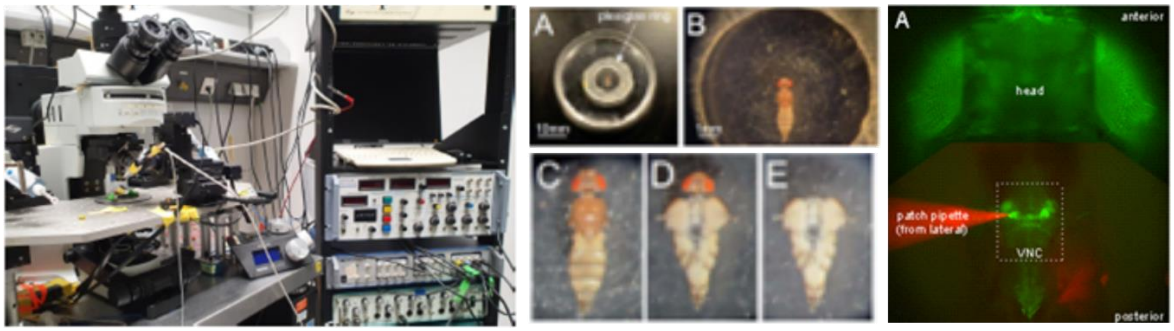
Cellular and Molecular Principles of Motor Behavior

Institute of Developmental Biology and Neurobiology

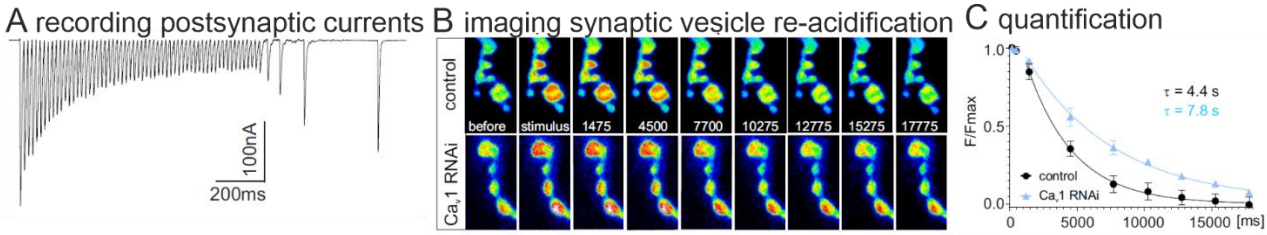
Content and Qualification Goals of Module 12

The module is accompanied by a lecture (10 x 2 hours, daily 9:00 to 11:00) on ion channel function, structure, function, and plasticity of chemical and electrical synapses, as well as physiological principles of single neurons and neuronal networks that are essential for the generation of motor behavior. In the lab class, we will employ the experimental advantages of the genetic model organism, *Drosophila melanogaster*, to address molecular and physiological mechanisms of motor control and motor system development. During the A module (after lecture until 5pm) we will learn cutting edge opto- (calcium imaging) und electrophysiological methods (current and voltage clamp), confocal laser scanning (CLSM) and stimulus emission depletion (STED) super resolution microscopy, neurogenetics, and state-of-the art quantitative image and data analysis tools.



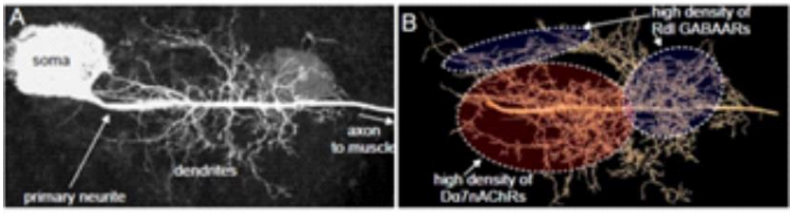
Experimental set-up for electro- and optophysiological recordings in Drosophila. Left panel shows fixed-stage fluorescent micros-cope with movable stage and micromanipulators for electrodes. Left panel shows fixed-stage fluorescent microscope with movable stage and micromanipulators for electrodes, all on a hydraulic vibration cancellation table. Tower houses amplifiers, digitizers, and electronic controllers. Middle panel shows the steps of dissection of adult flies for *in situ* recordings from CNS neurons. Right panel shows view through the fluorescent microscope with red dye filled microelectrode and GFP labeled flight motoneurons (green).

During the B module (4 weeks whole day project work, flexible dates), teams of 2 students each will carry out research projects. These projects are always part of our ongoing research, will be carried out with cutting edge research equipment in close collaboration with researchers in our lab, and are newly conceptualized every year, according to the current state of our research.



Example for chemical synapse physiology: (A) Voltage clamp recording of postsynaptic currents shows synaptic depression during high frequency presynaptic stimulation. (B) Imaging of pH with genetically encoded indicator in synaptic vesicles shows the time course of re-acidification of recycled vesicles after high frequency stimulation (C) Quantification of re-acidification in control and genetic knock down shows effect of a specific calcium channel on synaptic vesicle recycling. From Krick et al., PNAS, 2021.

All projects will employ a hypothesis driven experimental design to decipher clearly defined neurobiological research questions. Students will be exposed to professional data analysis, interpretation, and presentation. Module C is a literature seminar that aids presentation skills.



Quantitative neuroanatomy. (A) CLSM image of intracellular fill of a motoneuron. (B) Quantitative 3-dimensional dendrite reconstruction from CLSM image stack. From Ryglewski et al., Neuron, 2017.

Module 12 general information:
- lecture, lab class, project, seminar
- offered every winter term
- lab class capacity is 8 students
- lecture capacity is 20 students
- Prof. Dr. Duch and Dr. Ryglewski research labs, Biocenter 1, 2nd floor