Development of Three Photon Large Field of View Microscope for Mouse Brain Imaging

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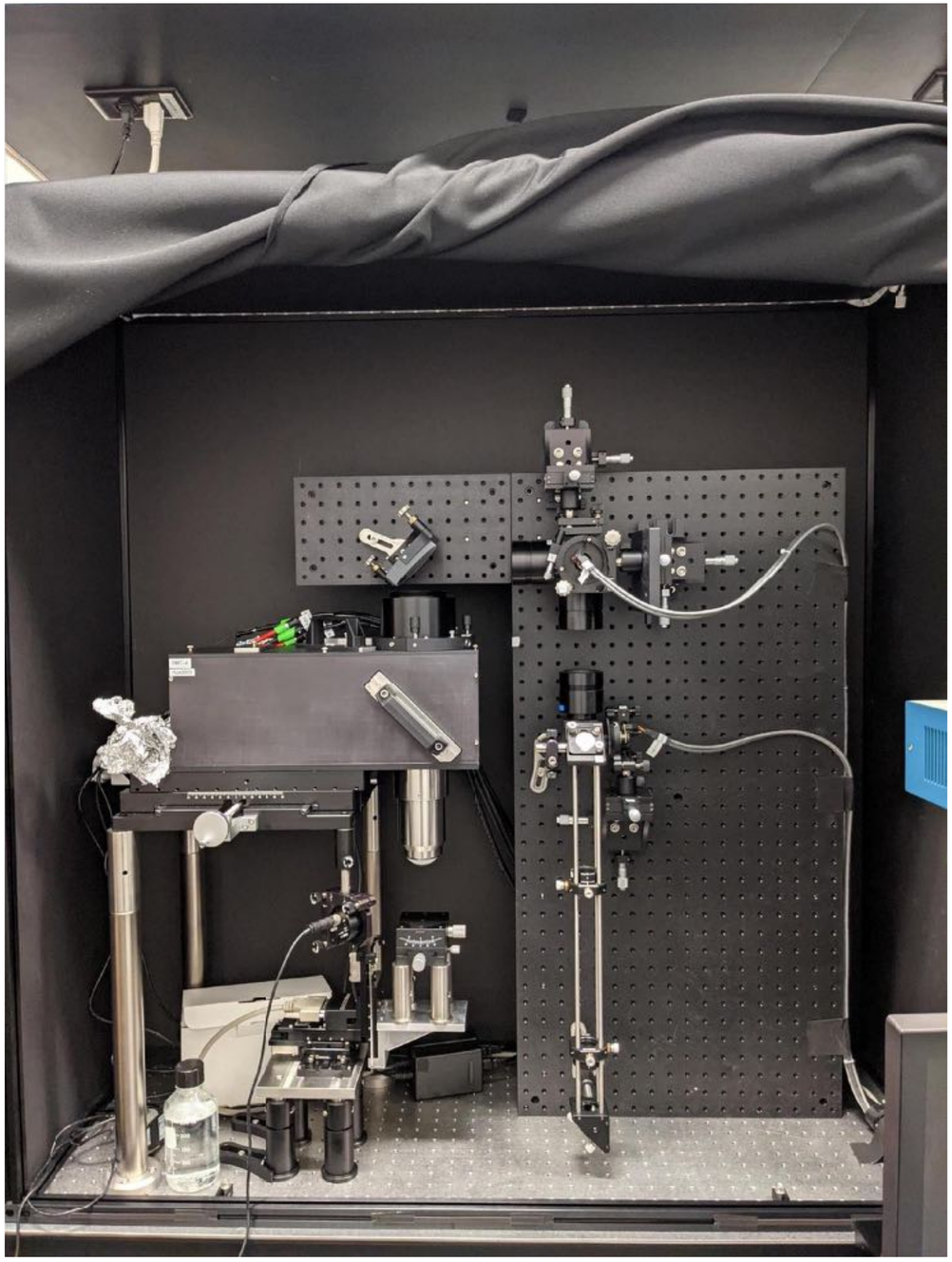
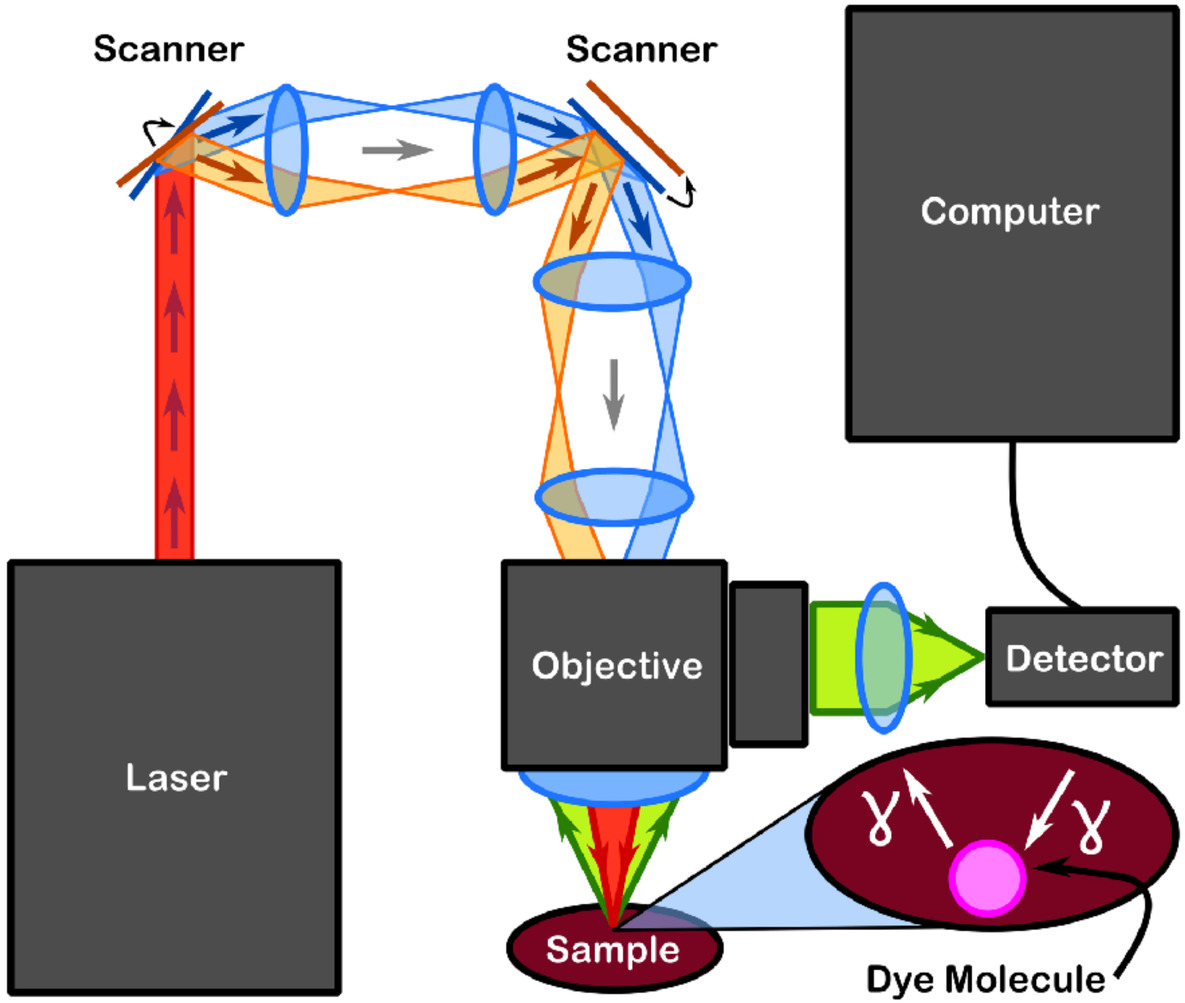
August 13 2021



