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Electron Matter-Wave Vortices in Double Photoionization of Helium by Attosecond Pulses[1] JEAN MARCEL NGOKO DJIOKAP, The 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, The University of Nebraska - Lincoln — Double photoionization of helium by a pair of time-delayed circularly-polarized attosecond pulses is shown to produce two-electron momentum distributions that exibit *two*-start spiral vortex structures. These structures originate from Ramsey interference of the created pair of two-electron wavepackets, each carrying a total angular momentum of unity. The predicted vortex-shaped patterns occur for any energy partitioning between electrons, and are exquisitely sensitive to the time delay between the two pulses, their relative phase, their ellipticity and handedness. Moreover, these kinds of vortices occur for both in-plane and out-of-plane detection geometries; however, they only take place when the angular separation $\hat{p}_1 \cdot \hat{p}_2$ between the electron momenta is held fixed. Our results are obtained by solving *ab initio* the seven-dimensional two-electron time-dependent Schrödinger equation and are analyzed using a perturbation theory. Such vortices are thus general phenomena, as similar patterns have been reported following single-electron ionization in both atomic[2] and molecular[3] processes.

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[2]J.M. Ngoko Djiokap *et al.*, Phys. Rev. Lett. **115**, 113004 (2015).
[3]K.-J. Yuan *et al.*, Phys. Rev. A **93**, 053425 (2016).

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