

# Multiphoton microscopy in every lab: the promise of ultrafast semiconductor disk lasers

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**Abstract:** We use an ultrafast diode-pumped semiconductor disk laser (SDL) to demonstrate several applications in multiphoton microscopy. The ultrafast SDL is based on an optically pumped Vertical External Cavity Surface Emitting Laser (VECSEL) passively mode-locked with a semiconductor saturable absorber mirror (SESAM) and generates 170-fs pulses at a center wavelength of 1027 nm with a repetition rate of 1.63 GHz. We demonstrate the suitability of this laser for structural and functional multiphoton *in vivo* imaging in both *Drosophila* larvae and mice for a variety of fluorophores (including mKate2, tdTomato, Texas Red, OGB-1, and R-CaMP1.07) and for endogenous second-harmonic generation in muscle cell sarcomeres. We can demonstrate equivalent signal levels compared to a standard 80-MHz Ti:Sapphire laser when we increase the average power by a factor of 4.5 as predicted by theory. In addition, we compare the bleaching properties of both laser systems in fixed *Drosophila* larvae and find similar bleaching kinetics despite the large difference in pulse repetition rates. Our results highlight the great potential of ultrafast diode-pumped SDLs for creating a cost-efficient and compact alternative light source compared to standard Ti:Sapphire lasers for multiphoton imaging.

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The details of this presentation can be found in the following open-access article:

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