What Is A Three-Photon Microscope?

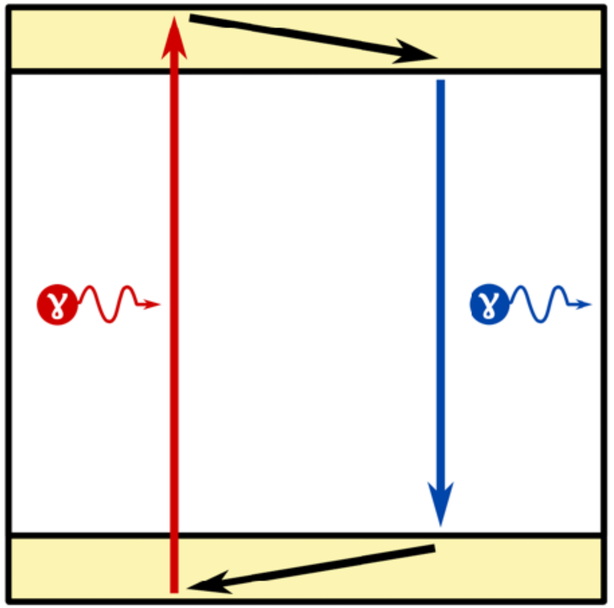
- A three-photon microscope is a type of fluorescence microscope.



