The Bergamo II Series is Thorlabs’ platform for multiphoton microscopy. Used to acquire high-resolution, multi-channel images in vivo, ex vivo, and in vitro, our versatile, sensitive microscopes are specifically engineered for exceptional performance under a wide variety of experimental conditions.
Overview of the Bergamo II Series
Multiphoton Microscopes

Thorlabs' multiphoton imaging platforms are designed around various experimental needs. Customize and future-proof your investment with a system specifically tailored to your application. Choose between two body options:

**Flexibility with the Rotating Body**

### Applications
- Live Imaging
  - Awake and Behaving Animals
  - Large Animals
  - Small Animals

### Advantages
- The Industry’s Only Microscope that Rotates Around the Focal Spot of the Objective
- Motion in X, Y, Z, and $\theta$ to Image Around Orientation-Sensitive Experiments
- -5° to +95° or -50° to +50° of Rotation, 2" Travel in X and Y, 5" Microscope Base Travel in Z, and 1" Objective Travel
- 24+ Cubic Inches (393 cm$^3$) of Total Objective Viewing Volume
- Maintain Beam Alignment Throughout the Full Range of Motion via Articulating Periscopes

**Configuration**

<table>
<thead>
<tr>
<th>Rotating Body</th>
<th>In Vivo</th>
</tr>
</thead>
</table>

Deep Brain Imaging
Performed with Rotating Body
(Courtesy of Dr. Hajime Hirase and Katsuya Ozawa, RIKEN Brain Science Institute, Wako, Japan)
Versatility with the Standard Body

**Applications**
- Imaging
  - Cells
  - Tissues
  - Live Small Animals

**Advantages**
- All-in-One Rig for a Wide Array of Applications
- DIC or Dodt Contrast; Camera or Laser Scanned
- High-Sensitivity Forward Fluorescence Detection
- Removable Transmitted Light Path to Configure the Microscope on the Fly for *In Vivo* or *In Vitro*
- Large Working Space Around the Objective to Accommodate Various Samples and Equipment

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Best For</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Body</td>
<td>In Vivo</td>
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<tr>
<td></td>
<td>Ex Vivo</td>
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<tr>
<td></td>
<td>In Vitro</td>
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</tbody>
</table>
Rotating Bergamo II Microscopes

Overview of Options and Benefits

Scan Paths
- Galvo-Galvo and/or Galvo-Resonant
- Excitation Path Optimized for 400 - 1100 nm or 680 - 1600 nm Wavelength Range

Rotational Configuration
- -5° to +95°
- -50° to +50°

Widfield Viewing
- Scientific Camera
- Thorlabs’ Epi-Illuminator with High-Power LED

Dichroic Changers
- Manual or Computer Controlled

Piezo Objective Focus Control
- High-Speed Z Stacks

Widefield Viewing

PMT Detection Module
- Up to Four Channels
- With or Without Shutters

Microscope Controller
- Advanced 5-Axis Controller with Touchscreen

Epi-Detection Module
- Three Collection Angle Options: 8°, 10°, and 14°
- Easy-to-Exchange Filters
- Emission Detection Optimized at 400 - 800 nm

