

凝縮系物理学ゼミナール

Condensed Matter Seminar

Location: **Room 413**, School of Science Bldg. 5 (理学 5 号館 413 号室)

Date: **13:30-15:00**, Wednesday, 15 May 2024

“A model of randomly-coupled Pauli spins”

Speaker:

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Abstract:

The Sachdev-Ye-Kitaev (SYK) model was proposed in 2015 as a quantum mechanical model of $(0+1)$ -dimensional N fermion with random, all-to-all 4-body couplings. The model has been extensively studied as a promising candidate of a holographic dual of $(1+1)$ -dimensional AdS black holes in the low temperature and large- N limit, as well as a model to approach the strange metal phase in strongly correlated materials. Several schemes have been proposed to experimentally realize the model, however the large number of all-to-all couplings and the minus signs associated with the fermion exchange statistics have kept it difficult to reach large N in devices available. Previously we proposed a binary coupling sparse SYK model, which dramatically decreases the required resource [1] and still shows scrambling dynamics. [2]

In this talk, after summarily introducing the SYK model, we introduce a quantum mechanical model of $N/2$ $S=1/2$ quantum spins, whose x and y components have all-to-all four-operator couplings. Equivalently, we replace fermions in the SYK model with hard-core bosons. We discuss the striking similarities and some differences between this model and the SYK model. We also discuss the possibility of quantum simulations. [3]

References:

[1] Masaki Tezuka, Onur Oktay, Enrico Rinaldi, Masanori Hanada, and Franco Nori, *Phys. Rev. B* **107**, L081103 (2023) (arXiv:[2208.12098](https://arxiv.org/abs/2208.12098)).

[2] Yoshifumi Nakata and Masaki Tezuka, [Phys. Rev. Research](https://arxiv.org/abs/2402.12221) **6**, L022021 (2024).

[3] Masanori Hanada, Antal Jevicki, Xianlong Liu, Enrico Rinaldi, and Masaki Tezuka (in alphabetical order), *J. High Energ. Phys.* in press. (arXiv:[2309.15349](https://arxiv.org/abs/2309.15349)).