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Communication channels between membrane bound proteins JAMES SETHNA, BENJAMIN MACHTA, Deparment of Physics, Cornell University, SARAH VEATCH, Department of Biophysics, Univerity of Michigan, Ann Arbor — Much of what might be called biological computation takes place on the plasma membrane, a 2D liquid composed of a diverse soup of lipids and embedded proteins. Motivated by the recent discovery that these membranes seem to be tuned close to a 2D liquid-liquid critical point, we set out to understand the different channels through which membrane bound proteins can communicate. Diffusing proteins can carry out reactions like phosphorylation when they come in contact with each other. Near criticality, proteins can also exert long-ranged critical Casimir forces on one another by coupling to the local composition order parameter. By modulating the growth and breakdown of the rigid cytoskeleton, they can direct forces on even more distant regions. In addition, proteins can control the release and production of second messengers that diffuse either through the bulk, or in the plane of the membrane itself. By making simple models for these processes we bound functional measures for them as communication channels. These include information theoretic measures of bandwidth, as well as physical measures of energetic efficiency and speed. Our results will likely shed light on the functional role of clustering and other collective behaviors often seen in experiments.

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