NSLS-II Overview

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Data Acquisition and Scientific Computing Workshops
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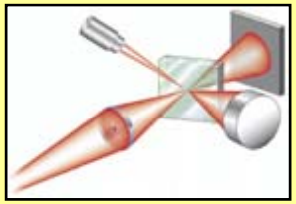
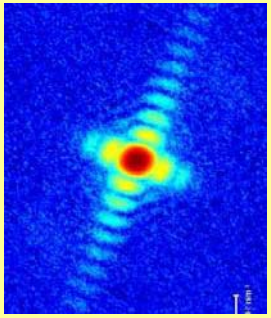
High Level Description of NSLS-II

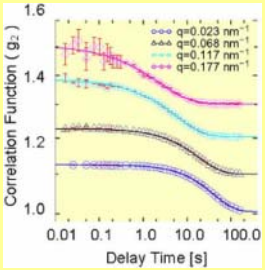
New Capabilities



Nanoprobes



Diffraction Imaging



Coherent Dynamics

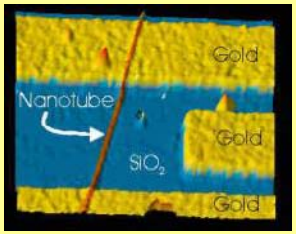
Highly optimized x-ray synchrotron delivering:

- extremely high brightness and flux
  - > 10,000x brighter than NSLS
- exceptional beam stability
- suite of advanced instruments, optics, and detectors that capitalize on these special capabilities

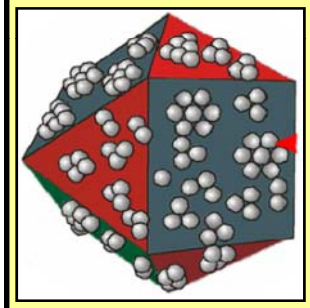
Together, these will enable

- ~ 1 nm spatial resolution
- ~ 0.1 meV energy resolution
- single atom sensitivity

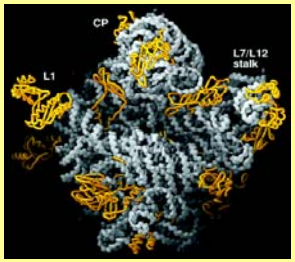
New Science



Nanoscience



Nanocatalysis



Life Science

Project Scope

Accelerator Systems

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

Conventional Facilities

- Ring Building and Service Buildings
- Laboratory/Office Buildings (LOBs) to house beamline staff & users
- Reuse of existing NSLS office/lab space for NSLS-II staff
- Total of ~ 500,000 gsf new construction

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 high-β straights (9.3 m)
  - 15 low-β straights (6.6 m)

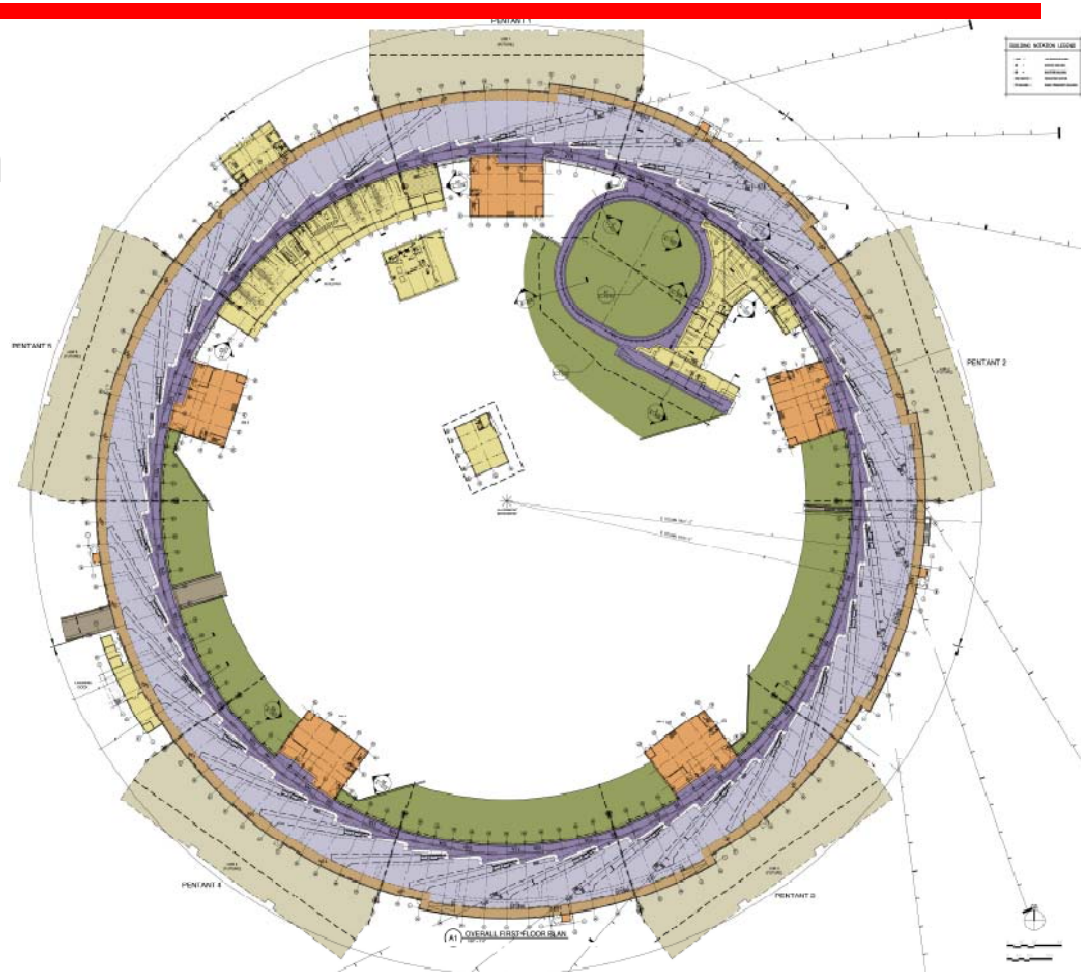
Novel design features:

