Inhomogeneous quasi-adiabatic driving of quantum critical dynamics in disordered spin chains

Marek M. Rams[1], **Masoud Mosheni**[2], **and Adolfo del Campo**[3]

[1]*Institute of Physics, Jagiellonian University, Łojasiewicza 11, 30-348 Kraków, Poland*
[2]*Google, Venice, CA, 20291, USA*
[3]*Department of Physics, University of Massachusetts, Boston, MA 02125, USA*

We introduce an inhomogeneous protocol to drive a disordered quantum spin chain quasi-adiabatically across a quantum phase transition and minimize the residual energy of the final state. The number of spins that simultaneously reach the critical point is controlled by the length scale of the inhomogeneity in which the magnetic field is modulated, introducing an effective size that favors adiabatic dynamics. The dependence of the residual energy on this length scale and the velocity at which the magnetic field sweeps out the chain is shown to be nonmonotonic. We determine the conditions for an optimal suppression of the residual energy of the final state and show that inhomogeneous driving can outperform conventional adiabatic schemes based on homogeneous control fields by several orders of magnitude.

[1] M.M. Rams, M. Mosheni, and A. del Campo, arXiv:1606.07740
[2] M. Mosheni, A. del Campo, and M.M. Rams, *in preperation*