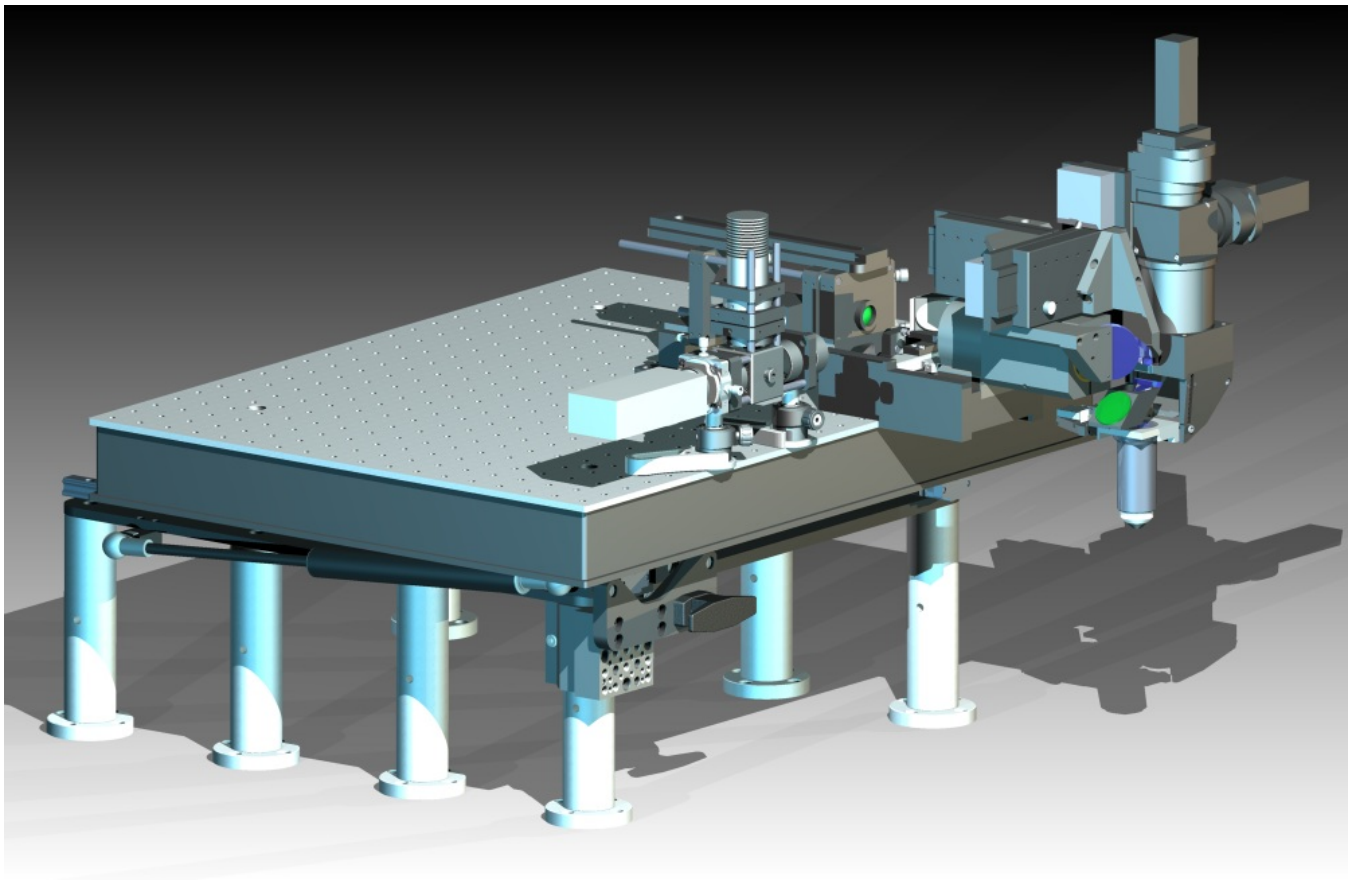
Shared Two-photon Microscope Designs

Notice! The following pages are out of date. MIMMS shared designs are currently available at Flintbox, with registration at that site. The MIMMS microscope has also undergone continual revisions by other members of Janelia's Instrument Design and Fabrication department since the content below was posted. Some of these revisions are available in the designs shared at Flintbox. Designs for support electronics (such as the PMT Controller or PMT Preamps) are also available at Flintbox.



This site contains designs and documentation for some custom-built, two-photon laser scanning microscopes (TPLSM) that have been designed and used at the Janelia Farm Research Campus (JFRC) and Cold Spring Harbor Laboratory (CSHL). The initial users and supporters of these designs were Karel Svoboda and members of his lab group. Additional user/supporters are noted below. Unless otherwise noted, shared designs were made by Dan Flickinger within the Instrument Design and Fabrication service group at JFRC, with critical suggestions and feedback from JFRC users. Designs are compatible with and primarily used with the open-source ScanImage laser scanning microscope software.

Designs shared on this site are offered under one of two specific terms-of-use agreements. See specific terms posted next to download areas for each separate microscope system.

Users

Users of these designs must register first before designs will be made available. Registration forms are available in the pages for each separate microscope system.

Design format

Parts list

Parts lists in MS Excel format are available.

Mechanical designs

Mechanical designs of individual parts designed at JFRC and CSHL are available as PDF files of production drawings, suitable for sending to most machine shops. Full 3D assemblies of parts are available as Design Web Format (DWF) files, which can be viewed using the free Autodesk Design Review software. The DWF assembly files contain all parts in the main assemblies, including commercial-off-the-shelf (COTS) items, and contains basic information about each part (including part number, and vendor and estimated price for COTS items). Autodesk Design Review supports taking measurements on any parts in the assembly.

