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Dephasingless two-color terahertz generation

A laser pulse composed of a fundamental and an appropriately phased second harmonic can drive a time-dependent current of photoionized electrons that generates broadband THz radiation. Over the propagation distances relevant to many experiments, dispersion causes the relative phase between the harmonics to evolve. This "dephasing" slows the accumulation of THz energy and results in a multi-cycle THz pulse with significant angular dispersion. Here, we introduce a novel optical configuration that compensates the relative phase evolution, allowing for the formation of a half-cycle THz pulse with almost no angular dispersion. The configuration uses the spherical aberration of an axilens to map a prescribed radial phase variation in the near field to a desired longitudinal phase variation in the far field. Simulations that combine this configuration with an ultrashort flying focus demonstrate the formation of a half-cycle THz pulse with a controlled emission angle and 1/4 the angular divergence of the multi-cycle pulse created by a conventional optical configuration.

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