Multi-TW sub-3-cycle pulses at 1.7 μm by DC-OPA
: Towards GW-scale water window isolated attosecond pulse

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Recently, strong-field laser science has been experiencing a shift towards the use of infrared (IR) driving wavelengths, especially with high demand on high pulse energy. However, conventional optical parametric amplification (OPA) can generate only mJ class IR fs pulses. Recently, we circumvented the energy scaling difficulty in conventional OPA and obtained 100 mJ class IR pulses with multicycle durations using a dual-chirped optical parametric amplification (DC-OPA) method [1]. In this work, we aim to further shorten the pulse duration to a few-cycle for generating intense soft x-ray isolated attosecond pulses. Employing a BiBO crystal-based DC-OPA system, we obtained 32 mJ pulse energy with spectrum (1.3-2.1 μm) supporting sub-3-cycle pulse duration.

The detailed experimental setup can be found elsewhere [1]. Broadband 1.7 μm seed pulse with a stable carrier envelope phase (CEP) is obtained by broadening the spectrum of an idler pulse, which is generated by a conventional OPA via white-light continuum generation, using a multi-plate continuum method [2]. Then, the 1.7 μm broadband seed is amplified in a two stage noncollinear DC-OPA system which is pumped by a high energy 10 Hz Ti:sapphire laser. Type-I BIBO crystals with cutting angles of θ=11° are employed in the DC-OPA system. The thickness of crystals in the first and second stages was 6 mm and 4 mm, respectively. The output energy of the first stage DC-OPA is 1.1 mJ under 50 mJ pumping energy. In the second stage, the pulse is further amplified to 32 mJ under 185 mJ pumping energy. The spectrum is shown in Fig. 1(a), which support a transform-limited (TL) pulse duration of 15.7 fs as shown in Fig. 1(b), which contains sub-three cycles at 1.7 um. In the next work, we will further increase pulse energy approaching 100 mJ by increasing pump energy, and shorten its pulse duration up to sub-two cycles using a broader seed pulse. These pulses will be compressed by a high throughput bulk compressor (>95%),

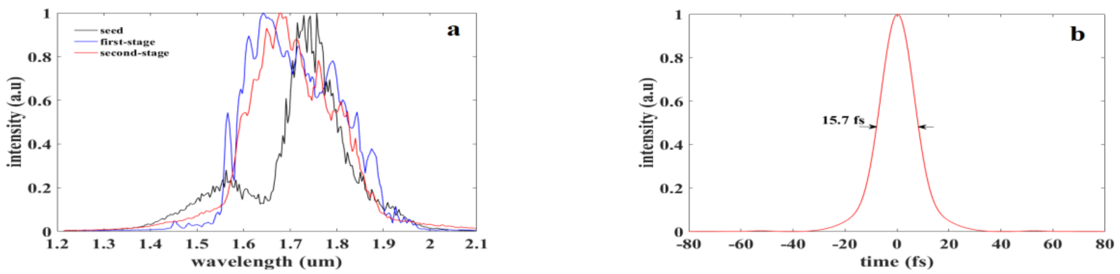

Fig.1 (a) the spectrum of seed, the first and second DC-OPA stage, respectively; (b) the TL pulse duration of the output.

resulting a multi-TW peak power.

Reference

1. Y. X. Fu, *et al.*, Sci. Rep. 8, 7692 (2018); 2. C. H. Lu, *et al.*, Optica, 6, 400 (2014).