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Measurement of vertical and horizontal emittance via undulator high harmonics at the APS-U

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The transition from 3rd to 4th generation synchrotron light sources can primarily be characterized by a significant reduction in horizontal emittance. This enables a nearly uniform transverse X-ray beam profile and a brilliance that approaches the diffraction limit. A consequence of the upgrade to Diffraction Limited Storage Rings (DLSRs) is that the traditional emittance measurement techniques lack the resolution required to accurately measure emittances in the picometer-radian range. At the Advanced Photon Source Upgrade (APS-U), we explore the use of high harmonics of undulator radiation for precise emittance characterization. Previously at the Advanced Photon Source (APS), vertical emittance measurements, validated through SPECTRA simulations, were performed. This drove the desire to measure the horizontal emittance at the APS-U. Simulations performed in SPECTRA and Synchrotron Radiation Workshop (SRW) guide our experimental strategy for characterization. We present measurements of both the horizontal and vertical emittance at the APS-U, including variations across different bunch timing modes. We conclude by discussing the advantages of this approach over traditional methods.

Footnotes

Paper preparation format

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