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Measurements of the Hamiltonians of quantum computers and applications to analogue quantum simulation

We are interested in using quantum computers for analog quantum simulation.

Quantum computers offer the possibility to engineer a variety of Hamiltonians that are relevant for investigating non-equilibirum quantum phenomena.

Quantum states properties, including entanglement, can be then measured with high fidelity, in order to reveal universal features of quantum dynamics.

I will present on-going work on Hamiltonian learning on IBM cross-resonance quantum computers, where we can measure efficiently hamiltonians expressed as a sum of two-body interactions, which are engineered via microwave drives.

In particular, I will present the experimental implementation of a Hamiltonian reconstruction algorithm based on shadow process tomography [1].

I will also show how to measure entanglement entropies via the randomized measurements toolbox [2].

References

[1] Efficient and robust estimation of many-qubit Hamiltonians - https://arxiv.org/abs/2205.09567

[2] The randomized measurement toolbox - https://arxiv.org/abs/2203.11374

Affiliation de l'auteur principal

LPMMC, UGA & Cnrs Grenoble

Auteur principal: LAM, William (LPMMC-Cnrs Grenoble)

Orateur: LAM, William (LPMMC-Cnrs Grenoble)

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