Investigation of ultrashort, partially coherent XUV lasers operated in the ASE mode.

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XUV lasers pumped by collisional excitation of Ni-like and Ne-like ions can be generated in several types of hot and dense plasmas, produced by different pulse pumping techniques. These techniques involve either a high-power laser with short (0,5 ns to few ps) to ultrashort (~30 fs) duration, or a fast (few ns) electrical discharge. The duration of the pump pulse largely controls the timescale of the resulting population inversion, which in turns controls the duration of the output XUV laser pulse generated from amplification of spontaneous emission (ASE). As a result the duration of currently available ASE collisional XUV lasers typically range between 2 ps to 1 ns. On the other hand the coherence time of these pulses is related to the spectral width of the XUV laser line, which was shown to vary over a much smaller range from one system to the other (typically $\Delta\nu \sim 10^{11}$-10^{12} Hz [1]). This means that the different types of ASE XUV lasers with different pulse durations also have significantly different temporal coherence properties, with a number of longitudinal modes ranging from ~2 to more than 500.

Using numerical simulations based either on a partial coherence model [2], or on the Maxwell-Bloch code COLAX [3] we have recently investigated how the number of longitudinal modes can influence the behaviour of the field autocorrelation, when measured by scanning the pulse delay in an interferometer. The results of this study will be discussed and compared with measurements available from the literature. The short pulse case, with few longitudinal modes, is shown to exhibit specific features, which are also encountered in free-electron lasers operated in the self-amplified spontaneous emission (SASE) mode.

1. A. Klisnick, A. Le Marec, L. Meng, O. Larroche, O. Guilbaud, M. Kozlova, J. Nejdl and A. Calisti, in X-Ray Lasers 2014, Springer Proceedings in Physics Vol. 169 (2015) 45
2. T. Pfeifer, Y. Jiang, S. Düsterer, R. Moshammer, and J. Ullrich, Opt. Lett. 35(20), 3441–3443 (2010).
3. O. Larroche, D. Ros, A. Klisnick, A. Sureau, C. Möller and H. Guennou, *Phys. Rev. A* **62**, 043815 (2000)