Projekt 3.4. Odpowiedz bakterii na antybiotyki w laboratoryjnych modelach infekcji.

Promotor: prof. Piotr Garstecki/promotor pomocniczy: dr Bartłomiej Waclaw

Nazwa zespołu IChF PAN: Dioscuri Centre for Physics and Chemistry of Bacteria/Microfluidics and Complex Fluids group

WWW: https://bartekwaclaw.wordpress.com
(tymczasowy, zanim powstanie strona Dioscuri Centre)

Opis:
The newly created Dioscuri Centre for the Physics and Chemistry of Bacteria invites applications for an experimental PhD project on bacterial response to antibiotics in laboratory models of infections.
Many bacteria live on- and inside animals and humans, but only a small fraction is pathogenic. Bacterial infections are often treated with antibiotics. However, bacteria, with their short generation times (0.3-1h), can rapidly evolve resistance to antibiotics. This has been demonstrated in computer models [1] and simple laboratory experiments [2,3], but not in complex environments encountered by bacteria in the human body. Our current understanding of processes such as the emergence and fixation of resistant mutants important for predicting the dynamics of bacterial infections is thus incomplete.
A particularly interesting unexplored problem is the role of spatial constrains (e.g., physical organisation of the epithelium or dendritic-like structure of lung bronchioles) and biochemical gradients (e.g., non-uniform distribution of nutrients, oxygen, antibiotics in tissues). Such constraints are very difficult to study in animal models due to biological variability, insufficient control of experimental conditions, and problems with direct visualisation of bacterial growth and evolution.
The proposed project will address these questions in a more realistic experimental model without compromising the ability to monitor and control the dynamics of bacteria.
[1] P. Greulich, B. Waclaw, and R. J. Allen, Phys. Rev. Lett. 109, (2012).
[2] Q. Zhang, G. Lambert, D. Liao, H. Kim, K. Robin, C. -k. Tung, N. Pourmand, and R. H. Austin, Science 333, 1764 (2011).
[3] M. Baym, T. D. Lieberman, E. D. Kelsic, R. Chait, R. Gross, I. Yelin, and R. Kishony, Science 353, 1147 (2016).

Cel:
You will study the evolution of resistance in a microfluidics-based model of a lung bronchiole. The device will be filled with artificial mucus and inoculated with bacteria, and the concentration of the antibiotic diffusing into the device through a permeable membrane will be modulated to reproduce antibiotic therapy. You will use optical- and DNA-sequencing methods to monitor bacterial dynamics. Your results will feed into computer models (developed by others) and used to calculate the risk of resistance in real infections.

Wymagania:
Msc in biology, physics, chemistry, or engineering. Very good English. Very good manual skills. Strong interest in developing new experimental kits. Very good academic achievements and a strong motivation to learn the required biology. Ability to work with people from diverse background (cultural and scientific).
The candidate is expected to work closely with other experimentalists and modellers from the Dioscuri Centre and the microfluidics group, and with theorists from the Department of Evolutionary Theory in MPI in Ploen, Germany. Regular visits to Ploen (a few weeks/year), Edinburgh (B. Waclaw's previous research group), participation in national and international conferences and in internal seminars/group discussions will be required.