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

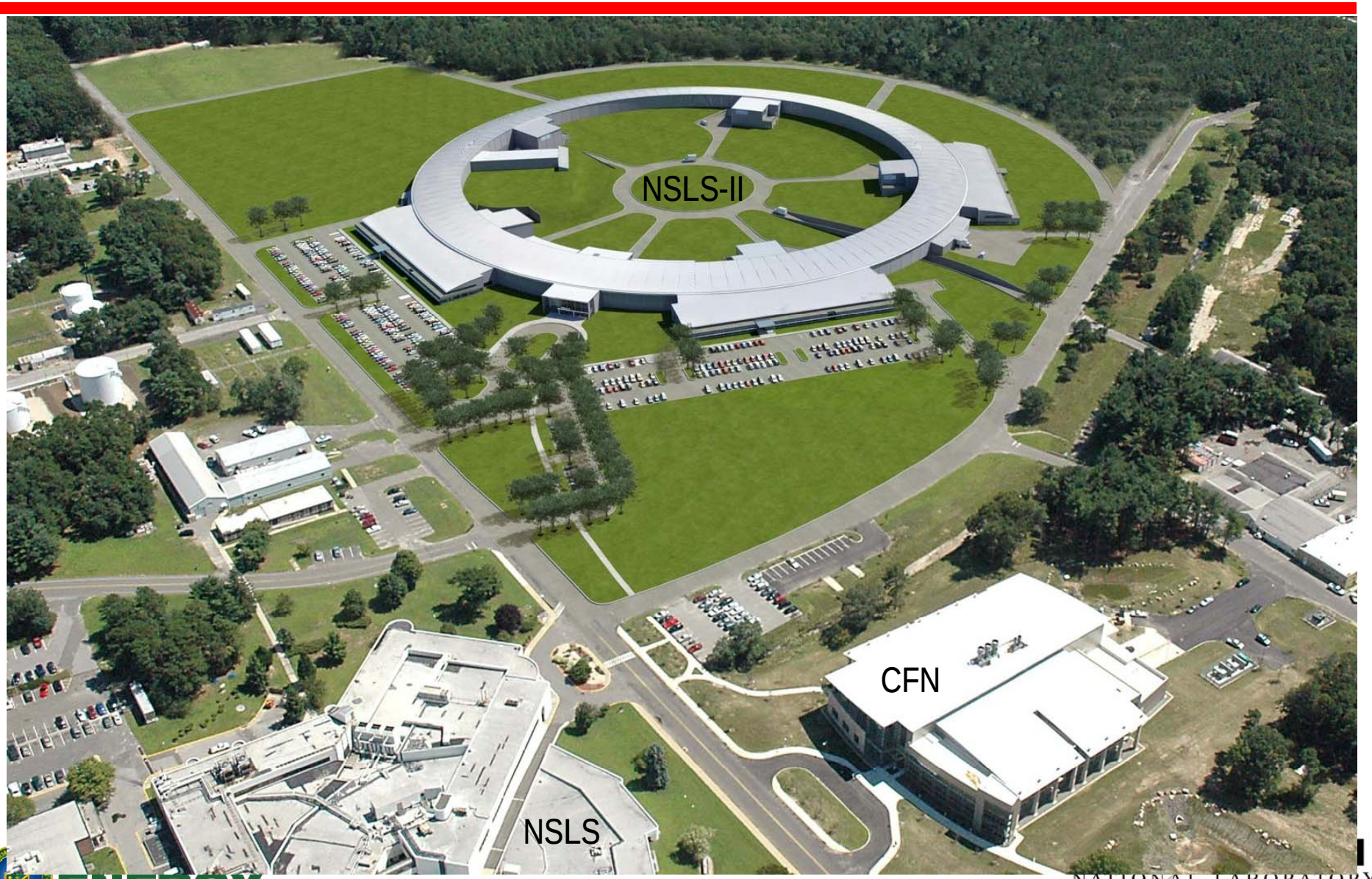
Ultra-low emittance

- ε_x, ε_y = 0.6, 0.008 nm-rad
- Diffraction limited in vertical at 12 keV
- Small beam size: σ_y = 2.9 μm, σ_x = 33 μm, σ'_y = 2.7 μrad, σ'_x = 17 μrad

