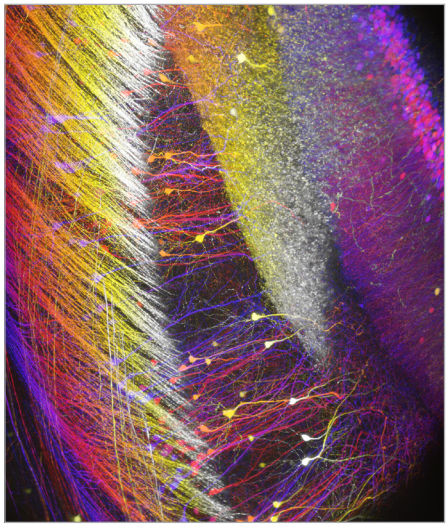
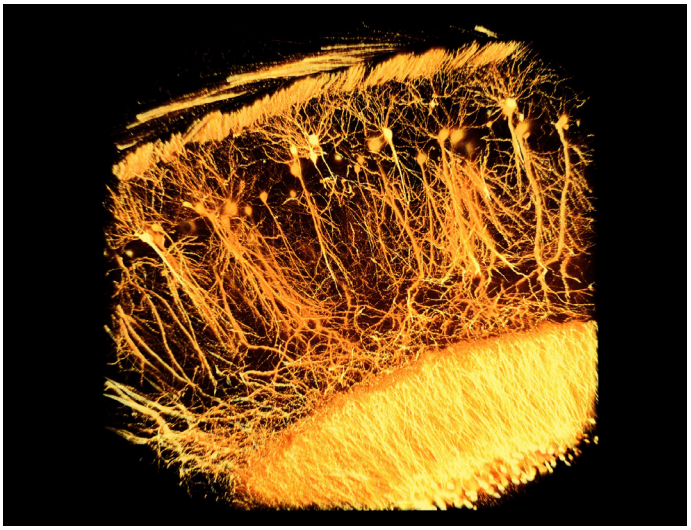
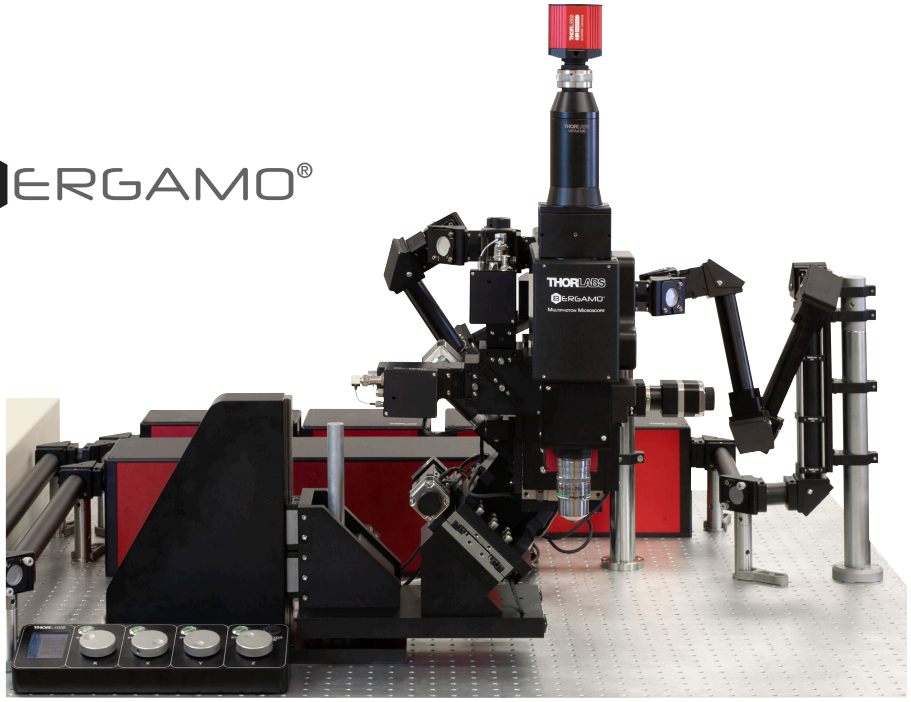
Multiphoton Imaging





BERGAMO®

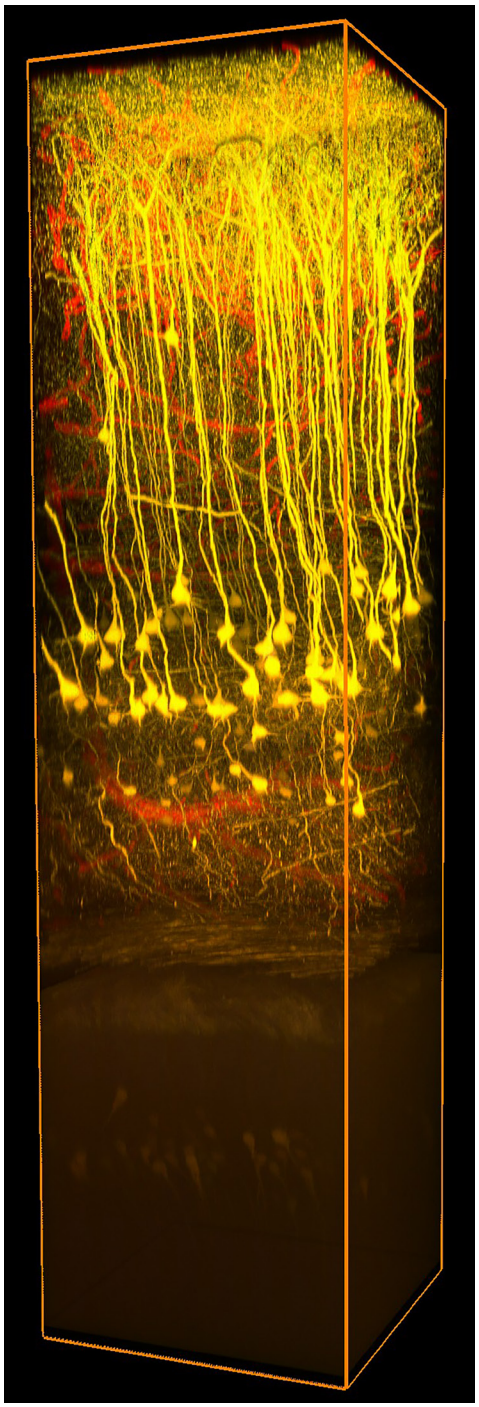


Bergamo® II: Versatile, High Performance Imaging Platforms

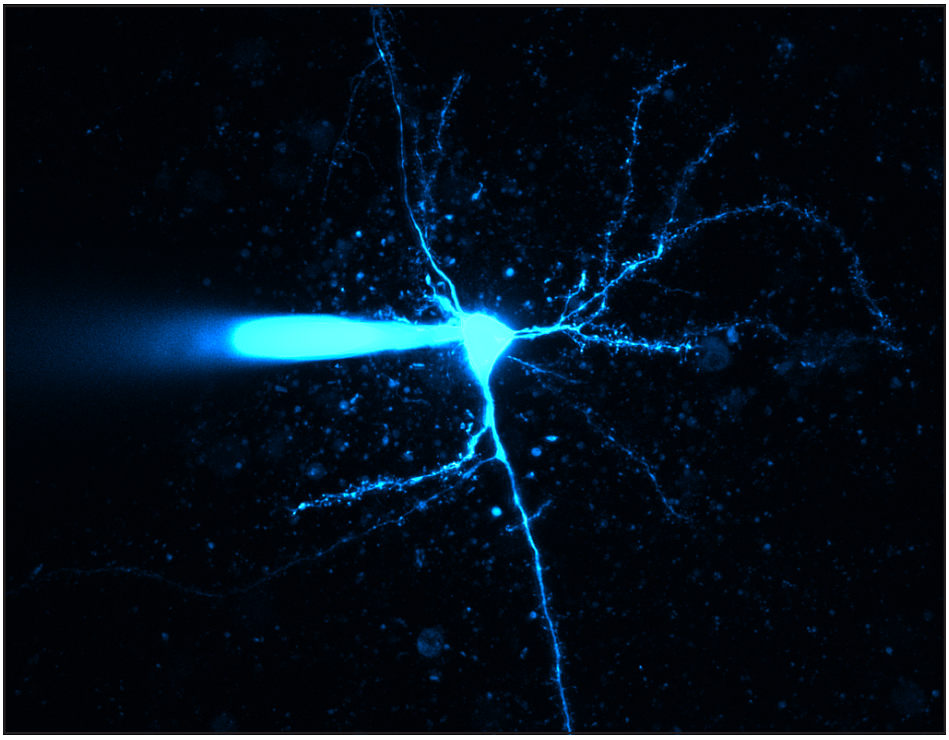
Backed by Thorlabs' skilled in-house team of optical, software, and applications engineers, Bergamo II multiphoton microscopes deliver exceptional performance and a seamless user experience.

Overview of Bergamo® II Microscopes

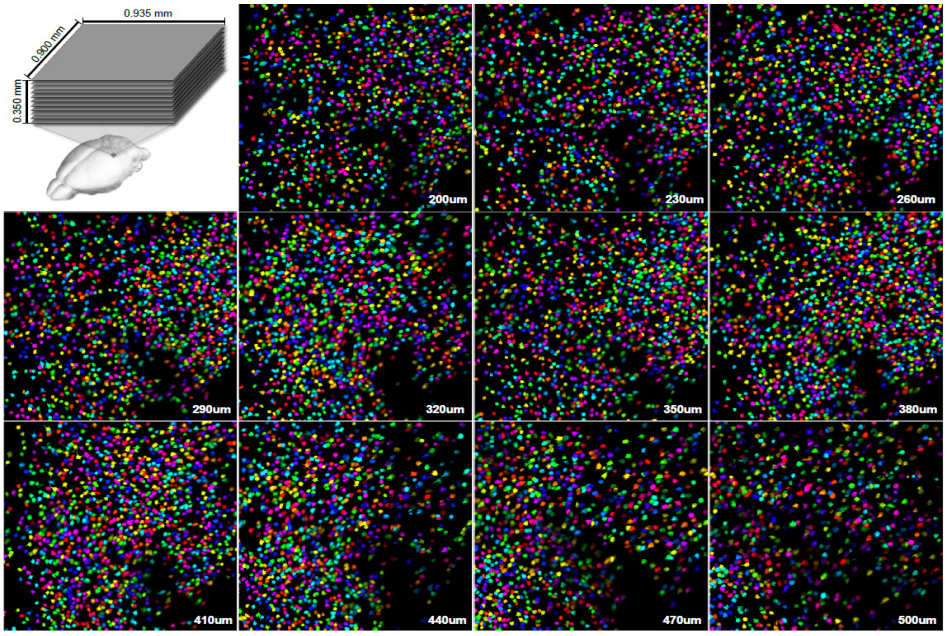
Following the principle that the microscope should conform to the specimen, rather than the other way around, we created the Bergamo II multiphoton imaging platform: a completely modular system that adapts to a wide range of experimental setups.



