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**Strong field atomic physics at mid-infrared wavelengths**[1]

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The development of intense, ultrafast laser sources in the mid-infrared (1 $\mu$m $< \quad \lambda \quad <$ 5 $\mu$m) region enables new opportunities in strong-field physics, control of electronic motion and attosecond science. Systematic investigations of the wavelength scaling in this region pave the way to the realization of brighter and shorter attosecond light sources using longer-wavelength driving fields. We will discuss two aspects of mid-infrared laser-atom interaction. First, high harmonic generation leading to intense, ultrashort XUV pulses and attophysics have properties which scale favorably in the mid-infrared. One of them is the group delay dispersion, also known as attochirp, of harmonics generated in gases. It has been identified as the main intrinsic limitation to the duration of Fourier-synthesized attosecond pulses. Theory implies that the attochirp can be decreased at longer wavelength. I will discuss the first measurement of the wavelength dependence of the attochirp and show that a 2 $\mu$m driving wavelength reduces the attochirp with respect to 0.8 $\mu$m at comparable intensities, as predicted . Second, we have revisited strong field ionization of atoms, of which, over the past thirty years, extensive studies have revealed both quantum and classical aspects: the electron wavepacket drift, quiver and rescattering motions lead to a seemingly complete picture of the fundamental laser-atom interaction. The photoelectron energy spectra (Above-threshold Ionization) are thus very well understood. However, with long wavelength (mid-infrared) lasers, an effect which appears to have eluded observation so far is revealed: the photoelectron energy distribution manifests an unexpected characteristic spike-like structure at low energy. This feature, observed in all investigated atoms and molecules, appears universal. Although the structure is qualitatively reproduced by numerical solutions of the time-dependent Schrödinger equation, its physical origin is not yet identified. If, of course, the non-relativistic Schrödinger equation appears to be numerically correct, the observed feature does not fit in the well established picture which provides a clear classical foundation to strong field atomic ionization.

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