

### **Project 3.3. Quantitative, label-free and real-time monitoring of bacterial growth in nanoliter droplets**

**Supervisor:** Prof. dr hab. Garstecki Piotr

**Unit:** Microfluidics and Complex Fluids Group

**WWW:** <http://ichf.pong.pl/en/>

#### **Background:**

Antimicrobial resistance (AMR) is a major threat to global health. Bacteria are acquiring resistance and resistant pathogens are spreading at alarming rates. Sustainable and effective use of antibiotics depends critically on a proper understanding of the response of bacterial cells and populations to antibiotic stress. This translates into an urgent need for new analytical methods to provide reliable and informative measures of susceptibility. Currently, susceptibility is measured by the level of minimum inhibitory concentration (MIC) that fails to capture either the so-called inoculum effect (IE, cell-density dependent response of the bacteria colony to drugs), or the single cell MIC (scMIC), or the heterogeneity of phenotypic response of individual cells in population. All of these parameters are critical for understanding the response of bacteria to antibiotics. The principal goal of the project is to develop a droplet microfluidic platform for 'digital' assessment of bacterial susceptibility to antibiotics. The methods that we propose will allow to quantify the IE, the scMIC and the probability distribution,  $p(\text{scMIC})$ . We propose to develop label-free methodology compatible with a large portfolio of bacterial species and antibiotics.

#### **Aim:**

The goal of the PhD project is to investigate the heterogeneity and hetero-resistance of the phenotype of growing bacterial populations upon exposure to antibiotics from the single cell level. The PhD candidate will study the differences in the magnitude of the phenotypic single cell heterogeneity to clinically relevant antibiotics, to beta-lactam antibiotics for strains carrying a range of different beta-lactamase enzymes and study the influence of inhibitors of resistance on the breadth of the scMIC distribution.

#### **Requirements:**

- MSc diploma in microbiology, bioengineering, biotechnology, chemistry, physics, electronic engineering, mechanical engineering, or similar
- creativity and enthusiasm measured by the quality and number of projects, study record, internships, authorship in peer-reviewed publications and patents in which the Candidate participated and contributed
- analytical thinking and critical problem solving skills
- excellent communications, organization and time management skills
- fluent in spoken and written English
- flexibility and ability to work in a multidisciplinary and multicultural research team
- direct experience with microfluidics as well as microbiological and molecular biology techniques is an asset