Beam Conditioning Modules
- Variable Beam Expander
- Pockels Cell
- Variable Attenuator
<table>
<thead>
<tr>
<th>Features</th>
<th>Details</th>
</tr>
</thead>
</table>
| Rotational Configuration       | ◆ -5° to +95° or -50° to +50° (Factory Configured)  
                          - Image Around Orientation-Sensitive Experiments  
                          - Optical Alignments are Maintained Throughout the Full Range of Motion                                                                                                                                 |
| Scan Paths                     | ◆ Galvo-Resonant  
                          - Image at 2 fps (4096 x 4096 Pixels), 15 fps (1024 x 1024 Pixels), 30 fps (512 x 512 Pixels), and Up to 400 fps (512 x 32 Pixels)  
                          ◆ Galvo-Galvo  
                          - Custom Scan Geometries: Squares, Rectangles, Circles, Ellipses, Lines, and Polylines  
                          - Capture Weak Signals with Long Dwell Time Integration  
                          - Achieve Consistent Dwell Times Across Field of View  
                          ◆ Super Broadband Optics Optimized for 400 - 1100 nm or 680 - 1600 nm Excitation Wavelengths  
                          - Designed for the Latest Widely Tunable Ti:Sapphire and OPO Systems                                                                                                                                 |
| PMT Modules                    | ◆ Up to Four Channels  
                          - Cooled or Non-Cooled PMTs  
                          - Configure Up to Four Channels with Simultaneous Detection                                                                                                                                              |
| Epi-Detection Modules          | ◆ Choice of Signal Collection Angle to Accommodate Different Sample Depths  
                          - 8° (Two PMTs)  
                          - 10° (With or Without Shutters and Up to Four PMTs)  
                          - 14° (With or Without Shutters and Up to Two PMTs)  
                          (Angles Quoted When Using an Objective with a 20 mm Entrance Pupil)                                                                                                                                 |
| Widefield Viewing              | ◆ Thorlabs or Third-Party Scientific Cameras  
                          - Visualize Samples with Fluorescence or Reflected Light  
                          - Compatible with C-Mount-Threaded Scientific Cameras  
                          ◆ Single- or Multi-Filter-Cube Epi-Illuminator  
                          - Locate Areas of Interest Without Unnecessary Laser Excitation  
                          - Thorlabs’ LEDs Provide Bright Illumination  
                          - Industry-Standard Liquid Light Guides Illuminate Across the Visible Spectrum                                                                                                                                 |
| Objective Focus Control        | ◆ Piezo Objective Focus Control  
                          - Fast Z Stacks  
                          - Nanometer-Level Axial Resolution                                                                                                                                                                          |
| Sample Holders                 | ◆ Choice of Sample Holders  
                          - Rigid Stand with Platform, Slide Holder, or Recording Chamber  
                          - XY Platform with Micromanipulators                                                                                                                                                                      |
| Microscope Controller          | ◆ Advanced 5-Axis Controller with Touchscreen  
                          - Control X, Y, Z (Base), Z (Objective), and Rotation Angle  
                          - Speed Control, Saved Positions, and the Convenience of a Touchscreen Interface                                                                                                                                 |
| Beam Conditioning Modules      | ◆ Variable Beam Expander  
                          - 1X - 3X Beam Diameter Modulation into the Objective Back Aperture Using Software Control  
                          ◆ 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  
                          - Improves Pockels Cell Performance  
                          - One-Click Shutter  
| Software Acquisition Packages  | ◆ ThorImageLS™  
                          - Designed for Seamless Integration with Thorlabs’ Imaging Systems  
                          - Powerful and Intuitive Interface  
                          - Direct Support from Software Engineers  
                          - Open Source for Custom Features and Participation with the Life Science Community  
                          ◆ ScanImage and LabVIEW  
                          - Large User Base                                                                                                                                                                                                 |
**Standard (Z and XYZ Motion) Bergamo II Microscopes**

**Overview of Options and Benefits**

**Scan Paths**
- Galvo-Galvo and/or Galvo-Resonant
- Excitation Path Optimized for 400 - 1100 nm or 680 - 1600 nm Wavelength Range

**Beam Conditioning Modules**
- Variable Beam Expander
- Pockels Cell
- Variable Attenuator

**Widefield Viewing**
- Scientific Camera
- Thorlabs' Epi-Illuminator with High-Power LED
- Binoculars or Trinoculars
- Hold up to Six Filter Cubes