Kinds of Fluorescence Microscopes

One-Photon Excitation

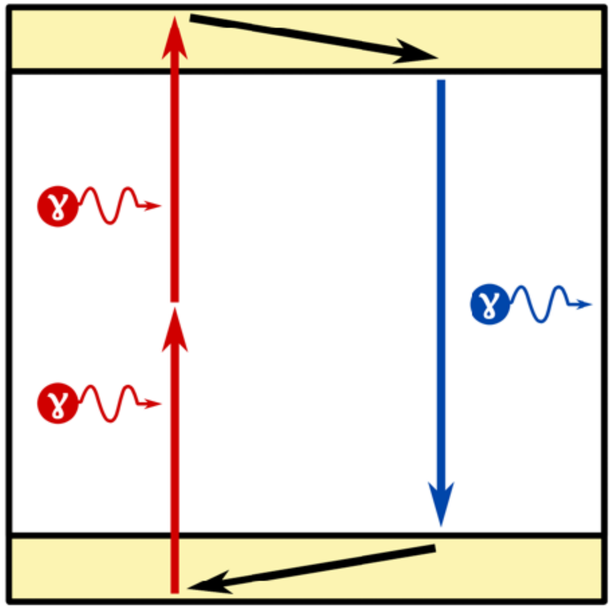
Excited State



Ground State

Two-Photon Excitation

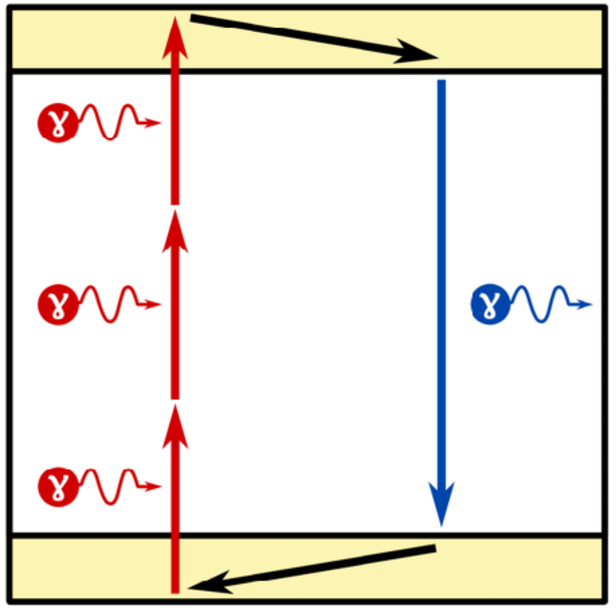
Excited State



Ground State

Three-Photon Excitation

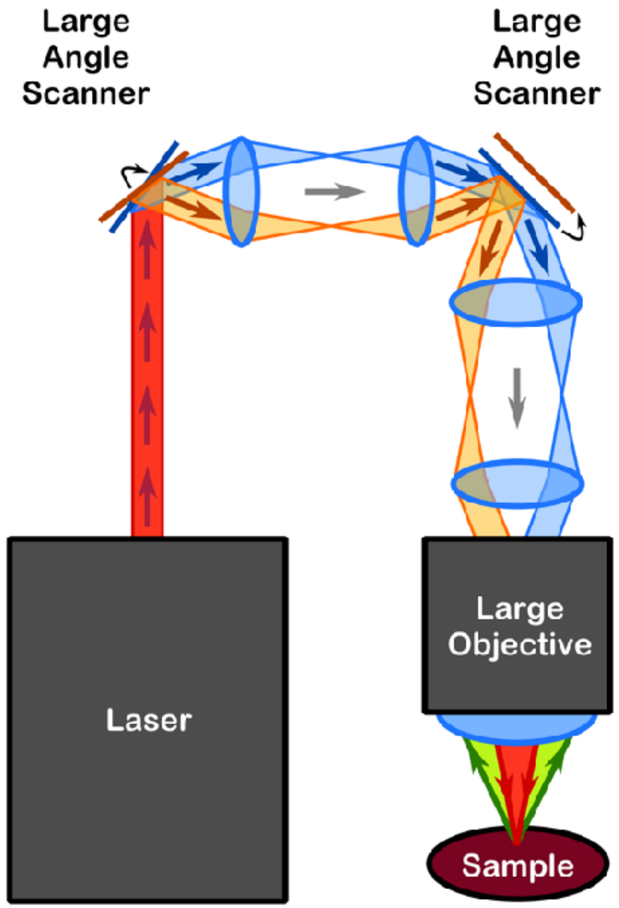
Excited State

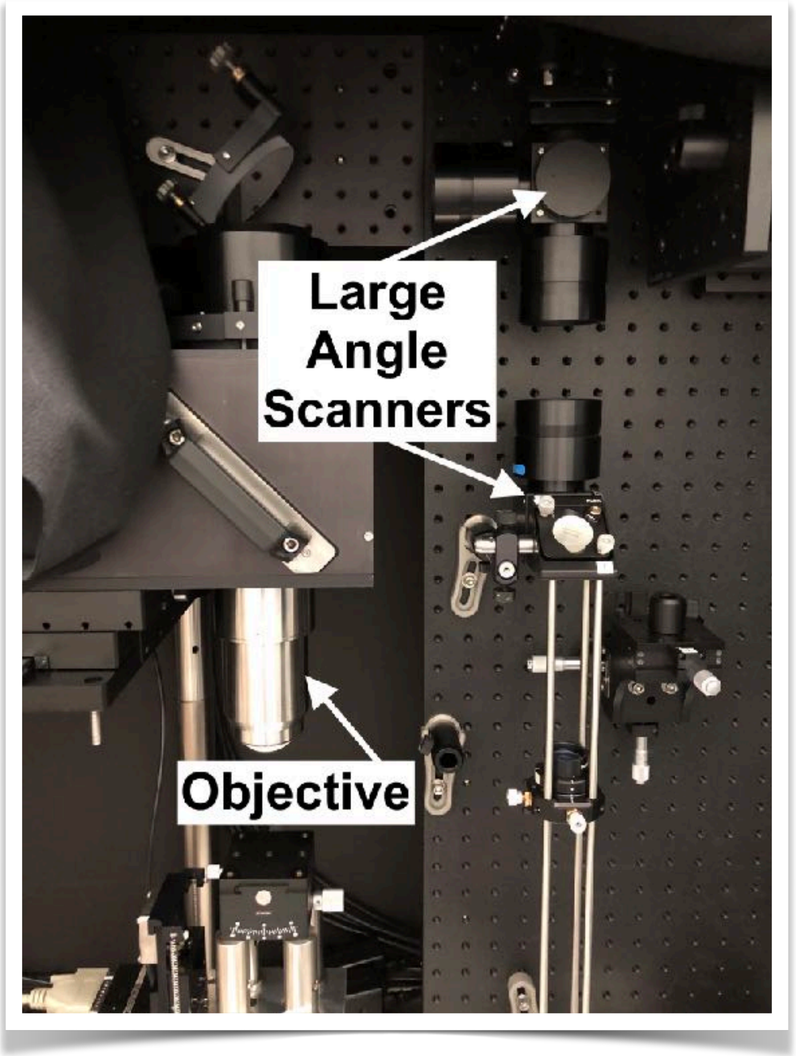


Ground State

Large Field of View Microscope

- What is a LFOV microscope?
  - A LFOV microscope is a fluorescent microscope (3PM in our case) that uses a large objective lens and large angle scanners to capture a larger area (3000 μm^2 vs 600 μm^2).





