Department of Biomedical Engineering
香港城市大學
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The Design Principles of Dynamic Gene Regulation

Prof. James CW Locke

Professor
Sainsbury Laboratory, University of Cambridge

THURSDAY
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TIME
15:30 – 16:30

VENUE
G5-216, 5/F Yeung Kin Man Academic Building

ABSTRACT

Cells are dynamic systems. Rather than stably expressing genes at fixed levels, they often produce gene expression pulses, oscillations, and other time-varying behaviours that differ from cell to cell. These dynamics arise in part from gene expression noise caused by random molecular fluctuations, but are also modulated by gene circuit architecture.

In this talk, I will explore how cells generate and regulate these dynamic behaviours, and what this reveals about the design of gene regulatory systems. We combine single-cell time-lapse imaging with stochastic modelling and synthetic biology approaches to investigate these questions. I will begin with recent work showing how bacterial gene circuits that combine positive and negative feedback can amplify noise to produce diverse single-cell behaviours.

I will then turn to the cyanobacterial circadian clock, a robust 24-hour oscillator that we find couples to pulsatile processes through pulse amplitude modulation. I will also show how this clock filters both molecular and environmental noise, even under natural light conditions.

Finally, I will briefly touch on multicellular systems, highlighting how plant circadian clocks use local coupling between cells to coordinate timing and filter noise. Together, these systems show how cells regulate dynamic gene expression, from amplifying noise to create variability to filtering it for precise control.

BIOGRAPHY

James CW Locke is a Professor at the Sainsbury Laboratory, University of Cambridge, and a Royal Society University Research Fellow. He received his undergraduate degree in Physics and later completed a joint PhD in Biology and Theoretical Physics at the University of Warwick under the supervision of Professors Andrew Millar and Matthew Turner. He subsequently conducted postdoctoral research with Professor Michael Elowitz at the California Institute of Technology.

Professor Locke is a leading figure in stochastic biology and single-cell dynamics. He was among the first to demonstrate, both experimentally and through mathematical modeling, how cells can amplify gene expression noise into distinct transcriptional states, ultimately leading to divergent cell fates even under uniform environmental conditions. His laboratory now integrates single-cell time-lapse microscopy, mathematical modeling, and synthetic biology to uncover and reengineer dynamic gene regulatory behaviors in both bacteria and multicellular organisms.

In recognition of his contributions to quantitative systems biology, Professor Locke has received several notable honors, including the Merrimack-CSB2 Prize in Systems Biology and a Royal Society University Research Fellowship.