1.2 mm *In Vivo* Deep Brain Volume[a]



Establishing a Patch in a Neuron[b]

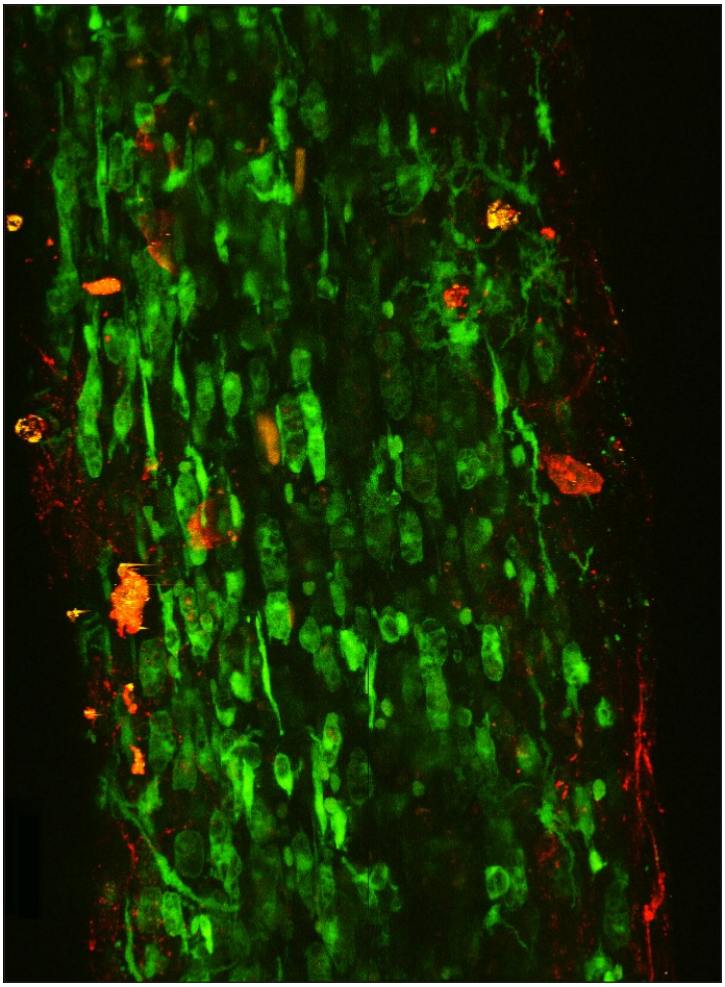


Simultaneous Detection of 10,000+ Neurons in an Awake, Behaving Mouse[c]

Image Credits

Cover Page Top Left: Two-photon image of neurons expressing thy1-YFP in a cleared region of the hippocampus. Courtesy of the 2017 Imaging Structure and Function in the Nervous System Course at Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.
Cover Page Top Right: Two-photon image of neurons expressing thy1-YFP in a cleared region of the dentate gyrus. Courtesy of the 2017 Imaging Structure and Function in the Nervous System Course at Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.

a. Courtesy of Dr. Hajime Hirase and Katsuya Ozawa, RIKEN Brain Institute, Wako, Japan.
b. Courtesy of the 2016 Neurobiology Course at the Marine Biological Laboratory, Woods Hole, MA.
c. Courtesy of Marius Pachitariu, Matteo Carandini, and Kenneth D. Harris, University College London, United Kingdom.



Activated Microglial Cells Expressing Transgenic YFP in an *Ex Vivo* Perfused Mouse Spinal Cord Section[d]

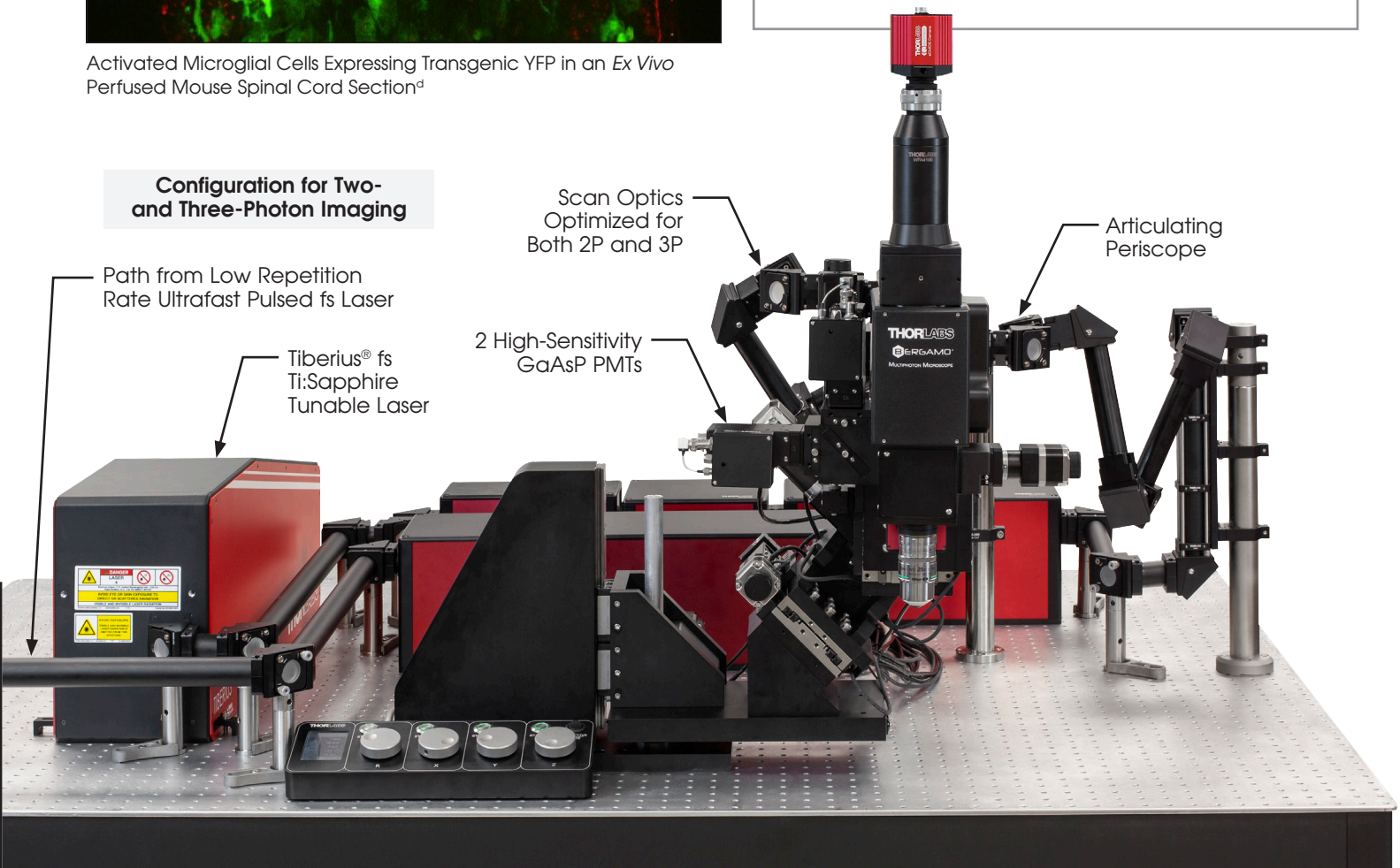
Techniques

- Two- and Three-Photon Imaging
- Photoactivation / Uncaging
- Multi-Target Photoactivation with Spatial Light Modulator
- Confocal Imaging
- DIC (Widefield and Laser Scanned)
- Dodt Gradient Contrast (Widefield and Laser Scanned)
- FRAP
- Fast Sequential Imaging
- Fast Functional Imaging
- Deep Brain Imaging
- Simultaneous Multi-Channel Detection
- Rapid Volumetric Imaging Using Bessel Beams

Applications

- Structural Neurobiology
- Neurological Disorders
- Neural Development and Plasticity
- Neurogenetics
- Functional and Molecular Imaging
- Synapses and Circuits
- Ion Channels, Transporters, and Neurotransmitter Reporters
- Cell Biology of Neurons, Muscles, and Glia
- Drug Discovery

