Abstract Submitted
for the DAMOP07 Meeting of
The American Physical Society

Experimental nonlinear studies of atoms and molecules with an intense VUV-photon source. JEROEN VAN TILBORG, TOM ALLISON, MARCUS HERTLEIN, THORSTEN WEBER, ANDREW AQUILA, Lawrence Berkeley National Laboratory, SASA BAJT, Lawrence Livermore National Laboratory, ROGER FALCONE, ALI BELKACEM, Lawrence Berkeley National Laboratory — Photons of energy in the 30-100 eV range can interact with core electronic states in atoms and small molecules. Through high-harmonic generation (HHG) by a terawatt near-infrared laser, such photons can now be delivered as energetic and ultra-short pulses (>10 nJ in <50 fs). After focusing of such VUV pulses, peak intensities can reach 10^{13}-10^{14} W/cm^2, enabling nonlinear processes such as two-photon absorption to become detectable. In addition, intrinsic synchronization between laser and VUV photons allows for ultra-fast pump-probe experiments. The challenge in realizing these high harmonic pulses lays in phase matching, source optimization, separation of laser- and VUV-pulse, and their spectral and spatial characterization. Detailed information about these issues and their solution at LBNL will be presented On the application side, the latest results as well as planned experiments will be discussed. Such experiments include two-photon absorption of core electrons in Xenon, where a quadrupole giant resonance is expected, and two-photon double-ionization experiments on atoms and molecules.

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Date submitted: 02 Feb 2007 Electronic form version 1.4