Contribution ID: **254**

Type: **Talk**

【26】How do single bacterial cells think?

Thursday 12 September 2024 12:00 (45 minutes)

The functioning of genome-wide gene regulatory networks in bacteria presents us with an apparent paradox. On the one hand, bacterial populations successfully coordinate their gene expression patterns and phenotypes to allow them to grow in a huge variety of environments, including complex combinations of nutrients and stresses that natural selection cannot possibly have specifically prepared them for. For example, bacteria can even adapt their phenotype to grow in fully deuterated water.
On the other hand, the more we study gene regulation in bacteria at the single cell level, the more noisy and haphazard it appears. Moreover, given the low molecule numbers involved, there are severe thermodynamic limitations on the accuracy of both sensing and regulation of gene expression in single bacterial cells, which seem to preclude the robust adaptation that is observed at the population level.
In this talk, I will present a new picture that is emerging from recent joint experimental and theoretical studies of gene regulation at the single-cell level in bacteria, suggesting a subtle stochastic strategy for phenotypic adaptation in which noise and regulation are deeply entangled.
The key experimental observations that form the main ingredients of this picture include:
1. That gene expression fluctuations are largely driven by propagation of noise through the gene regulatory network,
2. That, through the effects of dilution, growth rate controls the sensitivity of gene regulatory circuits to fluctuations, and
3. That gene expression noise and phenotypic fluctuations systematically decrease with growth rate.
I will discuss how these observations combine into a stochastic strategy by which bacterial populations successfully adapt their phenotypes to complex unpredictable environments, in spite of highly noisy and inaccurate regulation at the single cell level.

Author: Prof. VAN NIMWEGEN, Erik (Universität Basel)

Presenter: Prof. VAN NIMWEGEN, Erik (Universität Basel)

Session Classification: Plenary Session