Configuration for Two- and Three-Photon Imaging



Other Highlighted Features & Upgrades

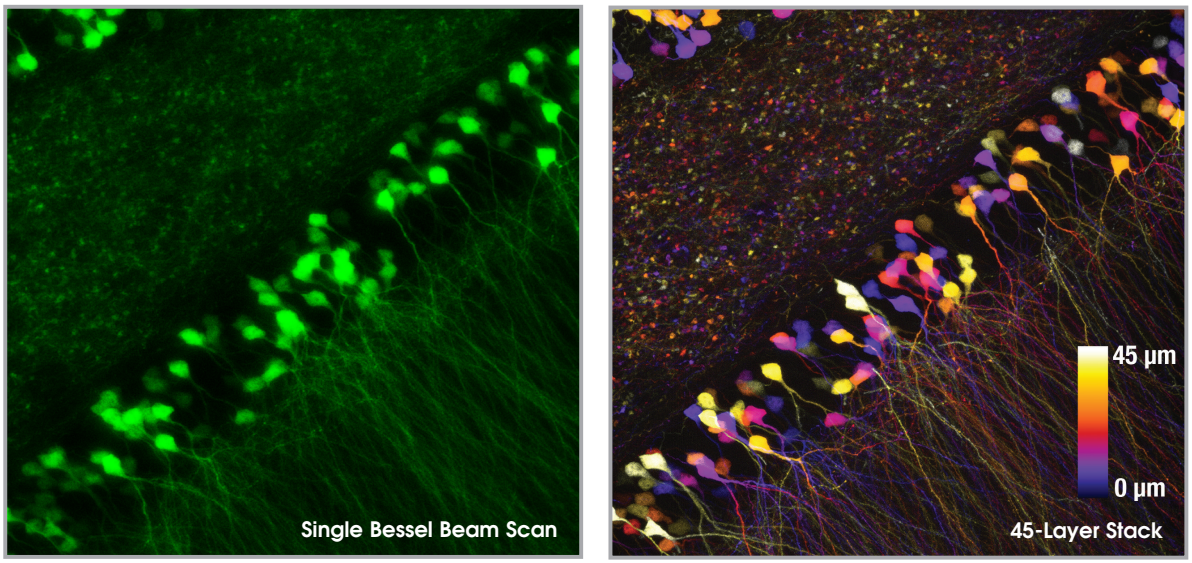
Our Bergamo® II microscopes are modular systems that can be customized in the design process to meet the exact needs of the experiment. The highlighted features below reflect our focus on developing cutting-edge capabilities without compromising usability.

Rapid Volumetric Imaging Using Bessel Beams

In partnership with the Howard Hughes Medical Institute and Prof. Na Ji (University of California at Berkeley), Thorlabs is offering a Bessel beam module for our Bergamo multiphoton laser scanning microscopes. As demonstrated in Ji's pioneering work[1], this rapid Bessel beam-based imaging technique has synaptic resolution, capturing Ca^{2+} dynamics and tuning properties of dendritic spines in mouse and ferret visual cortices.

In vivo volume imaging of neuronal activity requires both submicron spatial resolution and millisecond temporal resolution. While conventional methods create 3D images by serially scanning a diffraction-limited Gaussian beam, Bessel-beam-based multiphoton imaging relies on an axially elongated focus to capture volumetric images. The excitation beam's extended depth of field creates a 2D projection of a 3D volume, effectively converting the 2D frame rate into a 3D volumetric rate.

1. R. Lu et al., "Video-rate volumetric functional imaging of the brain at synaptic resolution," Nat. Neurosci. 20, 620 - 628 (2017).

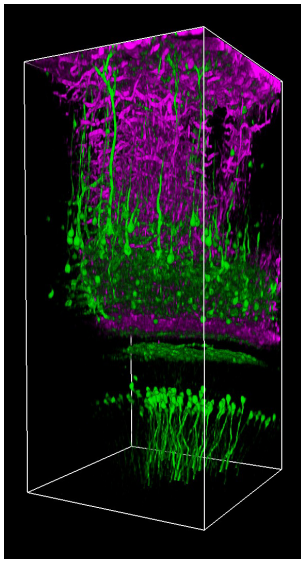


A single Bessel scan (left) captures the same structural information obtained from a Gaussian volume scan created by stacking 45 optical sections (right), reducing the total scan time by a factor of 45. The images show a brain slice scanned over a 300 µm x 300 µm area. Scan depth for the Gaussian stack is indicated by the scale bar.[e]

Three-Photon Imaging

We have developed scan path optics for the 800 - 1800 nm range in response to requests from our collaborators in the field. Extending deeper into the infrared than the existing choices, these scan optics open the door to three-photon techniques, which provide reduced background scatter for greater sensitivity in deep tissue imaging.

This wavelength range joins 450 - 1100 nm and 680 - 1300 nm as one of the three super broadband options available for newly ordered Bergamo II microscopes.

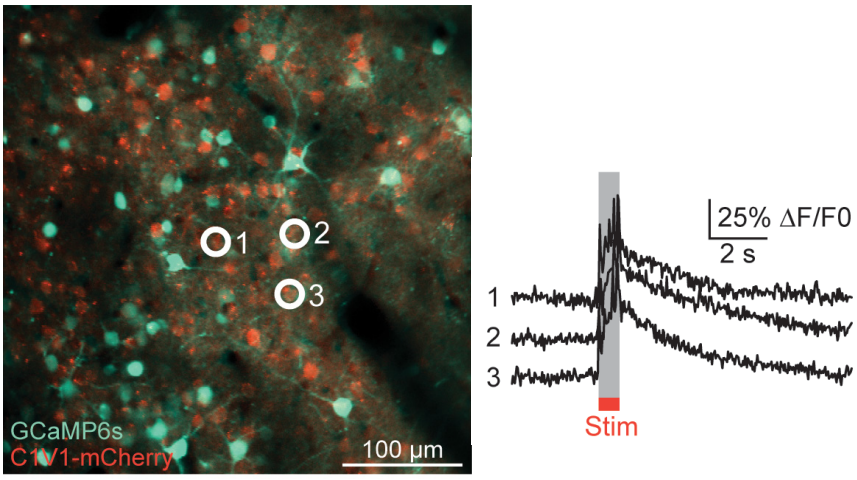


Thy1-YFP male mouse, 21 weeks old, imaged at 1300 nm, 326 kHz repetition rate, pulse width ~60 fs. At the top of the cortex (0 µm, 1.1 mW laser power), the window was centered at 2.5 mm lateral and 2 mm posterior from the Bregma point over somatosensory cortex.[f]

Spatial Light Modulator for Simultaneous Multi-Site Activation

Thorlabs' Spatial Light Modulator (SLM) uses holography patterns to enable photoactivation of multiple locations in a specimen simultaneously. Designed for two-photon excitation with femtosecond pulses, the SLM manipulates the phase across the activation profile to generate hundreds of user-determined focal points. Each beam can be shaped to improve the efficacy of photoactivation, a crucial feature for activating neural populations at varying depths within a single FOV.

The SLM phase mask pattern can be rapidly switched, enabling multiple individual focal points to be targeted independently in any sequence. The calibration process, hologram generation, and external hardware synchronization are entirely managed through the ThorImage®LS software, enabling seamless control.



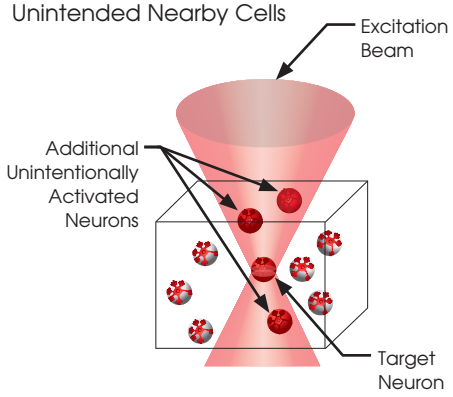
Photoactivation and Ca^{2+} Imaging of Three Cells using SLM[9]

Other Highlighted Features

- User-Installable Transmitted Light Imaging Tower for Rotating Bodies
- Piezo Objective Scanner Designed by Thorlabs
- Mechanical Shutters for 8° Collection Optics
- Translating Platform with Manual Actuators
- Conjugated Scanners for Pupil Relay
- Scientific-Grade Cameras with Color Sensors & USB 3.0 Connectors
- ThorSync™ Hardware Control Package

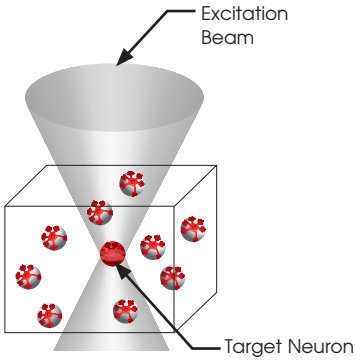
Single-Photon Activation

- Lack of Depth Control for 3D Neural Activation
- Activate Target Cell Along with Unintended Nearby Cells



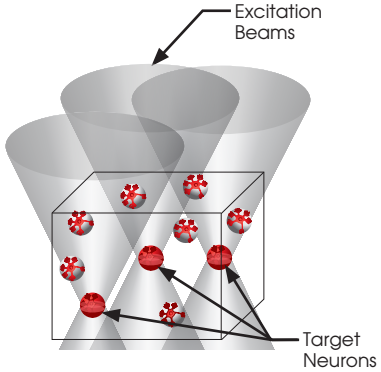
Two-Photon Activation

- Single-Cell Resolution Targeting
- Activate Only Target Cell



Two-Photon Activation + Spatial Light Modulator (SLM)

- Generate Multiple Focal Points
- Simultaneously Activate Multiple Target Cells

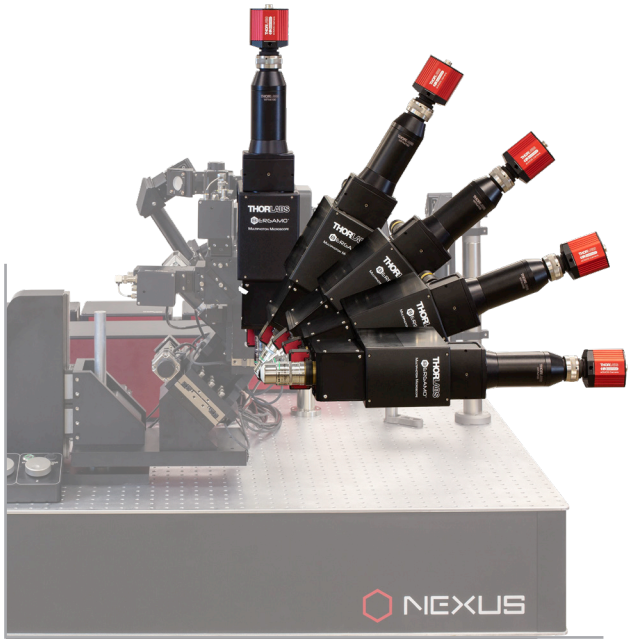


Two-photon activation with SLM allows simultaneous excitation of multiple target cells, which is not possible with single-photon (top) or two-photon (middle) activation.

