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Spontaneous Planar Chiral Symmetry Breaking in Cells JEREMY HADIDJOJO, DAVID LUBENSKY, Univ of Michigan - Ann Arbor — Recent progress in animal development has highlighted the central role played by planar cell polarity (PCP) in epithelial tissue morphogenesis. Through PCP, cells have the ability to collectively polarize in the plane of the epithelium by localizing morphogenetic proteins along a certain axis. This allows direction-dependent modulation of tissue mechanical properties that can translate into the formation of complex, non-rotationally invariant shapes. Recent experimental observations[1] show that cells, in addition to being planar-polarized, can also spontaneously develop planar chirality, perhaps in the effort of making yet more complex shapes that are reflection non-invariant. In this talk we will present our work in characterizing general mechanisms that can lead to spontaneous chiral symmetry breaking in cells. We decompose interfacial concentration of polarity proteins in a hexagonal cell packing into irreducible representations. We find that in the case of polar concentration distributions, a chiral state can only be reached from a secondary instability after the cells are polarized. However in the case of nematic distributions, we show that a finite-amplitude (subcritical, or "first-order") nematic transition can send the system from disorder directly to a chiral state. In addition, we find that perturbing the system by stretching the hexagonal packing enables direct (supercritical, or "second-order") chiral transition in the nematic case. Finally, we do a Landau expansion to study competition between stretch-induced chirality and the tendency towards a non-chiral state in packings that have retained the full 6-fold symmetry. [1] K. Taniguchi *et al.*, Science (2011)

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