Photoswitchable chemical reagents for high-precision spatiotemporal control of living organisms

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Abstract:

Many of the most important cellular proteins are multifunctional, performing distinct roles at different places and times (in different cells, in response to different stimuli, etc). Such proteins include cytoskeleton components (actin, tubulin, motors), DNA read/write/execute proteins, and metabolic enzymes. Ideally, studies of these enzymes need to selectively and reversibly, spatiotemporally modulate these different roles. Such modulation is quasi-impossible using traditional pharmaceuticals (protein-specific inhibitors); and stimulus-responsive genetic approaches have only limited potential with critical cellular components.

Ongoing research in our group includes the design and use of light-modulatable chemical reagents to solve this spatiotemporal selectivity problem. This talk will present the logic behind these “photopharmaceuticals”, discuss alternative chemical methods, and present a case study in photopharmaceuticals for the microtubule cytoskeleton which can achieve single-cell-specific control over embryonic development; and the demonstration of light-guided tissue-specific antimitotic activity in live mouse – towards tumour-specific chemotherapy without systemic mechanistic side-effects.

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