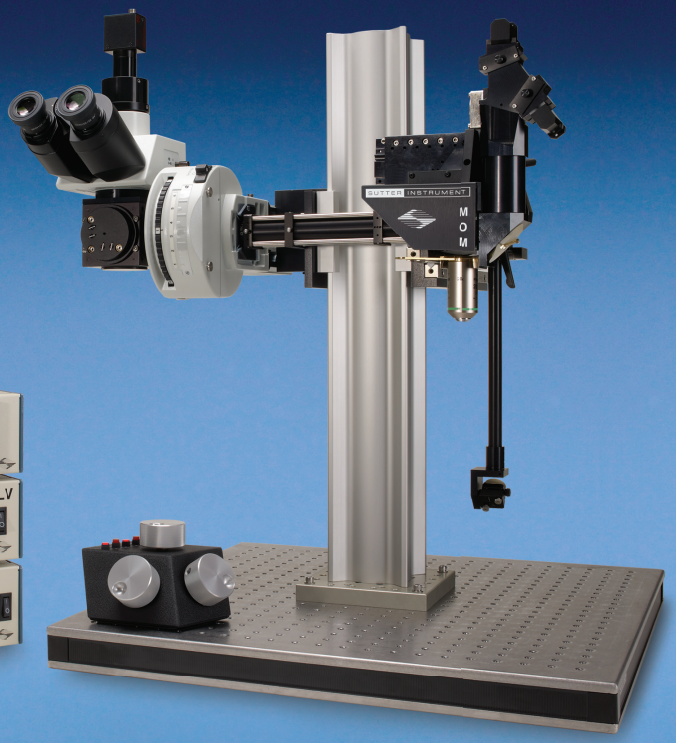
- OBJECTIVE MOVES 22 mm IN X, Y, AND Z
- OBJECTIVE ROTATES ABOUT OPTICAL AXIS FOR IMAGING OF NON-HORIZONTAL SURFACES AND VOLUMES
- CUSTOMIZABLE OPEN PLATFORM DESIGN
- TWO- OR THREE-PHOTON COMPATIBLE SCAN LENS AND TUBE LENS
- NEW LIGHT BLOCK KEEPS VISUAL STIMULI, PHOTOSTIMULI AND AMBIENT LIGHT OUT OF DETECTOR PATH
- CAMBRIDGE TECHNOLOGY XY SCANNERS
- TWO OR FOUR CHANNEL DETECTOR SYSTEM WITH HAMAMATSU PMTs AND PREAMPLIFIERS
- SUTTER PS-2 / PS-2 LV DUAL CHANNEL PMT POWER SUPPLY
- NATIONAL INSTRUMENT / MEASUREMENT COMPUTING BASED DATA ACQUISITION SYSTEMS



(Shown with optional trinocular head and CCD camera. Objective not included)

MOM® MOVABLE OBJECTIVE MICROSCOPE®

The Movable Objective Microscope® (**MOM**®) is a two- or thee-photon microscope capable of imaging deep within living specimens when combined with an appropriate laser. The Sutter **MOM** was the first scope to provide 3-dimensional objective movement and rotation allowing the specimen to remain horizontal and stationary. Many highly regarded imaging laboratories around the world use the Sutter MOM and we constantly work with our customers to adapt the design for their changing needs.

MOM *Opto-mechanical Design*

The **MOM** consists of two independent microscopes. The wide-field half of the microscope consists of an Olympus vertical illuminator, Sutter Xenon arc lamp and camera mount to provide standard epifluorescence. The two-photon side of the microscope provides the optical pathway for guiding the excitation laser light from the table up into the scanning galvanometric mirrors and then expanding the beam through the scan lens and directing into the back of the objective. Following twophoton excitation, the emitted photons are directed by a dichroic mirror immediately above the objective into the detection pathway. The main body of the microscope moves backwards on a rail system allowing easy access to the specimen prior to imaging.

The objective translates in X, Y and Z as well as rotates around the X axis. Two moving mirrors allow the microscope to maintain efficient delivery of the excitation light to the back aperture of the objective regardless of movement or orientation. The X, Y and Z movements used are the same as that in our **MP-285** micromanipulator so you know the movements are smooth, fine in scale, drift-free and highly reproducible. These movements permit Z-stacks and mosaic images of large regions of tissue to be recorded without the need for a moving stage.

The horizontal light path allows for rotation of the objective away from the standard vertical position. As a result of this rotation, the **MOM** can easily be converted from an upright to an inverted microscope and the objective positioned from 0 to 180 degrees. This positional freedom permits the imaging of non-horizontal surfaces and volumes.

MOM *Scanning Systems*

During the last 10 years, scanning systems for multiphoton microscopes have changed in several ways. Large aperture, high NA objectives became available and thus required larger aperture scanners. Resonant scanner technology allowed faster imaging. Two-photon scopes now include both resonant-galvo and resonant galvo-galvo systems. The Sutter **MOM** developed in parallel with these changes and new technology can be bolted into older, existing scopes with minimal changes. Many original scopes with 3 mm galvo scanners have been upgraded to either 6 mm galvo scanners or resonant/galvo scanners. As an example, the Vidrio RMR scanner (a resonant galvo-galvo scanner system) can be purchased as part of any new **MOM** system or retrofit into existing **MOM** scopes.

