Theoretical modelling of competitive microbial range expansion with heterogeneous mechanical interactions

E. Maikranz and L. Santen

[1]*Department of Theoretical Physics, Saarland University, Saarbrücken, Germany*

Microbial range expansion experiments provide insight into the complex link between dynamic structure, pattern formation and evolutionary dynamics of growing populations. Our work is inspired by experiments of range expanding *N. gonorrhea* strains which can display different levels of piliation. In the case of equal mean division times the non-piliated strain outcompetes the piliated strain [1]. Even more remarkable the outcompetition is still observed when the piliated strain divides twice as fast.

In our work [2], we develop a theoretical model in order to investigate the interplay of growth statistics and mechanical interactions which are implemented as division driven pushing and swapping of cells. For the case of the competitive growth of a strongly and a weakly interacting strain we investigate the influence of different mean division times, as well as different mechanical interactions on the development of the colony. Our results show that the susceptibility to cell division induced pushing has a much stronger influence on the structure of the colony than cell sorting towards the colony's perimeter. In particular, we show that for the initial conditions realized in the experiments a pure swapping mechanism is not able to reproduce the experimental observed patterns. Rather a heterogeneous susceptibility to pushing is sufficient even in the absence of any swapping.

[1] R. Zöllner, E. R. Oldewurtel, N. Kouzel, and B. Maier, Scientific Reports 7, 12151 (2017)

[2] E. Maikranz and L. Santen, Physical Biology 18, 016008 (2021)