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Attosecond Electron Interferometry[1]

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Attosecond optical pulse generation is electron interferometry. Quantum mechanical tunnelling in an intense laser field splits the electron. After tunnelling, one component of the electron wave function is accelerated away from the ion by the laser field, but returns once the field reverses its sign. The other component remains bound to the ion. These two paths form the two arms of the interferometer. When the two components of the electron wave function overlap, they interfere. The interference leads to an oscillating dipole that produces attosecond optical pulses and simultaneously images molecular orbitals. Interferometry allows sub-wavelength changes in the length of one arm to be measured relative to another. Using rotational wave packets, we show that the high harmonics are very sensitivity to very small molecular motion and local fields. We adapt transient grating spectroscopy with two or more grating elements to observe phase changes to the high harmonics as we rotate a molecule.

[1]In collaboration with Y. Mairesse, N. Dudovich, and D. M. Villeneuve.