Title: Criticality, self-organization and scale invariant avalanches in spin dynamics away from thermal equilibrium

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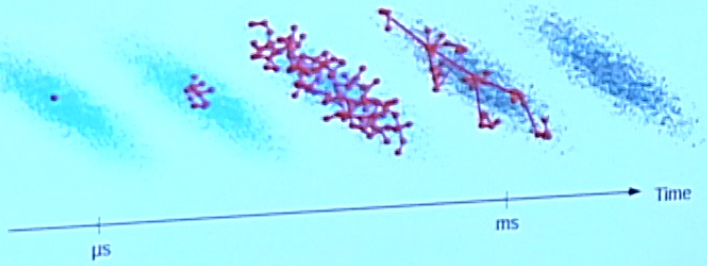
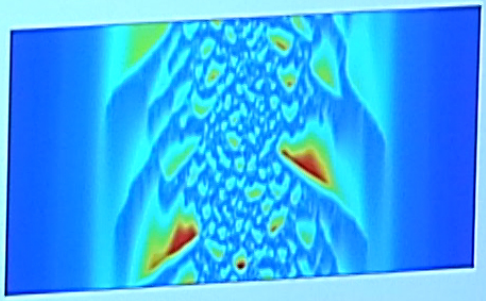
Abstract: The appearance of scale invariance and diverging response functions in many-body systems is inseparably linked to the presence of a critical point and spontaneous symmetry breaking. In thermal equilibrium critical points mostly correspond to isolated spots in parameter space, which require rather strong fine tuning of e.g., the temperature of magnetic fields, in order to be reached. Pushing systems away from thermal equilibrium, e.g., by exposing them to external drive fields or dissipation, can give rise to more unconventional forms of criticality. External driving and dissipation may even turn critical points robust and attractive, imposing scale invariance for a large variety of external parameters, a phenomenon known as self-organized criticality (SOC).

I will discuss the manifestation of SOC in driven dissipative cold atom ensembles, for which a direct mapping of their microscopic parameters to an SOC field theory exists. This yields an opportunity to study SOC, typically associated with hard-to-control, large scale non-equilibrium setups, such as earthquakes, solar flares, or neural networks, under very controlled conditions. In addition, I will briefly explain the theoretical challenges for a quantum theory of self-organized criticality and point out current steps towards their realization.

Nonequilibrium Phase Transitions with Spin Dark States





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