

XSD Strategic Plan

The XSD Strategic Plan reflects the mission “to enable APS users to perform world-class research using x-rays.” This plan provides a set of objectives that address the challenges that XSD faces to achieve this mission now, during the next five years and beyond. It is the blueprint for how the Division will support our staff and beamlines and provide required technical support.

Guiding Principles

To produce great science XSD needs both great facilities and great staff. The hiring, development, and retention of highly skilled scientists, engineers and technical professionals is required for the success of XSD. XSD must also have world-class beamlines and technical support to produce world-class science. These investments and the continued development of a diverse user community provide the basis for the XSD strategy.

Vision

The goals for FY2016 and beyond required by the XSD mission are:

- Develop an outstanding portfolio of world class x-ray science, in particular with regards to methods development and the development of enabling techniques
- Be the first choice for world-class scientists in a wide array of disciplines who use x-rays in their research: develop and operate top-of-the-line beamlines & provide outstanding user support.
- Be the top choice for scientists, engineers, and technical support staff pursuing careers at synchrotrons: maintain a vibrant, challenging, open, diverse and inclusive work environment where innovation, excellence, and perseverance flourish.

Strategy

To achieve the XSD vision, we must concentrate on:

- Invest in Our People — the XSD staff is key in providing the scientific vision for the future as well as the technical and scientific leadership for the facility. We must therefore invest in our staff, attract and retain scientists, engineers and technical support personnel who will become the next generation of leaders and innovators at the APS. This investment involves having clear career advancement paths, resources available for R&D, and opportunities for professional growth.
- Invest in Beamlines — Continue to operate and develop the most innovative, relevant, and effective beamlines, and allocate resources to address obsolescence and maintenance issues. As the APS upgrade nears, we need to shift the APS beamline portfolio to take advantage of the unique source characteristics resulting from the APS upgrade.
- Invest in R&D, methods development and technical support — the development of coherence preserving optics, engineering of high stability beamline

components, *in-situ/operando* sample environments, and robust nano-positioning instrumentation as well as new detectors and advanced beamline controls/automation are needed to make full use of our capabilities. Similarly, the development of new methods is required to mitigate radiation damage issues, enable effective multi-modal and multi-scale data acquisition and integration, etc. Lastly, addressing issues in data transfer, storage, reduction, and interpretation is required to not only effectively use the capabilities of the APS today but in particular after the upgrade (with estimated data rate increases of 1000x and more).

- Invest in Our Users — allocate resources to continue to provide excellent user support. Expand outreach efforts in known and new scientific communities, with particular emphasis on areas that will benefit greatly from the APS upgrade.
- Communicate Our Success — share with the public, our sponsors and policymakers XSD's central role in addressing challenges in many vital scientific and technical areas including e.g. energy sciences, human health, and the environment.

Priorities

1. Brightness and coherence driven beamlines and techniques

The APS source after the upgrade will provide world leading beam coherence and brightness. These beam characteristics will greatly enhance experiments in the areas of microscopy, imaging, ptychography, coherent diffraction, and XPCS, as well as make possible completely new experiments not feasible today. To work towards the upgraded APS, we will give the highest priority for beamline improvements, beamline staffing and beamline technical support that enhance these areas, and work today to establish methods and techniques that can fully use the upgraded APS when it comes online.

2. High energy beamlines and techniques

A unique characteristic of the present APS among U.S. light sources is high flux at high energies (>20 keV). This capability has been exploited by the XSD staff to provide a number of world leading capabilities in Materials Science and Chemistry to APS users. After the upgrade, the APS will have significantly enhanced flux densities at high energies, as well as significantly increased degrees of coherence. To fully exploit these unique features, the development of high-energy techniques (eg, optics, focusing, detectors...) and additional beamline development in this area are a high priority for XSD.

