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Photon acceleration of high-intensity vector vortex beams into the extreme ultraviolet

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Extreme ultraviolet (XUV) light sources allow for the probing of bound electron dynamics on attosecond scales, interrogation of high-energy-density and warm dense matter, photolithography of nanometer-scale features, and access to novel regimes of strong-field quantum electrodynamics. Despite the importance of these applications, coherent XUV light sources remain relatively rare, and those that do exist are limited in their peak intensity and spatio-polarization structure. Here, we demonstrate that photon acceleration of optical laser pulses in the moving density gradient of an electron-beam-driven plasma wave can produce relativistically intense XUV laser pulses that preserve the spatio-polarization structure of the original pulse. Quasi-3D, boosted-frame particle-in-cell simulations show the formation of XUV attosecond vector vortex pulses with ~30-nm wavelengths, nearly flat phase fronts, and intensities exceeding 10^{21} W/cm^2.

Working group

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