**Piezo Objective Focus Control**
- High-Speed Z Stacks

**Detection Modules**
- Forward and Epi-Detection Modules
- Easy-to-Exchange Filters

**PMT Detection Module**
- Up to Four Channels
- With or Without Shutters

**Microscope Controllers**
- Advanced 5-Axis Controller with Touchscreen
- 3-Axis Controller

**Sample Holders**
- Rigid Stand with Platform
- Rigid Stand with Slide Holder or Recording Chamber
- XY Platform with Micromanipulators

**Contrast Imaging**
- Dodt Contrast
- Differential Interference Contrast (DIC)
<table>
<thead>
<tr>
<th>Features</th>
<th>Details</th>
</tr>
</thead>
</table>
| Scan Paths   | - **Galvo-Resonant**  
  - Image at 2 fps (4096 x 4096 Pixels), 15 fps (1024 x 1024 Pixels), 30 fps (512 x 512 Pixels), and Up to 400 fps (512 x 32 Pixels)  
  - **Galvo-Galvo**  
  - Custom Scan Geometries: Squares, Rectangles, Circles, Ellipses, Lines, and Polylines  
  - Capture Weak Signals with Long Dwell Time Integration  
  - Achieve Consistent Dwell Times Across Field of View  
  - Super Broadband Optics Optimized for 400 - 1100 nm or 680 - 1600 nm Excitation Wavelengths  
  - Designed for the Latest Widely Tunable Ti:Sapphire and OPO Systems |
| PMT Modules  | - Up to Four Channels  
  - Cooled or Non-Cooled PMTs  
  - Configure Up to Four Channels with Simultaneous Detection |
| Epi-Detection Modules | - Choice of Signal Collection Angle to Accommodate Different Sample Depths  
  - 8° (Two PMTs)  
  - 10° (With or Without Shutters and Up to Four PMTs)  
  - 14° (With or Without Shutters and Up to Two PMTs)  
  (Angles Quoted When Using an Objective with a 20 mm Entrance Pupil) |
| Widefield Viewing | - Thorlabs or Third-Party Scientific Cameras  
  - Visualize Samples with Fluorescence or Reflected Light  
  - Compatible with C-Mount-Threaded Scientific Cameras  
  - Single- or Multi-Filter-Cube Epi-Illuminator  
  - Locate Areas of Interest Without Unnecessary Laser Excitation  
  - Thorlabs’ LEDs Provide Bright Illumination  
  - Industry-Standard Liquid Light Guides Illuminate Across the Visible Spectrum |
| Objective Focus Control | - Piezo Objective Focus Control  
  - Fast Z Stacks  
  - Nanometer-Level Axial Resolution |
| Sample Holders | - Choice of Sample Holders  
  - Rigid Stand with Platform, Slide Holder, or Recording Chamber  
  - XY Platform with Micromanipulators |
| Microscope Controller | - Advanced 5-Axis Controller with Touchscreen  
  - Control X, Y, Z (Base), Z (Objective), and Rotation Angle  
  - Speed Control, Saved Positions, and the Convenience of a Touchscreen Interface  
  - 3-Axis Controller  
  - Control X, Y, Z Axes with Speed Adjustment |
| Contrast Imaging | - Dodt Contrast and DIC Modules  
  - Removable Modules to In Vivo or In Vitro Configurations  
  - View Features in Tissue Slices with Dodt Contrast or Laser-Scanned Dodt Contrast  
  - View Features in Thinner, Transparent Samples with DIC Imaging or Laser-Scanned DIC Imaging |
| Beam Conditioning Modules | - Variable Beam Expander  
  - 1X - 3X Beam Diameter Modulation into the Objective Back Aperture Using Software Control  
  - 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  
  - Improves Pockels Cell Performance  
  - One-Click Shutter  
| Software Acquisition Packages | - ThorImageLS™  
  - Designed for Seamless Integration with Thorlabs’ Imaging Systems  
  - Powerful and Intuitive Interface  
  - Direct Support from Software Engineers  
  - Open Source for Custom Features and Participation with the Life Science Community  
  - ScanImage and LabVIEW  
  - Large User Base |
Innovations in Detail