SUTTER INSTRUMENT®

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MADE IN USA

10-2020

Imaging Software
Starting in 2011, Sutter began offering the **MOM**® Computer System and Software (MCS). Before this software package was developed, most users relied on ScanImage or MPScope to generate scanned images. Customers valued the fact that the **MOM** would operate with open source freewares, however, there seemed to also be a market for a commercial package. MCS continues to offer a simple, easy to use package available at a price that compares with other commercial and freeware packages. **MScan** 3.0, the latest version, is Windows 10 compatible. A recent publication takes advantage of the long (1-2 hour) data files that can be captured in the MCS proprietary data file structure. (reference Kuhn, 2020).

The **MOM** has always been compatible with ScanImage freeware, the twophoton imaging software developed by Karel Svoboda and collaborators. One of the reasons the **MOM** platform exists in its present form is the strong support from the ScanImage community. In 2014, Vidrio became the principle vehicle for support and new development of ScanImage. Sutter is happy to make Vidrio ScanImage Premium available to customers who wish premium support and the latest features. ScanImage Basic is available as an entry level system with a year of support included. ScanImage freeware is still available but does not include support. Sutter provides packages that include the necessary data acquisition hardware to couple the **MOM** and other scanning microscopes to ScanImage Premium, ScanImage Basic or the freeware version. We also sell Vidrio's hardware line including ScanImage ready computers, the vDAQ acquisiton system and the RMR scanner.

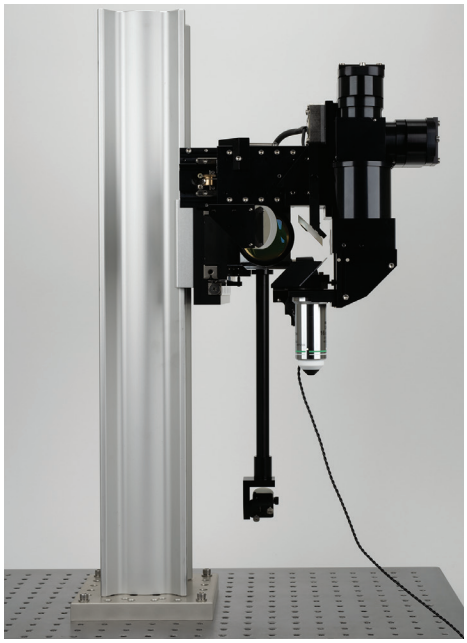
Sutter **MOM** packages include all of the equipment (less the Ti:Sapphire laser and objective), needed for a complete imaging system.

- Scan lens and tube lens appropriate for two- or three-photon imaging
- Cambridge Technology XY galvanometric and resonant scanners. (conventional with 3 mm or 6 mm mirrors or resonant with 5 mm mirrors).
- Hamamatsu photomultiplier tubes (PMTs): R6357 multialkali or H10770PA-40 (GaAsP) products. (Sutter is an authorized reseller for Hamamatsu).
- Power supplies for PMTs: Either a Sutter PS-2 (dual channel high-voltage power supply for R6357 PMTs) or Sutter PS-2LV (dual channel low-voltage power supply for H10770PA-40 (GaAsP) PMTs) can be ordered.
- Hamamatsu, Sigmann or FEMTO pre-amplifiers, selection varies with software and type of scan.
- Data acquisition: National Instruments and Measurement Computing systems.
- Conoptics Pockels Cells for laser intensity control.

Forget multiphoton! *The new Sutter* ***3P-MOM***® *is ready to go for deep-tissue, three-photon imaging.*
Despite the intense interest in three-photon microscopy over the last two years, this is still a relatively nascent field. Neurobiologists doing two-photon imaging and microscope manufacturers building two-photon microscopes have been eager to make the jump into the technology that will allow experimenters to image deeper into the brain, probably close to twice the sub millimeter depth of the best two-photon recordings. We all hoped we could just dial the laser up to 1300 nm and start imaging deeper. After all, Chris Xu made it look so easy!

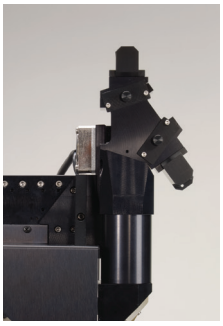
Three-photon microscopy is in about the same status as two-photon microscopy was in the late '90s. There were a small number of labs doing the necessary work to establish the field. Most made their own microscopes and commercialized systems were not well suited to doing functional imaging *in vivo.*

*T*oday, with respect to three-photon microscopy, there are several handfuls of labs that are establishing the field, using largely either homemade microscopes or adapting existing two-photon scopes. There does not seem to yet be a huge market for de novo commercial platforms, possibly because the technique is more challenging than twophoton and possibly because three-photon requires a completely different excitation source than two-photon with more power concentrated

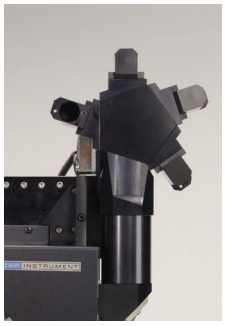


3-P MOM

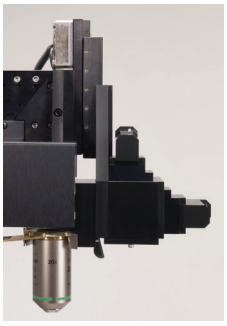
FG-MOM-LB-WIDE (shown installed on wide path detector, blocks external light sources from entering detector path).



