Title of Project: The Influence of Stress on Visual Processing

Main Supervisor: Alessandro Filosa, **Co-supervisor:** Margaritis Voliotis

Main topics: Neuroscience, Behaviour, Molecular Genetics, Microscopy, Mathematical Modelling

Project

The way we sense the world surrounding us relies on information detected by our sensory organs, but interpretation of this information by our brain is strongly influenced by our emotions and physiological needs. For example, we may pay more attention to food-related sensory cues when hungry, or to potential threats when stressed. Although this modulatory effect influences very strongly how people and animals experience their environment, we currently have limited understanding of the neuronal mechanisms mediating it.

With this project, the candidate will investigate how stress, a very strong emotional state, modifies visual processing and behavioural responses to aversive stimuli. The project involves the use of a multidisciplinary approach in the zebrafish larva, a model organism particularly useful for cracking neuronal codes underlying visually guided behaviour. Importantly, we previously showed that internal needs strongly influence visual processing in zebrafish (Filosa et al., 2016, *Neuron*; Zaupa et al., 2024, *Neuron*), and that zebrafish is well-suited for studying the neuronal circuits controlling stress (Corradi et al., 2022, *Current Biology*). The candidate will use transgenic zebrafish larvae, labelling specific neurons regulating stress and neuronal types in the visual system, to study with optogenetics and *in vivo* microscopy how stress-regulating neuronal circuits control processing of visual information. Experimental work will be combined with mathematical modelling to provide a mechanistic understanding of how stress alters vision and initiation of defensive behaviour.

For this interdisciplinary project, the PhD candidate will work closely with two supervisors, a neuroscientist (Alessandro Filosa) and a mathematician (Margaritis Voliotis), and use a combination of state-of-the art molecular genetic techniques (i.e., transgenesis and CRISPR/Cas9), microscopy (i.e., confocal, two-photon), optogenetics, behaviour analysis methods, and mathematical modelling.

Preferred scientific background: Neuroscience and/or molecular biology, with motivation to learn principles of mathematical modelling. However, we welcome applications from outstanding candidates with other backgrounds wishing to try something new.

Candidate profile: Enthusiastic and highly motivated team player with a strong sense of responsibility, critical thinking, and the potential to drive the project with original ideas.

Selected project-related publications from our group:

Zaupa M., Nagaraj N., Sylenko A., Baier H., Sawamiphak S., Filosa A. (2024) The Calmodulin-interacting peptide Pcp4a regulates feeding-state-dependent behavioral choice in zebrafish. *Neuron*, 112(7), 1150-1164

Filosa A., Barker A.J., Dal Maschio M., Baier H. (2016) Feeding State Modulates Behavioral Choice and Processing of Prey Stimuli in the Zebrafish Tectum. *Neuron* 90(3), 596-608

Corradi L., Bruzzone M., dal Maschio M., Sawamiphak S., Filosa A. (2022) Hypothalamic Galanin-producing neurons regulate stress in zebrafish through a peptidergic, self-inhibitory loop. *Current Biology*, 32(7):1497-1510.e5

Corradi L., Filosa A. (2021) Neuromodulation and behavioral flexibility in larval zebrafish: from neurotransmitters to circuits. *Frontiers in Molecular Neuroscience,* doi: 10.3389/fnmol.2021.718951