Dynamical control of the resonant interaction: 
towards new x-ray sources

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We discuss the possibilities to dynamically control an interaction of high-frequency radiation with a resonant medium (atomic and nuclear transitions in gases, plasmas or solids) by variation in time and in space of the parameters of such interaction under the action of the sufficiently strong far-off-resonant low-frequency field.

We review a recent advantage on the way to coherent intense attosecond sources in the soft-x-ray range and suggest two paths towards intense coherent sub-femtosecond pulses in the soft-x-ray range, namely: (i) time-compression of ps radiation of the x-ray plasma lasers without essential loss of the energy; (ii) amplification of the high-harmonic radiation. We show that both paths can be implemented using essentially the same technique, namely, modulation of the resonantly absorbing/amplifying medium by a moderately strong IR/optical field [1,2].

We discuss also application of such dynamical control for spectral enhancement of the XFELs radiation, manipulation of the waveforms of the individual hard x-ray photons, new techniques of quantum atomic-optical and x-rays-nuclear memories, etc.