Image with Speed and Accuracy with Galvo-Resonant and/or Galvo-Galvo Scan Paths

Bergamo II multiphoton microscopes can be configured with a galvo-resonant scan path, a galvo-galvo scan path, or both, depending upon the needs of the experiment. Equip both types of scan paths to get the best of both worlds. Scan at up to 400 fps at 512 x 32 pixels using our galvo-resonant scanners. Achieve uniform images with edge blanking and protect samples with high-speed masking in tandem with our Pockels cells. Alternatively, use our galvo-galvo scanners to accurately photoactivate or photobleach specific areas of the sample with preset (line, square, rectangle, circle, and ellipse) or custom-drawn geometries.
Superior Photodetection Systems

Bergamo II systems can be configured with up to four PMT detection channels and are fully compatible with industry-standard fluorescence emission filters. Our unique design makes it simple and quick to exchange filters without having to worry about maintaining optical alignment.

Capture weak fluorescence signals or protect highly photosensitive samples using high-sensitivity, high-quantum-efficiency GaAsP PMTs. Full software integration of the protection circuit ensures maximum PMT longevity.

Super Broadband Scan Optics

Bergamo II microscopes feature proprietary scan optics that are optimized for 400 - 1100 nm or 680 - 1600 nm excitation wavelengths, allowing single or multiphoton excitation of a wide variety of fluorophores. Designed with the latest widely tunable Ti:Sapphire lasers and OPO systems in mind, the Bergamo II platform future-proofs your investment.

Image more by taking full advantage of the optical designs used in low-magnification, high-numerical aperture objectives that have become the standard in multiphoton objectives. Capture large sample areas with the Bergamo II’s maximum field number (FN) of 20.

Customizable Software Options

In addition to hardware versatility, Thorlabs offers a selection of software acquisition packages. Choose either the ThorImageLS™ software package, which is designed in parallel with the Bergamo II Multiphoton Microscope, or the popular ScanImage software from Vidrio Technologies. Regardless of the selection, Thorlabs will install and test the performance of your system with the chosen software platform.
Innovations in Detail

Imaging Optimization using the Variable Beam Expander

Utilize the Variable Beam Expander to adapt to and optimize the experimental conditions. Match the beam diameter to the back aperture of the objective to utilize the entire NA, overfill to achieve more even illumination, or underfill for higher power through thick samples. The software-controlled variable beam expander adjusts the input beam diameter from 1X to 3X.

Large-Collection-Angle Optics

A high photon collection efficiency in the PMTs is made possible by a wide collection angle while simultaneously minimizing the distance between the collecting lens and the sample. This system design allows Bergamo II Series Multiphoton Microscopes to achieve high sensitivity and a high signal-to-noise ratio for deep physiological imaging.
Advanced Multi-Axis Controller with Touchscreen

Specifically designed for the rotating Bergamo II Microscope, this controller allows individual control of up to five directions of movement. In addition to the standard X, Y, and Z axes, the controller also provides fine movement along the optical axis of the objective. The objective can be factory configured to rotate from -5° to 95° or -50° to 50°. The integrated touchscreen allows two quick memory settings, while the ThorImageLSTM image acquisition software suite can save up to eight positions, allowing convenience and enabling experimental repeatability.

Superior Engineering for a Flexible, Rotating Platform

The Bergamo II Multiphoton Microscope maintains alignment during rotation around the sample through multi-jointed articulating periscopes. Our periscopes’ engineering and design offer enhanced flexibility to allow the entire scanning system to rotate around the sample while still maintaining laser alignment into the scan head.
Adaptability for Specialized Objectives

Bergamo II microscopes directly accept infinity-corrected objectives that have M32 threads, while also having highly stable mechanical adapters for M34, M25, and RMS threads. Together, these options encompass the vast majority of low-magnification, high-NA objectives. Our scan optics are designed with these specialized objectives in mind to ensure that the microscope is always able to handle light collection over a large field of view.

