Intense Attosecond Pulses

P. Tzallas[1], E. Benis[1], E. Skatzakis[1,2], Y. Nimura[3], G.D. Tsakiris[3] and D. Charalambidis[1,2]

[1]FORTH-IESL, PO Box 1527, GR711 10 Heraklion, Greece
[2]Department of Physics, Univ. of Crete, PO Box 2208, GR71003 Heraklion, Greece
[3]Max-Planck-Institut für Quantenoptik, D-85748 Garching, Germany

We report on recent results in the generation of high peak power XUV radiation, depicting sub-fs temporal confinement. The research is targeting XUV intensities, high enough to induce clearly observable non-linear XUV processes. Such processes are considered as pivotal for both the temporal characterization of attosecond pulses, as well as for the investigation of ultrafast dynamics in the XUV spectral region.

The main barrier in increasing the XUV peak power is the depletion of the generating medium, due to ionization saturation. In media suffering depletion, this barrier can be partially overcome in loose-focusing geometries, thus maintaining high driving energies, while intensities remain below saturation. This approach has led to the demonstration of a number of non-linear XUV processes and applications induced by attosecond pulse trains or individual harmonics [1-5].

In non-depleting media, there is in principle no limitation on the driving intensity. A highly promising such medium is the laser driven surface plasma. Recently, surface plasma harmonics in the spectral region 12eV-21eV have been measured to have an energy content of 40μJ at the source [6]. This energy is more than one order of magnitude higher than that of harmonics emitted by ionizing gaseous media. The superposition of these harmonics has been further successfully 2nd-order autocorrelated and a sub-fs temporal confinement in the pulse train has been deduced from the measured trace [6].

Current efforts are focusing on merging the "isolated pulse" and "intense pulse" characteristics. Towards this goal the highly promising method of the Interferometric Polarization Gating (IPG) has been recently successfully implemented [7]. By this technique, utilizing many cycle, high peak power driving laser pulses, a 40eV broad super continuum, extending down to 15nm, with an energy content of 20nJ has been measured [8]. Those are parameters that will enable the observation of a two-XUV-photon transition induced by an isolated attosecond pulse.

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