My Contributions

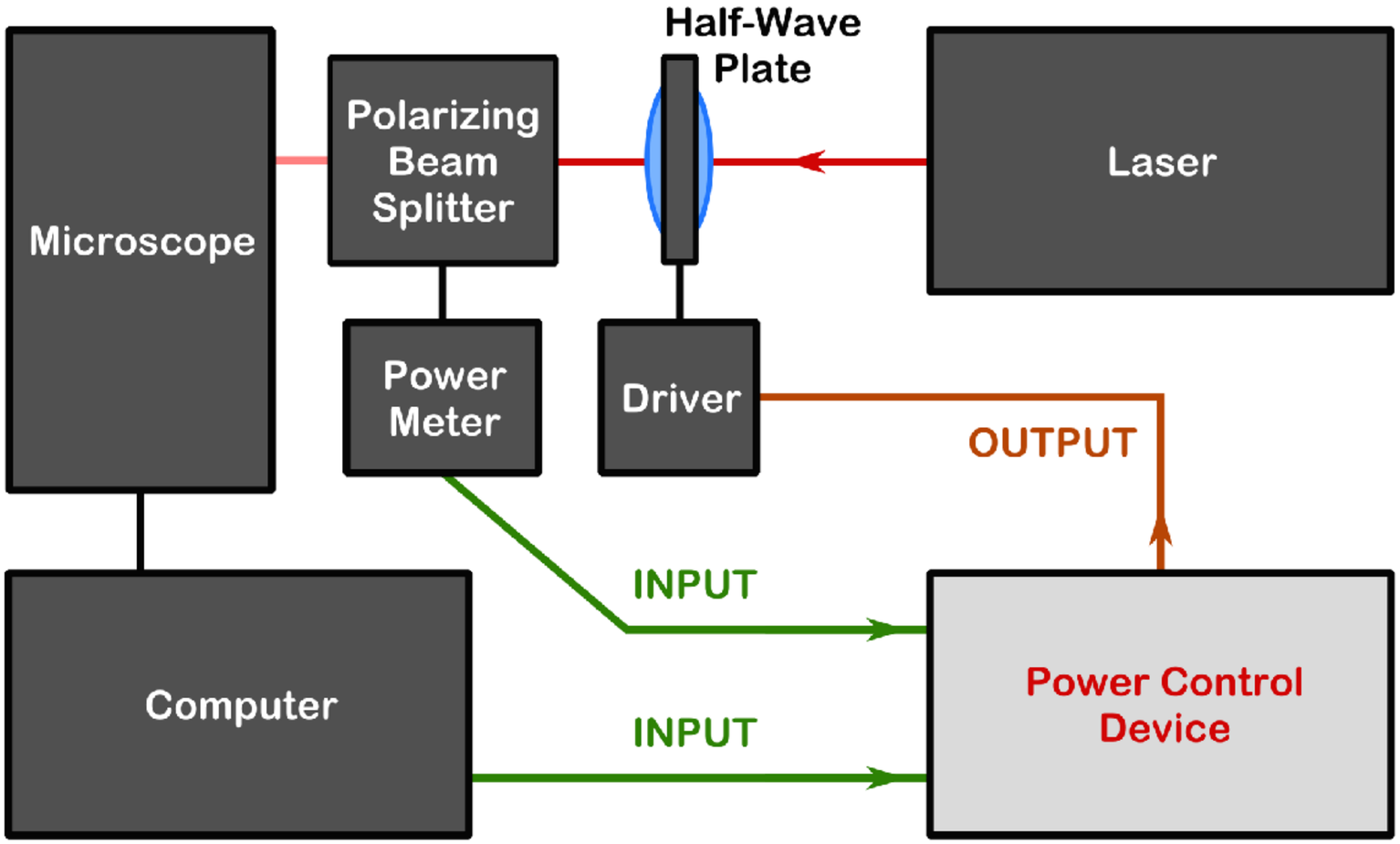
Solving a Problem

- A LFOV microscope is a major project that involves many different parts, and one of those parts is power control.
- ***Problem:*** Imaging takes a long time because power needs to be manually adjusted for different depths.
- ***My Solution:*** Build a device that would do this automatically for a Large Field of View Microscope.

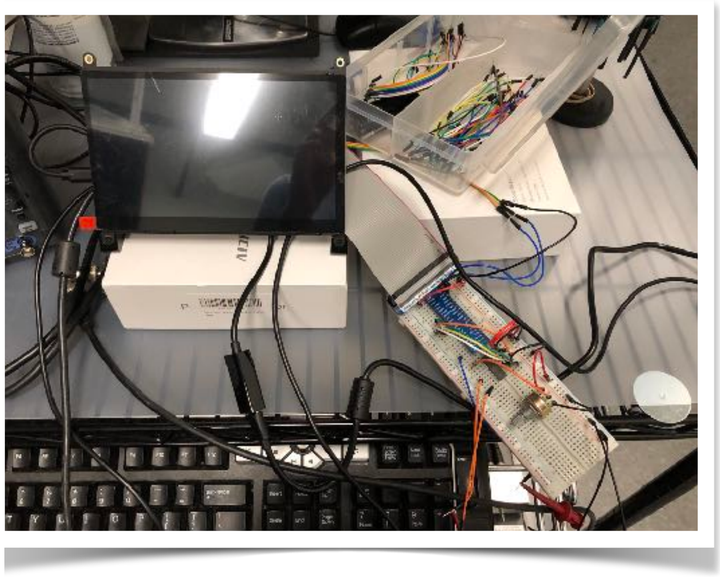
Learning New Skills

- Hardware Control
- Craniotomy (sample preparation surgery) for mouse brain imaging.