Highly Sensitive Scientific-Grade Cameras

Thorlabs' scientific cameras are designed to locate point-of-reference markers in specimens being studied with Bergamo II microscopes. Their low noise and high quantum efficiency make it easy to find fluorescence labels and provide the high sensitivity needed to obtain contrast in thick, unlabeled specimens using DIC or Dodt contrast.

These cameras operate independently from the multiphoton laser scanning apparatus, protecting delicate samples by minimizing their exposure to laser light. By combining epi-fluorescence images with images obtained by DIC, Dodt contrast, and laser scanning, co-registered, multimodal pictures that yield deeper insights into your specimen are created.

Thorlabs' Customer Advantages

<table>
<thead>
<tr>
<th>Our Approach</th>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully Designed and Manufactured in House</td>
<td>◆ Our Systems Are Engineered at a Single Location, Maximizing Efficiency and Ensuring Cost Savings</td>
</tr>
<tr>
<td></td>
<td>◆ In-House Expertise in Every Component and System</td>
</tr>
<tr>
<td>Modular System Construction</td>
<td>◆ Future-Proof Your Investment and Upgrade as Needs Evolve Without Sacrificing Existing Capabilities</td>
</tr>
<tr>
<td>Professional Installation</td>
<td>◆ Thorlabs' Technicians Meticulously Assemble, Test, and Verify Each System to Meet Our High Standards of Quality and Performance</td>
</tr>
<tr>
<td>Unmatched Professional Support</td>
<td>◆ Receive Support for Your Experimental Needs from Our Life Science Application Engineers</td>
</tr>
<tr>
<td></td>
<td>◆ Receive Direct Support from Engineers Who Designed the Bergamo II Series Multiphoton Microscopes</td>
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<tr>
<td></td>
<td>◆ Receive Direct Support from Software Engineers Who Wrote ThorImageLS™</td>
</tr>
<tr>
<td>Quick Support</td>
<td>◆ Receive Support via Video Teleconferencing (Receive a Camera and Microphone from Thorlabs if Needed)</td>
</tr>
<tr>
<td></td>
<td>◆ Let Thorlabs Do the Work! With Your Permission, Thorlabs Can Remotely Access Your Computer to Address a Software-Related Issue</td>
</tr>
<tr>
<td>Specifications</td>
<td>Configuration</td>
</tr>
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</tr>
<tr>
<td><strong>Laser Scanning</strong></td>
<td></td>
</tr>
<tr>
<td>Scan Path Wavelength Range</td>
<td>400 - 1100 nm or 680 - 1600 nm</td>
</tr>
<tr>
<td>Field of View</td>
<td>20 mm Diagonal Square (Max) at the Intermediate Image Plane</td>
</tr>
<tr>
<td>Scanners</td>
<td>Single or Dual Scan Paths: Galvo-Resonant, Galvo-Galvo, or Both</td>
</tr>
<tr>
<td>Galvo-Resonant Scan Speed</td>
<td>30 fps at 512 x 512 Pixels; 400 fps at 512 x 32 Pixels</td>
</tr>
<tr>
<td>Galvo-Galvo Scan Speed</td>
<td>3 fps at 512 x 512 Pixels; 48 fps at 512 x 32 Pixels; 70 fps at 32 x 32 Pixels</td>
</tr>
<tr>
<td>Galvo-Galvo Scan Modes</td>
<td>Imaging: Line, Polylne, Square, or Rectangle</td>
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<tr>
<td></td>
<td>Non-Imaging: Circle, Ellipse, Polygon, or Point</td>
</tr>
<tr>
<td>Scan Zoom</td>
<td>1X - 16X (Continuously Variable)</td>
</tr>
<tr>
<td>Scan Resolution</td>
<td>Bi-Directional: 2048 x 2048 Pixels (Max)</td>
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<td></td>
<td>Unidirectional: 4096 x 4096 Pixels (Max)</td>
</tr>
<tr>
<td>Compatible Objective Threading</td>
<td>M34 x 1.0, M32 x 0.75, M25 x 0.75, and RMS</td>
</tr>
<tr>
<td><strong>Detection</strong></td>
<td></td>
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<tr>
<td>Epi-Detection</td>
<td>Up to 4 GaAsP PMTs, Cooled or Non-Cooled</td>
</tr>
<tr>
<td>Forward Detection</td>
<td>2 GaAsP PMTs, Non-Cooled</td>
</tr>
<tr>
<td>Collection Optics</td>
<td>8°, 10°, or 14° Collection Angle</td>
</tr>
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<td></td>
<td>(Angles Quoted When Using an Objective with a 20 mm Entrance Pupil)</td>
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<tr>
<td></td>
<td>User-Changeable Emission Filters and Dichroic Cubes</td>
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<tr>
<td><strong>Widefield Viewing</strong></td>
<td></td>
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<td></td>
<td>Manual or Motorized Switching Between Scanning and Widefield Modes</td>
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<tr>
<td></td>
<td>Thorlabs’ High-Power LED or Liquid Light Guide for Illumination</td>
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<td></td>
<td>C-Mount Threads for Scientific Cameras</td>
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<tr>
<td><strong>Transmitted Light Imaging</strong></td>
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<td></td>
<td>Widefield and (Laser-Scanned) Dodt Contrast or Differential Interference Contrast (DIC)</td>
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<tr>
<td></td>
<td>Visible and/or NIR LED Illumination</td>
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<tr>
<td></td>
<td>Air or Oil Immersion Condenser</td>
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<tr>
<td><strong>Translation</strong></td>
<td></td>
</tr>
<tr>
<td>X and Y</td>
<td>2” (50.8 mm) Total Travel; 0.5 µm Encoder Resolution</td>
</tr>
<tr>
<td>Objective Axis</td>
<td>1” (25.4 mm) Total Travel; 0.1 µm Encoder Resolution</td>
</tr>
<tr>
<td>Base Axis (Z)</td>
<td>5” (127 mm) Total Travel; 1 µm Encoder Resolution</td>
</tr>
<tr>
<td>Rotation</td>
<td>-5° to +95° or -50° to +50° Around Objective Focus</td>
</tr>
<tr>
<td></td>
<td>0.1° Encoder Resolution</td>
</tr>
</tbody>
</table>
Selected Publications Using Thorlabs' Imaging Systems


