PHYSICAL MATHEMATICS SEMINAR

Heterogeneous dynamics of cells and gels in complex spaces

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ABSTRACT:

In this talk, I will describe two different examples of how we investigate heterogeneous transport in porous media. First, I will describe how we study the drying of shrinkable, granular materials—materials composed of hydrated grains that individually shrink when dried. Prominent examples include clays, soils, biological tissues, foods, and coatings. In many cases, these materials crack during drying, critically hindering applications. By combining experiments, discrete-element simulations, and poroelasticity theory, we reveal how grain shrinkability dramatically alters crack evolution during drying—in some cases, even causing cracks to spontaneously self-heal. Our work helps to elucidates the rich physics underlying cracking, and yields new strategies to controlling crack evolution and patterning. Second, I will describe how we study bacterial migration in porous media. Diverse applications, ranging from bioremediation to drug delivery, rely on this process; however, how pore-scale confinement alters bacterial motility is unknown. Using a novel experimental platform, we demonstrate that the paradigm of run-and-tumble motility is dramatically altered in a porous medium. Instead, we find a new form of motility in which cells are intermittently and transiently trapped as they navigate the pore space. Moreover, we find that the trapping duration and the length of "hops" between traps together can predict the long-time bacterial translational diffusivity. Our work thus provides a revised picture of bacterial motility in complex media and yields principles for predicting cellular migration over large length and time scales, with implications for healthcare, agriculture, and bioremediation. Ultimately, our work stimulates new findings and questions at the interface of Applied Mathematics, Physics, Biology, Materials Science, and Engineering.

TUESDAY, MAY 7, 2019
2:30 PM – 3:30 PM
Building 2, Room 139

Reception following in Building 2, Room 290
(Math Dept. Common Room)

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