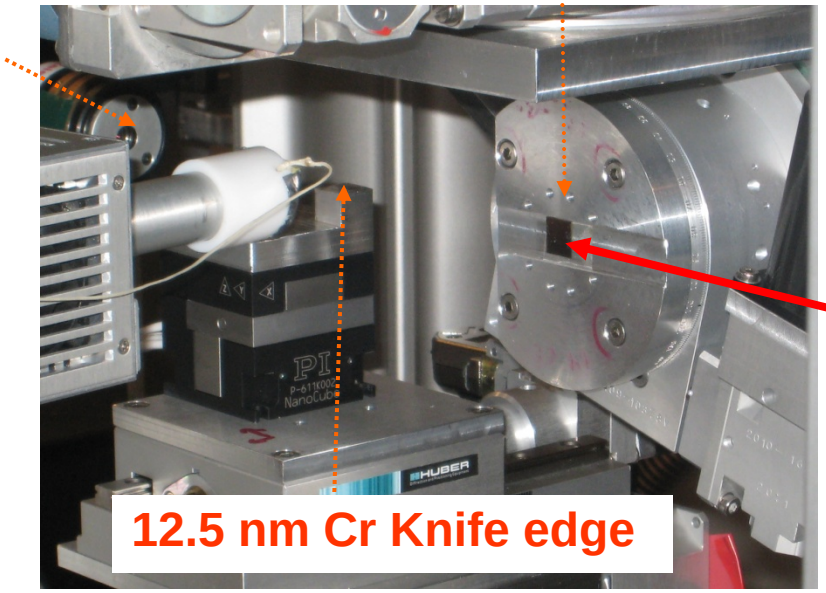
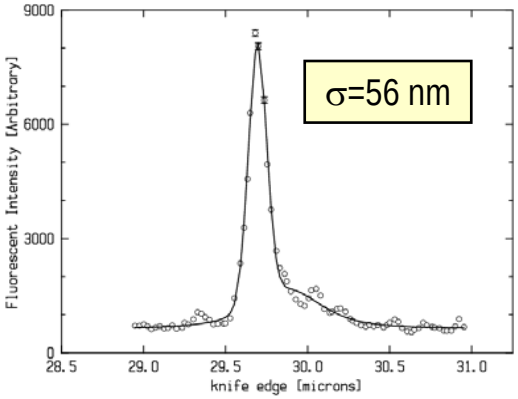
Recent Results in 1 nm R&D

NSLS-II Si lenses measured at 8-ID, APS

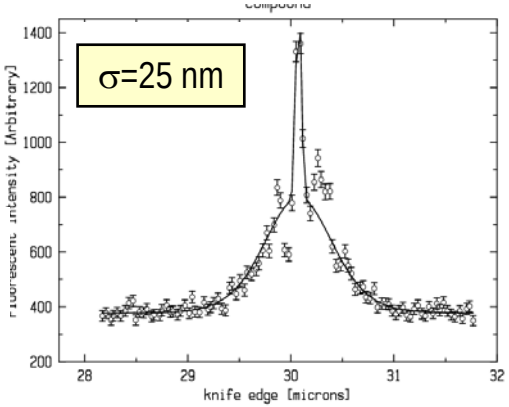


Single Lens



(82 nm at CD-2)

Compound Lens



300 μm aperture

Data from 2/20/08

Evans-Lutterodt, Stein, Isakovic, Warren (BNL: NSLS, NSLS-II, CFN, Instrum.)
Sandy, Narayan, Sprung (APS), Fetter (Lucent)

Next steps:
- Improve temperature control
- Improve vibrational stability
- Push higher resolution

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Phased Transition to Operations

Transitioning from NSLS to NSLS-II

- We are planning for this transition now
- Continue operations of NSLS until NSLS-II operational (CD-4)
- Begin moving NSLS programs to NSLS-II in FY12 (before CD-4)

Beneficial Occupancy of Experimental Floor (Feb 2012)

- Enables early operations funding from DOE
- Used to transfer selected NSLS beamlines to NSLS-II
  - Ensures significant capacity at start of operations
  - Primarily techniques with high demand, high productivity
  - Mainly occupy 3-pole wigglers and soft-bends
- Expect to transfer about 20 beamlines, accommodating > 1300 users/yr

Early Project Completion (June 2014) / CD-4 (June 2015)

- Start of Full Operations
- All commissioning goals have been achieved

NSLS-II Beamlines

19 straight sections for undulators

- Fifteen 6.6 m long low-β and four 9.3 m long high-β
- Highest brightness sources from UV to hard x-ray

