Cerebellar control of cognition via higher-order thalamus

Supervisory team:
Main supervisor: Dr Paul Chadderton (University of Bristol)
Second supervisor: Dr Paul Anastasiades (University of Bristol)

Collaborators: Prof Clopath (Imperial College London)

Host institution: University of Bristol

Project description:

Communication between the cerebellum and prefrontal cortex (PFC) is central to higher cognitive functions and disrupted in psychiatric disorders such as schizophrenia and autism. Despite the importance of this pathway, our understanding of the specific circuits that mediate these connections is still limited. This project will use a cutting-edge combination of techniques to determine how specific projections between cerebellum, thalamus and PFC are organised and how they contribute to specific aspects of behaviour.

The cerebellum contains multiple subdivisions, which signal via distinct output pathways. The student will first apply anatomical tracing techniques to map the long-range axon projections of specific cerebellar nuclei throughout the brain. Using optogenetic circuit-mapping they will then determine the functional implications of these projections, measuring how different regions of the cerebellum target separate populations of thalamic neurons and how these thalamic neurons subsequently relay information to the PFC. Using in vivo methods to record neural activity in behaving mice, they will then determine when these different pathways are activated. Finally, they will manipulate different components if the circuit to confirm their causal role in aspects of PFC-dependent behaviour.

The student will benefit from the combined expertise of Dr Anastasiades, whose research involves applying optogenetic approaches to understand the thalamo-cortical circuits of the prefrontal cortex (for example Collins, Anastasiades et al., 2018; Anastasiades Collins et al., 2020), and Dr Chadderton, whose lab focuses on understanding the role of the cerebellum in sensory guided behaviour and decision making (Chen et al, 2016; Chen et al., 2017). They will receive expert training in an array of in vitro and in vivo approaches to understand the contribution of neural circuits to behaviour; including anatomy, slice physiology, optogenetics, chemogenetics in vivo silicon probe recordings and rodent behaviour. Using this powerful approach, the successful candidate will extend our understanding of how cerebellar outputs are relayed to the prefrontal cortex via the thalamus.