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Arrested phase separation in reproducing bacteria: a generic route to pattern formation?

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In this talk I will present a generic mechanism by which reproducing microorganisms can form stable patterns. This mechanism is based on the competition between two separate ingredients. First, a diffusivity that depends on the local population density can promote phase separation, generating alternating regions of high and low densities. Then, this is opposed by the logistic law for birth and death of microorganisms which allows only a single uniform density to be stable. The result of this contest is an arrested nonequilibrium phase separation in which dense droplets or rings become separated by less dense regions, with a characteristic steady-state length scale. I will illustrate this mechanism by considering a model of run-and-tumble bacteria, for which a density dependent diffusivity can stem from either a decrease of the swim speed or an increase of the tumbling rate at high density. No chemotaxis is assumed in this model, yet it predicts the formation of patterns strikingly similar to those believed to result from chemotactic behavior.