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Criticality in Plasma Membranes BENJAMIN MACHTA, STEFANOS PAPANIKOLAOU, JAMES SETHNA, Cornell University, SARAH VEATCH, University of Michigan — We are motivated by recent observations of micron-sized critical fluctuations in the 2d Ising Universality class in plasma membrane vesicles that are isolated from cortical cytoskeleton. We construct a minimal model of the plasma membrane's interaction with intact cytoskeleton which explains why large scale phase separation has not been observed in Vivo. In addition, we use analytical techniques from conformal field theory and numerical simulations to investigate the form of effective forces mediated by the membrane's proximity to criticality. We show that the range of this force is maximized near a critical point and we quantify its usefulness in mediating communication using techniques from information theory. Finally we use theoretical techniques from statistical physics in conjunction with Monte-Carlo simulations to understand how criticality can be used to increase the efficiency of membrane bound receptor mediated signaling. We expect that this sort of analysis will be broadly useful in understanding and quantifying the role of lipid "rafts" in a wide variety of membrane bound processes. Generally, we demonstrate that critical fluctuations provide a physical mechanism to organize and spatially segregate membrane components by providing channels for interaction over relatively large distances.

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