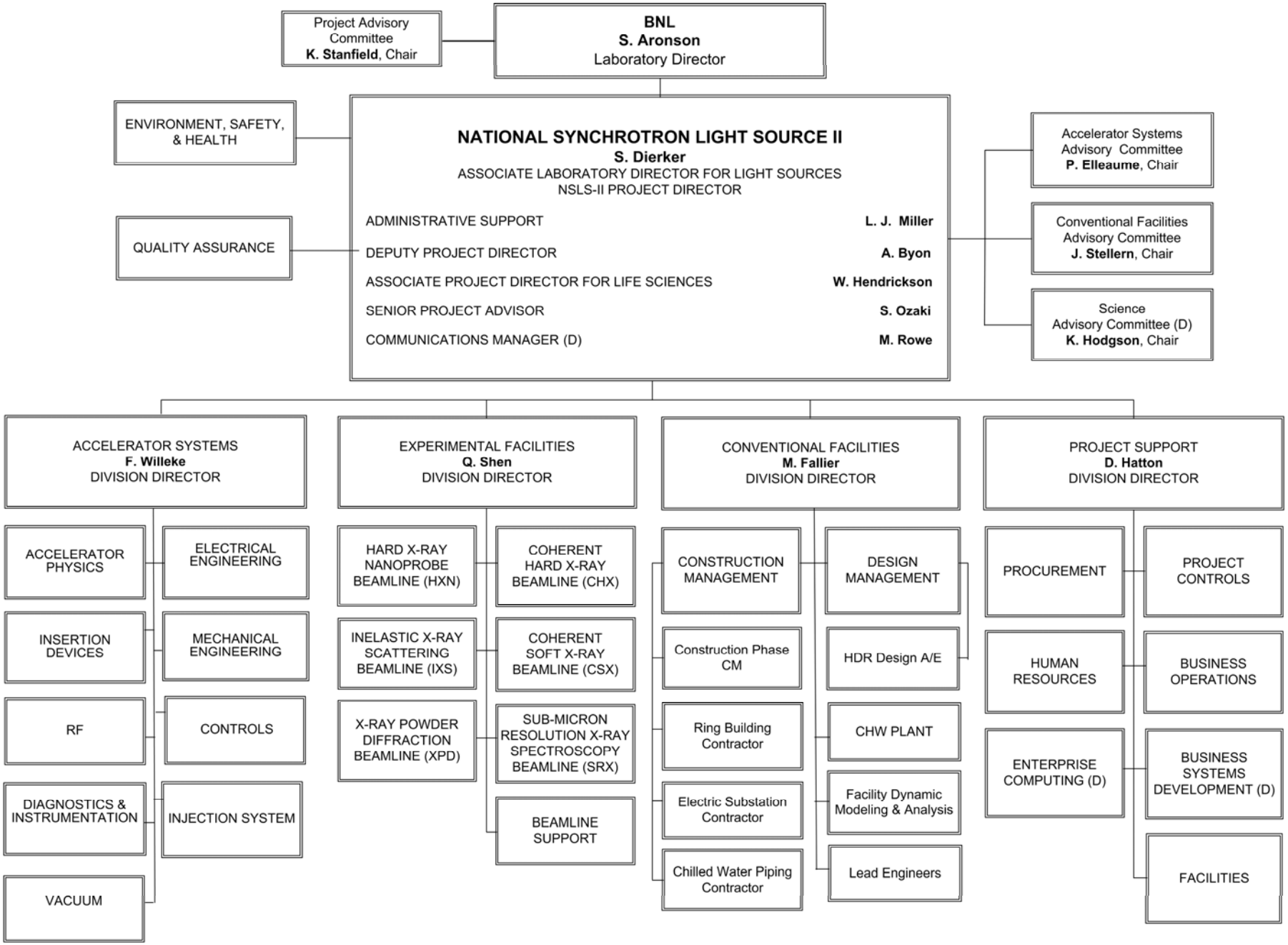
Pulse Length (rms) ~ 15 psec



Aerial View



NSLS-II Project Organization



Status of NSLS-II Project

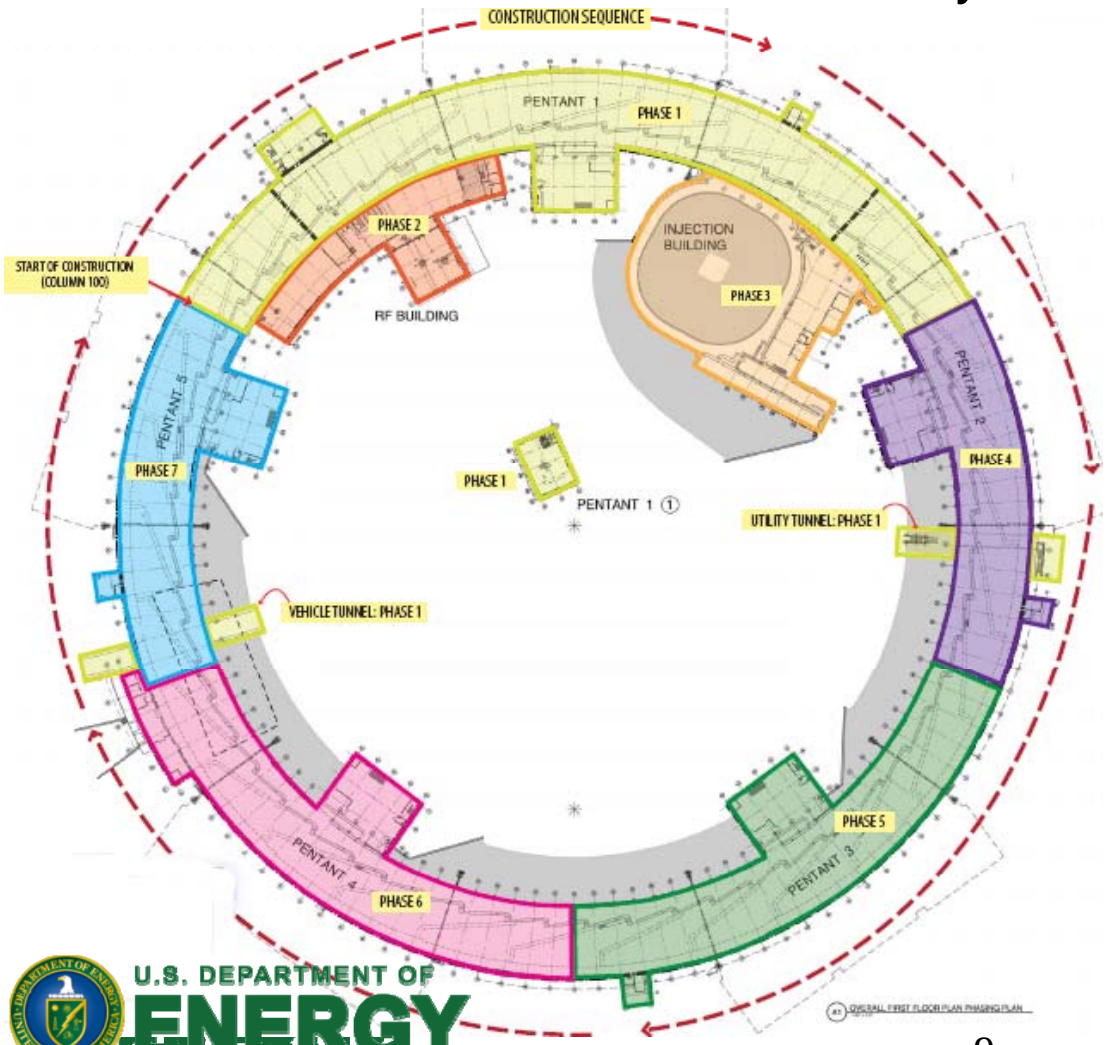
- Excellent progress
- Project is 26% complete as of end of March 2010
  - Full construction phase with a burn rate of ~$11M per month in 1st quarter of 2010, ramping up to ~$21M in 4th quarter of 2010
- On schedule and on budget (Total Project Cost = $912M)
  - Excellent technical, cost & schedule performance to date
  - All major procurements, totaling $214M to date, were awarded within 1% of planned cost
  - 16 month float based on technically limited schedule has been holding for last 8 months
- Key Project Milestones

