



Graduate Seminar – MPhil Oral Defence

Student : Miss HAN Yueyue
Supervisor : Prof. DUAN Liting
Date : 30 July 2025
Time : 11:00 am
Venue : Room1118, William M W Mong Engineering Building, CUHK

Title: Optogenetic Control of Protein Localization in Bacteria and Activation of Receptor Tyrosine Kinases in Mammalian cells

Optogenetics, a rapidly developed technology in recent years, combines optical and genetic techniques to control the target protein binding and dissociation by light-induced photosensitive protein interaction. Optogenetics demonstrated great capabilities and has been used to noninvasively regulate intracellular biological processes with unprecedented precision.

This thesis developed different optogenetic strategies for temporal and spatial control of protein localization in bacteria via light-induced membrane recruitment and cluster formation. We discovered that the expression level of optical dimerizers is critical for effective light-induced binding. Furthermore, we demonstrated quick and reversible control of the chemotaxis protein CheY** in bacteria and explored the functional effects of CheY** of changing its concentration and cellular localization. Our results provide insights into designing effective optogenetic tools in bacteria. In addition, we applied light-inducible strategies to activate tyrosine kinase receptors (RTKs) that are responsible for regulating cell survival, growth, and functions. We designed optogenetic tools for activating multiple RTKs, including neurotrophin receptor TrkC, insulin-like growth factor-1 receptor (IGF1R), fibroblast growth factor receptor (FGFR), and rearranged during transfection (RET). We demonstrated that optogenetic activation of these signaling pathways is capable of phenotypically promoting PC12 neuronal cell differentiation and neurite outgrowth. We further explored the combinatorial activation of two or more RTKs by leveraging light-inducible interactions of different receptor intracellular domains.

In summary, we developed optogenetic strategies that successfully manipulate protein localization in bacteria and activate receptor tyrosine kinases in mammalian cells.

***** ALL ARE WELCOME *****

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