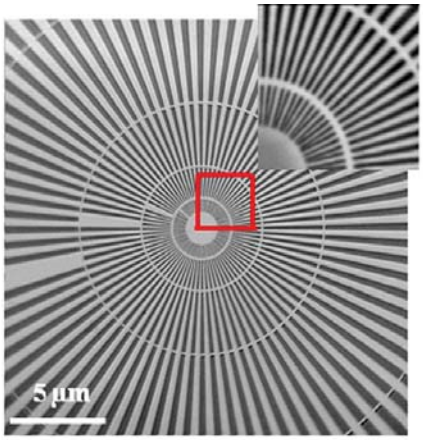
NSLS-II EXperimental Tools (NEXT)

Progress Report

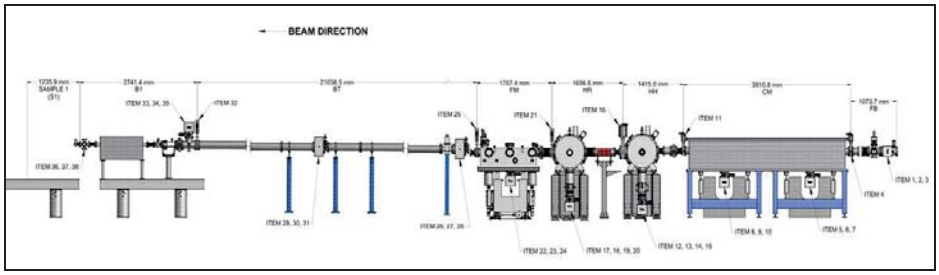
June 2012

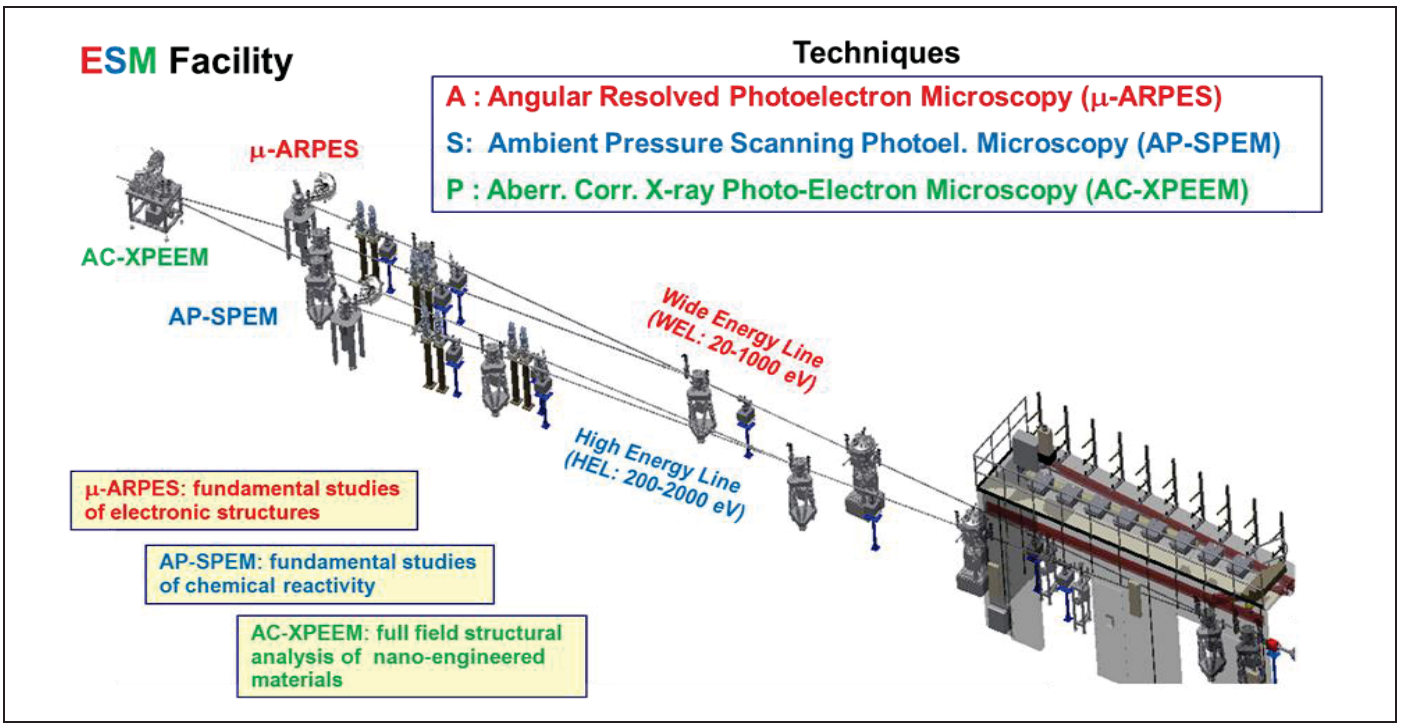
Graphics related to three of the six NEXT beamlines are shown below and discussed in the reports.



