ADVANCED ULTRAFAST LASERS FOR MULTIPHOTON MICROSCOPY

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Compact, fully automated, and widely wavelength-tunable femtosecond lasers are widely used in a broad array of multiphoton microscopy techniques. Laser manufacturers have constantly improved the performance characteristics of these sources to meet the requirements of the bio-imaging user community for improved cell viability and deeper tissue penetration.

This presentation will summarize the latest advances in the development of user-friendly and flexible sources for nonlinear and multimodal microscopy, and how they benefit the end user and progress application development. It will include an overview of automated and compact Ti:sapphire lasers plus accessories for extending their wavelength range, like OPO and supercontinuum sources for long wavelength imaging and CARS microscopy [1, 2]. Special focus will be on the Spectra-Physics® InSight™ compact and fully automated one-box ultrafast laser [3]. This latest source delivers from one output beam sub-120 femtosecond pulses, which are continuously wavelength-tunable from 680 nm to 1,300 nm. This 620 nm wide tuning range is about twice that of the Ti:sapphire lasers, which for more than two decades have been the workhorses in multiphoton microscopy. Most importantly, this new laser provides convenient access to the relative transparency window of tissue in vivo beyond 1,000 nm, where excitation photons experience a lower scatter and penetrate deeper [4]. Integrated, automated dispersion compensation allows for optimizing the pulse width within the specimen to further improve image quality and penetration depth. In addition, the laser features an optional second femtosecond output beam at 1,041 nm, which can be effectively utilized for dual-wavelength excitation and multimodal nonlinear imaging applications, including femtosecond CARS microscopy [5, 6].