

Title: Condensed Matter Review-15

Date: Feb 13, 2015 09:00 AM

URL: <http://pirsa.org/15020012>

Abstract:

$$\psi \in \mathcal{H}_R \subset \mathcal{H} = \mathcal{H}_A \otimes \mathcal{H}_B$$

↑ Haar measure

$$d_B \gg d_A$$

almost always \Downarrow ψ_A has the max. possible entropy

↓ energy constraint

$$\psi_A = \frac{e^{-\beta H_A}}{\mathcal{Z}_A}$$

$$\text{Tr}[H \psi] = E = \text{Tr}[H e^{-\beta H} / \mathcal{Z}]$$

$$|\psi\rangle = |\psi_A\rangle \otimes |\psi_B\rangle \quad t=0$$

$$H \rightarrow \psi(t) = e^{-iHt} (\psi_A \otimes \psi_B)$$

$$\lim_{t \rightarrow \infty} \left[\|\psi_A(t) - e^{-\frac{PH_A}{\hbar}}\| \right] \text{ is very small}$$

$$H \rightarrow V^\dagger H V$$

$$|\psi\rangle = |\psi_A\rangle \otimes |\psi_B\rangle \quad t=0$$

$$H \rightarrow \psi(t) = e^{-iHt} (\psi_A \otimes \psi_B)$$

$$H \rightarrow U^\dagger H U$$

$$\lim_{t \rightarrow \infty} \left[\|\psi_A(t) - e^{-iH_A t} \psi_A\| \right] \text{ is very small}$$

$$H(t) = \sum_k H_k(t)$$

$$U(0, \tau) = \mathcal{T} \exp \left[-i \int_0^\tau H(s) ds \right]$$

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$$H(t) = \sum_k H_k(t)$$

$$U(0, \tau) = \mathcal{T} \exp \left[-i \int_0^\tau H(s) ds \right] \approx \prod_{j=1}^n \prod_X \exp \left[-i H_k(i\Delta t) \Delta t \right]$$

$$n \Delta t = \tau$$

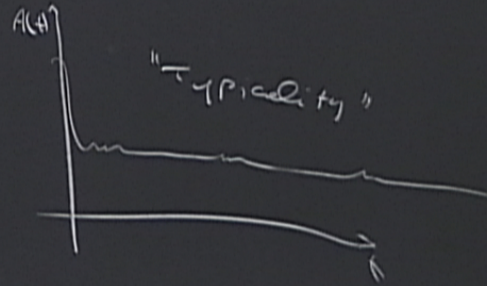
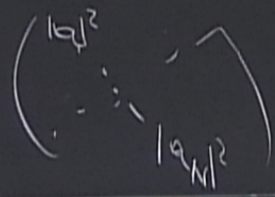
E TH Hypothesis

$H \rightarrow |E\rangle$ eigenstates

$$\langle A(t) \rangle \xrightarrow[\text{dephasing}]{\text{+ long}} \bar{A} = \sum_n |a_n|^2 A_{nn} = \text{Tr}[\hat{A} \bar{\Psi}_0]$$

↑
few-bodies

$$|\psi_0\rangle = \sum_n a_n |E_n\rangle$$



states

$$\bar{A} = \sum_n |a_n|^2 A_{nn} = \text{Tr}[\hat{A} \overline{\Psi_0}]$$

2. $\bar{A} = \langle A \rangle_{\text{thermal}}$

microcanonical

$$\frac{1}{N} \sum_{|E' - E| < \Delta E} A_{kk}$$

Gibbs state

$$\frac{1}{Z} e^{-\beta H}$$

$$\text{ent}^2 A_{nn} = \text{Tr} [\hat{A} \overline{\Psi_0}]$$

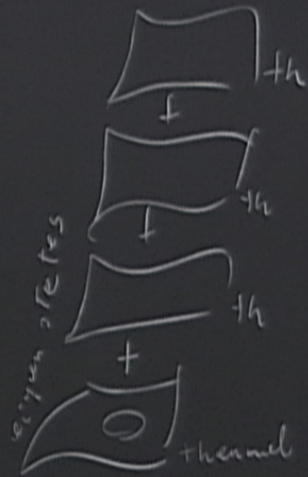
$$2. \quad \bar{A} = \langle A \rangle_{\text{thermal}}$$

