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Order and instabilities in dense bacterial colonies[1]

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The structure of cell colonies is governed by the interplay of many physical and biological factors, ranging from properties of surrounding media to cell-cell communication and gene expression in individual cells. The biomechanical interactions arising from the growth and division of individual cells in confined environments are ubiquitous, yet little work has focused on this fundamental aspect of colony formation. By combining experimental observations of growing monolayers of non-motile strain of bacteria Escherichia coli in a shallow microfluidic chemostat with discrete-element simulations and continuous theory, we demonstrate that expansion of a dense colony leads to rapid orientational alignment of rod-like cells. However, in larger colonies, anisotropic compression may lead to buckling instability which breaks perfect nematic order. Furthermore, we found that in shallow cavities feedback between cell growth and mobility in a confined environment leads to a novel cell streaming instability. Joint work with W. Mather, D. Volfson, O. Mondragón-Palomino, T. Danino, S. Cookson, and J. Hasty (UCSD) and D. Boyer, S. Orozco-Fuentes (UNAM, Mexico).

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