Contribution ID: **7** Type: **not specified**

Going beyond fluorescence: bringing label-free optical spectroscopy in deep brain regions using a single thin optical fiber

Thursday, 16 May 2024 11:30 (20 minutes)

Optical approaches for in vivo neural monitoring using genetically-encoded fluorescent molecular reporters offer a precious window on brain functions, and on the mechanisms of development, ageing or disease progression. Nonetheless, the existing methods are still shortsighted with respect to the complex biomolecular alterations that accompany these physiological and pathological dynamics. As a result, our grasp of the multifaceted components of brain activity is still partial. To surpass these limitations, this talk will discuss the opportunities offered by the broad physical phenomenologies underlying light-brain interactions to capture a more comprehensive picture of neural mechanisms using label-free optical spectroscopy in deep brain regions. In particular, I will present a vibrational fiber photometry method, based on spontaneous Raman scattering, that allows monitoring the bio-molecular content of arbitrarily deep brain volumes of the mouse brain –in vivo –to gather information on molecular alterations caused by traumatic brain injury and to detect diagnostic markers of brain cancer using a single thin optical fiber. This approach, which can be employed alongside conventional photometry techniques, has the potential to empower emerging research on brain-immune and brain-cancer bidirectional dynamics.

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Session Classification: Session 2. Advanced platforms and optical tools