Towards generation of sub-fs pulses using lasing to ground states of H-like LiIII at 13.5nm and He-like CV at 4nm

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Abstracts: *The method to generate sub-fs pulses in the process of x-ray plasma lasing from the first excited to the ground state is suggested. The method is based on adiabatic modulation of an upper lasing state under the action of an external IR field of a moderately strong intensity. The possibility to produce sub-fs pulses in H-like LiIII at 13.5nm and He-like CV at 4nm is theoretically shown.*

Sub-femtosecond XUV pulses provide a unique combination of high spatial and time resolution. Modern table-top plasma lasers are able to generate quite high energy (in the μJ up to several mJ range) soft X-ray pulses, but with relatively long duration in the range of few picoseconds. Thus, a highly efficient method of transformation of an output pulse of X-ray laser into the sub-fs pulses would be desirable. The water window wavelength range 2.3-4.4nm is of particular interest for applications.

Recently the technique for an efficient conversion of the quasi-monochromatic XUV field into the train of ultrashort pulses in the resonant absorbing medium of the H-like ions was suggested [1,2]. It is based on space-time modulation of the atomic levels of the first excited atomic state via the adiabatic (quasi-static) linear Stark effect caused by application of an external IR field. In this report we show that using of an IR field with the wavelength 2000nm and intensity $3.6 \times 10^{14} W/cm^2$ under the experimental conditions described in [3], where lasing in H-like LiIII at 13.5nm was demonstrated, may result in formation of a train of 0.9 fs pulses. We show also that the technique of an excited state modulation by an IR field can be generalized to the case of He-like ions, providing the possibility for formation of the sub-fs pulses in the process of lasing in He-like CV at 4nm.

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