8 straight sections for damping wigglers

- Each 9.3 m long high-β
- Broadband high flux sources from UV to hard x-ray

27 BM ports for IR, UV and Soft X-rays

- These can also have three pole wigglers for hard x-rays

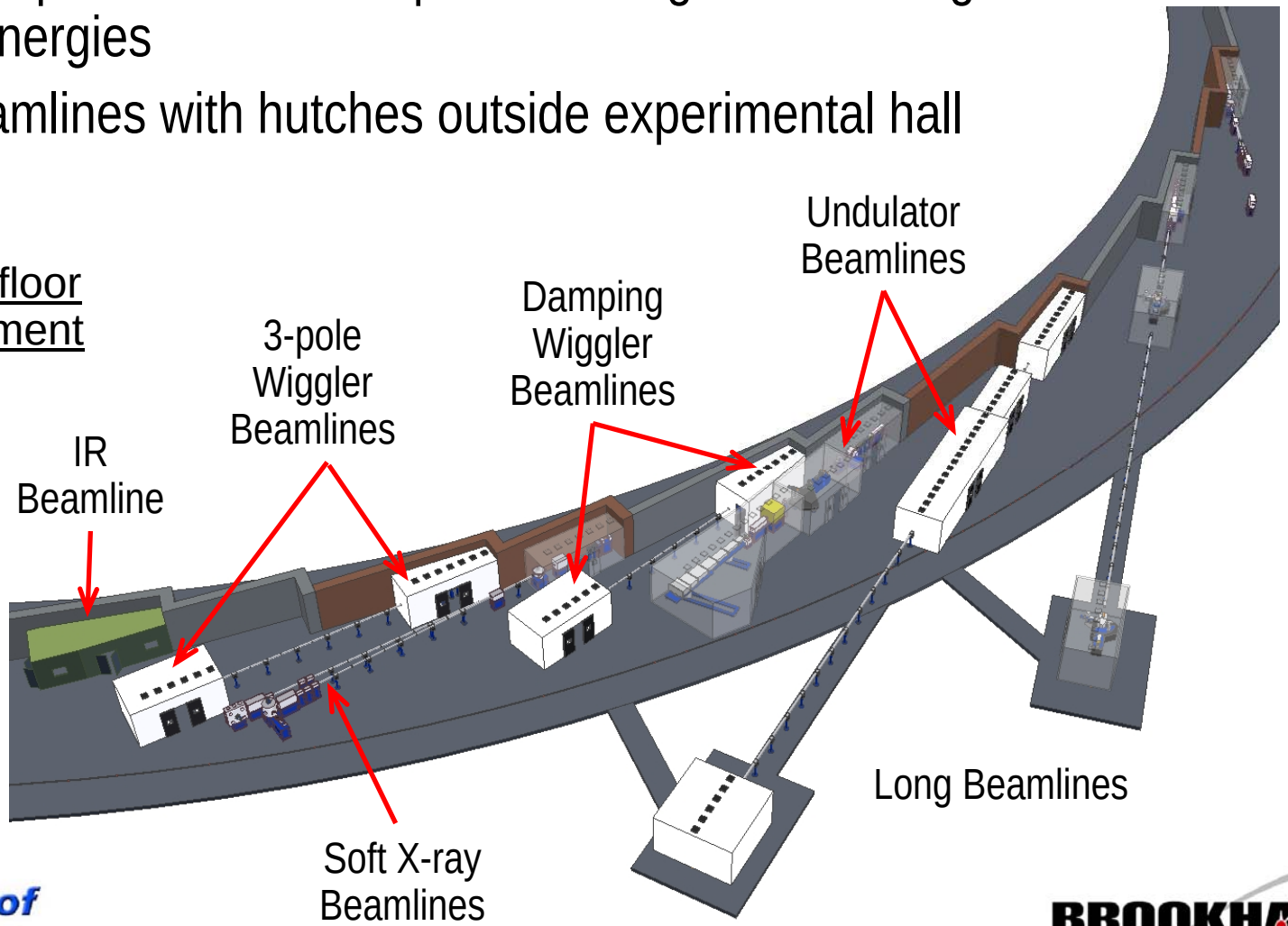
4 Large Gap BM ports for far-IR

At least 58 beamlines
More beamlines by canting multiple IDs per straight
Multiple end-stations/beamline are also possible

For comparison, NSLS has 65 operating beamlines

Experimental Floor

- Diverse experimental techniques covering a broad range of photon energies
- Long beamlines with hutches outside experimental hall



