SFB 1027

ZBP

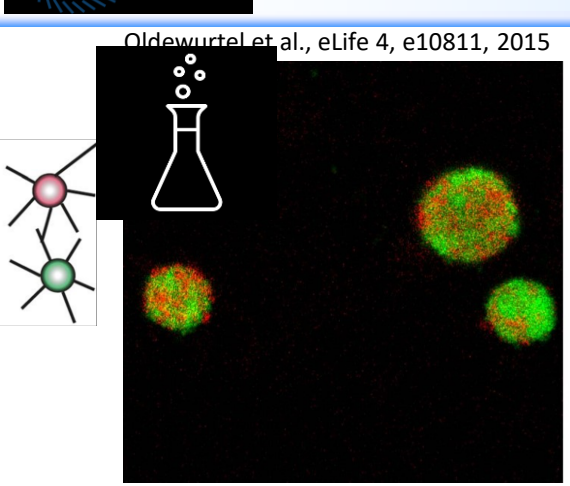
Theoretical modelling of competitive microbial range expansion with heterogeneous mechanical interactions

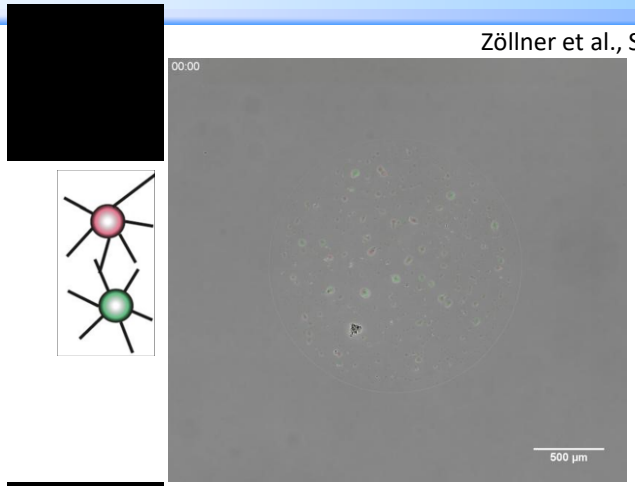
UNIVERSITÄT DES SAARLANDES

E. Maikranz, L. Santen, Physical Biology, 2021, 18, 016008

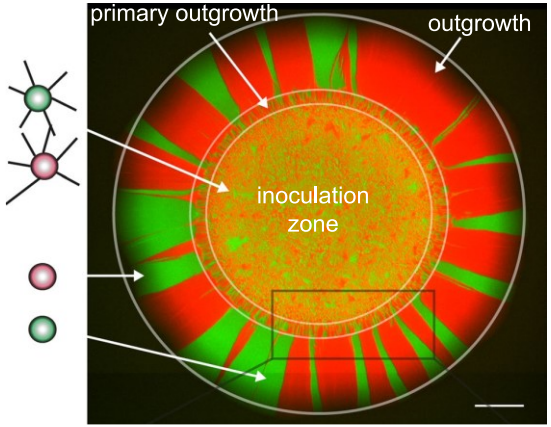
Range expansion of Neisseria gonorrhoeae

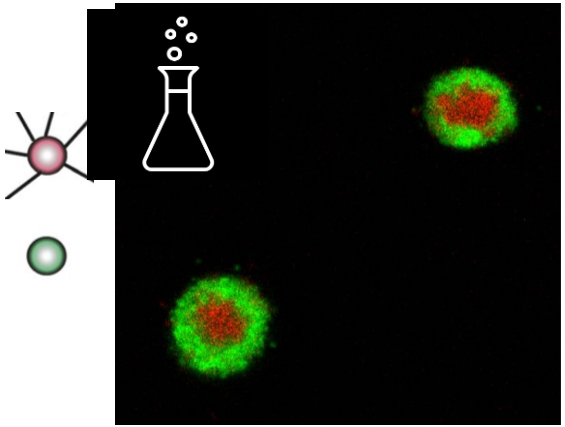
Oldewurtel et al., eLife 4, e10811, 2015