Power Control Device: How It Works

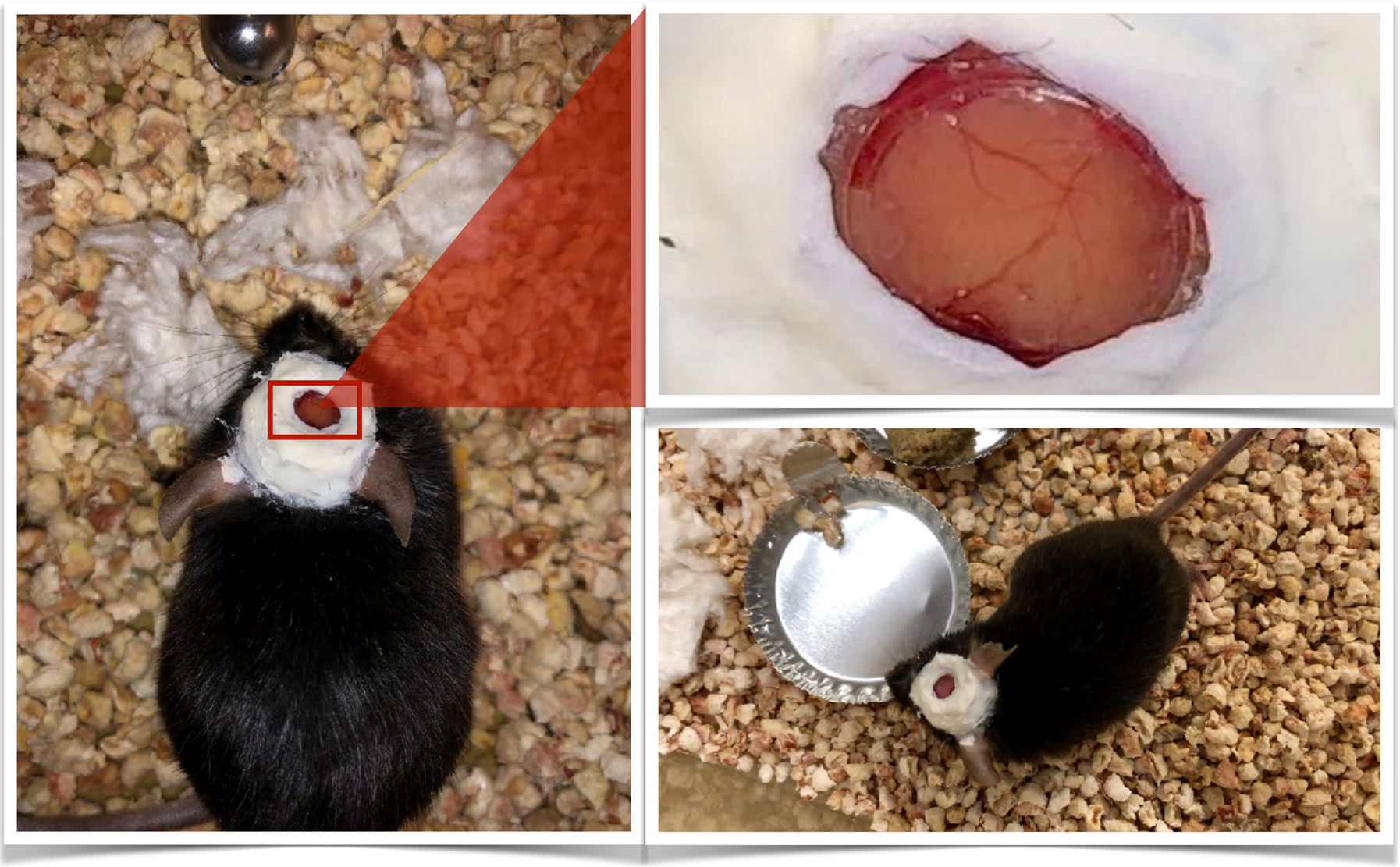


The Device:



