The newly created Dioscuri Centre for Physics and Chemistry of Bacteria invites applications for a PhD position in computer modelling of the response of intracellular bacteria to antibiotics.

Antibiotics are indispensable in treating serious bacterial infections, but bacteria can rapidly develop resistance to antibiotics [1]. To find better methods of fighting off infections, we need a thorough understanding of bacterial and human physiology, mechanisms of response and evolution of resistance to antibiotics. Mechanism-based, mathematical models can help here: by comparing model predictions with experimental data we can obtain valuable insight into processes that are difficult to observe directly. Data-driven models able to predict the dynamics of bacterial infections and treatment are also an important step towards the "*in silico* patient" – the Holy Grail of computational medicine.

Bacteria interact with host cells in many complex ways [2]. In particular, bacteria can invade and live inside animal cells. It is believed that changes in bacterial metabolism and reduced antibiotic concentration inside the animal cell help bacteria survive exposure to antibiotics. However, quantitative characterization of these processes is lacking, and their mechanistic modelling is still in its infancy. In particular, existing models are based on laboratory experiments in which bacteria are cultured in standard media [3, 4] – an environment very different to that of the animal cell.

[1] Q. Zhang, G. Lambert, D. Liao, H. Kim, K. Robin, C. -k. Tung, N. Pourmand, and R. H. Austin, Science 333, 1764 (2011).
[2] A. L. Flores-Mireles, J. N. Walker, M. Caparon, and S. J. Hultgren, Nat. Rev. Microbiol. **13**, 269 (2015)
[3] P. Greulich, M. Scott, M. R. Evans, and R. J. Allen, Molecular Systems Biology 11, 796 (2015).
[4] N. Ojkic, E. Lilja, S. Direito, A. Dawson, R. J. Allen, B. Waclaw, bioRxiv:791145v2 (2019).

Objectives. You will develop a computer model of how the bacterium *E. coli* growing in epithelial cells of the bladder responds to antibiotics used to treat urinary infections. You will include processes such as stress response, increased mutation rate, delay between the emergence of a mutation and phenotypic resistance, and others. The model will be parametrized using data from in-house experiments, and will help to build population-level models of urinary infections.

Requirements for applicants. Msc in mathematics, informatics, physics, chemistry, or bioengineering. Very good English. Very good programming skills (any language). Very good academic achievements and a strong motivation to learn the required biology. Strong interest in developing quantitative models inspired by data. Ability to work with people from diverse background (cultural and scientific). The candidate is expected to work closely with other modellers and experimentalists from the Dioscuri Centre and the Biophysical Chemistry group (Dr A. Ochab-Marcinek), and with theorists from the Department of Evolutionary Theory in MPI in Ploen, Germany (Prof. A. Traulsen). 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.

Salary. Tax-free doctoral school scholarship (approximately 2100 PLN/month, 3200 PLN/month following successful mid-term evaluation). In addition, the Dioscuri Centre will supplement the scholarship with up to 10,000 EUR/year (830 EUR/month).

How to apply: submit application via http://warsaw4phd.eu/en/candidates/admissions/

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