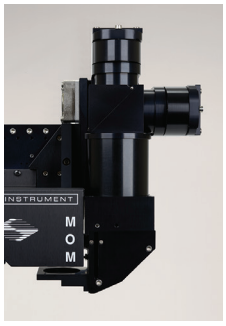
2-channel



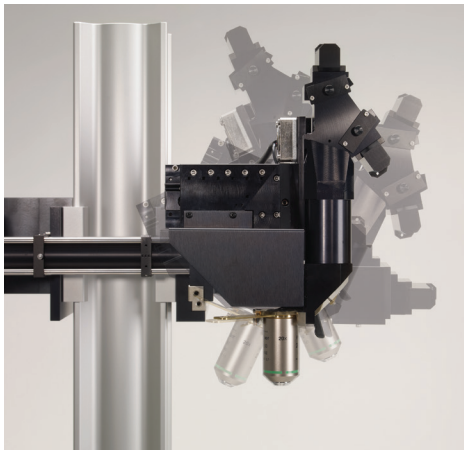
4-channel



Short path (2-channel)



Wide path



The MOM is both an inverted and upright microscope with 0° to 180° rotation

in narrower, taller pulses. In this developing field, Sutter's Microscope division is exactly where you would expect and want us to be. We are already working with a significant portion of the labs developing threephoton microscopy. Most started with our two-photon **MOM** design and have converted them to three-photon platforms either on their own or with our assistance. Sutter now can incorporate those changes into any existing Sutter **2P-MOM**. The most important change is to convert the scan and tube lenses to better transmit IR to beyond 1700 nm. We have also collaborated to develop a more efficient version of one of our detector paths to do a better job of collecting emission from even deeper focal depths.

In the last two years we have quoted and built a number of three-photon **MOMs** as well as a few that were designed to be "three-photon ready". We have collaborated with several labs to convert existing **2P-MOMs** into **3P** platforms.

We are excited to be fully involved in this developing field. Let us help you see what the challenges and benefits of three-photon imaging can be. Whether you are just entering the field of multiphoton imaging or are an experienced two-photon imager who wishes access to deeper and lower-noise images that three-photon excitation can bring, please contact us.

COMMON APPLICATIONS

- *In vivo* two-photon imaging
- *In vivo* three-photon imaging
- Electrophysiological recording and imaging (culture, large *in vivo* preparations, etc.)
- Immunology
- Embryology
- Non-horizontal surface microscope
- Simultaneous retinal stimulation and two-photon microscopy*
- Whole animal imaging

** "Eyecup scope-optical recordings of light stimulus-evoked fluorescence signals in the retina", Euler et al, Pflugers Arch, 2008*

BASIC SYSTEM FOR 2-PHOTON AND 3-PHOTON MICROSCOPY

Includes Moving Objective Microscope®, 2 channel detector with PMTs, preamps and PS-2 power supply, XY scanners with drive electronics, wide field fluorescence unit including vertical illuminator, **Lambda LS** 300 Watt Xenon Arc lamp, LLG and light guide adapter, C-mount for wide field camera, data acquisition system.

MOM-3MM[1]	MOM System with 3 mm galvo scanners and multi-alkali PMTs
MOM-6MM[1]	MOM System with 6 mm XY scanners and multi-alkali PMTs
MOM-RES-MCS[1]	MOM System with Resonant scanners, GAasP PMTs, and MScan 3.0 software
MOM-RES-SIP[1]	MOM System with Resonant scanners, GaAsP PMTs, and ScanImage Premium
MOM-RMR-SIP[1]	MOM System with Vidrio RMR scanners, GaAsP PMTs, vDAQ acquistion system and ScanImage Premium
MOM-3P	MOM System with 3P scan and tube lens, 3P detector path, 6 mm galvo scanners, and ScanImage Premium

ACCESSORIES

MOM-SETUPKIT-M	Basic table optics for laser routing
MOM-ALIGNTOOL[2]	MOM alignment tool
MOM-LB-WIDE	Light blocking cover excludes ambient and other light from detector path
MOM-3P-CONVERSION	3P compatible scan lens and tube lens. Price depends on current MOM configuration, Call Sutter For Details
MOM-3P-SHORT PATH	Call Sutter For Details

[1] *Final pricing depends on detector path selected and does not include several devices necessary for a complete 2-photon microscope (i.e. Ti:Sapphire laser, objective, camera, trinocular head, table mount optics). Please phone Sutter for details.*

[2] *Useful tool for aligning the laser in MOM scopes, especially those with resonant scanners.*

CE