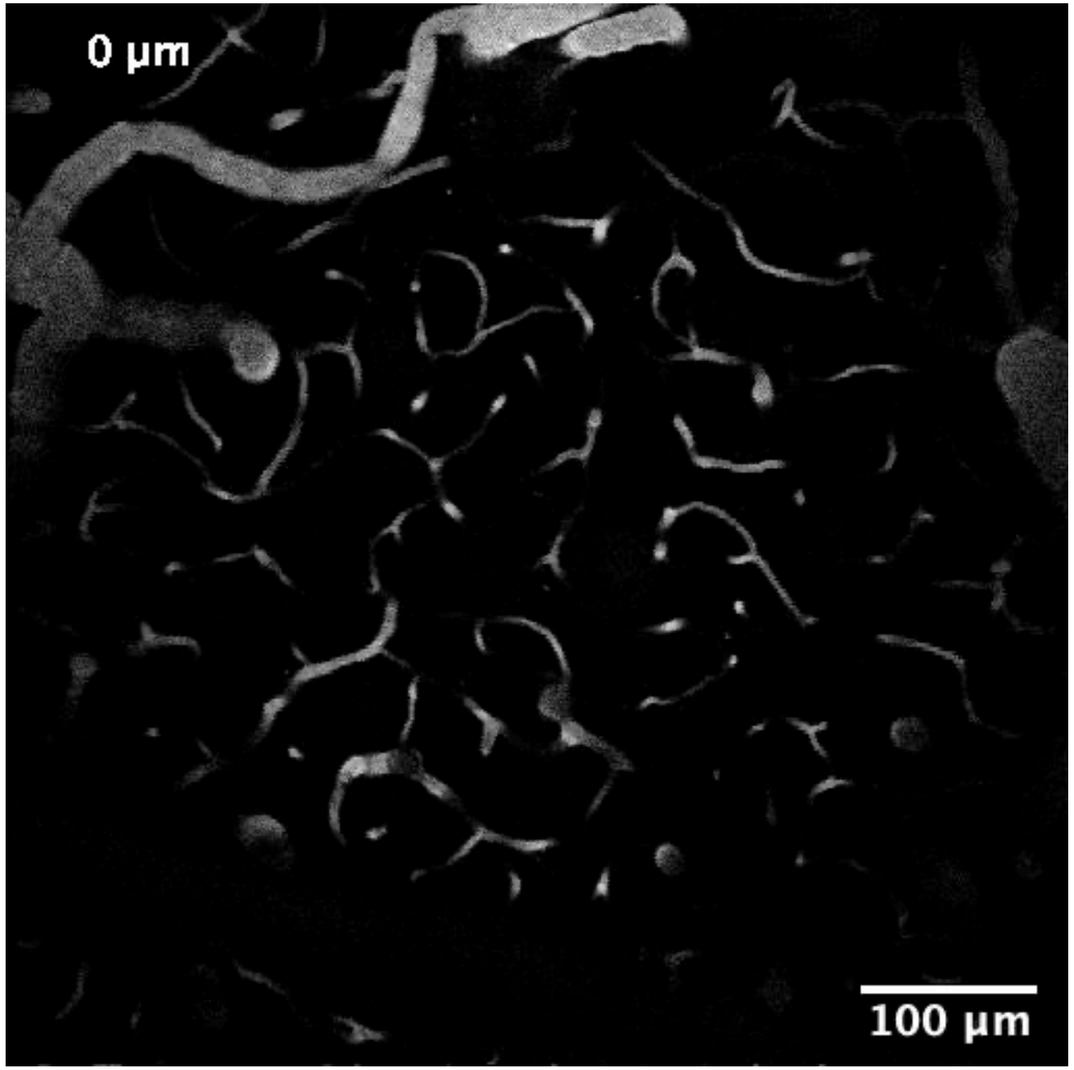
Craniotomy

- What is craniotomy?
  - Craniotomy is a surgical procedure to prepare mice for in vivo brain imaging.



Mouse Imaging Data

- We imaged a volume from 0 μm to 1270 μm.



