# Thesis Project Form

**Title (tentative):** Development of a holographic module coupled with a two photon microscope for optogenetics and imaging of fluorescent calcium indicators

**Thesis advisor(s):** Raiteri Roberto, Tommaso Fellin

**E-mail:** rr@unige.it

**Address:** Via Opera pia 11a 16145 Genova

<table>
<thead>
<tr>
<th>Phone: (+39) 010 33 52762</th>
</tr>
</thead>
</table>

## Description

### Motivation and application domain

Two-photon microscopy is currently one of the most widespread techniques for imaging calcium indicators that are reporters of the neuronal activity both in vivo and in vitro. This tool, coupled with optogenetics, allows for all optical visualization and manipulation (inhibition/stimulation) of a set of neurons giving the chance of studying the role of particular circuits in the central nervous system of mice.

### General objectives and main activities

The project focuses on developing a holographic setup for photostimulation, coupled with a two-photon microscope. The student needs to develop the light shaping module containing the spatial light modulator (SLM) and design the optimal optical path based on the requirements imposed by holography (diffraction). Moreover, the student will work on the Matlab code for controlling the SLM. Finally, the setup needs to be tested for comparing its performance with older holographic modules and for verifying the activation/deactivation of opsin-expressing neurons in a biological sample.

### Training Objectives (technical/analytical tools, experimental methodologies)

The student will learn the principles of diffraction theory governing the design and projection of holograms. This mathematical background is essential for developing the Matlab code that calculates and sends the phase masks to the SLM. The student will work with optics components and lasers on a two-photon microscope understanding its unique imaging capabilities.

### Place(s) where the thesis work will be carried out:

Optical Approaches to Brain Function Laboratory, Istituto Italiano di Tecnologia, Morego (GE)

### Additional information

**Pre-requisite abilities/skills:** laser and microscopy basic knowledge

**Maximum number of students:** 1