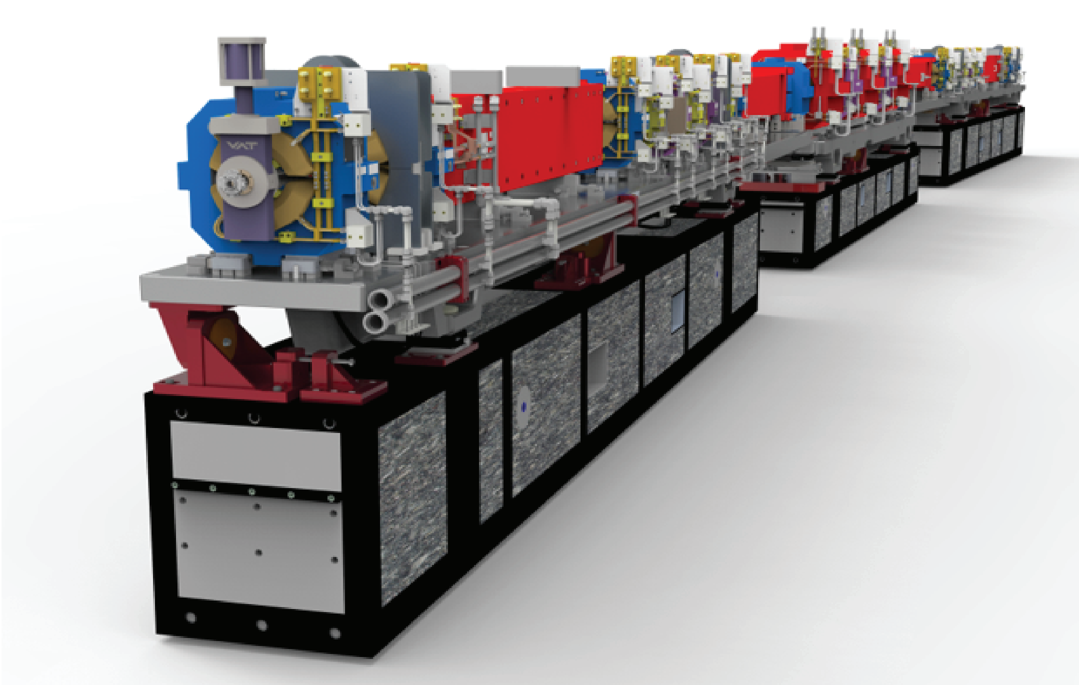
Glenn Decker

The Advanced Photon Source Upgrade Storage Ring



With the advent of advanced particle accelerator simulation codes, together with developments in technology that enable precise, small aperture, high performance accelerator components, the possibility of enhancing the hard x-ray brightness of the Advanced Photon Source (APS) by two to three orders of magnitude in is now within reach. The APS upgrade (APS-U) is an $815M DOE Office of Science, Basic Energy Sciences project, which recently achieved critical decision 3 (CD-3), marking the formal start of major fabrication and procurement activities. APS-U involves installing a multi-bend achromat (MBA) lattice employing seven gradient bending magnets and six weak reverse bends per sector to replace the double bend lattice for the present APS. In so doing, the electron emittance will be reduced by a factor of 75 or more with a corresponding enhancement in x-ray brightness that is further enhanced with small-gap permanent magnet and superconducting insertion devices. In addition to the reconfiguration of the accelerator magnet lattice, the energy will be reduced from 7 to 6 GeV and the stored beam current doubled from 100 to 200 mA, in both cases to optimize x-ray brightness.

While largely based on proven conventional copper, steel, and aluminum components, several novel advancements are planned. The APS was the first third-generation light source to employ top-up operation in the late 1990's, defined as electron injection with beamline shutters open to maintain constant stored beam current, enhancing thermal stability of both the accelerator and beamline optical components. The APS-U takes this a step further with the concept of on-axis swap-out injection, entailing wholesale replacement of entire bunches, necessary to accommodate the relatively small dynamic acceptance of the strong-focusing and highly-nonlinear electron optics. The extremely small transverse particle beam dimensions enhance mechanisms causing particle loss such as Touschek scattering and intrabeam scattering, reducing beam lifetime. To counteract these effects, a passive superconducting harmonic cavity will be used to lengthen the stored electron bunches. In addition, the vacuum system design employs non-evaporable getter (NEG)-coated chambers to reduce gas scattering losses to manageable levels, along with an array of strategically-placed absorbers and collimators. A state-of-the-art orbit feedback system has been prototyped and very successfully demonstrated in the present APS, to enhance source stability at the 100 nanoradian scale. This talk will describe expected machine performance and describe the different technologies that have gone into the APS-U storage ring accelerator design.

Glenn Decker is an Argonne Senior Scientist and is presently the APS-U Associate Project Manager - Accelerator. He served as storage ring manager during the construction phase of the present APS and led the facility commissioning team. Past research interests include particle beam diagnostics, orbit feedback systems, and radio-frequency and x-ray beam position monitoring for electron storage rings.

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Bldg. 402 | APS Auditorium
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