

## Master thesis / internship: cell-to-cell variability in changing environments

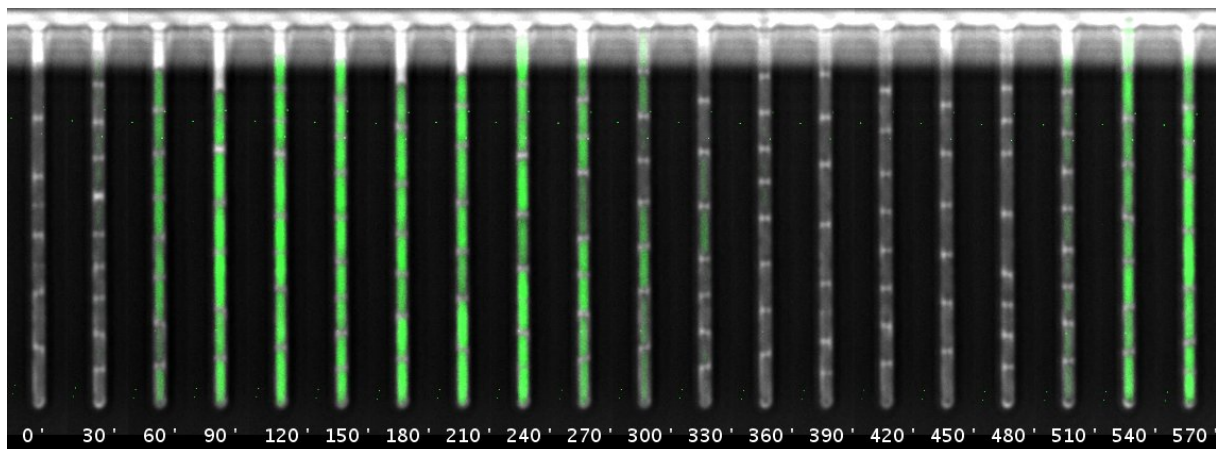
The behaviour of cells is driven by molecular processes that are intrinsically stochastic. Consequently, even genetically identical cells can exhibit different behaviours in a homogeneous environment. This stochastic variability in phenotypes underlies many important processes such as persistence to antibiotics and sporulation in bacteria, and theoretical considerations suggest that stochasticity is particularly significant when cells face changing environments. With the advent of microscopy and microfluidics, studying bacteria populations with single cell resolution has become a powerful approach to study the stochasticity of cellular processes.

Our lab uses a combination of experimental and theoretical approaches to study growth and gene expression at the single cell level in bacteria (see e.g. [1]). We have recently developed a microfluidic system that allows us to measure growth, division and gene expression of single cells in a dynamically changing environment [2]. In this internship, the focus will be to study how cell-to-cell variability in growth and gene expression is impacted as *E. coli* cells are subjected to changing environmental conditions. The student will be given the chance to pick one of several projects, based on his interests and on preliminary results obtained in our lab; the topic will revolve around questions such as the interplay between growth fluctuations and gene expression fluctuations, the impact of gene regulation on gene expression noise, or how noise in growth and gene expression changes between exponential and stationary phases.

The student will be in charge of running the experiments in which bacteria carrying fluorescent reporters are grown inside a microfluidic device and followed using time-lapse microscopy, he/she will learn to process their data with our image analysis pipeline, and will help implement quantitative data analysis procedures aimed to answer specific biological questions. Depending on the student's abilities and interest, the work can be extended to include computational modelling of the dynamic and variability of the cellular traits under study, as well as of their evolutionary implications. Moreover, competitive funding is available for motivated students desiring to start a PhD after the internship (in particular Biozentrum's "Fellowships for Excellence").

The [van Nimwegen Lab](#) [3] at Basel University's Biozentrum is an international and multidisciplinary team with extensive expertise in the study of transcription regulation and cell-to-cell variability. A list of our group's publications can be found on [Google Scholar](#) [4]. Our computational and experimental groups work together to combine cutting edge statistical and computational tools with quantitative experiments.

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[1] Wolf L, *et al.* (2015) Expression noise facilitates the evolution of gene regulation. *eLife* 4.

[2] preprint available at <http://www.biorxiv.org/content/early/2016/09/20/076224>

[3] <http://www.biozentrum.unibas.ch/research/groups-platforms/overview/unit/nimwegen/>

[4] <http://scholar.google.ch/citations?user=N24KB1wAAAAJ>