SES20-2020-000058

Abstract for an Invited Paper
for the SES20 Meeting of
the American Physical Society

Biophysics: Life at the frontier

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The behavior of living systems is governed by physical principles. The study of biological processes on all scales, including the folding of proteins, the mechanics of cell division, and even the migration and expansion of animal species benefits from applying our understanding of physical laws, and statistical physics, in particular. We will discuss how statistical physics helps explain the properties of competition and evolution at the edges of growing cellular populations, such as a developing tissue, a cancerous invasion, or an expanding microbial colony. Such populations may have a complex shape, such as the branched growth of kidney ducts or microbial colonies grown under nutrient-limited conditions. We will show how the population shape impacts the ability of a cell strain to survive within the population and calculate survival probabilities by applying the tools of statistical physics. In doing so, we draw surprising connections between the biology and more "common" physical phenomena such as the freezing of water and the separation of oil and vinegar.