Two Microscope Body Choices

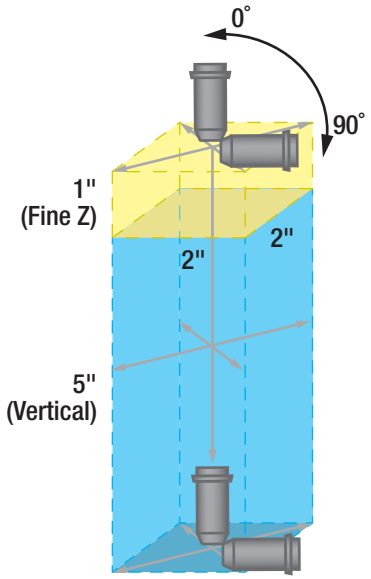
Rotating Bodies

Rotating Bergamo® II microscope bodies include five axes of motion, providing near-total freedom to study *in vivo* systems. Because the microscope body itself translates, the field of view can move without having to perturb the sample preparation.



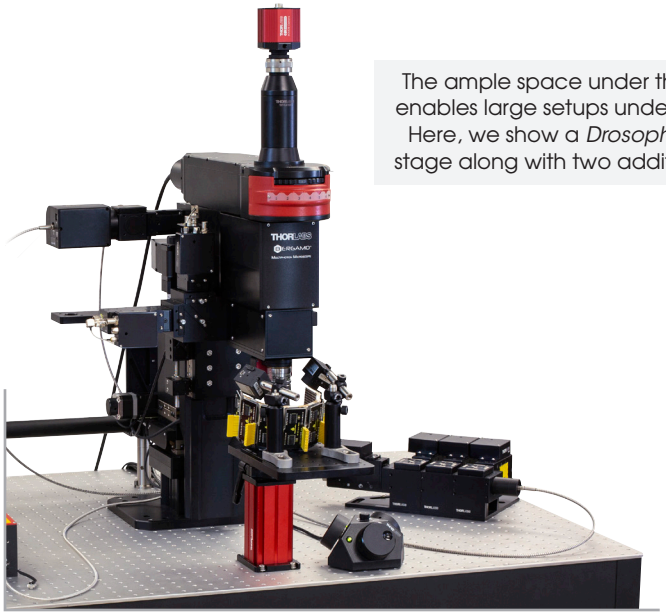
Range of Motion

- 5" of Coarse Vertical Motion
- 0° to 90° or -45° to 45° Rotation Around the Sample
- 2" of Fine and Coarse XY Motion
- 1" of Fine Z Motion
- X, Y, and Z Rotate with Objective
- **26+ Cubic Inches** (426+ Cubic Centimeters) of Accessible Objective Volume

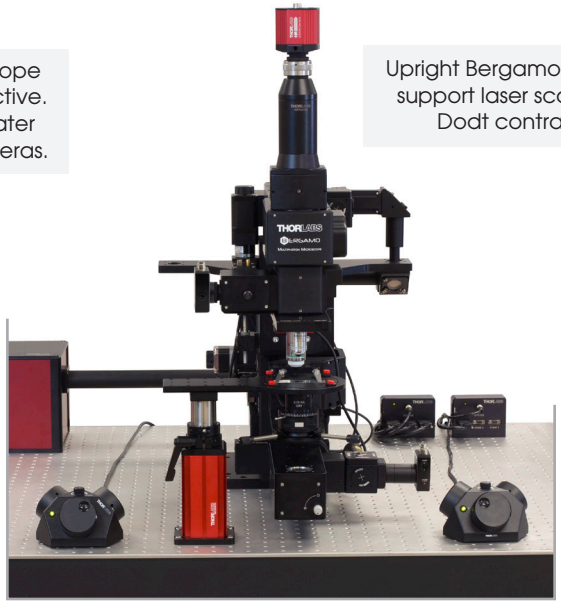


Upright Bodies

Upright Bergamo II microscope bodies include one or three axes of motion and an industry-leading throat depth, creating a large three-dimensional working volume around the objective and letting the user bring the objective to the experiment.



The ample space under the microscope enables large setups under the objective. Here, we show a *Drosophila* VR theater stage along with two additional cameras.



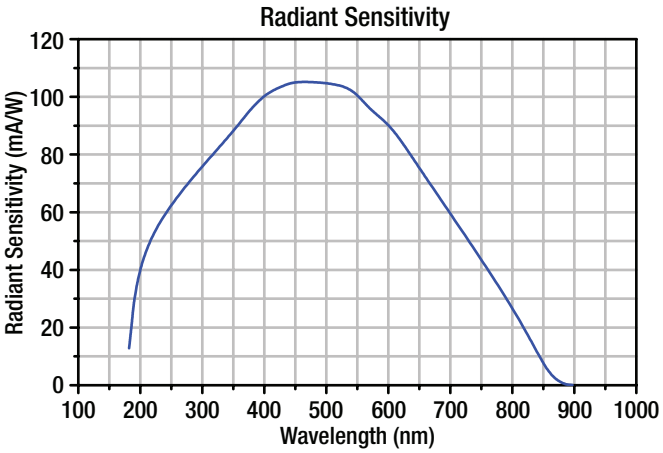
Upright Bergamo bodies support laser scanned Dodt contrast.

Versatile Photodetection Systems

Simultaneous Multi-Channel Detection

Bergamo II microscopes can collect signals from up to four PMT detection channels simultaneously. The ThorImage®LS software integrates with the PMT protection circuit to improve the detector's longevity, and mechanical shutters that shield the photocathode during photoactivation / uncaging are also available.

Magnetically secured filter holders are easily accessed from the front, making it simple to configure the rig for different fluorophores.



Our high-sensitivity GaAsP PMTs reduce the laser exposure necessary to obtain signal from sensitive specimens.

Detection Options

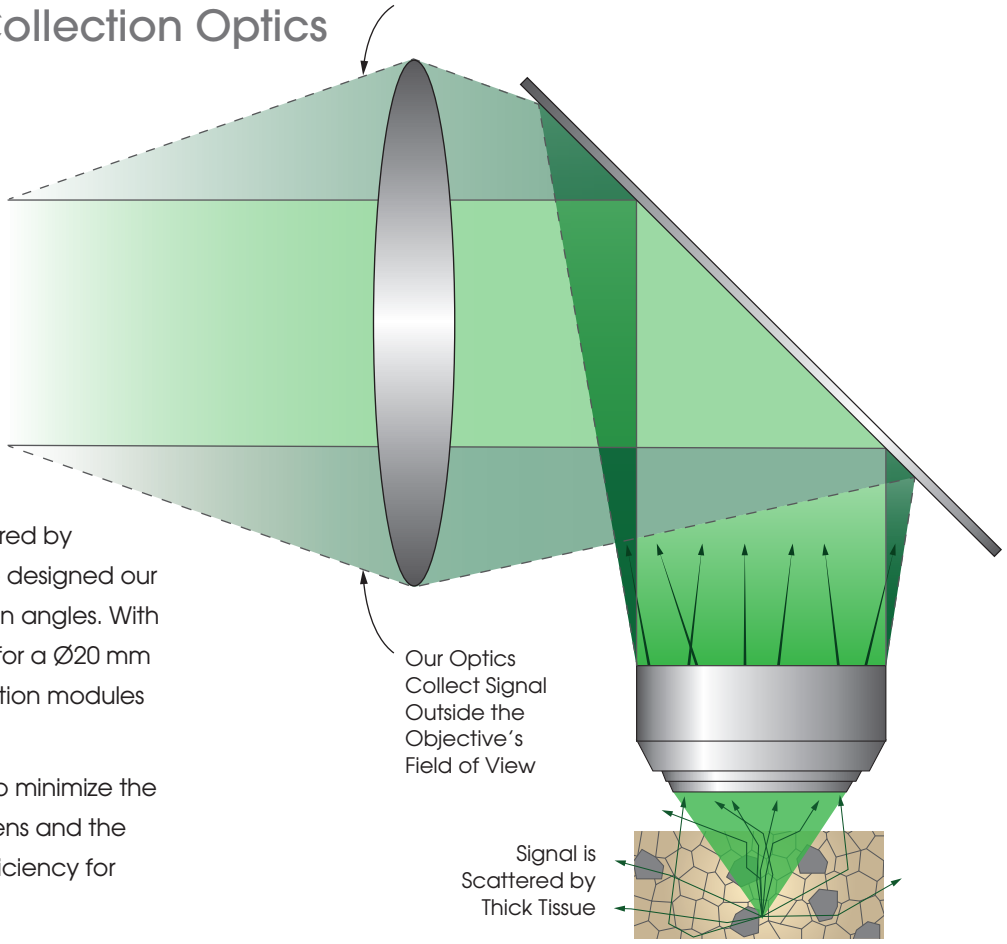
PMT Modules

- Up to Four Simultaneous Detection Channels
- Choice of Thermoelectrically Cooled or Non-Cooled GaAsP PMTs
  - Cooled PMTs Detect Weak Signals
  - Non-Cooled PMTs have Larger Collection Angle
- Option for Two Highly Sensitive Forward Fluorescence Detection Channels

Epi-Detection Modules

- Choice of Collection Angles for Different Imaging Depths
  - 8° (For Two PMTs)
  - 10° (For up to Four PMTs)
  - 14° (For Two PMTs)
- Available With or Without Mechanical Shutters for Photoactivation Experiments
- Compatible with All Industry-Standard Fluorescence Filters

Large-Angle Signal Collection Optics



Because emitted signal can be scattered by thick tissue as it exits the specimen, we designed our detection modules with wide collection angles. With full collection angles of 8°, 10°, or 14° (for a Ø20 mm entrance pupil), our proprietary detection modules enable deep physiological imaging.

