Pumping dynamics of XUV laser plasma amplifiers – towards the GW coherent pulses

M. Kozlová[1,2], M. Krůs[1]

[1] Institute of Plasma Physics CAS, Za Slovankou 1782/3, 182 00 Prague, Czech Republic

[2] Institute of Physics CAS, Na Slovance 1999/2, 182 21 Prague, Czech Republic

Plasma based XUV laser amplifiers represent promising path to generation of high intense, high brightness pulses of XUV fully coherent radiation delivering up to 10^{15} photons in a pulse (being about two orders of magnitude higher than at free-electron lasers). The successful implementation of the amplification scheme is dependent on the pumping dynamics of the amplification medium. Within this work, we will present the study of the XUV radiation gain as a function of the temporal properties of the pumping infrared lasers. The presented experiment was focused on the generation of the Ne-like ions (Ti and Fe) XUV laser radiation (32.6 nm and 25.5 nm, respectively). Within the experiment, the two-pulse scheme (prepulse and main pulse) was adopted. The population inversion is produced between $2p^5 3p$ and $2p^5 3s$ fine-structure levels of Ne-like ions, through electron collisional excitation from the Ne-like ground state $2p^6$. The inversion is maintained by strong radiative dipole decay from the 3s levels back to the ground state while the upper 3p levels are metastable with respect to this process. The intensity, gain and beam profile emitted by this type of XUV laser radiation strongly depends on the density profile of the amplifying plasma, as the largest population inversion on the $J = 0 \rightarrow 1$ transition occurs at high electron densities. Hence various laser beam parameters (i. e. intensity ratio, delay between pulses etc.) were investigated. The main focus was to study the dependence between the XUV laser radiation and the pulse duration of the driving laser beam, especially the leading-edge of the pulse.