FXI

ISS





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OVERALL ASSESSMENT

In June 2012, the NEXT project continued preliminary design activities in preparation for the ALD's review in August and the DOE CD-2 review in September. Prior to these reviews, an internal red team will review the progress on July 18–19 and provide valuable recommendations for inclusion in the external review documents and presentations.

The proposed project baseline scope and associated cost and schedule cover the design of six beamlines and construction of five. The proposed TPC of $90M includes total estimated project cost of $69M and 32% contingency. The proposed early project completion date is September 2016; the CD-4 milestone is September 2017.

All beamline WBS Level 2 managers are in place. Four of the five beamline mechanical engineers have been in place since April 2012. The search for the fifth, and final, beamline mechanical engineer is underway.

LOOKING AHEAD

EVMS tracking of NEXT cost and schedule systems began with the May 2012 data. These data are still being refined in preparation for CD-2 review. We expect to include a Cost Performance Report with the August monthly report.

BAT meetings for four NEXT beamlines were conducted in April and May 2012. Meetings of the ESM and SIX beamlines are being scheduled for October – November 2012.

ESM – ELECTRON SPECTROMICROSCOPY

Preparing the ESM section of the NEXT PDR document has taken the best part of this month. The PDR is the main technical document for the upcoming ALD's PDR review and DOE CD-2 review. A 3D layout drawing of the ESM beamline is shown on the cover of this report.

Testing of the new ARPES endstation (based on a Scienta SR400) is in progress at beamline U5UA at NSLS. After having tested the 2D-ARPES detector, we are now testing the two mini-Mott spin-detectors (Fig. 1). Electron energy analyzer and spin-detectors will be transferred to the μ-ARPES endstation of the ESM beamline at NSLS-II.

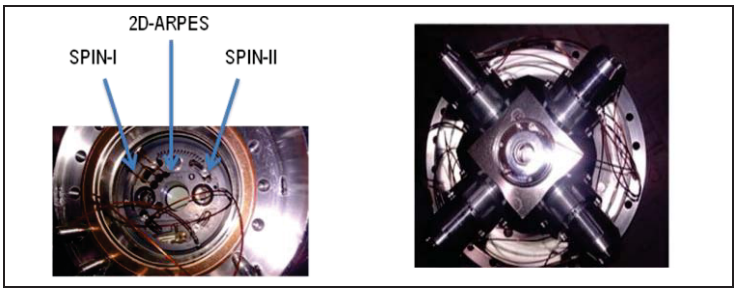


Figure 1. Left: Exit plane of the Scienta R4000 electron energy analyzer adapted for a 2D detector (center) and two single channel spin-polarimeters. Right: One of two mini-Mott polarimeters. The Th target is at the center, surrounded by the two orthogonal pairs of Channeltron electron detectors.

FXI – FULL-FIELD X-RAY IMAGING

Simulations began, to determine the motion specifications for the FXI beamline optics. The risk registry was updated. A response to comments from the Beamline Advisory Team (BAT) resulting from the BAT meeting on April 2 was prepared. Figure 2, part of which is shown on the cover of this report, demonstrates successful achievement of sub-50nm spatial resolution with the existing TXM currently in operation at NSLS beamline X8C. Discussions continue with XRADIA regarding the TXM upgrade, which will prepare this endstation for use at the FXI beamline.

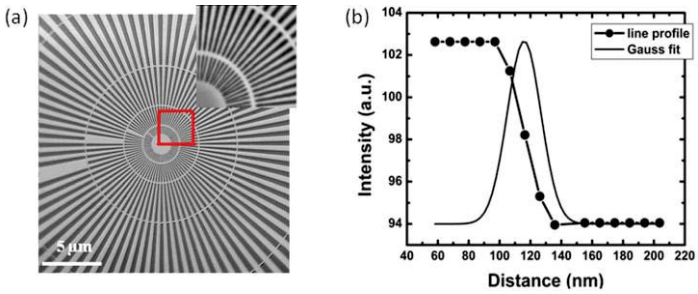


Figure 2. (a) Siemens gold star pattern with 30nm finest feature size, measured by absorption contrast mode of the TXM. (b) Knife-edge intensity pattern from a sharp feature of the star pattern, along with a Gaussian fit of the differentiated edge response.

SIX – SOFT INELASTIC X-RAY

A viable solution to increase both the throughput of the SIX spectrometer and the energy window of the detector has been found. The design considered up to now requires an extreme grazing angle of incidence on the detector, resulting in a strong absorption by the detector dead layer and a narrow energy window. In June, using ray tracing, it was shown that the insertion of a vertical focus mirror before the grating substantially increases the incidence angle on the detector, improving both the detector efficiency and energy range. Figure 3 shows this " Hettrick-Underwood" design.