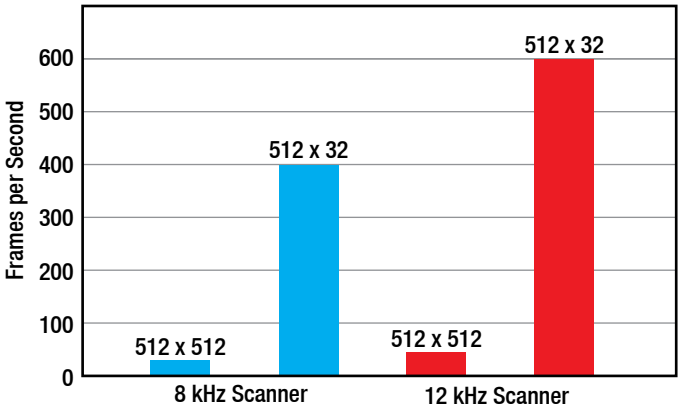
We have engineered these modules to minimize the distance between the first collecting lens and the objective, improving the collection efficiency for signal photons.

Highly Flexible Scanning & Photoexcitation Systems

New and existing Bergamo® II microscopes can be configured with a resonant-galvo-galvo scan path, a galvo-galvo scan path, and/or a spatial light modulator (SLM). These choices allow the user to optimize each experiment as needed for high frame rates, high sensitivity, and/or targeted exposure of the region of interest.

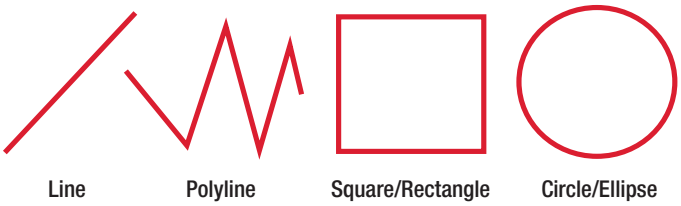
Galvo-Resonant Scanners for High-Speed Imaging

Thorlabs offers 8 kHz and 12 kHz galvo-resonant scanners. Our 8 kHz scanners utilize the entire field of view and offer a maximum frame rate of 400 fps, while our 12 kHz scanners provide an increased maximum frame rate of 600 fps.



Galvo-Galvo Scanners for Custom Scan Geometries

Galvo-galvo scanners support user-defined ROI shapes (lines, polylines, squares, and rectangles) and photo-stimulation patterns (circles, ellipses, polygons, and points).

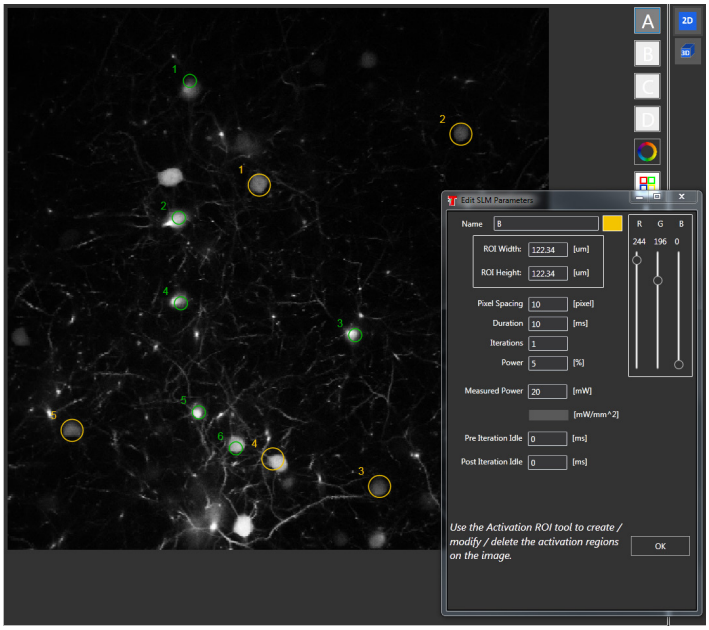


Resonant-Galvo-Galvo Scanners for Multimodal Scanning

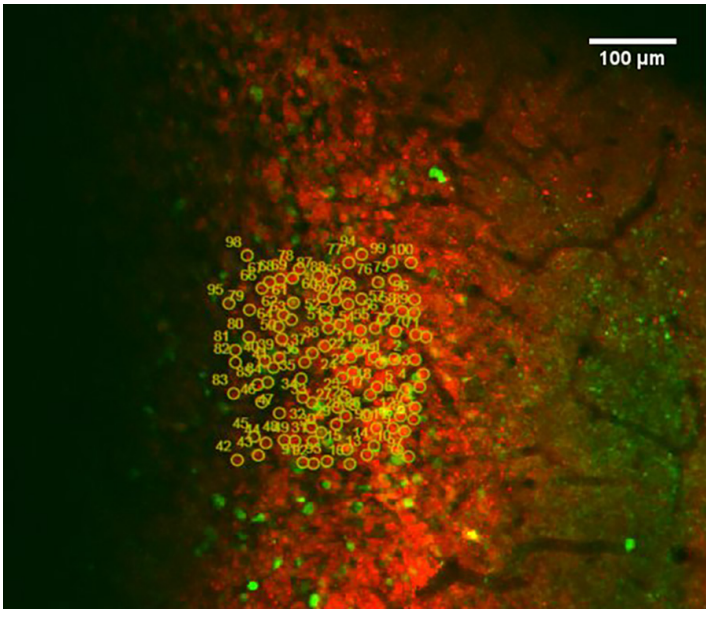
Thorlabs offers 8 kHz and 12 kHz resonant-galvo-galvo (RGG) scanners. This multimodal scanner provides features of both the galvo-resonant and galvo-galvo scanners in a single scan head. Our 8 kHz scanners version utilize the entire field of view and offer a maximum frame rate of 400 fps, while our 12 kHz scanners provide an increased frame rate of 600 fps. The galvo modality supports user-drawn scan geometries (lines, polylines, squares, and rectangles) and also supports custom photoactivation patterns (circles, ellipses, polygons, and points).

Spatial Light Modulator for Simultaneous Targeting

Unlike scanners, which physically move from point to point, our SLM uses holography to direct the beam. This allows multiple sites in a sample to be photoexcited truly simultaneously.



The ThorImage® LS software suite provides intuitive graphical control over photostimulation within the FOV.



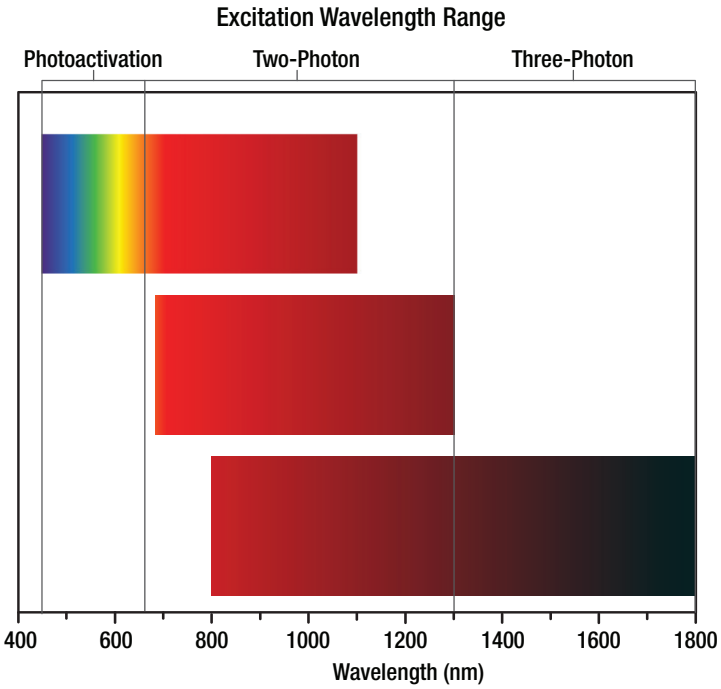
Simultaneous photostimulation of 100 cells co-expressing GCaMP6f (green) and C1V1 (red), obtained using SLM. (Courtesy of Lloyd Russell, Dr. Adam Packer, and Professor Michael Häusser, University College London, United Kingdom.)

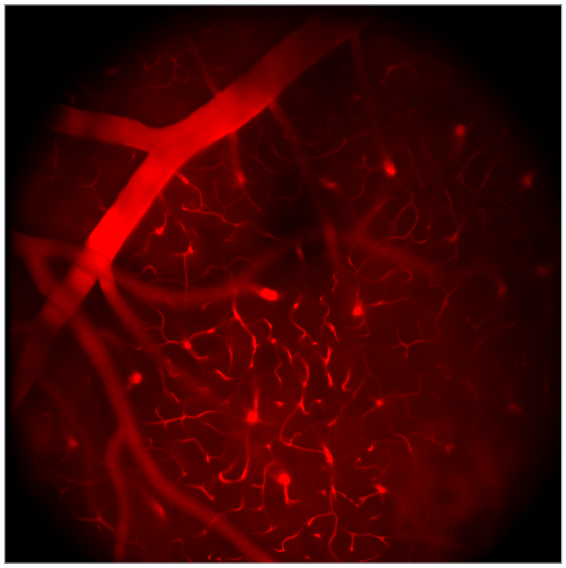
Super Broadband Scan Optics

The excitation wavelength ranges supported by Bergamo II microscopes accommodate the most recent lasers, fluorophores, and techniques. Three choices are available: 450 - 1100 nm, 680 - 1300 nm, and 800 - 1800 nm.

These super broadband ranges allow imaging of a wide range of fluorophores, and are optimized for photoactivation, two-photon excitation, or three-photon excitation. Our proprietary scan optics are fully compatible with popular tunable Ti:sapphire lasers and optical parametric oscillators, and also support dual-output lasers such as the Chameleon Discovery.

With a maximum field number (FN) of 20, they are well matched to the low-magnification, high-NA objectives that are the workhorses of multiphoton microscopy, helping to capture large sample areas, as shown below.