microcanonical
Gibbs state

$$\frac{1}{N} \sum_{|E' - E| < \Delta E} A_{kk}$$

$$\sum_i e^{-\beta H}$$

$\psi(0)$



microcanonical

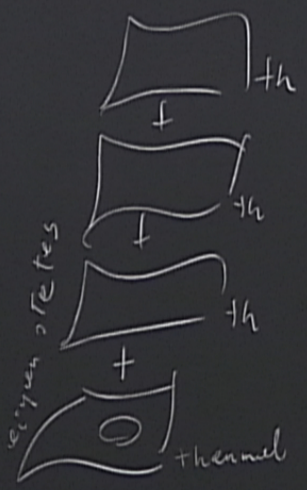
Gibbs state

$$\frac{1}{N} \sum_{|E' - E| < \Delta E} A_{kk}$$

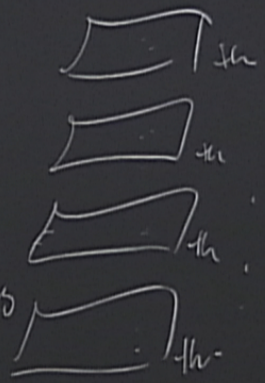
$$\sum_i e^{-\beta H}$$

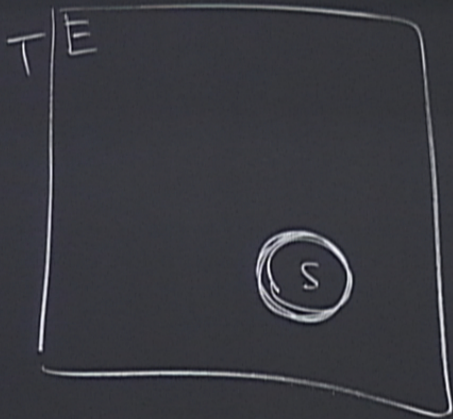
$\psi(0)$

eigenstates

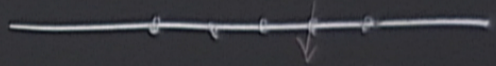
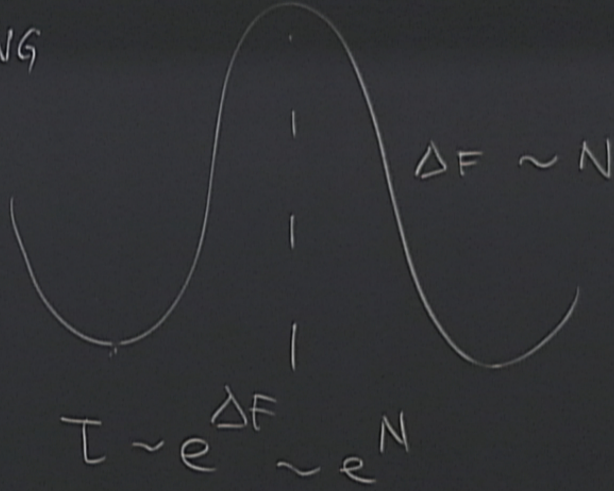
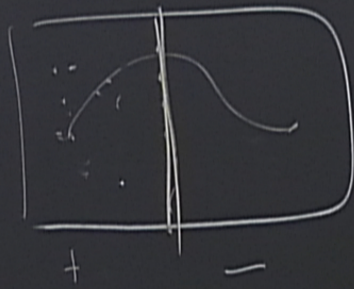


