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Multi-arm spiral electron vortices in multiphoton ionization by circularly polarized pulses[1] JEAN MARCEL NGOKO DJIOKAP, University of Nebraska-Lincoln, ALEXEI V. MEREMIANIN, NIKOLAI L. MANAKOV, Voronezh State University, SUXING HU, University of Rochester, LARS B. MADSEN, Aarhus University, ANTHONY F. STARACE, University of Nebraska-Lincoln
— Single ionization of helium by single-color two-photon absorption or two-color one-photon/two-photon absorption from two time-delayed circularly-polarized ultraviolet pulses are shown to produce ionized-electron momentum distributions in the polarization plane having respectively *even*-arm (*zero*- and *four*-start) or *odd*-arm (*one*- and *three*-start) spiral vortex structures. Results are obtained by both *ab initio* numerical solution of the six-dimensional two-electron time-dependent Schrödinger equation[2] and by perturbation theory. The *multi*-arm patterns are sensitive to the carrier frequencies, handedness, time-delay, and relative phase of the two pulses, allowing control of electron angular distributions. *Even*-arm spiral vortices have been observed in optics.[3] Thus, our *even*-arm spiral electron vortices are a dramatic example of wave-particle duality. Moreover, our *odd*-arm electron matter-wave vortices are consistent with recent findings [4] in strong-field physics.

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[4]C. A. Mancuso*et al.*, Phys. Rev. A **91**, 031402(R) (2015).

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