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Steven Cundiff

JILA and the University of Colorado, Boulder

Femtosecond Comb Technology

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Abstract

A mode-locked laser generates a regular train of ultrashort pulses. The optical spectrum of such a pulse train is a comb of equally spaced sharp lines, but only if carrier-envelope phase coherence is maintained. Over the last five years, techniques have been developed to measure and control the optical comb spectrum of mode-locked lasers. These techniques offer a simple route to connecting radio and optical frequencies, which has revolutionized the field of optical frequency metrology and enabled optical atomic clocks. As controlling the comb spectrum is equivalent to controlling the electric field of the pulses, these developments have also had a dramatic impact in high field physics, where processes occur that are directly sensitive to the electric field of light. After introducing the basic concepts of femtosecond comb technology and briefly reviewing some of the advances, I will present recent results on how quantum interference control of injected photocurrents in a semiconductor can be used for a carrier-envelope-phase-sensitive detector. I will also discuss applications of mode-locked lasers to time/frequency transfer over optical fiber.