Progress on Optical-Field Ionisation soft x-ray lasers at LOA

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We report here recent work on an optical-field ionized (OFI), high-order harmonic-seeded EUV laser. The amplifying medium is a plasma of nickel-like krypton [1] obtained by optical field ionization focusing a 1 J, 30 fs, circularly- polarized, infrared pulse into a krypton-filled gas cell or krypton gas jet. The lasing transition is the $3d^9 4p$ (J=0) $\longrightarrow$ $3d^9 4p$ (J=1) transition of Ni-like krypton ions at 32.8 nm and is pumped by collisions with hot electrons.

The polarization of the HH-seeded EUV laser beam was studied using an analyzer composed of three grazing incidence EUV multilayer mirrors able to spin under vacuum [2]. For linear polarization, the Malus law has been recovered while in the case of a circularly-polarized seed, the EUV signal is insensitive to the rotation of the analyzer, bearing testimony to circularly polarized.

The gain dynamics was probed by seeding the amplifier with a high-order harmonic pulse at different delays [3]. The gain duration monotonically decreased from 7 ps to an unprecedented shortness of 450 fs FWHM as the amplification peak rose from 150 to 1,200 with an increase of the plasma density from 3×10^{18} cm^{-3} up to 1.2×10^{20} cm^{-3}. The integrated energy of the EUV laser pulse was also measured, and found to be around 2 μJ. It is to be noted that in the ASE mode, longer amplifiers were achieved (up to 3 cm), yielding EUV outputs up to 14 μJ.

References

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