IBM Quantum Platforms:
A Quantum Battery Perspective

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We characterize for the first time the performances of IBM quantum chips as quantum batteries, specifically addressing the single-qubit Armonk processor [1]. By exploiting the Pulse access enabled to some of the IBM Quantum processors via the Qiskit package, we investigate the advantages and limitations of different profiles for classical drives used to charge these miniaturized batteries, establishing the optimal compromise between charging time and stored energy. Moreover, we consider the role played by various possible initial conditions on the functioning of the quantum batteries. As the main result of our analysis, we observe that unavoidable errors occurring in the initialization phase of the qubit, which can be detrimental for quantum computing applications, only marginally affect energy transfer and storage. This can lead counter-intuitively to improvements of the performances. This is a strong indication of the fact that IBM quantum devices are already in the proper range of parameters to be considered as good and stable quantum batteries comparable to state-of-the-art devices recently discussed in the literature. The possible extension of this analysis to the case of a three-level system will be also discussed [2] in comparison with state-of-the-art experiments [3].

References

[1] G. Gemme, M. Grossi, D. Ferraro, S. Vallecorsa, M. Sassetti, Batteries, 8 (2022) 43.
[2] G. Gemme *et al.* In preparation.
[3] C.-K. Hu *et al.* Quantum Science and Technology 7 (2022) 045018.

Figures

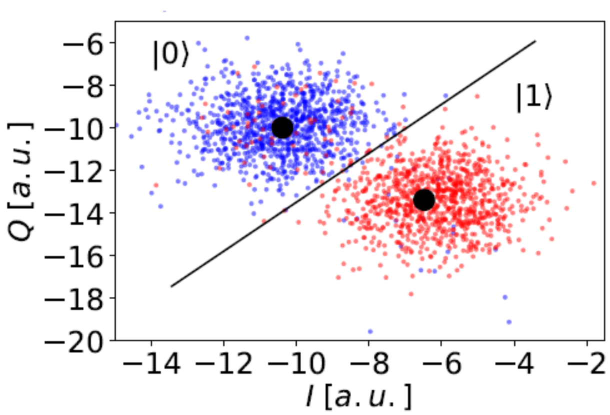

Figure 1: Example of data distribution associated to the measurements of the ground state (blue dots) and the excited state (red dots) in the (I, Q) plane (in arbitrary units) of the Armonk single-qubit device.

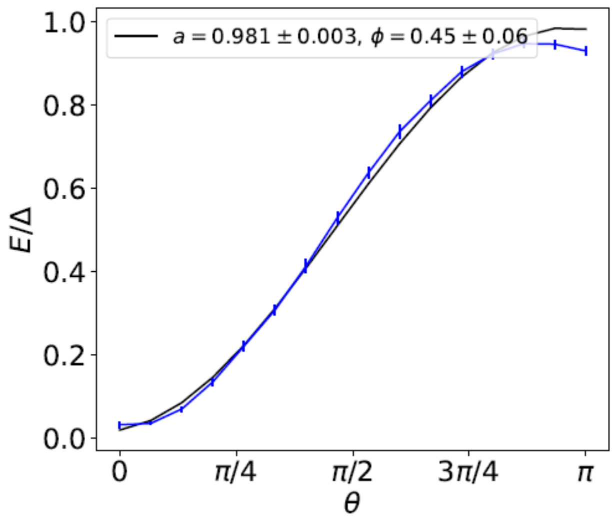

Figure 2: Best fit of the energy stored into the QB (in units of Δ) as a function of θ, time integral of the applied pulse, (black curves).