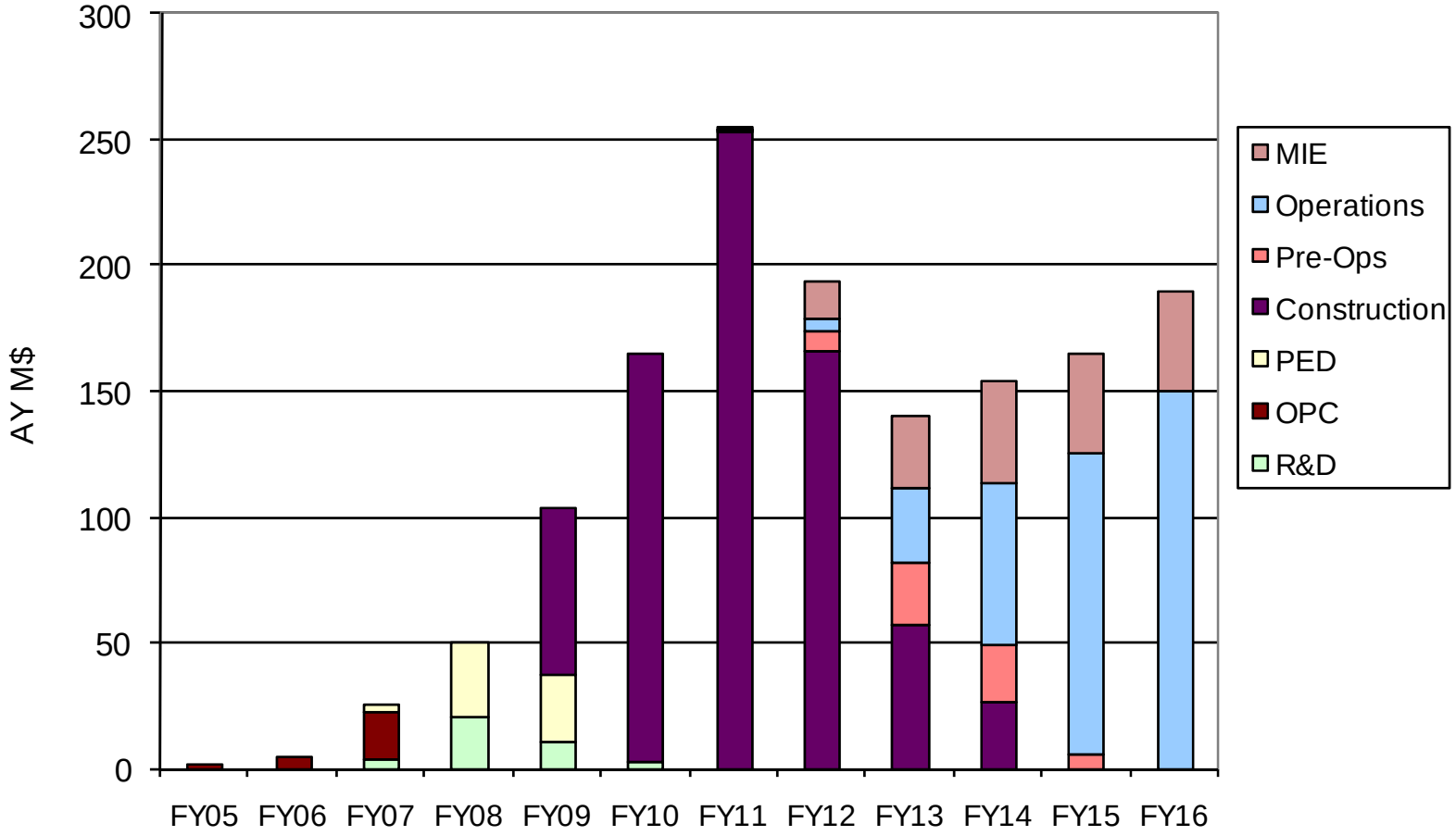
Beamline Acquisition Strategy

FUNDING	BEAMLINES
BES – Project	6 insertion device beamlines in base project scope
BES – Early Operations	~ 20 bending magnet beamlines transferred from NSLS to NSLS-II, using NSLS-II early operations funding
BES – MIE	~ 16 insertion device beamlines
Non-BES	Life Science beamlines and other non-BES missions

- 27 straight sections & 31 3PW/BM ports available – at least 58 beamlines

New Funding Profile with Operations & MIE

TPC = $912M TEC = $792M (including 30% contingency)



Note: Operations & MIE funding are not part of TPC

Guiding Philosophy for NSLS-II User Program

- NSLS-II has overall responsibility for operating all beamlines, ensuring that they are well integrated into the facility and with missions that are consistent with the overall strategic plan for the facility.
- The key to the delivery of outstanding science is rigorous peer review that is fair, clear, expedient and sensitive to the needs of users. The predominant mode of user access on all beamlines will be through peer-reviewed proposals, typically using the GU program of the facility.
- All beamlines will be well staffed (~ 6 FTEs) and resourced at a level appropriate with maintaining a high-level of technical and scientific quality.

