Soft Living Active and Adaptive Matter

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Topological defects promote layer formation in bacterial colonies.

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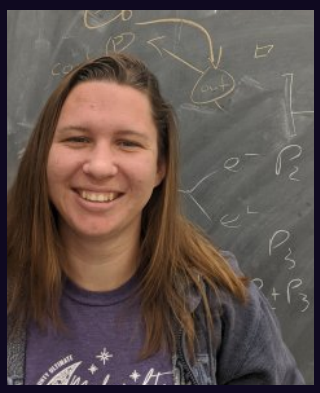
Abstract:

The soil bacterium *Myxococcus xanthus* lives in densely packed groups that form dynamic three-dimensional patterns in response to environmental changes, such as droplet-like fruiting bodies during starvation. The development of these multicellular structures begins with the sequential formation of cell layers in a process that is poorly understood. Using confocal three-dimensional imaging, we find that motile, rod-shaped *M. xanthus* cells are densely packed and aligned in each layer, forming an active nematic liquid crystal. Cell alignment is nearly perfect throughout the population except at point defects that carry half-integer topological charge. We observe that new cell layers preferentially form at the position of +1/2 defects, whereas holes preferentially open at -1/2 defects. To explain these findings, we model the bacterial colony as an extensile active nematic fluid with anisotropic friction. In agreement with our experimental measurements, this model predicts an influx of cells towards the +1/2 defects and an outflux of cells from the -1/2 defects. Our results suggest that cell motility and mechanical cell–cell interactions are sufficient to promote the formation of cell layers at topological defects, thereby seeding fruiting bodies in colonies of *M. xanthus*.

Date:
2/1/2021

Time:
9:00 AM-10:15 AM

About the speaker:



Katherine Copenhagen is a postdoctoral researcher in the Center for the Physics of Biological Function (CPBF) at Princeton University. She completed her Ph.D. with Ajay Gopinathan at UC Merced in 2017 on the thesis titled "collective motion in behaviorally heterogeneous systems". She was awarded several fellowships during her time at UC Merced including the Dean's distinguished scholar fellowship, and the IGERT fellowship.

She is currently continuing her work on understanding the physical mechanisms of active materials and collective behaviors with Joshua Shaevitz using the data gathered through experiments with bacterial colonies. In addition to being an excellent researcher, she is also an accomplished viola player and a skilled springboard diver.

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