Canonical Ensemble

closed Quantum System. 양자 상태 이론 ⌒ 통계역학.

Eigen state of Quantum Many Body.

Local 관점에서는 thermal equilibrium. ⇒ thermalization

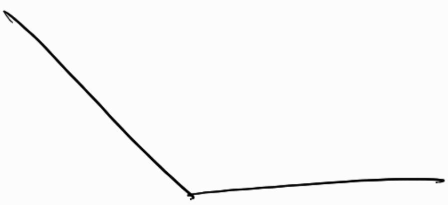
Local 에서는 thermal equilibrium 같이 보이나 mixed state, but 전체적으로는 pure state 로 유지 됨.

$$GI = \sum_{i=1}^{N} \beta_{\alpha} \sigma_{\alpha}^{+} \sigma_{\alpha}^{-}$$

MBL 상태: closed system ⇒ decoherence 억제.

$$S(\omega) = k\left(\frac{\omega_c}{\omega} + 1\right) \qquad \Gamma(\tau) = \frac{1}{2\pi}\int_{-\infty}^{\infty} k\left(\frac{\omega_c}{\omega}+1\right) e^{j\omega\tau}\, d\omega$$

$$= \underbrace{\delta(\tau)}_{\text{white noise}} + \frac{k\omega_c}{2\pi} \underbrace{\int_{-\infty}^{\infty} \frac{1}{\omega} e^{j\omega\tau}\, d\omega}_{?}$$



$$A(\tau) = \int_{-\infty}^{\infty} \frac{1}{\omega} e^{j\omega\tau}\, d\omega, \quad \frac{dA}{d\tau} = \int_{-\infty}^{\infty} e^{j\omega\tau}\, d\omega = 2\pi\delta(\tau).$$

$\Rightarrow A(\tau) = 2\pi u(\tau)$, step function.

$$\Rightarrow \Gamma(\tau) = \delta(\tau) + k\omega_c u(\tau) \quad \cdots \quad (X)$$

$$S(\omega) = k\left(\frac{\omega_c}{\omega}+1\right) \Rightarrow k\sqrt{\left(\frac{\omega_c}{\omega}\right)^2 + 1} \;\Big/\; k\left(\frac{\omega_c}{|\omega|}+1\right)$$

$\Rightarrow \Gamma(\tau) = \frac{1}{2\pi}\int_{-\infty}^{\infty} k\sqrt{\left(\frac{\omega_c}{\omega}\right)^2+1}\; e^{+j\omega\tau}\, d\omega$ ... analytic 한 solution 불가능.

$$\Gamma(\tau) = \frac{1}{2\pi}\int_{-\infty}^{\infty} k\left(\frac{\omega_c}{|\omega|}+1\right) e^{j\omega\tau}\, d\omega = \delta(\tau) + \frac{k\omega_c}{2\pi}\int_{-\infty}^{\infty} \frac{1}{|\omega|} e^{j\omega\tau}\, d\omega,$$

$$\underbrace{\int_{-\infty}^{\infty} \frac{1}{|\omega|} e^{j\omega\tau} d\omega}_{} = \int_{0}^{\infty} \frac{1}{\omega} e^{j\omega\tau} d\omega + \int_{-\infty}^{0} -\frac{1}{\omega} e^{j\omega\tau} d\omega$$

let $A(\tau)$

$$\frac{dA}{d\tau} = \int_{0}^{\infty} e^{j\omega\tau} d\omega + \int_{-\infty}^{0} -e^{j\omega\tau} d\omega = \frac{1}{j\tau}\left(\left[e^{j\omega\tau}\right]_{0}^{\infty}\right) - \frac{1}{j\tau}\left(\left[e^{j\omega\tau}\right]_{-\infty}^{0}\right)$$

$$= \frac{1}{j\tau}\left[e^{j\omega\tau}\right]_{0}^{\infty} + \frac{1}{j\tau}\left[e^{j\omega\tau}\right]_{0}^{-\infty} = \frac{1}{j\tau}\left(\lim_{T\to\infty}\left(\cos(\omega\tau) + j\sin(\omega\tau)\right)\right.$$