Framework for NSLS-II User Program

- NSLS-II has the capacity for at least 58 beamlines that will meet the needs of a diverse, and vibrant, user community
- User policies needs to ensure that the facility is as scientifically productive as possible
- Beamline development at NSLS-II needs to ensure that the appropriate capabilities are present at the facility:
  - We need to develop, with the users, a coherent, facility-wide plan that is responsive to the needs of the various communities and reviewed by our advisory committees

NSLS-II User Workshop – July 17-18, 2007

More than 450 attendees from 130 different institutions

OSTP: John Marburger
DOE: Pat Dehmer (BES)
Pedro Montano (BES)
Susan Gregurick (BER)
NIH: Charles Edmonds (NIGMS)
Alan McLaughlin (NIBIB)
Michael Marron (NCRR)
Amy Swain (NCRR)
NSF: Guebre Tessema

Pat Dehmer announcing the award of CD-1

John Marburger addressing the audience

NSLS-II User Workshop

First Day Plenary Session

- Described conceptual design and status of project
- Highlight talks on physical and life sciences and user access models
- Described process for beamline development at NSLS-II
- Described Joint Photon Sciences Institute
- Described plans for transitioning from NSLS to NSLS-II

Second Day Breakout Sessions

Technique-based Sessions

- Hard x-ray Nanoprobe
- Soft Coherent Scattering and Imaging
- Powder Diffraction
- Macromolecular Crystallography
- Liquid Interfaces
- Inelastic X-ray Scattering
- Hard Coherent and XPCS/SAXS
- XAFS
- Bio-SAXS
- Photoemission Spectroscopy

Science-based Sessions

- Life Sciences
- Catalysis
- Environmental Science
- High-Pressure
- Strongly Correlated Electrons
- Magnetism
- Radiometry and Metrology
- Soft Condensed Matter

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Beamline Specific Workshops

Workshop (Attendees)	Date
• XPCS/SAXS (44)	Jan 10, 11th
• XAS (59)	Jan 16th
• Powder Diffraction (95)	Jan 17th, 18th
• Soft x-ray Scattering (34)	Feb 4th
• Inelastic Scattering (42)	Feb 7th, 8th
• Nanoprobe (29)	Feb 15th
• Coherent Diffraction (17)	March 14th

Presentations posted at: http://www.bnl.gov/ls/workshops.asp

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Selecting Project Beamlines and Establishing BATS

- Eleven Letters of Interest (LOIs) received expressing interest in construction of specific beamlines and forming corresponding Beamline Advisory Teams (BATS)
- LOIs were reviewed by NSLS-II Experimental Facilities Advisory Committee (EFAC) on May 5-7
- We are awaiting the EFAC recommendations on selection of six project beamlines

Scientific Strategic Planning Workshops

Workshop (attendees)	Date
Life Sciences (72)	Jan. 15-16
Materials Science and Engineering (95)	Jan. 17-18
Earth and Environmental Sciences (54)	Jan. 22-23
Chemical and Energy Sciences (37)	Feb. 1
Hard Condensed Matter and Materials Physics (50)	Feb. 5-6
Soft and Biomolecular Materials (60)	Feb. 11-12

Life Sciences

Earth and Environmental Sciences

Chemical and Energy Sciences

Scientific Strategic Planning Workshops

- White papers received from recent round of user workshops (see http://www.bnl.gov/ls/workshops.asp)
- These are under review as inputs to development of a coherent picture of a fully built-out facility
- One clear message was the advantages (scientific and technical) to be gained by appropriately combining communities with similar requirements
  - For example, Life Sciences workshop identified clear overlap in interests with environmental sciences (XAS and most imaging techniques) and soft and biomaterials (SAXS/WAXS)

The Need for Strategic Planning

- NSLS-II is a finite resource and demand, based on recent user workshops, outweighs supply:

