Uncovering how behaviour arises out of inhibitory circuits

To pursue goal-directed behaviours, humans and animals have to select appropriate actions after evaluating all available information.

Beyond their well-recognized homeostatic functions, astrocytes have emerged as relevant elements in brain physiology through their ability to regulate neuronal and synaptic activity that underlie. neural networks and animal behaviors. However, it is largely unknown how GABAergic interneurons and astrocytes interact and contribute to stable performance of complex behaviors. We found that genetic ablation of GABAB receptors in medial prefrontal cortex astrocytes altered firing properties of cortical neurons, which affected goal-directed behaviors. We were able to restored the deficits by optogenetic stimulation of astrocytes with melanopsin. Therefore, our work identifies astrocytes as a hub for controlling inhibition in cortical circuits, providing a novel pathway for the behaviorally relevant midrange time-scale regulation of cortical information processing and consistent goal-directed behaviors.

I will then focus in other important aspect of selecting actions, how innate drives can be shaped by experience and the internal state, allowing animals to react differently to the same environmental stimuli depending on circumstance. The ventral lateral geniculate nucleus (vLGN) is an inhibitory, subthalamic nucleus that has been shown to provide strong, bidirectional inhibitory control over visual threat-evoked escape behaviour. Moreover, vLGN activity is modulated by previous threat experience and the anxiety state of the animal.

We have identify visual cortex provides inputs to the vLGN during visual threat signals. Furthermore, by calcium imaging, and optogenetic manipulations, we have tested the influence of these inputs to vLGN over instinctive defensive reactions on paradigms that allow to test the animal's behaviour depending previous knowledge and internal state.

Further characterization of these outcomes will elucidate important pathways and mechanisms by which the brain can control the generation of flexible behavioural responses to environmental stimuli depending on the behavioural context.