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Quasi Phase Matching and Quantum Path Control of High Harmonic Generation using Counterpropagating Light[1] XIAOSHI ZHANG, AMY LYTLE, OREN COHEN, HENRY KAPTEYN, MARGARET MURNANE, JILA, UNIVERSITY OF COLORADO, BOULDER TEAM — We demonstrate the first use of a 3-pulse train of counterpropagating pulses to enhance the coherent upconversion of an intense ultrashort laser pulse into the extreme ultraviolet region of the spectrum. This all-optical quasi-phase-matching technique uses interfering beams to scramble the quantum phase of the generated high-order harmonics, to suppress emission from out-of-phase regions. A wavelength selective enhancement in the flux of up to $\approx$ 300x is observed at photon energies around 70 eV in Argon, that cannot otherwise be phase matched. We also show that further very large enhancements are possible, presenting a real prospect for orders-of-magnitude improvement in coherent upconversion of lasers into the soft x-ray region of the spectrum. Finally we show that by adjusting the intensity of the counterpropagating light, we can selectively enhance different electron quantum path trajectories, demonstrating attosecond time-scale coherent control of the radiating electron wavefunction.

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