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Regulation by a Critical Membrane OFER KIMCHI, Program in Biophysics, Harvard University; Department of Physics, Princeton University, SARAH VEATCH, Department of Biophysics, University of Michigan, BENJAMIN MACHTA, Lewis-Sigler Institute, Department of Physics, Princeton University, —
Many of the processes that underlie neural computation are carried out by ion channels embedded in the plasma membrane, a two-dimensional liquid that surrounds all cells. Recent experiments have demonstrated that this membrane is poised close to a liquid-liquid critical point in the Ising universality class. We use Monte Carlo simulations on the lattice Ising model to explore the ramifications of proximity to criticality for idealized ion channels that are allosterically coupled to Ising composition modes. Owing to diverging generalized susceptibilities, such a channel's activity becomes strongly influenced by perturbations that influence the membrane's critical temperature. In addition, the channel's kinetics acquire a range of time scales from its surrounding membrane, naturally leading to non-Markovian dynamics. Our model may account for the sensitivity of many diverse ion channels to chemically diverse anesthetics and other membrane perturbations.

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