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Time-dependent theory of resonance fluorescence for ultrafast and ultraintense x rays[1] STEFANO M. CAVALETTO, ZOLTÁN HARMAN, CHRISTOPH H. KEITEL, Max-Planck-Institut fuer Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany, CHRISTIAN BUTH, Argonne National Laboratory, Argonne, Illinois 60439, USA — The recent development of intense sources of coherent x-ray radiation such as the Linac Coherent Light Source (LCLS) in Menlo Park, California, USA, provides one with an unprecedented way to study nonlinear physics at short wavelengths. In this regard, resonance fluorescence, i.e. the spectrum of photons scattered off atoms and molecules driven by a near-resonant electric field, is expected to play a decisive role. We compute the time-dependent spectrum of resonance fluorescence of a two-level system excited by an ultrashort pulse. We allow for inner-shell hole decay widths and destruction of the system by further photoionization. This two-level description is employed to model neon cations strongly driven by LCLS light tuned to the $1s\,2p^{-1} \to 1s^{-1}\,2p$ transition at 848 eV: x rays induce Rabi oscillations which are so fast that they compete with Ne $1s$-hole decay. First, we predict resonance fluorescence spectra for chaotic pulses generated at present-day LCLS; second, we explore the exciting novel opportunities offered by Gaussian pulses which will become available in the foreseeable future with self-seeding techniques. In the latter case, we predict a clear signature of Rabi flopping in the spectrum of resonance fluorescence.

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