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Control of Attosecond Electron Diffraction by Elliptical Long-Wavelength Radiation PREDRAG RANITOVIC, ELI-ALPS, ELI-Hu Nkft, Dugonics ter 13, Szeged H6720, Hungary, XIAO-MIN TONG, Division of Materials Science, Faculty of Pure and Applied Science, University of Tsukuba, Ibaraki 305-8573, Japan, DANIEL HICKSTEIN, MARGARET MURNANE, HENRY KAPTEYN, JILA and Department of Physics, University of Colorado and NIST, Boulder, CO 80309, USA — Generation of intense laser pulses in the mid-IR regime, has opened door for several novel applications in the ultrafast AMO physics. Attosecond electron diffraction and holography, driven by the mid-IR radiation is one example of these new developments. In this work we utilize a broad range of laser wavelengths (267 to 2000 nm) in a strong-field regime, to obtain holographic 2D images of electrons diffracting off small atoms and molecules. By comparing 2D electron momenta taken with different laser wavelengths, using a VMI geometry, we found that for the long-wavelength laser pulses (1.3 and 2 um), the main features in the electron momenta come from the interference of the plane, and spherical electron wave packets diffracting off the parent ion. By controlling the ellipticity of the driving laser fields, we were able to tune the returning electron direction, and in turn the amplitudes of the diffracting spherical electron wave packets that carry the information of the electron-ion differential cross sections. In this combined theoretical and experimental work we showed how to control the amplitudes and the phases of these rescattering electron wave packets, and how to use this method to image matter with attosecond temporal and Angstrom spatial resolution.

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