

ESR14 - Onset of swarming: why don't single cells swarm?

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In bacterial swarming, individual or sparsely distributed cells are unable to move. However, swarm cells transition to collective coherent flow if their surface density reaches a threshold. Individual bulk-swimmer cells, on the other hand, are mobile. Thus, recent self-propelled-rods (SPR) models that include steric effects and hydrodynamics interactions fall short in describing properly the dynamics of swarming. Because surfactant secretion is mandatory for swarming, quorum-sensing, that controls surfactant production, was hypothesized to play a major role in the initiation of swarming. However, the single 'trapped' cells are often located in regions of the colony where surfactant is already above the threshold for swarming, thus physical cell-surface adhesion forces may be those that trap the cells in dry pockets, and weaken if the number of cells increases locally. In this project we intend to study the role of local ($\sim 1 \mu\text{m}$) and global ($\sim 1 \text{cm}$) surfactant concentration on the onset of swarming in *Bacillus subtilis*. To this end, we will mix fluorescently labelled wild-type cells with fluorescently labelled (by a different color) surfactant-defective mutants. We will also use a fluorescently labelled mutant that controls surfactant production by external induction. The initiation of swarming in the colony will be studied as a function of the local and global concentration of the surfactant. The work in this project is interdisciplinary. It involves precise microscopy, physical analyses, mathematical modeling, computer programming and wet-lab biological based experiments – all in one state of the art lab. We aim to achieve three main goals: (1) Study quantitatively the onset of swarming in a mix of wild-type and surfactant-defective mutants. (2) Characterize the main mechanism that controls surface adhesion of sparse swarm cells: quorum sensing or surface friction. (3) Build a swarm-related SPP model to describe the initiation of collective swarm motion.

Salary: The PhD salary is based on the [regulations of appointment and remuneration](#) for Marie Skłodowska Curie Fellows in ITN networks. The successful candidate will also benefit from additional funding for several visiting trips (typically 1 month each) in the partner teams.

Requested profile: We welcome highly-motivated applicants holding a MSc and with excellent background in experimental physics, biophysics, and/or soft matter physics.

Further obligations: The Early Stage Researcher (ESR) is expected to travel to network partners for secondments and a mini-project for durations up to 2-3 months. In addition, the ESR participates in outreach activities (social media, participation in public events), as well as dissemination to popular press.

Funding conditions: Candidates must not have resided or carried out their activities - work, studies, etc. - in Israel for more than 12 months in the 3 years immediately before starting the PhD.

Hiring procedure: Applications (CV, transcript of studies, statement of motivation and at least one letter of recommendation) should be sent by email to Avraham Be'er (beera@bgu.ac.il). The recruitment is taking place following the [European Code of Conduct for Recruitment of Researchers](#), which all candidates should study.

Selection process: PHYMOT is open to researchers regardless of gender, religion, ethnicity, disability, sexual orientation, political views, language, age and nationality. Applications from highly qualified applicants from outside the EU will thus be equally considered to other applicants. The integration of refugees is an EU priority and we will ensure equal opportunities to the researchers whose scientific careers have been interrupted. To ensure a gender balance in the project and work towards the Commission's own policies on narrowing the gap between the genders in research, should two applicants be found to be equally qualified the preference will be given to the one that will balance the gender distribution in the entire Network. All submitted applications will be checked against the defined admissibility and eligibility criteria (e.g. submitted electronically, readable, complete, in English, including grades and references), and applicants will be informed by email within two work weeks on the outcome. Evaluation criteria include: Scientific background (with particular focus on theoretical physics), previous publications, capacity for creativity and independent thinking and leadership, mentoring and presentation abilities.

Protection of personal data: The personal data of the applicants will be handled in compliance with applicable EU and national law on data protection (GDPR).

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