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Demonstration of Hard X-ray Multiplexing using Microbunch Rotation through an Achromatic Bend

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Electrons in a X-ray free electron laser (XFEL) develop periodic density fluctuations, known as microbunches, which enable the exponential gain of X-ray power in an XFEL. When an electron beam microbunched at a hard X-ray wavelength is kicked, microbunches are often washed out due to the dispersion and R56 of the bend. An achromatic (dispersion-free) bend with small R56, however, can preserve microbunches, which rotate to follow the new trajectory of the electron bunch. Rotated microbunches can subsequently be lased in a repointed undulator to produce a new beam of off-axis X-rays. In this work, we demonstrate hard X-ray multiplexing in the Linac Coherent Light Source (LCLS) Hard X-ray Undulator Line (HXU) using microbunch rotation through a 10 microrad first-order-achromatic bend created by transversely offsetting quadrupole magnets in the FODO lattice. Quadrupole offsets are determined analytically from beam-matrix theory. We also discuss the application of microbunch rotation to out-coupling a cavity-based XFEL (CBXFEL) [1].

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