09
NEUROSCIENCE

Principal Investigator

Dr. Owen Ko

Team

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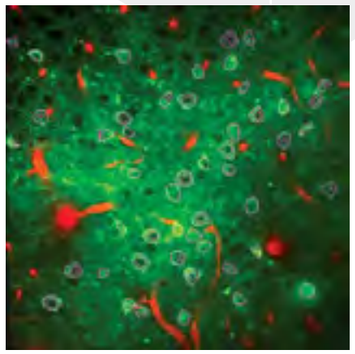
Research Progress Summary

1. Neural circuitry underlying sensory processing

Dr. Owen Ko and his team are currently building up their laboratory. They plan to employ multiple technologies, including multiphoton fluorescence excitation microscopy, light field microscopy, microfluidics and single-cell RNA sequencing to uncover the principles underlying the neural circuitry functionality. A novel methodology is being developed by the team based on these technologies to relate with single cell precision, landscape of gene expression of individual neurons to their functions (e.g. visual feature selectivity in visual areas of the cerebral cortex), as well as patterns of long range connections from, or projections to, other brain areas. The team seeks to understand fundamental principles which govern logics underlying the functionality of neural circuits using the methodology. For instance, they plan to apply the methodology to study how long range connections and spectrum of gene expression allow visual response properties to be built up in the visual cortex.

2. Pathogenesis underlying cerebral small vessel disease

Apart from Alzheimer's disease, dementia that caused by cerebral small vessel disease (SVD) is currently another dominant cause of cognitive impairments in the elderly population. Spontaneous SVD, the most common form of SVD, is more likely to develop in populations with cardiovascular risk factors (e.g. ageing, hypertension, diabetes) and variants of specific genes (e.g. foxf2). The team is currently developing rodent models of cerebral SVD by varying these parameters in mice systematically. They plan to employ *in-vivo* functional imaging, *in-vitro* structural imaging, and RNA sequencing techniques to assay how local neurovascular coupling, cerebral vascular network morphology, and gene expression of neurovascular unit constituting cells are being altered in cerebral SVD. The team seeks to uncover mechanisms underlying the eventual neuronal dysfunction from SVD, and discover potential new therapeutics.



In-vivo two-photon imaging of cortical neurons (green) & blood vessels (red)

Publications

A. Journal Papers

1. Wei X, Kong C, Sy S, Ko H, Tsia K, Wong K. Ultrafast time-stretch imaging at 932 nm through a new highly-dispersive fiber. *Biomedical Optics Express.* 2016; 7(12):5208.

B. Conference Papers

1. Wei X, Kong C, Samanta GK, Ko H, Tsia KK, Wong KK. Compact Airy-beam optical swept-source at 1.0 μm. In: *CLEO: Science And Innovations 2016*; San Jose, California, USA; 2016 Jun 5-10.