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Criticality in Plasma Membranes BEN MACHTA, JAMES SETHNA, SARAH VEATCH, STEFANOS PAPANIKOLAOU — Recent work in giant plasma membrane vesicles (GPMVs) isolated from living cells demonstrated that they can be tuned with a single parameter (temperature) to criticality, not far from in vivo temperatures [1,2]. Criticality requires the fine-tuning of two parameters suggesting important biological function, and its presence resolves many of the paradoxes associated with putative lipid rafts. Here we present a minimal model of membrane inhomogeneities. We incorporate criticality using a conserved order parameter Ising model coupled to a simple actin cytoskeleton interacting through fields which act as point-like pinning sites. Using this model we make a host of experimentally testable predictions that are in line with recent published findings. At physiological temperatures we find inhomogeneities in the form of critical fluctuations with a length scale of roughly 20nm. Individual constituents making up these liquid domains are mobile, though they diffuse anomalously, but the correlated regions themselves can last as long as the cytoskeleton persists. We explain this by considering the effective long ranged interaction mediated by the Ising order parameter. In general we find Ising criticality organizes and spatially segregates membrane components by providing a channel for interaction over large distances. [1] Veatch et al., ACS Chem Biol. 2008 3(5):287-93 [2] Honerkamp-Smith, Veatch, and Keller, Biochim Biophys Acta. 2008 (in press)

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