	Requested	Available
Straight Sections	34	27
3PWs	18	~15
Soft Bend/IR	14	~12
Far-IR	4	4

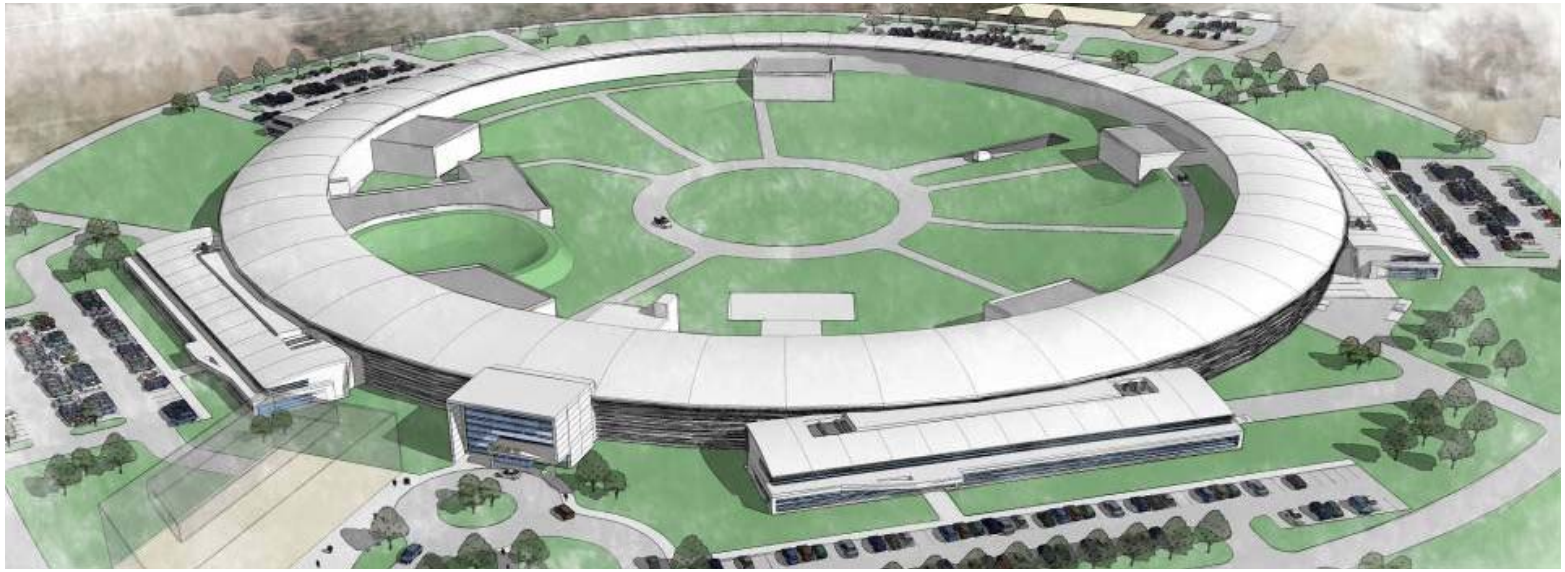
- We need to prioritize among competing demands
  - New ideas vs continuation of existing communities
  - The appropriate balance between different scientific communities
  - High impact, few users vs high thru-put beamlines
- Identification of growth areas and opportunities for entirely new directions
- Guidance on physical placement of beamlines (weighted constraints)
- We have an opportunity to coherently plan the entire facility in a way that takes advantage of synergies in techniques and beamlines across communities

NSLS-II Strategic Plan

- The strategic plan will guide the development of experimental facilities at NSLS-II
- To date, we have held multiple workshops to gather input for the plan, and we expect to hold more in the future
- Development of the plan will be a major activity in the coming year
- NSLS-II will call for future LOIs against this plan

Joint Photon Sciences Institute Update

- Leverage the unique capabilities and science programs of NSLS-II
- Development and application of photon sciences
- New York State has committed $30 million for the JPSI building
- The first $10M to begin design of JPSI is expected soon
- Positive discussions with key stakeholders
  - DOE-BES
  - NYS companies, including IBM, GE, and SEMATECH (Albany nanotech)
  - Key NYS academic and research institutions
  - NIST – promote industrial research beyond NYS
- A JPSI workshop is being planned for 2HFY08

Summary

- Novel design w/ outstanding performance and flexibility from the far-IR to the very hard x-ray
- Exciting opportunities for new science
- Planning underway for transition from NSLS
- A bright future for synchrotron science!