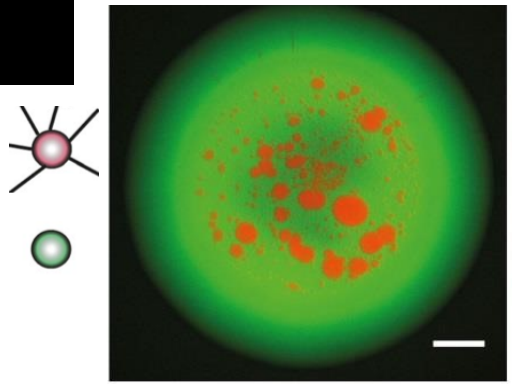


Zöllner et al., Sci Rep 7, 12151, 2017





$r_d = 0.9$



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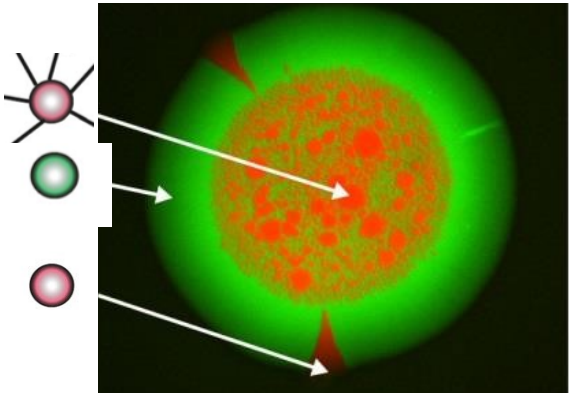
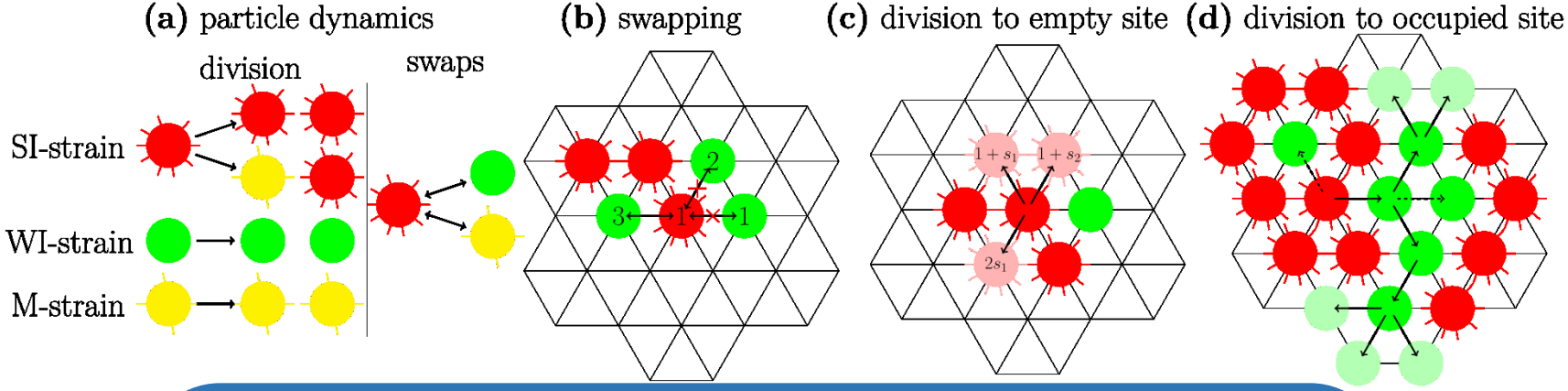
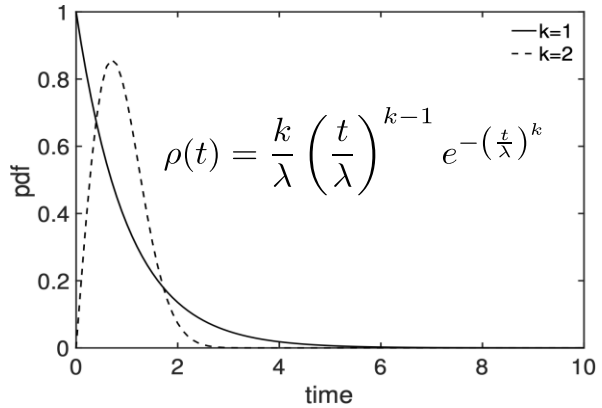


