Nonequilibrium entanglement entropy of quantum spin chains

F. Iglói

Research Institute for Solid State Physics and Optics, H-1525 Budapest, P.O.Box 49, Hungary, E–mail: igloi@szfki.hu
Institute of Theoretical Physics, Szeged University, H-6720 Szeged, Hungary

We consider a quantum spin chain (such as the Ising chain in a transverse field of strength h) at $T = 0$ which is divided into two parts, $\mathcal{A}$ and $\mathcal{B}$. The interaction of the system is suddenly changed: for time $t > 0$ the system is at the quantum critical point, and measure the time evolution of the von Neumann entropy, $\mathcal{S}_{\mathcal{A}}(t)$. We consider different type of quenches and obtain different type of asymptotic time-dependence.

i) For a *global quench* of the control parameter of the homogeneous chain we obtain analytically [1]:

$$\mathcal{S}_{\mathcal{A}}(t) = \alpha(h)t.$$

ii) Quenching out a gradient field: $h_i = 1 + gi$, we have [1]:

$$\mathcal{S}_{\mathcal{A}}(t) \sim gt^2.$$

iii) For a *local quench* of an interface defect [2]:

$$\mathcal{S}_{\mathcal{A}}(t) = \frac{2c_{eff}}{3} \log t,$$

with c_{eff} is the effective central charge.

iv) For a *local quench* in a disordered chain [3]:

$$\mathcal{S}_{\mathcal{A}}(t) = \frac{c_{eff}}{3} \log\log t.$$

1. V. Eisler, F. Iglói and I. Peschel, Entanglement in spin chains with gradients, J. Stat. Mech. P02011 (2009).
2. F. Iglói, Zs. Szatmári, and Y.-C. Lin: Entanglement entropy with localized and extended interface defects, e-print arXiv:0903.3740.
3. Zs. Szatmári and F. Iglói, (unpublished).