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A Perfect X-Ray Beam Splitter and its Applications to Time-Domain Interferometry and Quantum Optics Exploiting FELs

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Brilliant, ultrashort, and coherent X-ray FEL pulses allow investigations of dynamics at the inherent time and length scale of atoms. However, the user community still lacks access to phase-locked X-ray pulses, desirable for time domain correlation spectroscopies and coherent quantum control. Based on selective electron-bunch degradation in the accelerator, combined with two-stage, self-seeded photon emission, we propose an FEL mode generating subfemtosecond, phase-locked X-ray pulse pairs with up to 100 fs delay. Splitting the electron bunch in the accelerator, instead of photon pulses in the beamline, avoids relative phase jitter. This enables time-domain interferometry, such as the X-ray analog of the ubiquitous Fourier transform infrared spectrometer, and, more generally, all of nonlinear and quantum optics requiring coherent copies of beams.

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Yes

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