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A 52 W few-cycle OPCPA for soft X-ray generation

Femtosecond time-resolved soft X-ray spectroscopy (fs-SXS) offers unique insights into photo-physical and photo-chemical processes through its combination of element specificity and ultrafast time resolution. While sufficiently bright and short pulses of soft X-rays are available at a handful of free electron laser facilities worldwide, laser-based 'tabletop sources'have the potential to vastly expand the application space of fs-SXS. Such laser sources typically operate with wavelengths in the short-wave infrared (1.4 –3.0 µm, SWIR), in order to exploit the favorable wavelength scaling of the well-known High-order Harmonic Generation (HHG) cut-off law. However, the HHG conversion efficiency into the SXR is low, and applications have been limited by the photon fluxes in the SXR available in practice. It is therefore important to develop high-average power SWIR sources with millijoule-level pulse energies and femtosecond pulse durations (few-optical cycle pulses) to serve as HHG drivers [1 –3].

In this talk, we present a high-average-power (52 W in the amplified signal) optical parametric chirped pulse amplifier (OPCPA) generating pulses of 20 fs duration at a central wavelength of 2.1 µm [3]. Achieving this performance while maintaining overall system robustness and long-term stability required potentially deleterious effects due to the high peak and average powers to be overcome. In the first tests, the pulses were focused to an intensity of ~5 x 1014 W/cm2 in a high-pressure helium gas cell, yielding a low-divergence (< 2 mrad half-angle) broadband SXR emission extending up to 600 eV.

References

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