**Neuromodulatory circuits enhancing visual plasticity in the adult rodent cortex**

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**Research overview**: Our lab is interested in understanding how neuromodulation regulates information processing and neuroplasticity in the visual systems. To this end, we apply a combination of systems approaches including electrophysiology, optogenetics, and 2-photon imaging to reveal the biological basis of visual cortical plasticity.

**Research project**: The limited plasticity in adult brain is responsible for reduced visual learning ability and incomplete vision recovery. Recent works have uncovered that running effectively enhances visual representation and promotes visual plasticity in the adult animals1,2 and human beings3,4, offering a potential to serve as a non-invasive procedure to clinically promote cortical plasticity. However, the circuit mechanisms by which running, a non-sensory information, regulates cortical plasticity remains unclear, making it difficult for developing therapeutic treatment.

The object of this project is to determine the role of subcortical neuromodulation in cortical processing and plasticity and reveal the underlying circuit basis using mouse model. We hypothesize that in the adult brain, the subcortical neuromodulatory projections sends running signals to modulate the visual representation in the primary visual cortex (V1). The study will 1) use viral tracing and calcium imaging to map the projecting neurons in candidate subcortical nuclei and verify if the activity of their axonal inputs to V1 carries running signal, and 2) use optogenetics and electrophysiology to assess the role of each neuromodulatory projections in regulating visual responses and long-term plasticity in V1 neurons.

The graduate student will work closely with Dr Sun and the senior research technician in the lab to develop experimental approaches to manipulate and measure neurophysiological properties in mouse V1. The successful completion of this study will advance our understanding of how neuroplasticity is regulated by long-range neuromodulatory projections and provide insights in new directions for translational works.

**Requirements**: This 3-year PhD studentship in Visual Neuroscience is sponsored by UCL and based at the Institute of Ophthalmology. The PhD student is expected start between Sep 2021 to Jan 2022. The student is expected to have an MSc degree in Neuroscience, Biology, Physiology, Optics, Engineering, or related fields. Past experience in Python / MATLAB and knowledge in systems neuroscience are desired.

**Reference**:

1. Kaneko, M. & Stryker, M. P. ***Elife*** 3, 1–16 (2014).

2. Kaneko, M., Fu, Y. & Stryker, M. P. ***J. Neurosci.*** 37, 3760–16 (2017).

3. Lunghi, C. & Sale, A. ***Curr. Biol.*** 25, R1122–R1123 (2015).

4. Perini, R., Bortoletto, M., Capogrosso, M., Fertonani, A. & Miniussi, C. ***Sci. Rep.*** 6, 25440 (2016).