81
标题: Ultrafast X-ray pulse characterization at free-electron lasers
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摘要: The ability to fully characterize ultrashort, ultra-intense X-ray pulses at free-electron lasers (FELs) will be crucial in experiments ranging from single-molecule imaging to extreme-timescale X-ray science. This issue is especially important at current-generation FELs, which are primarily based on self-amplified spontaneous emission and radiate with parameters that fluctuate strongly from pulse to pulse. Using single-cycle terahertz pulses from an optical laser, we have extended the streaking techniques of attosecond metrology to measure the temporal profile of individual FEL pulses with 5 fs full-width at half-maximum accuracy, as well as their arrival on a time base synchronized to the external laser to within 6 fs r.m.s. Optical laser-driven terahertz streaking can be utilized at any X-ray photon energy and is non-invasive, allowing it to be incorporated into any pump-probe experiment, eventually characterizing pulses before and after interaction with most sample environments.
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