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Vertex stability and topological transitions in vertex models of foams and epithelia[1] MERYL SPENCER, ZAHERA JABEEN, DAVID LUBENSKY, Univ of Michigan - Ann Arbor — Vertex models are widely used to computationally simulate dry foams and epithelial tissues. This class of models describes the shape and motion of cells as a function of the forces on vertices where 3 or more cells meet. Despite the widespread use of these models, relatively little is known about their basic theoretical properties. One outstanding issue is the stability of fourfold vertices. In real foams, fourfold vertices are always unstable, but it has been unclear whether vertex models necessarily reflect this behavior. In biological tissues, fourfold vertices arise as an intermediate in T1 transitions, which are one of the fundamental processes by which tissues change topology, and stable fourfold vertices have recently been observed in several different epithelia. We show that, when all edges have the same tension, stationary fourfold vertices in vertex models must always break up. However, when tensions depend on edge orientation, as they might in a planar-polarized tissue, fourfold vertices can become stable. These findings pave the way for studies of more biologically realistic models that couple topological transitions to the dynamics of regulatory proteins.

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