Show Us Your Work!

We would like to showcase your hard-earned results! Let us know that you published an article with images obtained using a Thorlabs system and gain increased visibility within the Thorlabs and scientific community. By sharing your successes, you can increase the overall awareness of the capabilities of your system while also learning more about what others have done.

Transgenic Zebrafish
(Courtesy of Katie Kindt, Porter Neuroscience Research Center, National Institutes of Health, Bethesda, MD)
Our dedicated Thorlabs sales team is ready to help you achieve your goals. Whether you are seeking more information or are ready to make a purchase, please contact us for immediate assistance.

(703) 651-1700 • ImagingSales@thorlabs.com

Confocal Microscopy Systems

Thorlabs’ Confocal Imaging System can be used to upgrade any research-grade microscope into a confocal workstation. Its high-speed galvo-resonant scan head provides a video frame rate of 30 fps at 512 x 512 pixels and a maximum frame rate of 400 fps at 512 x 32 pixels. Compatible with upright and inverted microscopes, it supports a large field number (FN) of 25.

Confocal imaging has several advantages over widefield imaging, including the elimination of out-of-focus light and improved spatial resolution. Combined with multi-channel acquisition, it creates detailed 3D volumetric images of biological samples.

Live, GFP-labeled hippocampal mouse neuron. Courtesy of the 2015 Cold Spring Harbor summer course: "Imaging structure and function in the nervous system."
Worldwide Locations