Ytterbium based laser systems for High Energy and Peak-Power Applications

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Synopsis Light Conversion's femtosecond laser systems are pushing toward higher energy and peak power applications. Their high power and unmatched stability make them ideal for research in ultrafast phenomena.

Ytterbium (Yb) femtosecond lasers have been used for both scientific and industrial applications for over 20 years. Thanks to their high average power and high repetition rate together with industrial level reliability, Yb lasers have expanded the availability of ultrafast applications, such as ultrafast spectroscopy [1], multiphoton spectroscopy, non-destructive material modification studies or high fluence XUV applications. However, until now, Yb based lasers were limited in their output energy and peak power. There has been a certain parameter space that seemed to be reserved for Ti:Sapphire (Ti:Sa) amplifiers. In this talk, we will cover recent results of amplifying Yb lasers to multi-mJ-level pulse energies while maintaining high average power and short pulse duration.

We will present our capabilities to scale the Yb laser pulse energy up to 5 mJ, while keeping the pulse duration at less than 250 fs, sustaining a stable long-term average power, good beam direction stability, and excellent pulse-to-pulse energy stability. All while maintaining a footprint of an existing compact commercial laser platform. We will also present our recent developments in sub-100 fs Yb based amplifiers.

Furthermore, as large part of ultrafast scientific applications require wide wavelength tunability, we will showcase the results of coupling the forementioned laser to an optical parametric amplifier (OPA). More than decade ago OPAs for Ti:Sa have become synonymous with the ultrafast spectroscopy community but, since Yb-based OPAs have been shown to reach similar pulse energy with significantly higher average power and pulse repetition rate, thus increasing the photon flux, improving the signal-to-noise ratio (SNR), or simply decreasing the time the experiment takes [1, 2], larger and larger shift toward Yb based systems is observed.

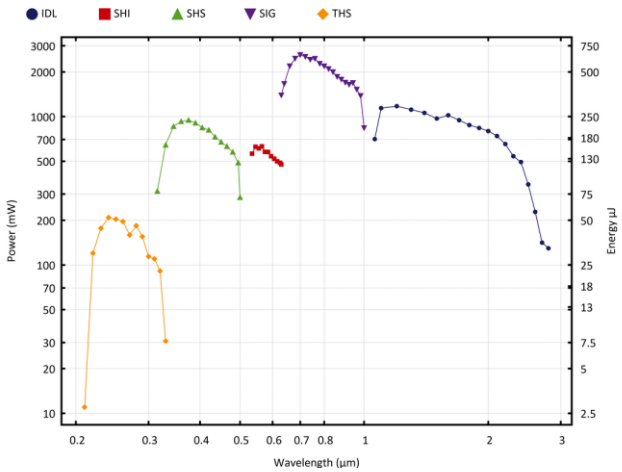

Figure 1. Optical parametric amplifier output power and energy vs. wavelength when pumped by 5mJ @ 20kHz, 250fs.

Finally, we will discuss the potential for coupling Yb laser output to optical parametric chirped-pulse amplification (OPCPA) systems or different pulse post-compression techniques [3] to obtain few-cycle optical pulses which are key for applications like High Harmonic Generation (HHG) or Laser Wakefield Acceleration (LWA).

References

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