A meeting was held with Peter Denes of LBNL, who is developing a high spatial resolution CCD detector ideally suited for use in the SIX emission spectrometer. It was concluded that our requirements, such as a 20- or even 10-nm thick dead layer, a horizontal acceptance of at least 1″, and the possibility to bring two chips as close as a few mm from each other, may all be feasible.

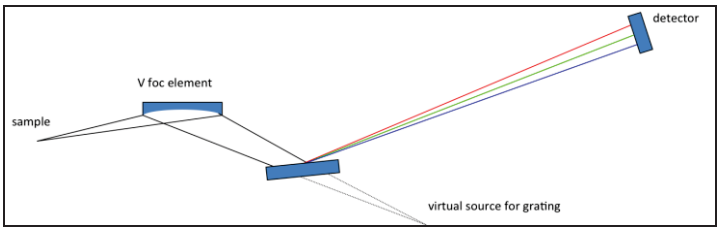


Figure 3. Diagram of the Hettrick-Underwood design.

ISS – INNER SHELL SPECTROSCOPY

A side view layout drawing of the ISS beamline is shown on the cover of this report.

By systematically varying the heat load conditions, the influence of the cooling geometry on the structural deformation of the proposed ISS monochromator crystal was analyzed using finite element analysis (FEA). Figure 4 shows the deformation of the crystal at a temperature distribution close to the zero expansion point for silicon. This crystal cooling design, which is not yet optimized, can be used over the full photon energy range needed for ISS, and most likely significant improvements can be achieved using an optimized cooling system. Additionally, a first version of the Bremsstrahlung and synchrotron ray tracing was performed and the necessary numbers and sizes of collimators and stops were determined.

The report from the ISS BAT meeting (16–17 April 2012) was received and a written response was delivered to the BAT Chair. Intense discussions have been started with the future biology and catalysis communities to define their requirements and specifications for the sample environment and sample handling at ISS.

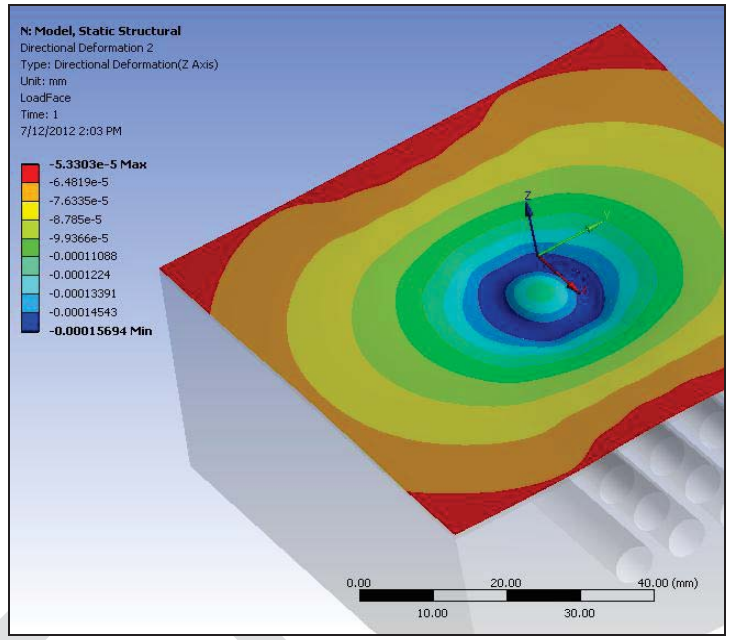


Figure 4. Deformation of the Si (511) crystal at 22 keV when exposed to a 0.1x0.5 mrad^2 damping wiggler beam. The surface temperature is close to the point of zero expansion, resulting in a central bump and a contraction of the remaining crystal.

SMI – SOFT MATTER INTERFACE

The team has been visiting beamlines at CHESS, APS, ESRF, PETRA III, and SOLEIL, studying layouts, phase space studies, and heat load analysis results shared by colleagues and vendors. SMI's proposed photon delivery design has been compared to several cutting edge beamlines having similar performance targets. In a parallel effort, the SMI team has completed more comprehensive undulator radiation simulations for the beamline's proposed source. They surveyed the most recent implementations of CRL (compound reflective lens) optical elements, which may extend their utility for SMI beyond what was proposed in CD-1. The SMI group is now able to complete crucial decisions regarding the optical design, and to specify candidate layouts for ray-tracing analysis, which is the next priority.