Model



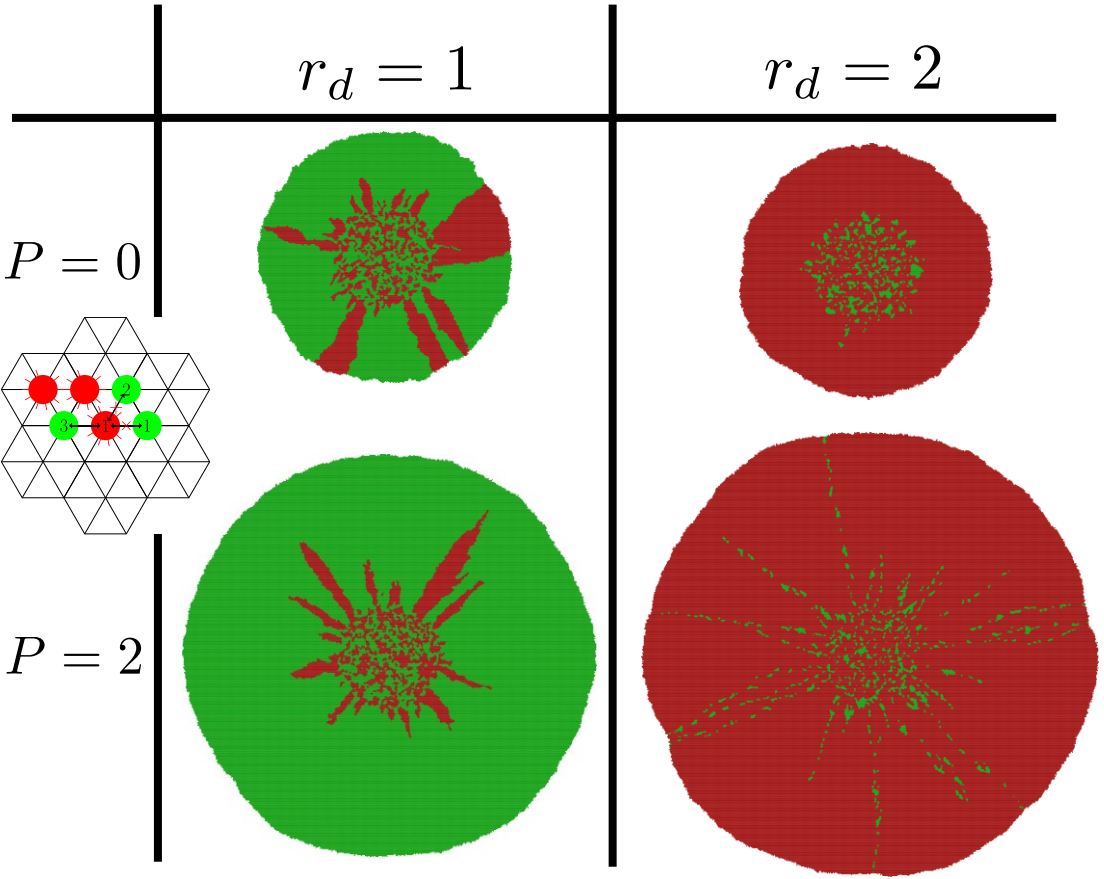
Waiting time distribution between divisions