Jan 2009	CD-3, Approve Start of Construction	(Complete)
Feb 2009	Contract Award for Ring Building	(Complete)
Aug 2009	Contract Award for Storage Ring Magnets	(Complete)
Feb 2011	1st Pentant Ring Building Beneficial Occupancy; Begin Accelerator Installation	
Feb 2012	Beneficial Occupancy of Experimental Floor	
Oct 2013	Start Accelerator Commissioning	
Feb 2014	Projected Early Completion; Beam Available to Beamlines	
Jun 2014	Early Project Completion; Beam Available to Beamlines	
Jun 2015	CD-4, Approve Start of Operations	

Construction Progress

Installation and Commissioning

- Detail installation and commissioning schedule formulated
- BO and start of installation in February 2011



Beneficial Occupancy

Description	SR Column CCW	SR Column CW	BOD
Pentant 1, Cooling tower, Vehicle tunnel Utility tunnel	100	21	1-Feb-11
RF Building	-	-	23-Mar-11
Injection building	-	-	18-May-11
Pentant 2	21	37	2-Jun-11
Pentant 3	37	60	27-Sep-11
Pentant 4	60	83	28-Nov-11
Pentant 5	83	100	9-Feb-12

Installation

BOD	Installation Activities	Technical Inst'l Cmp
1-Feb-11	Storage Ring Components	20-Jun-11
	Storage Ring RF cavities	21-Sep-12
23-Mar-11	RF Power Systems	29-Mar-12
18-May-11	Booster RF Cavity	21-Jun-11
	Linac	18-Oct-11
	Booster	8-Jun-12
2-Jun-11	Storage Ring Components	20-Oct-11
27-Sep-11	Storage Ring Components	14-Feb-12
28-Nov-11	Storage Ring Components	16-Apr-12
9-Feb-12	Storage Ring Components	28-Jun-12

NSLS-II Beamline Capacity

27 straight sections for undulators

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

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

- Any of these can also have a three pole wiggler 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 62 operating beamlines

Ramp Up of User Program

- DOE-BES
  - 6 Project beamlines
  - Planning "NEXT" MIE ("NSLS-II Experimental Tools")
    - 5-6 ID beamlines starting FY12
  - NEXT-II MIE expected to follow
    - 5-6 ID beamlines, possibly starting in FY15
  - Early operations starting in FY12 for establishing ~ 20 BM/3PW beamlines
- NIH
  - Committed $45M to fund construction of four ID beamlines
    - $12M awarded to NSLS-II in FY10 (ARRA) to design & construct undulators
    - $33M in President's FY11 budget request for beamlines
- DOE-BER & NSF
  - Expressed interest in funding beamlines
- Potentially 35-40 bemlines within two years of start of operations

Data Acquisiton & Scientific Computing Workshop Goals

- Achieving a fast ramp-up of the science program at NSLS-II requires a robust framework for supporting data acquisition and scientific computing
- The purpose of these two workshops is to:
  - discuss recent advances in user interfaces and experiment control
  - share information about modern techniques for data acquisition and visualization
  - identify the anticipated needs for scientific computing at synchrotron user facilities
  - recommend a set of strategies and approaches to meet these needs at NSLS-II
- Topics include all aspects of user interfaces, data acquisition, & scientific computing:
  - the practicalities and opportunities for standardization of user interface software
  - data formats / visualization / analysis / backup and retention policy
  - data handling requirements in typical high-data-rate synchrotron experiments
  - experimental data storage policies and strategies for short-term and long-term
  - data reduction and analysis capabilities during user experiments
  - post-experiment data analysis support and accessibility
  - organization structure optimized to achieve the goals