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X-ray resonance fluorescence and Rabi flopping for ultrafast and ultraintense pulses[1] STEFANO M. CAVALETTO, ZOLTÁN HARMAN, CHRISTOPH H. KEITEL, Max-Planck-Institut fuer Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany, CHRISTIAN BUTH, ELLIOT P. KANTER, LINDA YOUNG, STEPHEN H. SOUTHWORTH, Argonne National Laboratory, Argonne, Illinois 60439, USA — Resonance fluorescence is scattering of photons off atoms and molecules driven by a near-resonant external electric field; it is a cornerstone of spectroscopy and quantum optics. For intense x rays from existing and upcoming x-ray free electron lasers (FELs) such as the Linac Coherent Light Source (LCLS) in Menlo Park, California, USA, the cyclic excitation and decay of a core electron (Rabi flopping) can compete with spontaneous core-hole decay. We develop a two-level description of x-ray resonance fluorescence and exemplify it for neon cations strongly driven by LCLS light tuned to the $1s\,2p^{-1} \rightarrow 1s^{-1}\,2p$ transition at 848 eV. We compute the time-dependent spectrum of resonance fluorescence in order to study the coherent and fundamentally nonlinear process of Rabi flopping at x-ray frequencies. We predict resonance fluorescence spectra for two different scenarios: first, chaotic pulses generated at present-day LCLS and, second, Gaussian pulses which will become available soon with self-seeding techniques. In the latter case, as an example of the exciting opportunities deriving from the use of seeding methods, we predict a clear signature of Rabi flopping in the spectrum of resonance fluorescence.

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Stefano M. Cavaletto
Max-Planck-Institut fuer Kernphysik,
Saupfercheckweg 1, 69117 Heidelberg, Germany

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