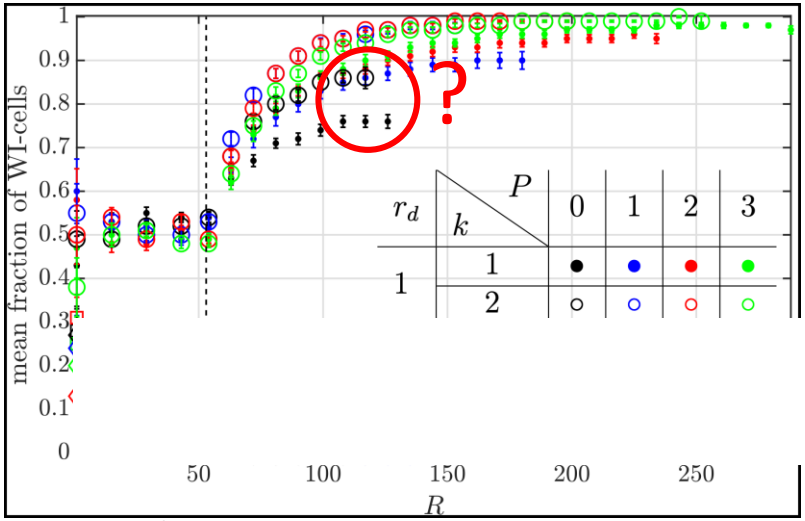


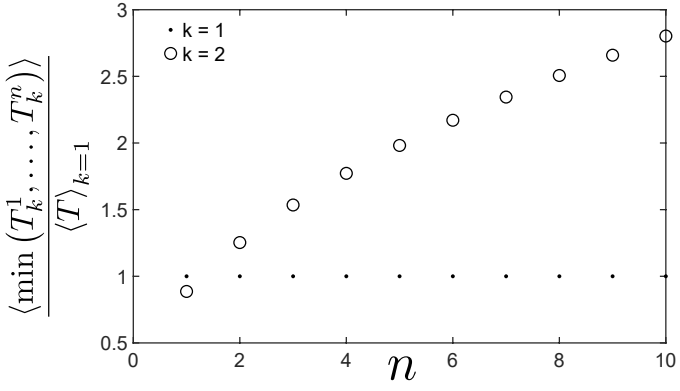
$$\langle T^n \rangle = \lambda^n \Gamma\left(1 + \frac{n}{k}\right)$$

