Towards the gigawatt peak power radiation from plasma based amplifiers in soft X-ray range

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One of the major success of high-power infrared laser application are soft X-ray lasers from laser driven plasmas. Depending on target material, which can be easily ionized to neon-like or nickel-like ionization state, lasing in the range from few nanometers up to dozens of nanometers occurring along the generated plasma column. Over past two decades our effort was dedicated to the development of such coherent short wavelength radiation sources. Within this presentation, the main mechanisms of soft X-ray wavelength generation will be discussed; this includes the high order harmonics generation, transient and quasi steady state plasma X-ray laser from solid targets. The main goal of our research is to boost the output power of these secondary sources. Besides the optimization of each individual source, we are focused on to combine them together to construct the X-ray laser chain delivering the high energy pulses with the narrowly collimated coherent beam.