ISR–IN-SITU AND RESONANT HARD X-RAY

A preliminary layout of the ISR beamline, including the canted build-out, was completed, and is shown in Figure 5. A General User proposal was submitted to the APS for Si(111) phase plate characterization, which is development work required to provide polarization control in the important 2.4-3 keV energy range.

Figure 5. 3D rendering of the ISR beamline (0 degree branch, running through the FOE, SOE, and two endstations) and the proposed future upgrade serving two side stations.

DRAFT

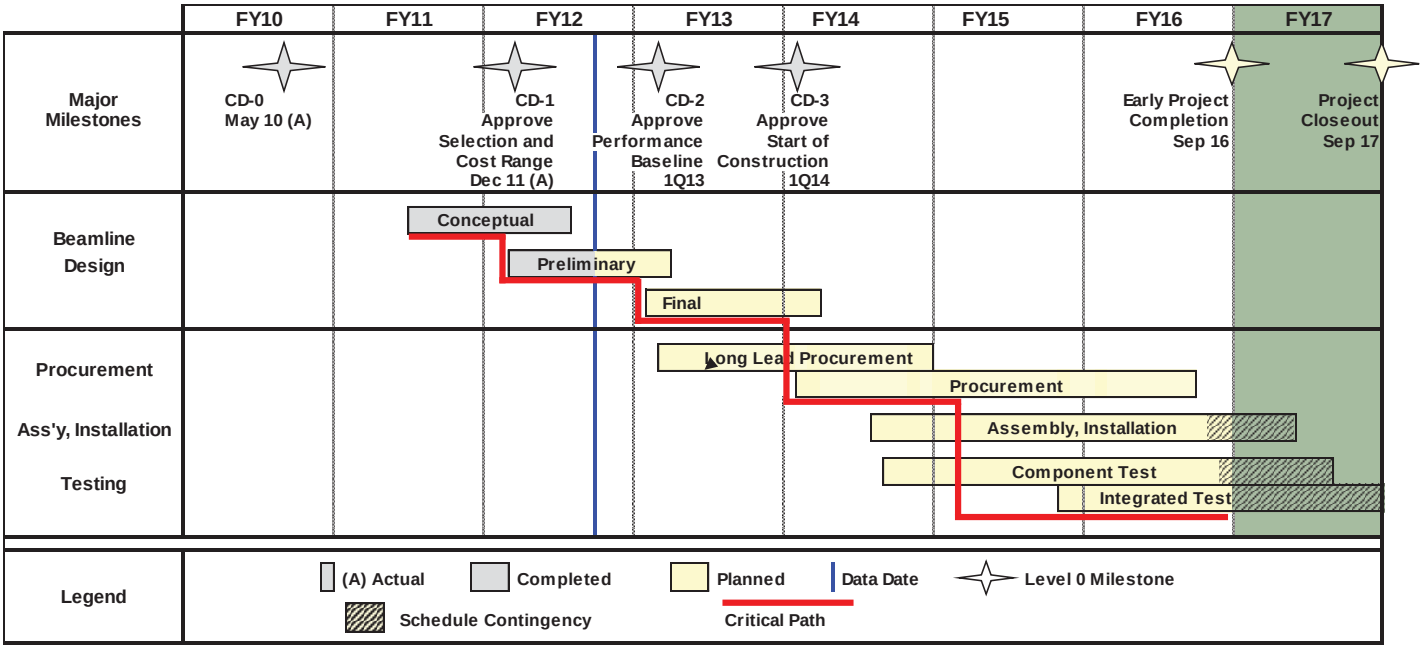
PROJECT MILESTONES

CD-0 (Mission Need):	Planned: 3Q10	Actual: May 27, 2010
CD-1 (Alternative Selection):	Planned: 4Q11	Actual: Dec. 19, 2011
CD-2 (Performance Baseline):	Planned: 1Q13	
CD-3 (Start Construction):	Planned: 4Q13	
Early Project Completion:	Planned: 4Q16	
CD-4 (Project Completion):	Planned: 4Q17	

UPCOMING EVENTS

ALD's Preliminary Design Report (PDR) Review	Aug 7–9
DOE CD-2 Review of NEXT Project	Sep 11–13

PROJECT SCHEDULE



Funding Profile

Funding Type	NEXT Funding Profile ($M)						
	FY11	FY12	FY13	FY14	FY15	FY16	TOTAL
OPC	3.0						3.0
TEC		12.0	12.0	25.9	21.6	15.5	87.0
Total Project Cost	3.0	12.0	12.0	25.9	21.6	15.5	90.0

Cost and Staffing Report

	Current Period		Cumulative-to-date	
As of 5/31/2012	Planned*	Actual	Planned*	Actual
Cost		$416,056		$2,353,673
Staffing (FTE-year)		1.7		9.9

*Planned values will be included once EVMS tracking has begun.

Key Personnel

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