Electrical designs

A few custom-made electrical components are used with these designs at JFRC. Schematic and/or PDF Gerber files are available so that these may be reproduced.

Optical designs

Optical designs (placement and separation of lenses, mirrors, filters, etc.) will be present in the mechanical assembly files to an accuracy sufficient for microscope assembly. Detailed optical designs of COTS and custom-ordered compound lenses are not owned or shared by JFRC. Optical designs in ray-trace modeling programs OSLO and TracePro *may* be available upon request.

Software

All designs have been used exclusively with the open-source ScanImage laser scanning microscope software.

Design "philosophy"

The microscope systems with shared designs on these pages are *not* turn-key systems. The designs were not necessarily created to maximize ease of assembly, and ease of use once assembled will usually not match that of turn-key systems.

Designs *were* usually created with the intent to make future customization, modifications, and experimentation relatively easy. Assemblies are generally open, and will often contain more degrees of freedom than would be expected with a monolithic, turn-key system, to allow the system to work with many different key components (lenses, scan systems, etc). Use of well-stocked, commercially available parts is made were possible. However, useless degrees of freedom which would result from exclusively COTS (e.g. Thorlabs) construction, and would require unnecessarily difficult assembly procedures, were usually eliminated through the use of custom parts.

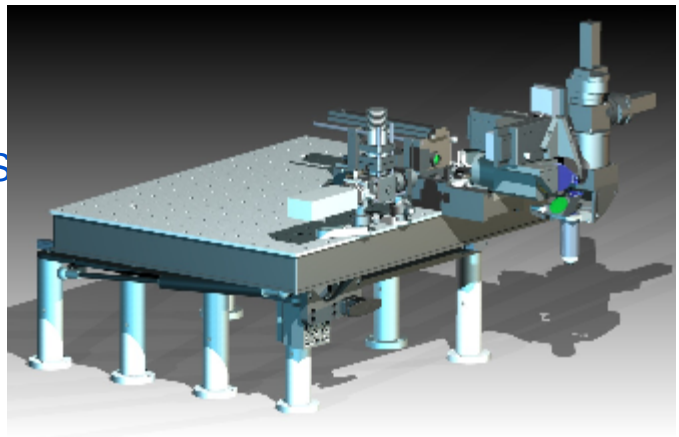
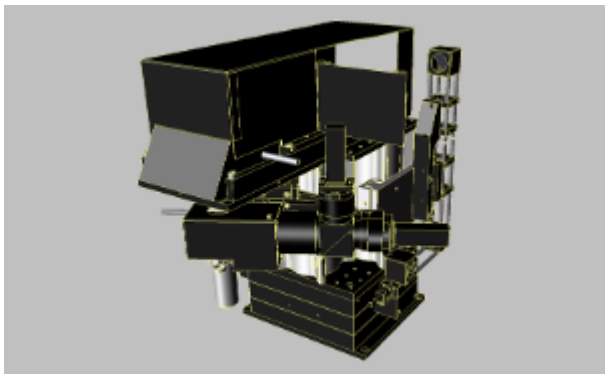
Experience required

Considerable effort and some skill will be required to successfully assemble these microscopes. Exhaustive documentation, necessary for a novice in custom mechanical construction and laser optics setup/alignment, do not exist. Experience in laser optics and alignment, and detailed knowledge of physical principle of TPLSM will be necessary.

Laser safety

Designs were not created to comply with any laser safely guidelines. Users are responsible for ensuring that they and others will not be exposed to dangerous laser radiation. Uncontrolled laser beams will be produced by these open-architecture microscope systems unless care is taken to block them!

Microscope systems

MIMMS		MIMMS (Modular In vivo Multiphoton Microscopy System) is a modular platform for performing two-photon laser scanning microscopy (TPLSM) optimized for *in vivo* applications. The system generally uses the core parts of the Sutter MOM (moveable objective microscope) system to provide for 4 degrees of freedom (three linear and one rotational) of objective movement for *in vivo* experiments. These parts are purchased from Sutter. The mechanical backbone of this system is a movable, raised optical breadboard, providing a large area for affixing optical equipment associated with the microscope, including multiple scanners, beamshaping optics, photostimulation lasers, cameras, etc. The raised design also provides space for behavioral apparatus, and allows the entire microscope to move out of the way for easy 360 degree access to this working area. A modular approach was taken in designing the microscope components, with interchangeable systems for different laser scanning modalities, both moving (based on the Sutter MOM system) and fixed objective lens mounting, widefield conventional imaging, and high acceptance, non-descanned fluorescence detection.
Non-MIMMS *In Vivo*		The MIMMS and non-MIMMS systems use more-or-less the same non-descanned detection optics and can use the same scan mirrors, so will have similar performance for basic operation. The non-MIMMS *in vivo* microscope systems, in contrast to the MIMMS system: • provides for only three degrees of freedom of objective movement (no rotation of objective is possible), • uses no mechanical parts from any microscope manufacturer, and will probably have a lower total cost of purchased parts, • uses an Olympus trinoc assembly, allowing for visual observation mode, • has extensive documentation for assembly, provided by Anthony Holtmaat, • will have a more-incomplete parts list and set of mechanical designs, due to lack of recent design efforts at JFRC (experience in custom 2P microscope construction will be necessary to "fill in the blanks").

Custom electronics designs

At JFRC we use three custom electronics assemblies, both with the MIMMS and non-MIMMS in vivo microscopes: a PMT controller, a control box for the motorized mirrors that these systems use, and a system for mounting and adding connectors to the driver boards for the Cambridge galvonometer scanners. The designs for these systems are shared here.

User Resources

User Suggestion Form

Coming soon! For now add a comment on the bottom of any page, and it will be seen and responded too, or email flickingerd #at# janelia*hhmi*org

User forum