

## **Reduced power measurements of *Drosophila* larvae for 2-photon optogenetic stimulation of neurons**

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### **Project Description (500 words maximum):**

Neuronal stimulation in live *Drosophila* larvae, using 2-photon excitation and calcium imaging, is a critical tool for optogenetic studies of learning and memory. However, typical sample preparation protocols and embedding materials introduce optical aberrations or do not prevent organism movement. This project will explore a novel material for reversibly embedding live *Drosophila* larvae and performing 2-photon optogenetic stimulation of individual neurons through holography. Previous studies have shown that this novel material can be used for reversibly embedding larva. Based on our preliminary studies with fluorescent beads, this novel material shows promising optical properties but requires further study. The student will continue the project (currently funded through the Integrated Biological Imaging Network) to determine whether this material has benefits for stimulating cells in live *Drosophila* larvae. In practice, the student will devise a protocol to stimulate larvae expressing photoactivatable-GFP (green fluorescent protein). The student will then compare results between several conventional materials and this novel material to determine which material is optimal. Based on our initial findings, we hope that this project will form part of a publication on the embedding of live organisms for 2-photon microscopy.

The student will learn about selecting relevant biocompatible polymers for imaging biological samples; 2-photon microscopy with holography; the use of *Drosophila* and larvae as a model organism; image analysis techniques. Depending on the student's interest, there will be the opportunity to work with researchers from collaborating groups to use machine learning techniques to enhance their image analysis pipeline. Additionally, the student will learn time management for research projects, and scientific writing and presentation of their findings.

### **Short summary:**

This project aims to identify the optimal immobilisation method for 2-photon imaging in live samples using a novel biomaterial. Tasks include optimising an embedding method for live *Drosophila* larvae. Designing a 2-photon stimulation protocol to photoactivate fluorescent proteins in individual neurons. Comparing the optical properties of several embedding materials. The student will then use existing methods or develop their own image analysis pipeline to quantify the resulting data.

### **Specific details:**

No essential previous skills are required, however it would be desirable for students to have a combined interest in optical microscopy, biotechnology, and neuroscience.

The project requires wet lab techniques. Depending on government regulations at the time, it is possible to perform the project remotely through learning or developing image analysis methods.

The duration the project is 6 weeks (~5 weeks wet lab, 1 week computational analysis).