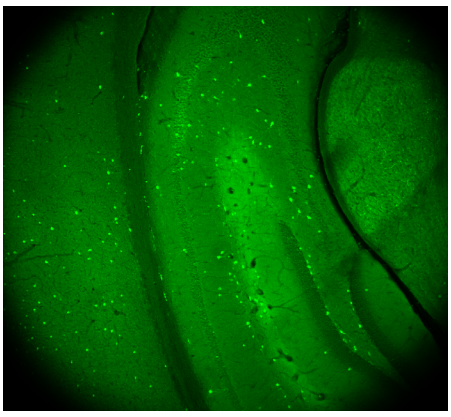


A large field number of 20 allows the 20X objective to obtain this deep tissue image over a 1 mm x 1 mm area.[i]

Adapts to a Wide Range of Multiphoton Objectives

Bergamo II microscopes accept infinity-corrected objectives with M34 x 1.0, M32 x 0.75, M25 x 0.75, or RMS threads. Together, these options encompass the vast majority of low-magnification, high-NA objectives. With a large field number of 20, our scan optics ensure that Bergamo II microscopes are able to collect more photons than competing microscopes using the same objectives.

10X Super Apochromatic Objective



- Ideal for Two-Photon Microscopy
- Infinity-Corrected Dry Objective with Super Apochromatic Axial Color Correction
- Correction Collar Enables Use with Samples in a Variety of Media
- 0.5 NA, 7.77 mm Working Distance, 400 to 1300 nm Transmission
- M32 x 0.75 Threading

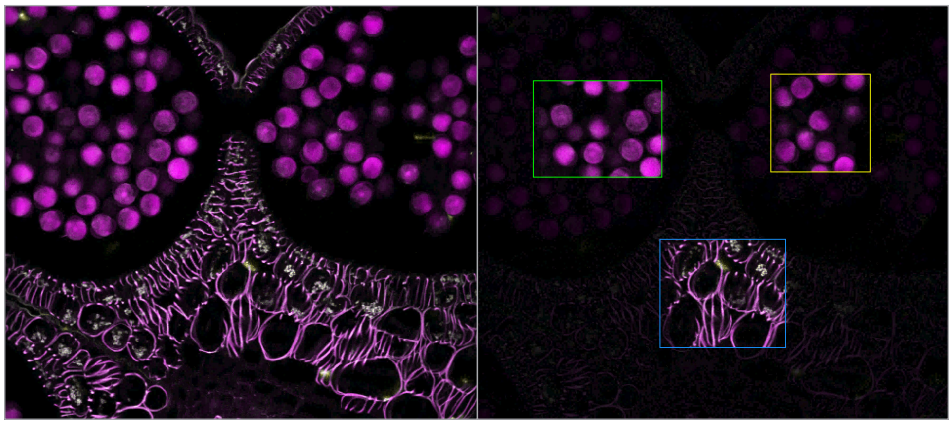
Native fluorescence from a 1 mm GFP-GAD65 transgenic mouse brain section.[h] Image size: 2 mm x 2 mm.

TL10X-2P

Pockels Cells for Image Uniformity

Pockels cells provide edge blanking and high-speed masking. These techniques provide improved laser excitation uniformity across the region of interest, while also preventing unnecessary exposure.

Masking is particularly useful for specimens that are sensitive to physical movement, since it can be used to select regions of interest without moving the sample or the microscope.

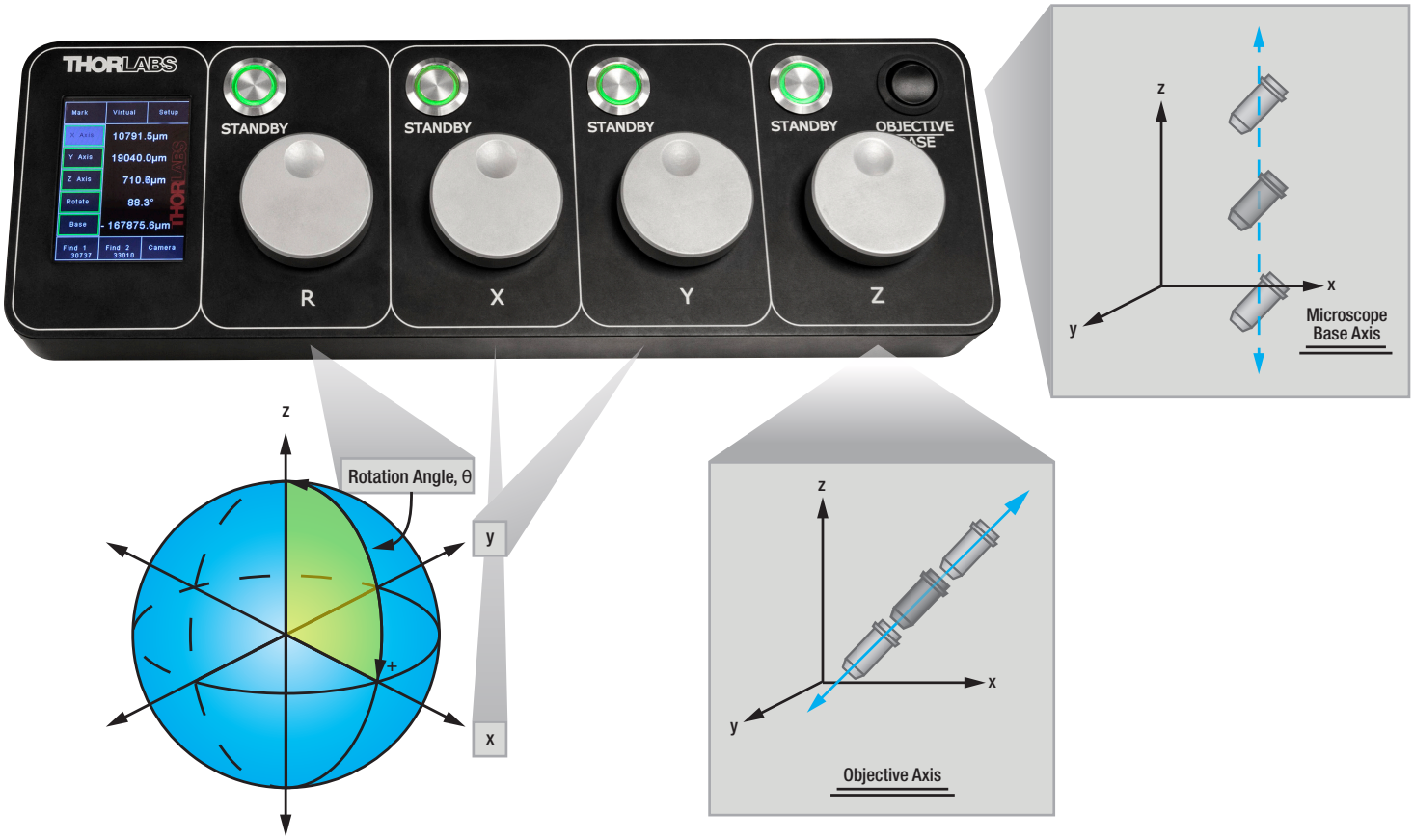


ThorImage®LS allows regions to be masked by a simple drag and drop across the live image.

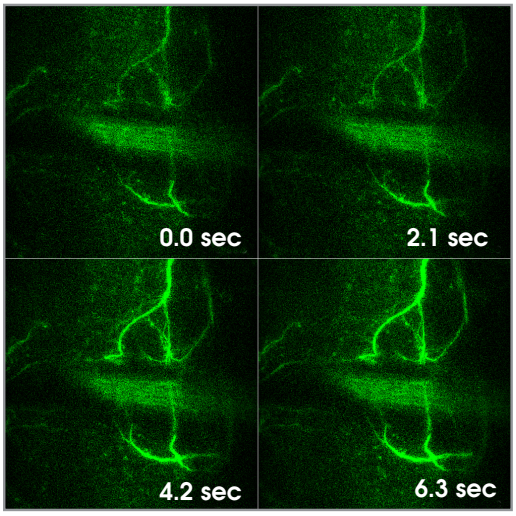
Multi-Axis Touchscreen Controller for Rotating Body

Designed for the rotating Bergamo® II microscope, this controller displays, sets, and recalls the positions of all five axes of movement. It rotates the objective and controls the X, Y, and Z axes (which rotate along with the objective). In addition, it moves the microscope base over a 5" vertical range.

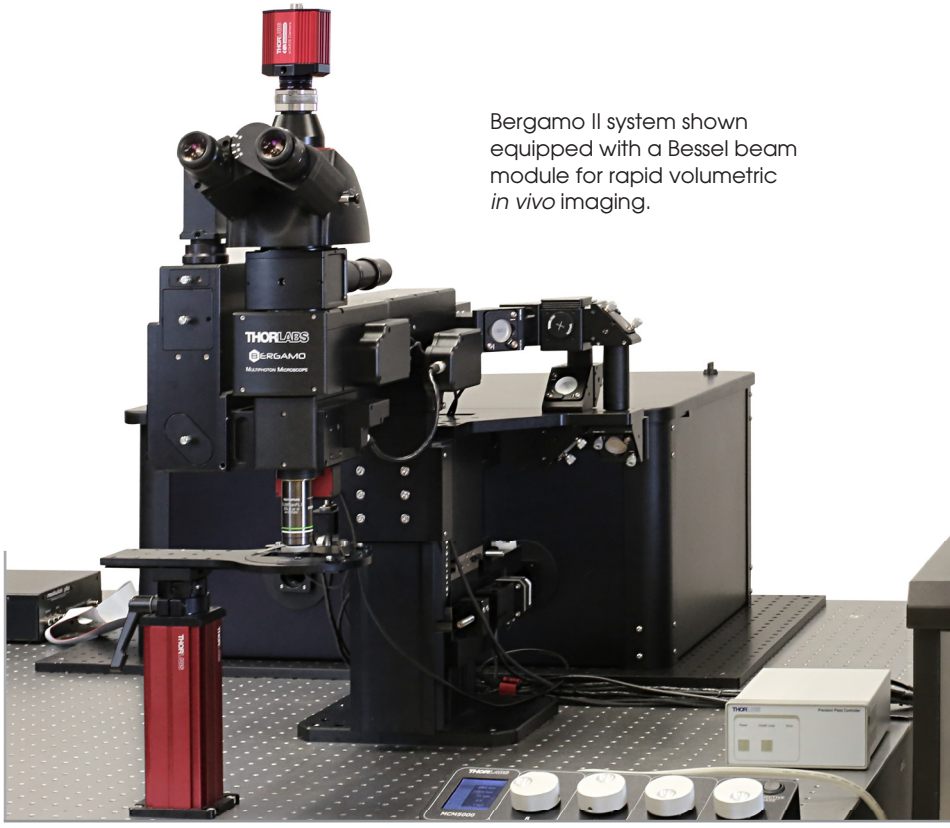
The integrated touchscreen offers quick, convenient retrieval of two spatial locations, while ThorImage®LS can save up to eight positions, easing experimental repeatability.



