Contribution ID: **42** Type: **Poster contribution**

Qutrit quantum battery: comparing different charging protocols

Tuesday, 7 May 2024 17:30 (1h 30m)

In recent years, the investigation of quantum systems out of equilibrium contributed to the advancement of quantum thermodynamics. In particular, the study of quantum batteries, small quantum mechanical systems able to temporarily store energy and further release it on-demand, recently emerged as a fast-growing subject in this field.
In this framework we have characterized the performances of IBM quantum devices, based on superconducting circuits in the transmon regime, as quantum batteries, establishing the optimal compromise between charging time and stored energy [1].
Considering this result, motivated by recent experimental observations [2] and encouraged by the the growing interested in exploring systems with more then two levels also in the framework of quantum computing, we have investigated the possibility of realizing charging protocols addressing two excited states of a superconducting qubit in the transmon regime, namely realizing a qutrit quantum battery [3]. This extension allows to store a greater amount of energy in the system and opens the door to a richer variety of charging protocols. We have compared two different charging protocols: in the first case the complete charging is achieved through the application of two sequential pulses, while in the second the charging occurs in a unique step applying the two pulses simultaneously. The latter approach is characterized by a shorter charging time, and consequently by a greater charging power. Moreover, both protocols are analytically solvable leading to a complete control of the dynamics of the quantum system and opening new perspectives in the manipulation of the so called qutrits. To support this analysis we have tested both protocols on IBM quantum devices. The minimum achieved charging time represents the fastest stable charging reported so far in solid state quantum batteries.

[1] G. Gemme et al., Ibm quantum platforms: A quantum battery perspective, Batteries 8, 10.3390/batteries8050043 (2022)
[2] C.-K. Hu et al., Optimal charging of a superconducting quantum battery, Quantum Science and Technology 7, 045018 (2022)
[3] G. Gemme et al., Qutrit quantum battery: comparing different charging protocols, arXiv:2306.14537 (2023)

Abstract category

Quantum Simulations

Primary author: GEMME, Giulia (Università degli studi di Genova)

Co-authors: Dr GROSSI, Michele (CERN, 1 Esplanade des Particules, CH-1211 Geneva, Switzerland); Dr VALLECORSA, Sofia (CERN, 1 Esplanade des Particules, CH-1211 Geneva, Switzerland); Prof. SASSETTI, Maura (Università degli studi di Genova); Prof. FERRARO, Dario (Università degli studi di Genova)

Presenter: GEMME, Giulia (Università degli studi di Genova)

Session Classification: Poster session