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Multi-photon resonant effects in strong-field ionization: origin of the dip in experimental longitudinal momentum distributions IGOR LITVINYUK, ALI ALNASER, CHAKRA-MAN MAHARJAN, PENGQUIAN WANG, LEW COCKE, J.R. Macdonald Laboratory, Kansas State University —
We studied ionization of neon and argon by intense linearly polarized femtosecond laser pulses of different wavelengths (400 nm, 800 nm and 1800 nm) and peak intensities, by measuring momentum distributions of singly charged positive ions in the direction parallel to laser polarization. For Ne the momentum distributions exhibited a characteristic dip at zero momentum at 800 nm, a complex multi-peak structure at 400 nm and no structure at 1800 nm. Similarly, for Ar the momentum distributions evolved from complex multi-peak structure (400 nm) to a smooth distribution characteristic of pure tunneling ionization (800 nm high intensities and 1800 nm). In the intermediate regime (800 nm, medium to low intensities), for both molecules we observed recoil ion momentum distributions modulated by quasi-periodic structures usually seen in the photoelectron energy spectra in multi-photon regime (ATI spectra). Ne did show a characteristic "dip" at low momentum, while longitudinal momentum distribution for Ar exhibited a spike at zero momentum instead. Based on our results, we conclude that the structures, observed in Ne and Ar momentum distributions, reflect the specifics of atomic structure of the two targets and should not be attributed to effects of electron re-collision, as was suggested earlier. Instead, as our results indicate, they are due to effects of multi-photon resonant enhancement of strong-field ionization.

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