3. Developments in timing beamlines and techniques

The APS bunch pattern, with ~100 ps bunches separated by ~ 150 ns, is unique as a normal operations mode at 3rd generation synchrotron sources. The upgrade presently plans to retain a similar bunch pattern, 100 ps bunches separated by ~75 ns, allowing timing experiments to continue to be performed in normal operations mode. To retain our strength in this area, and enable new approaches,

we will continue to invest in timing capabilities, in particular in combination with the first and second priorities.

4. Maintaining excellence in beamline operation and development

The APS serves a large number of users across a variety of scientific disciplines. These users apply a wide-range of the beamline capabilities found at the APS coupled with outstanding in-house staff expertise to address an array of problems of relevance to the US scientific community. In order to continue to serve this valuable need, we will continue to provide, improve, and optimize our unique synchrotron radiation capabilities, programs, and facilities that are most highly sought after by our users.

Technical developments underpinning and in support of priorities 1-4 above are a significant priority for investment and staffing.

To compete internationally and fully exploit the potential of the upgraded APS, technical developments are needed in numerous areas underpinning the priorities enumerated above. For example, R&D in fabrication of coherence preserving optics is required fully exploit the high brightness produced by new accelerator, R&D in focusing optics is required to achieve improved spatial resolution, etc. Advances in detectors, data analysis and data management and the engineering of stable beamline optics and instrumentation as well as nano-positioning capabilities are also required, with prioritization following their application areas.

Implementation

The APS X-ray Science Division is charged with operation and continued development of the facility supported beamlines at the APS. A challenge for the division will be to maintain the productivity of the XSD beamlines, sometimes with a limited operations budget, while transitioning to a portfolio of beamlines and instruments that more fully exploit the unique characteristics of the upgraded APS to enable new scientific opportunities. To provide resources to implement this goal, XSD beamlines serving small communities (particularly those for which alternative U.S. beamlines exist or soon will exist), beamlines with low productivity, and beamlines with limited scientific impact will have to be closed and reprogrammed as part of the evolution of the facility. The freed up resources (effort, equipment, real estate) can then be used to enhance programs that must grow to meet future user demand resulting from scientific opportunities produced by the APS upgrade.

- *APS management, XSD management, XSD group leaders and senior scientific and technical staff will together, within the next 3-6 months, determine the direction for the XSD beamline portfolio. Input from the APS user community will play a role as appropriate.*

Providing effective technical support to our current beamlines while simultaneously addressing future needs for the upgraded APS will be another challenge for XSD. In order to efficiently use our resources, efforts to develop optics, detectors, instrumentation, beamlines controls, and scientific software will have to be

thoughtfully planned and executed, in accordance to above priorities. Here too, decisions will be made on which projects to pursue and which to put on hold.

- *XSD will develop in the next 3-6 months strategy documents for optics, detectors, beamline instrumentation, beamline controls, and computing. These documents will be aligned with current and future APS priorities.*

Similarly, XSD effort will reflect the new emphasis on high brightness techniques. New hires with skills in these areas will work with current XSD staff to effectively recruit and support users in scientific domains relevant to the upgrade; enable new experimental techniques; develop optics, detectors, instrumentation, and scientific software that will be needed for new and refurbished APS-U beamlines.

- *APS and XSD management will maintain and update a hiring list aligned with current and future facility priorities.*

We will continue to maintain and improve our beamlines, using non-routine M&S and equipment spending and leveraging external partnerships as appropriate. We will focus our resources on beamlines that will benefit from new APS-U capabilities and have productive, well-established user communities, complementing efforts planned in APS-U. Going into and out of the APS upgrade, the aim is to provide a suite of beamlines, with associated scientific and technical staff, that are ready to exploit the unique capabilities of the APS source and serve the needs of both the scientific communities that have been built during the last 20 years of APS operations as well as new APS-U user communities. Non-routine XSD M&S and equipment spending must reflect this plan and adapt to funding availability and upgrade spending priorities.

- *XSD management, group leaders and staff will maintain the XSD projects document in line with XSD priorities and available funding.*