

Conformal window and symmetry breaking in coupled SYK/tensor models

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Strings 2019, Gong Show

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Collaborators: Jaewon Kim, Igor Klebanov,
and Grigory Tarnopolsky

Why SYK/tensor model?

"Whenever you are confused about a topic in QFT, find an ordinary quantum mechanical system that exhibits the same subtlety, and then analyze that to the end!"

- Nati Seiberg during TASI 2019


Why SYK/tensor model?

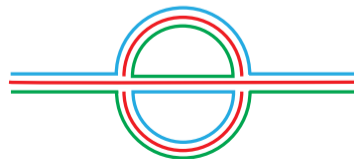
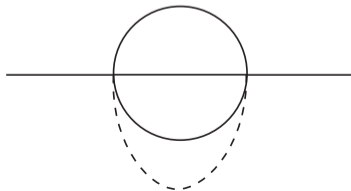
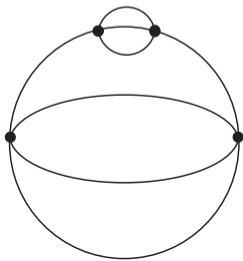
- ▶ A simple QM setup to exhibit rich physics in QFTs:
(Nearly) conformal symmetry, quantum chaos, **spontaneous symmetry breaking**, **line of fixed points**, **conformality lost** etc
Power of large N
- ▶ Holographic motivations: toy model for near extremal black holes, **traversable wormholes**, $\text{NAdS}_2/\text{NCFT}_1$ correspondence, etc

A quick review of the tensor/Sachdev-Ye-Kitaev model

[Bonzom, Gurau, Rivasseau'11; Carrozza, Tanasa'15; Witten'16; Maldacena, Stanford'16; Klebanov, Tarnopolsky'16; Giombi, Klebanov, Tarnopolsky'17; Klebanov, Popov, Tarnopolsky'18;]

$$\mathcal{L} = i\psi^I \partial_t \psi^I + \frac{J_{IJKL}}{4!} \psi^I \psi^J \psi^K \psi^L.$$

	SYK	Tensor model
J_{ijkl}	$\langle J^2 \rangle \sim \frac{\mathcal{J}^2}{n^3}$	
Global symmetry NCFT ₁	$\approx O(n)$ Up to $\mathcal{O}(\frac{1}{J^2}), \mathcal{O}(n^0)$	$O(N)^3, n = N^3$ Up to $\mathcal{O}(\frac{1}{J^2}), \mathcal{O}(N^2)$



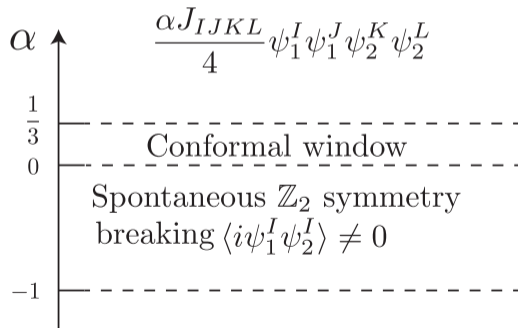
Coupled SYK/tensor models- richer physics

A simple model(SYK/tensor):

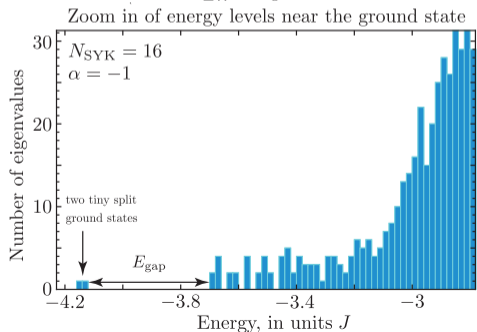
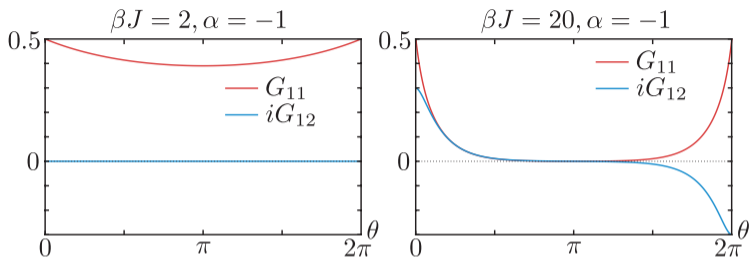
$$H = \frac{J_{ijkl}}{4!} \psi_1^i \psi_1^j \psi_1^k \psi_1^l + \frac{J_{ijkl}}{4!} \psi_2^i \psi_2^j \psi_2^k \psi_2^l + \frac{\alpha}{4} J_{ijkl} \psi_1^i \psi_1^j \psi_2^k \psi_2^l$$

Self duality: $\alpha \in [-1, \frac{1}{3}]$. Sign of α

Physical picture:



Spontaneous symmetry breaking for negative α



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Thank you for your attention!

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