

# PhotonMEADOW 2023

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## Advancements in X-ray Wavefront Sensing and At-wavelength Metrology at the Advanced Photon Source

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The Advanced Photon Source (APS) has achieved significant advancements in X-ray wavefront sensing and at-wavelength metrology, which are essential for optimizing the performance of X-ray optics and synchrotron beamlines. A notable breakthrough is the development of the coded-mask-based wavefront sensing technique, which merges the advantages of grating interferometry and speckle tracking. Capitalizing on this technique, two wavefront sensor prototypes have been engineered: one featuring adjustable zoom capabilities catering to varying beam conditions and resolutions and a second, more compact and cost-effective model adaptable for different beamline configurations. In terms of at-wavelength metrology, the technique has been used to evaluate the quality and performance of hundreds of lenses of different materials and types, mirrors, crystals, and windows for APS and the APS upgrade projects. The characterization results are critical to ensure optimal performance of the beamline instrument and, ultimately, the scientific experiments. For wavefront sensing, the applications are diverse, concentrating particularly on beamline diagnostics and wavefront control, which are vital for the precise adjustment and preservation of X-ray beam quality. Plans are underway to design and fabricate wavefront sensors customized for each APS upgrade beamline, promising further performance enhancements. Furthermore, a specialized application of these advancements is their integration into adaptive optics systems as feedback mechanisms for real-time wavefront control.

### Journal of Synchrotron Radiation Special Issue: will you submit your contribution?

no

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