$$r_d = \frac{\lambda_W}{\lambda_S}$$

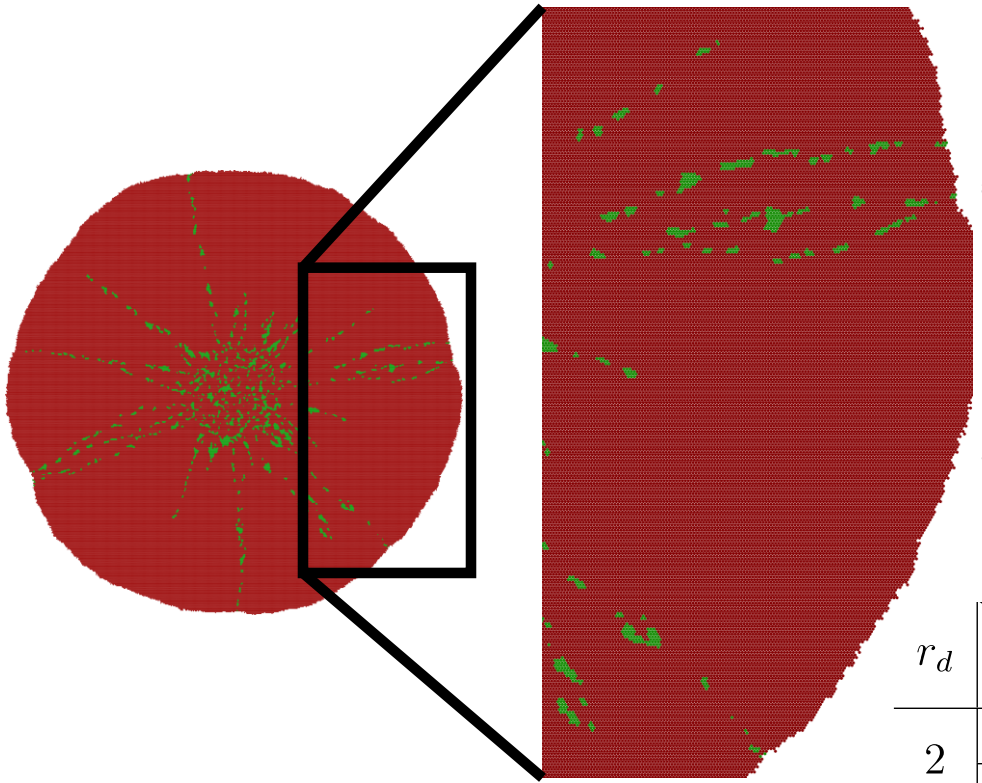
Homogenous passive mobility

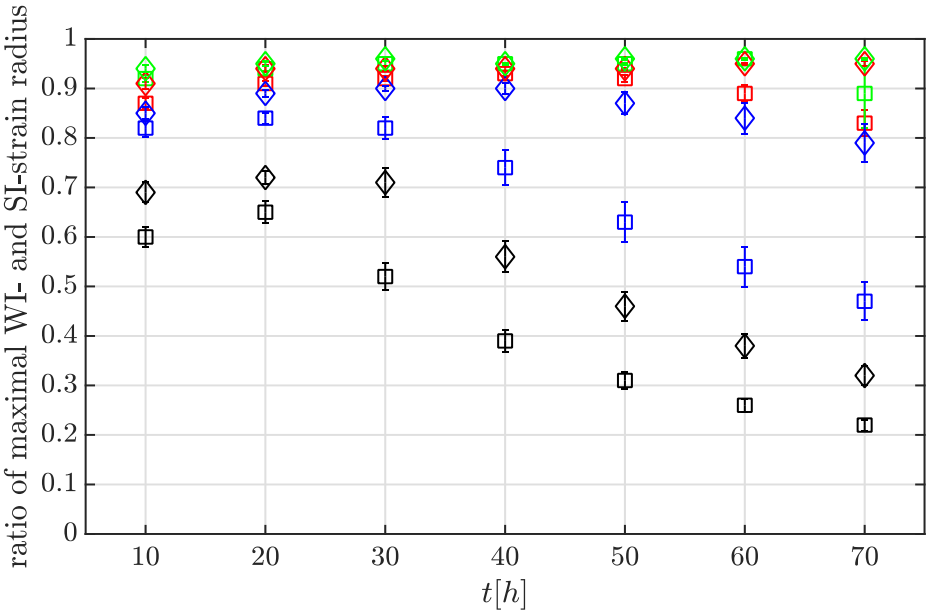