+
dephasing

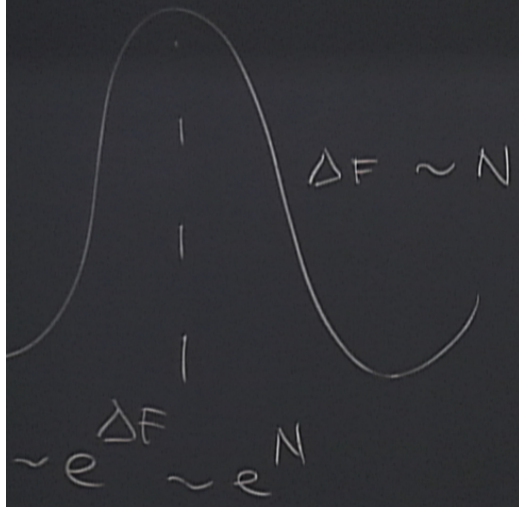




1. Integrable Systems fine-tuned
2. SYMMETRY BREAKING

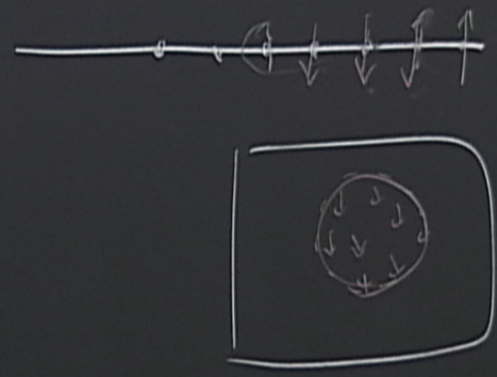
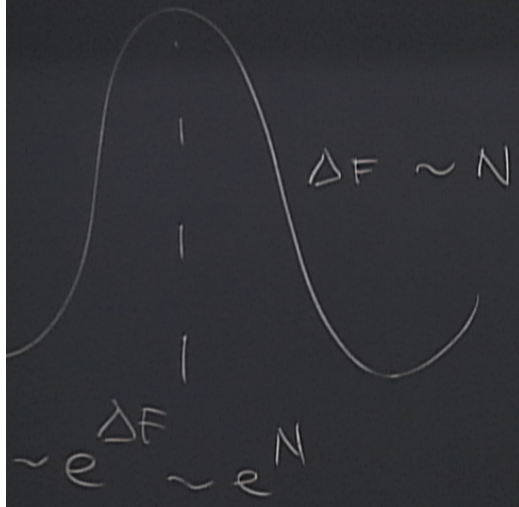


fixed



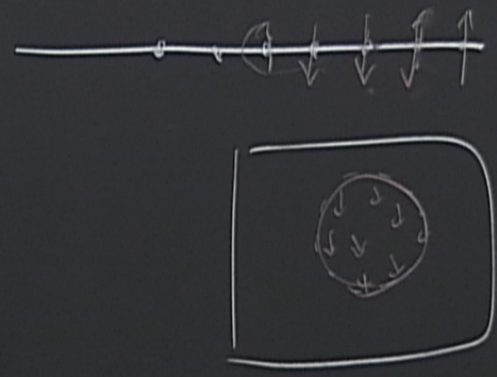
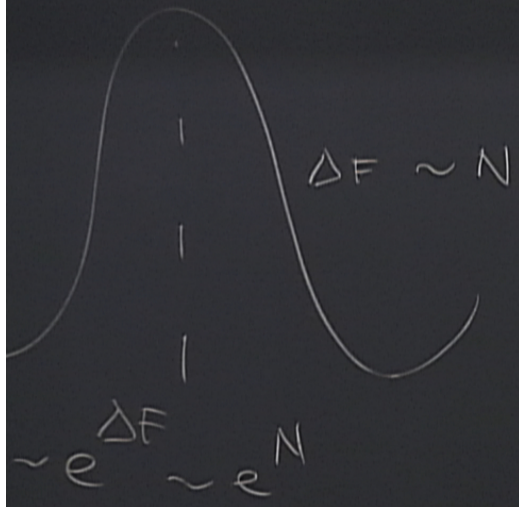
$$\Delta F = +K\Delta E - T\Delta S$$

time



$$\Delta F = +k\Delta E - T\Delta S$$
$$\Delta F = k\Delta E l - T c l$$

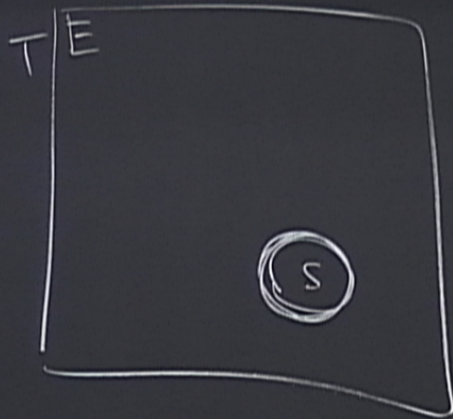
fixed



$$\Delta F = +K\Delta E - T\Delta S$$

$$\Delta F = K\Delta E l - T c l$$

$$(K\Delta E - cT) l$$



1. Integrable Systems fine-tuned
2. SYMMETRY BREAKING
3. Topological Order
4. Many-Body Localization

