The University of Edinburgh - Friedrich Schiller University

Population Dynamics Virtual Seminar

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Coordination of bacterial cell shape and growth

All living cells are bounded by envelopes that protect them from the environment and confer their sizes and shapes. These shapes help cells to spatially organize their internal biological processes, allowing them to divide and faithfully segregate genetic material to each daughter. Yet, we still know very little about how cells obtain and control cell shape despite rapidly changing intra- and extra-cellular conditions, even in the arguably simplest and best understood organism: *Escherichia coli*.

My lab uses approaches from physics to understand bacterial cell shape across spatial and temporal scales – from single-enzyme behavior via mechanical forces to cell shape and cell-cycle control. Here, I will present our work on how cells increase their cell size with cell mass: During growth, cells rapidly convert metabolites into biopolymers such as protein, RNA, and DNA, which are highly packed inside the cellular cytoplasm. To maintain the density of macromolecules roughly constant during growth, cells must increase their volumes in coordination with the rate of biomass growth. We developed and used label-free phase microscopy to study the extent and the design principles underlying this coordination. We propose that cells increase their size according to a new empirical growth law. Additionally, we found that turgor pressure plays an important role in the regulation of cell width. I will discuss possible regulatory pathways underlying both surface growth and width regulation.

Suggested reading: *Robust surface-to-mass coupling and turgor-dependent cell width determine bacterial dry-mass density* - Enno R. Oldewurtel, Yuki Kitahara, Sven van Teeffelen - Proceedings of the National Academy of Sciences Aug 2021, 118 (32) e2021416118; https://doi.org/10.1073/pnas.2021416118

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