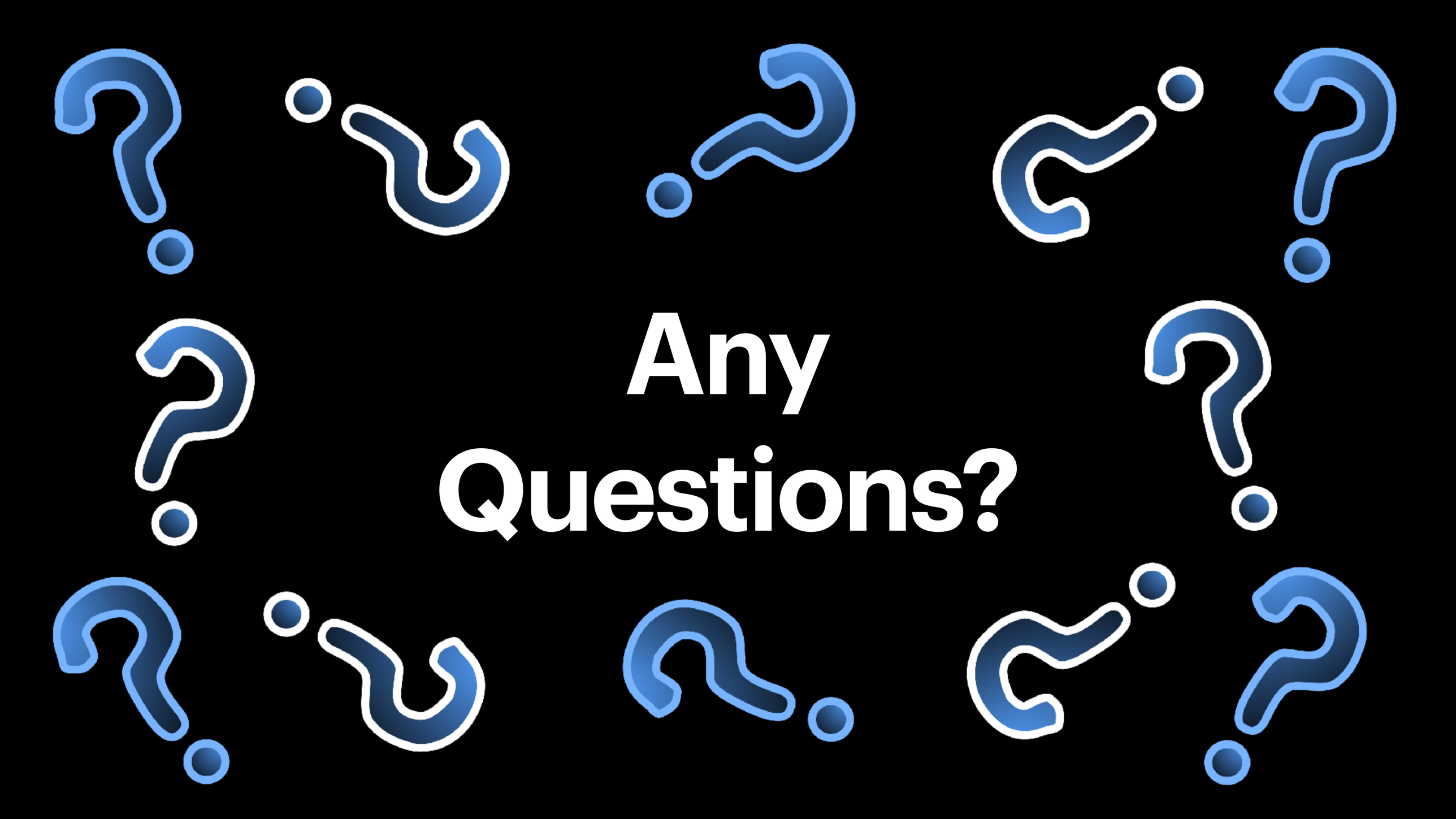
Thank YOU!

- **Special Thanks To...**

Image source: https://neuronex.org/projects/9

National Science Foundation

Image source: https://neuronex.cornell.edu


Any
Questions?

Resources

- Bumstead, Jonathan R et al. “Designing a large field-of-view two-photon microscope using optical invariant analysis.” Neurophotonics vol. 5,2 (2018): 025001. doi:10.1117/1.NPh.5.2.025001
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- Ouzounov, D., Wang, T., Wang, M. et al. In vivo three-photon imaging of activity of GCaMP6-labeled neurons deep in intact mouse brain. Nat Methods 14, 388–390 (2017). https://doi.org/10.1038/nmeth.4183
- Tianyu Wang and Chris Xu, "Three-photon neuronal imaging in deep mouse brain," Optica 7, 947-960 (2020)
- Two-Photon Microscopy. Lecture by Kurt Thorn, iBiology.org, iBiology, Apr. 2012, www.ibiology.org/talks/two-photon-microscopy/.