Non-local interactions enhance the performances of quantum batteries : the case of SYK

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Abstract

In this talk, motivated by the growing interest in building devices based on quantum principles, we will introduce and characterize some novel models of quantum batteries (QB). After an introduction to the notion of QB, as a quantum mechanical system able to store and release energy, we will study how a QB can be efficiently charged. In particular, we will focus on the so-called double sudden quench protocol. We will analyze the main universal and model-dependent features of the charging protocol, and we will show how strongly interacting quenches allow to improve drastically the charging performances, both in terms of temporal stability of the average energy stored in the battery and in terms of its charging power. In this respect, we will propose a quench based on the SYK Hamiltonian as an optimal choice, allowing us to reach the *quantum charging supremacy*.

In the second part of the talk, we will provide a theoretical explanation of the quantum charging supremacy of the SYK QBs, in terms of the size of the operators involved. As a by-product, we will argue that the time evolution of some simple spin-spin correlation functions can be used as a probe of *operator growth* dynamics. Such observation, in turn, could constitute a promising tool to probe the emergence of chaotic behavior, rather accessible in state-of-the-art quench setups.

References:

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3. D. Rossini, G. M. Andolina, D. Rosa, M. Carrega and M. Polini, *Quantum charging supremacy via Sachdev-Ye-Kitaev batteries*, arXiv:1912.07234 [cond-mat.str-el].