Passive mobility leads to standing variation of strains

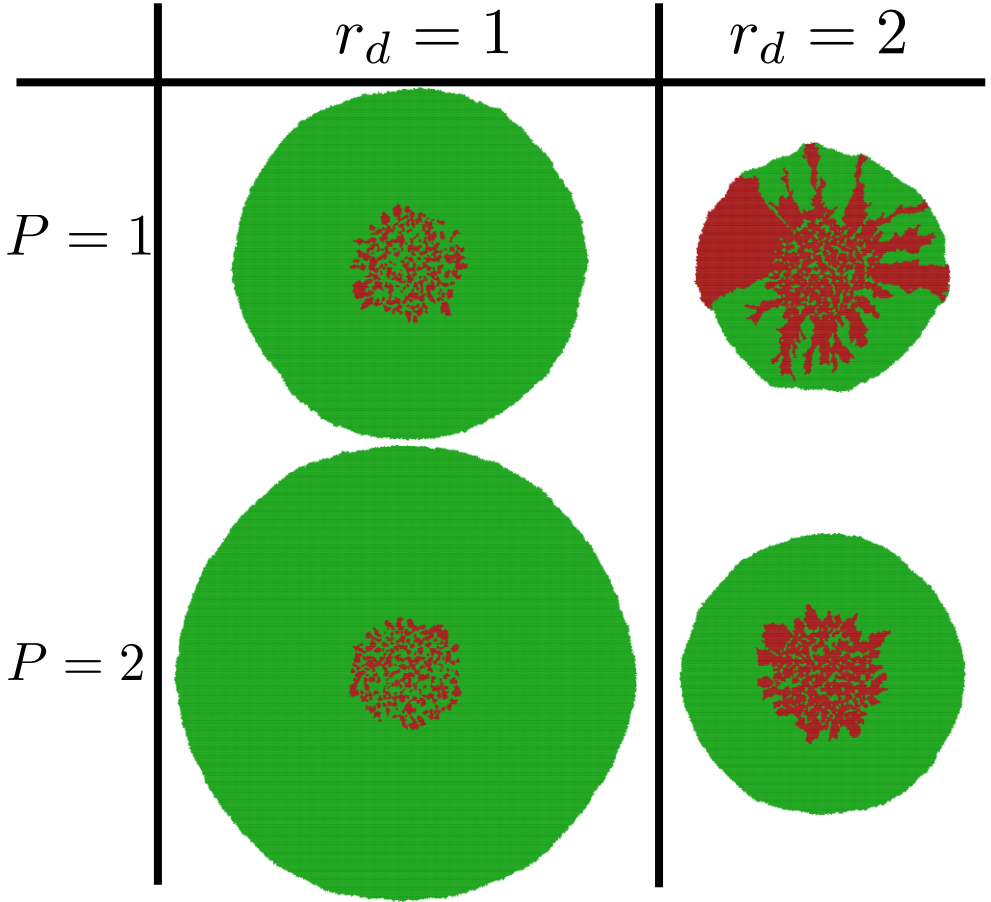




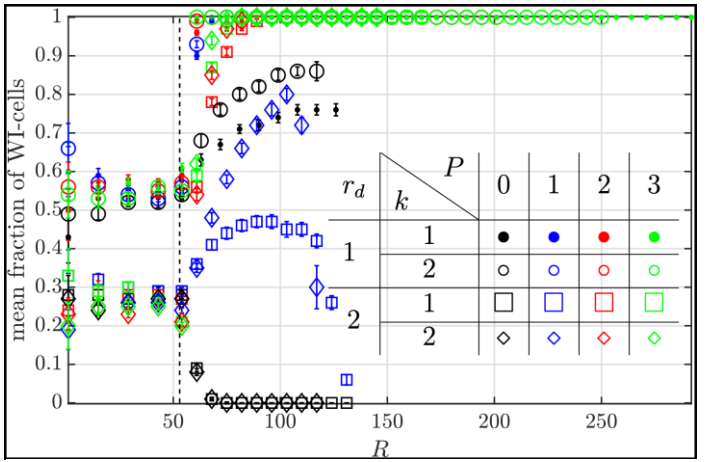
r_d	k \ P	0	1	2	3
2	1	□	□	□	□
	2	◇	◇	◇	◇