Example Configurations

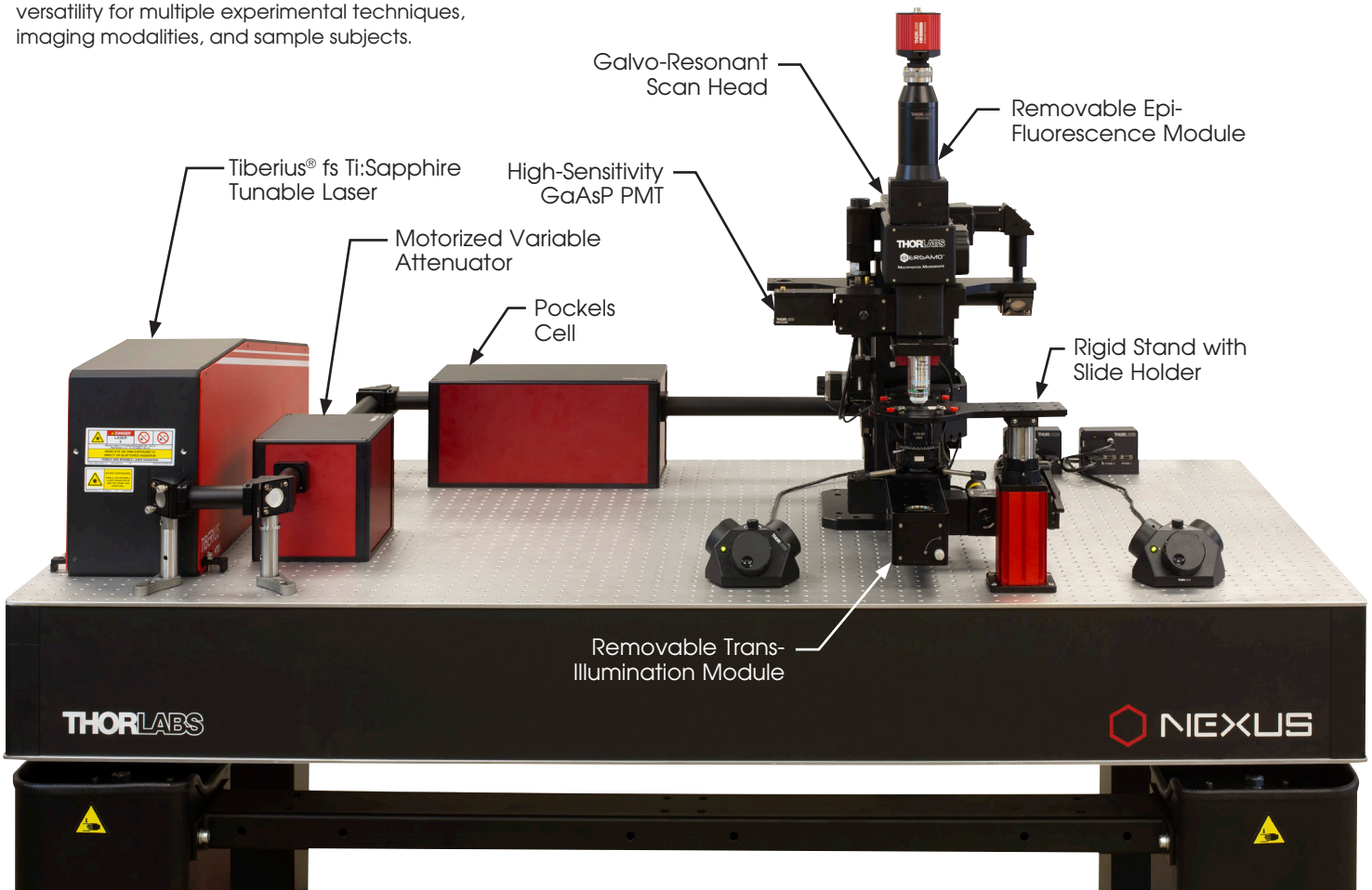


GCaMP6s expression in two neuron pairs arborized within the subesophageal zone of a fly brain. Ca^{2+} transients are captured by XY-scanning a 30 µm Bessel focus at a rate of 30 frames per second. A single Bessel scan corresponds to an XY scan with no translation in the Z-direction.[j]



Bergamo II system shown equipped with a Bessel beam module for rapid volumetric *in vivo* imaging.

This configuration is well-balanced for both *in vitro* and fixed stage *in vivo* microscopy research. The modular system with a removable trans-illumination module provides high versatility for multiple experimental techniques, imaging modalities, and sample subjects.



Specifications

Laser Scanning

Multiphoton Excitation	Wavelength Range	◆ 450 - 1100 nm, 680 - 1300 nm, or 800 - 1800 nm
	Scan Paths	◆ Resonant-Galvo-Galvo Scanners, Galvo-Resonant Scanners, Galvo-Galvo Scanners, or Spatial Light Modulator ◆ Single or Dual Scan Paths
	Resonant-Galvo-Galvo and Galvo-Resonant Scan Speeds	◆ 8 kHz: 2 fps (4096 x 4096 Pixels); 30 fps (512 x 512 Pixels); 400 fps (512 x 32 Pixels) ◆ 12 kHz: 4.4 fps (2048 x 2048 Pixels); 45 fps (512 x 512 Pixels); 600 fps (512 x 32 Pixels)
	Galvo-Galvo Scan Speeds	◆ 3 fps at 512 x 512 Pixels; 48 fps at 512 x 32 Pixels; 70 fps at 32 x 32 Pixels ◆ Pixel Dwell Time: 0.4 - 20 µs
	Galvo-Galvo Scan Geometries	◆ Imaging: Line, Polyline, Square, or Rectangle ◆ Non-Imaging: Circle, Ellipse, Polygon, or Point
	Field of View	◆ 20 mm Diagonal Square (Max) at the Intermediate Image Plane (12 mm Diagonal Square (Max) for 12 kHz Scanner)
	Scan Zoom	◆ 1X - 16X (Continuously Variable)
	Scan Resolution	◆ Bi-Directional: 2048 x 2048 Pixels (Max) (1168 x 1168 Pixels (Max) for 12 kHz Scanner) ◆ Unidirectional: 4096 x 4096 Pixels (Max) (2336 x 2336 Pixels (Max) for 12 kHz Scanner)
Confocal Imaging	◆ Motorized Pinhole Wheel with 16 Round Pinholes from Ø25 µm to Ø2 mm ◆ Two to Four Laser Lines (Options Range from 405 nm to 660 nm) ◆ Standard Multialkali or High-Sensitivity GaAsP PMTs ◆ Easy-to-Exchange Emission Filters and Dichroic Mirrors	
Three-Photon Imaging	◆ Scan Optics for 800 - 1800 nm Range ◆ Achieve Reduced Background Scatter for Greater Sensitivity in Deep Tissue Imaging	
Volume Imaging Using Bessel Beams	◆ 3D Volumetric Functional Imaging at Video Frame Rates ◆ Enhanced Temporal Resolution for Studying Internal Systems at Cellular Lateral Resolution *In Vivo*	

Multiphoton Signal Detection

Photomultiplier Tubes (PMTs)	◆ Thermoelectrically Cooled or Non-Cooled GaAsP PMTs with Preamplifiers Included ◆ Simultaneous Detection up to Four Channels
Epi-Detection	◆ Up to Four Ultrasensitive GaAsP PMTs, Cooled or Non-Cooled ◆ Easy-to-Exchange Magnetic Filter Holders
Forward Detection	◆ 13° Signal Collection Angle* (Two Ultrasensitive GaAsP PMTs, With or Without Shutters) ◆ Easy-to-Exchange Emission Filters and Dichroic Mirrors
Collection Optics	◆ 8°, 10°, or 14° Collection Angle* ◆ Easy-to-Exchange Emission Filters and Dichroic Mirrors

*Angles are quoted when using an objective with a Ø20 mm entrance pupil.

