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Interpreting collective neural activity underlying spatial navigation in virtual reality LEENOY MESHULAM, JEFF GAUTHIER, DAVID TANK, WILLIAM BIALEK, Princeton University — Traditionally, cognitive- demanding processes like spatial navigation were studied by recording the activity of single neurons. However, recent technological progress allows imaging the simultaneous activity of large neuronal populations in awake behaving animals. This progress in experimental work calls for a similar adjustments of the modeling frameworks. To achieve a description of the "real thermodynamics" of the neural system, we construct maximum entropy models for optical imaging data taken *in vivo*, from the hippocampus of mice navigating in a virtual reality environment. This provides a natural extension of statistical mechanics applicable to brain activity, by focusing on the interactions between cells rather than on single cell's activity. We aim to determine how the topology of the energy landscape predicted by the model corresponds to the location of the animal in the environment. Since large subpopulations of the neurons in this area are spatially modulated, we expect the landscape to exhibit a large "valley" structure of local minima, corresponding to the animal's position along the environment. Such a finding is especially of interest because the location information emerges solely from the activity patterns that are accessible to the brain.

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