$$P\left[T^1 \leq T^2\right] = \frac{1}{1 + r_d^k}$$

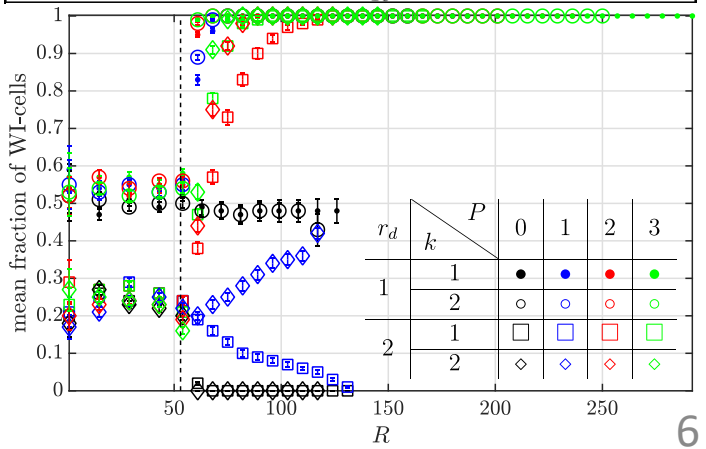
Heterogenous passive mobility



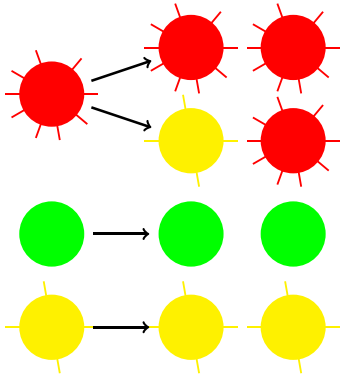
swaps



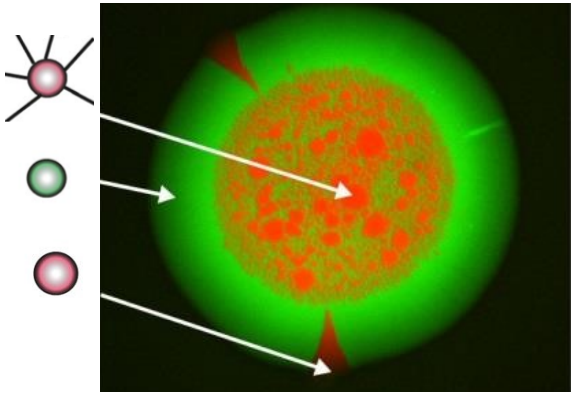
no swaps



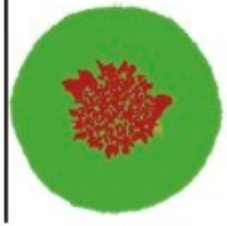
Mutants have intermediate passive mobility



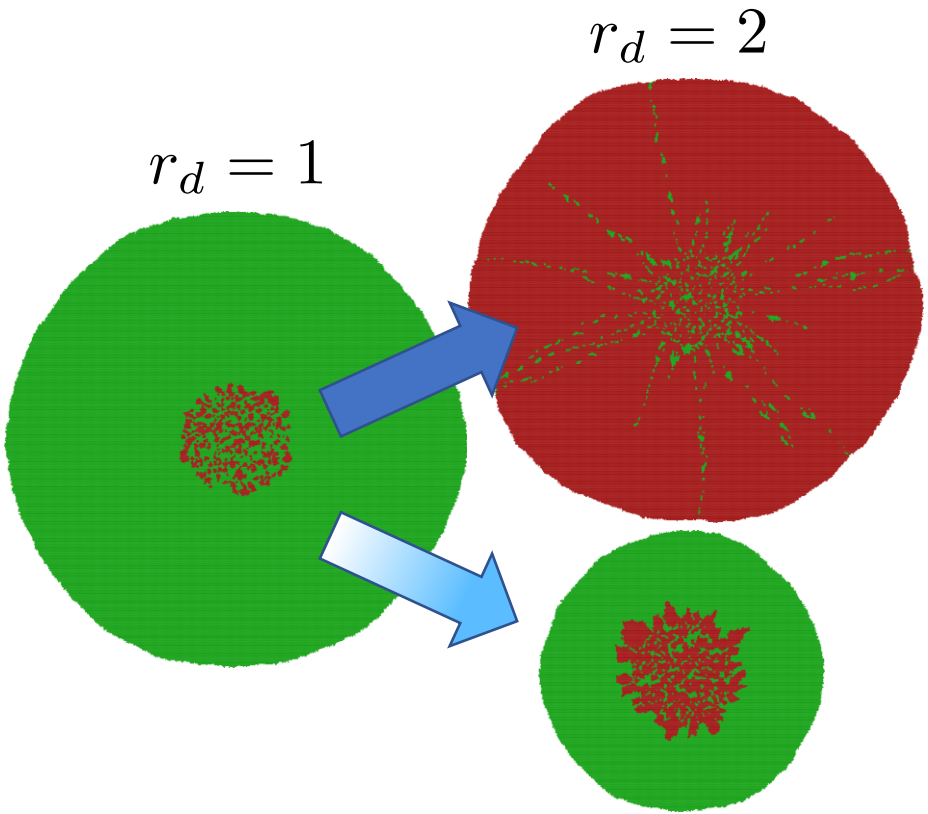
$r_d = 1.9$



Zöllner et al., Sci Rep 7, 12151, 2017

time [h]	mutant no push	mutant single push	mutant push
50			
60			
70			

Conclusions for range expansions



- mechanical interactions influence pattern formation
- passive mobility enhances survival
- competition for space
- fastest events are determining the structure
- heterogenous passive mobility for experimental observations
- mutants partially piliated

Thank you for the attention !

Analyzing sector growth