Translation

X and Y	◆ 2" (50.8 mm) Total Travel; 0.5 µm Encoder Resolution
Z	◆ 1" (25.4 mm) Total Travel; 0.1 µm Encoder Resolution ◆ Piezo Objective Scanner – Open Loop: 600 µm ± 10% Travel Range; 1 nm Resolution – Closed Loop: 450 µm Travel Range; 3 nm Resolution
Microscope Base (Rotating Bodies Only)	◆ 5" (127 mm) Total Travel; 1 µm Encoder Resolution
Rotation (Rotating Bodies Only)	◆ 0° to 90° or -45° to 45° Around the Sample ◆ 0.1° Encoder Resolution

Additional Features

Widefield Viewing	◆ Manual or Motorized Switching Between Scanning and Widefield Modes ◆ Illumination Provided via LED or Liquid Light Guide ◆ C-Mount Threads for Scientific Cameras
Transmitted Light Imaging	◆ Differential Interference Contrast (DIC) or Dodt Gradient Contrast ◆ Illumination Provided by Visible and/or NIR LEDs ◆ Compatible with Air and Oil Immersion Condensers
Objective Focus Control	◆ Stepper Motor: 1" (25.4 mm) Travel Range; 0.1 µm Encoder Resolution ◆ Piezo Objective Scanner with Nanometer-Level Axial Resolution for Objective Positioning and Z-Stack Acquisition
Sample Holder	◆ Choice of Sample Holders – Rigid Stand with Platform, Slide Holder, or Recording Chamber – Translating Platform Ideal for Micromanipulators
Microscope Controller	◆ Advanced 5-Axis Controller with Touchscreen – Rotating Body: Control X, Y, Z, Microscope Base, and Rotation Angle – Upright Body: Control X, Y, and Z Axes – Speed Adjustment, Saved Positions, and an Interactive User Interface ◆ 3-Axis Controller – Motorized Condenser Focus Control
Beam Conditioning Modules	◆ Pockels Cell – Edge and Fly-Back Blanking to Minimize Sample Photobleaching – High-Speed Masking for ROIs – Customize Laser Power at Each Slice Using Software Control ◆ Variable Attenuator with One-Click Shutter – Manual and Computer Control of Laser Power in Systems without a Pockels Cell – Improves Pockels Cell Performance ◆ Beam Stabilizer – Maintain Stable Beam Pointing While Changing Excitation Laser Wavelength

Image Credits

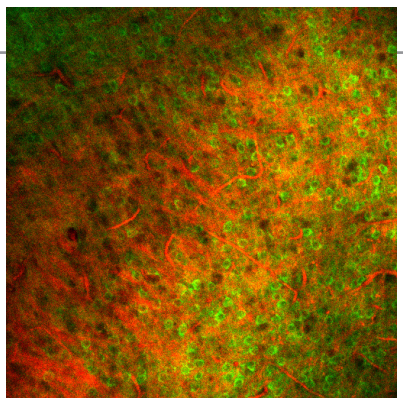
e. Sample Courtesy of Qinrong Zhang, PhD and Matthew Jacobs; the Ji Lab, Department of Physics, University of California, Berkeley
f. Courtesy of the Chris Xu Group, Cornell University
g. Courtesy of Lloyd Russell, Dr. Adam Packer, and Prof. Michael Häusser, University College London, United Kingdom.
h. Sample courtesy of Lynne Holtzclaw, NIH/NICHD/MIC
i. Image courtesy of the Neurobiology Course at the Marine Biological Laboratory, Woods Hole, MA.
j. Sample Courtesy of Zepeng Yao; the Scott Lab, Department of Molecular & Cell Biology, University of California, Berkeley

Recent Publications Using Thorlabs' Imaging Systems

1. Ceriani, F. et al. Dynamic coupling of cochlear inner hair cell intrinsic Ca2+ action potentials to Ca2+ signaling of non-sensory cells. bioRxiv. 2019 Aug 10; 731851.
2. Brawek, B. & Garaschuk, O. Single-Cell Electroporation for Measuring In Vivo Calcium Dynamics in Microglia. Microglia Methods in Molecular Biology. 2019 Aug 8; **2034**: 231-241.
3. Brawek, B., Olmedillas del Moral, M. & Garaschuk, O. In Vivo Visualization of Microglia Using Tomato Lectin. Microglia Methods in Molecular Biology. 2019 Aug 8; **2034**: 165-175.
4. Liang, Y. & Garaschuk, O. Labeling Microglia with Genetically Encoded Calcium Indicators. Microglia Methods in Molecular Biology. 2019 Aug 8; **2034**: 243–265.
5. Royzen, F., Williams, S., Fernandez, F. R. & White, J. A. Balanced synaptic currents underlie low-frequency oscillations in the subiculum. Hippocampus. 2019 July 13; 23131.
6. Rathore, A. P. S. et al. Dengue virus-elicited tryptase induces endothelial permeability and shock. J Clin Invest. 2019 July 2; JCI128426.
7. Stringer, C., Pachitariu, M., Steinmetz, N., Carandini, M. & Harris, K. D. High-dimensional geometry of population responses in visual cortex. Nature. 2019 June 26; **571**: 361–365.
8. Ziraldo, G. et al. A Human-Derived Monoclonal Antibody Targeting Extracellular Connexin Domain Selectively Modulates Hemichannel Function. Front Physiol. 2019 June 11; 10, 392.
9. Romero, S. et al. Cellular and widefield imaging of sound frequency organization in primary and higher-order fields of the mouse auditory cortex. bioRxiv. 2019 June 6; 663021.
10. Díaz-García, C. M. et al. Quantitative in vivo imaging of neuronal glucose concentrations with a genetically encoded fluorescence lifetime sensor. Journal of Neuroscience Research. 2019 May 20; **97**: 946–960.
11. Philip, V. et al. O54. The Effect of Gut Microbiota on Glutamatergic/GABAergic Gene Expression in Adult Mice. Biological Psychiatry. 2019 May 15; **85**: S127–S128.
12. Bowen, Z., Winkowski, D. E., Seshadri, S., Plenz, D. & Kanold, P. O. Neuronal avalanches in input and associative layers of auditory cortex. bioRxiv. 2019 Apr 29; 620781.
13. Burgold, J. et al. Cortical circuit alterations precede motor impairments in Huntington's disease mice. Sci Rep. 2019 Apr 29; **9**: 1–13.
14. Matovic, S. et al. Stress-induced neuronal hypertrophy decreases the intrinsic excitability in stress habituation. bioRxiv. 2019 Mar 31; 593665.

Show Us Your Work!

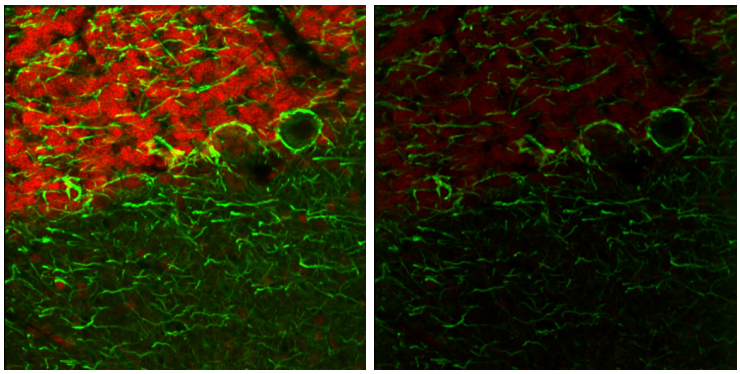
We would like to showcase your results! Let us know when you publish an article with images obtained from a Thorlabs system, and gain increased visibility within the scientific community. Experiments performed by our customers often form the basis of future engineering efforts for Bergamo® II upgrade paths.



Primary Visual Cortex of Transgenic Mouse Expressing
GCaMP6f (Green) and Third Harmonic Autofluorescence (Red)
(Courtesy of Jacob Reimer and Andreas Tolias, Baylor College of Medicine, Houston, TX, and
Tianyu Wang, Dimitri Ouzounov, and Chris Xu, Cornell University, Ithaca, NY)

Tiberius®: Tunable Ti:Sapphire Laser for Two-Photon Microscopy

- Wide Tuning Range: 720 - 1060 nm
- Industry-Leading Tuning Speed: Up to 4000 nm/s
- High Output Power: >2.3 W at 800 nm
- Ideal for Performing Fast Sequential Imaging
- Compact Footprint Uses Half the Table Space of Competing Lasers
- Seamless ThorImage®LS and ScanImage Integration for Photoactivation Experiments and Live High-Speed Imaging

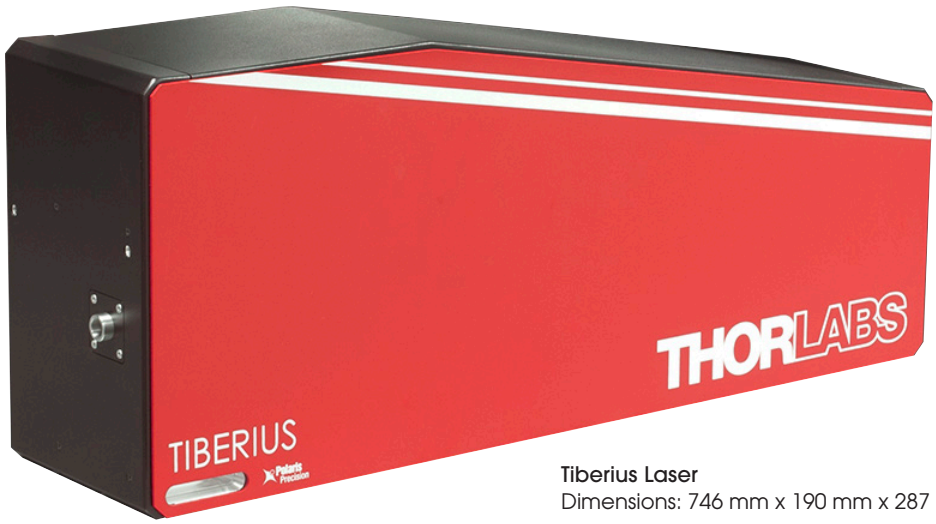


Fast switching between the optimal excitation wavelengths of 750 nm and 835 nm provides high contrast, seen in the composite image (left) when compared to the image acquired only using 788 nm light (right). (Sample Prepared by Lynne Holtzclaw of the NICHD Microscopy and Imaging Core Facility, a part of the National Institutes of Health (NIH) in Bethesda, MD.)

The Tiberius® Tunable Ti:Sapphire Laser was developed by Thorlabs' Laser Division in collaboration with Thorlabs' team of life science application specialists. When paired with a Bergamo II microscope, it allows us to provide a level of service that is superior to that available when using third-party lasers.

This ultrafast femtosecond laser offers an industry-leading tuning speed of up to 4000 nm/s, making it ideal for fast sequential imaging. Its software controls are seamlessly integrated with ThorImageLS, and a built-in piezo-controlled output mirror enables actively controlled beam pointing stabilization.

In addition, this laser's vertical cavity reduces the physical footprint to roughly half that of competing lasers, saving valuable table space for other elements of the experimental apparatus.



Tiberius Laser
Dimensions: 746 mm x 190 mm x 287 mm (L x W x H)

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