Cologne Evolution Colloquium

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Dynamics of Growth and Cell-cycle Progression in Single Cells

Dynamic single-cell data available today open unprecedented opportunities to explore the cell cycle. I will describe a set of tools that we have developed over the past years to reverse-engineer cell-cycle progression and its coupling to cell growth. Our methods combine data analysis of the available dynamic single-cell data (hundreds to tens of thousands cell cycles) with novel mathematical models. In metazoans, these methods allowed us to show for the first time that mammalian cells modulate their growth rate to achieve size homeostasis. A meta-analysis of the available dynamic single-cell data comparing size-homeostasis mechanisms across kingdoms, shows that control by growth-rate modulations appears to be unique of metazoans. In E. coli, this method has lead us to propose a new model the coordination of cell division with the chromosome replication-segregation cycle, which challenges the prevalent view that cells divide a fixed amount of time after they start to copy their chromosomes. Instead, we find that two concurrent processes - an inter-division process (limited, e.g., by septum completion) and a replication-limited process - compete to determine cell division. We propose that the concept of transitions between cell-cycle stages as decisional processes integrating multiple inputs instead of cascading from orchestrated steps can affect the way we think of the cell cycle in general.

Wednesday, April 3, 2019, 17:00
Institute for Biological Physics, Zülpicher Str. 77a
Seminar Room 0.02, Ground Floor

Hosted by Tobias Bollenbach

CRC 1310 Predictability in Evolution