Recent developments and future plans at the Advanced Photon Source

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The upgrade of the Advanced Photon Source (APS) will create a synchrotron x-ray lightsource optimized to produce hard x-rays with a high degree of spatial coherence. The upgraded source will exceed the capabilities of today's synchrotrons by two to three orders of magnitude in brightness and coherent flux in the hard x-ray range, enabling a transformational range of new probes for structure, properties, and functionality of matter. A greatly increased flux of spatially coherent x-rays will provide an unprecedented level of understanding of nanometer-scale heterogeneity and fluctuation dynamics in matter ranging from "soft" biomolecules to "hard" structural materials.

The increase in coherence will particularly benefit techniques such as (1) Intensely focused x-ray beams for dramatically advanced nanoscale imaging, nanospectroscopies, and nanodiffraction; (2) coherent diffractive imaging and ptychography reaching spatial resolution approaching atomic lengthscales and permitting time-resolved studies; and (3) photon correlation spectroscopies to open up previously inaccessible time- and lengthscales.

In addition, advances in instrumentation, such as faster detectors, better optics, and improved data acquisition strategies are fundamentally changing the way experiments are carried out, giving us the ability to more completely interrogate samples, at higher spatial resolution, across multiple lengthscales, with higher throughput, and with better sensitivity.

We will present future plans for an upgraded APS as well as recent developments at the APS leading into the upgrade, and also discuss challenges and opportunities in the context of emerging possibilities with the next generation of synchrotron light sources.