# Key points lecture 05/04/2022

For 1D Ising model : $Q_N = \lambda_+^N + \lambda_-^N$

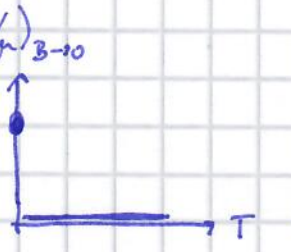
$$\lambda_\pm = e^{\beta J}\cosh(\beta H) \pm \sqrt{e^{-2\beta J} + e^{2\beta J}\sinh^2(\beta H)}$$

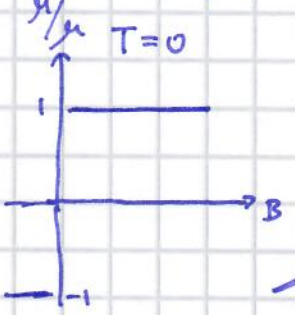
$$Q_N \xrightarrow[N\to\infty]{} \lambda_+^N \Rightarrow \frac{1}{N}\log Q_N \to \log \lambda_+$$

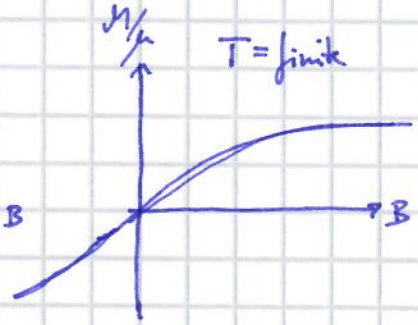
$$\Rightarrow M = RT\frac{\partial}{\partial B}\left(\frac{\log Q_N}{N}\right) \xrightarrow[N\to\infty]{} RT\frac{\partial}{\partial B}(\log \lambda_+)$$

↑ no volume (spin chain)

the model does not support phase transition at finite T



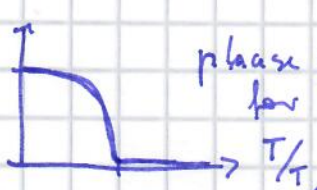

$T = 0$ : all spins in one direction minimizes energy
$S = 0$ (just one configuration)

$T > 0$ :
assume we create domain wall excitation :
change in energy = $2J$ (less negative)
change in entropy = $R\log(N-1)$ ← ways of placing domain wall

$\Delta A = \Delta U - T\Delta S$
$= 2J - RT\log(N-1)$

domain walls will be created till spins are completely randomized and net magnetization = zero

In 2D: creating a domain wall increases the Helmholtz free energy




$$\xi \sim \left|\frac{T - T_c}{T_c}\right|^{-\nu}$$ ← critical exponent

↑ near critical point, the correlation length is only scale