Highlights

RESEARCH AREA 3 - **Quantum Science and technologies** -2022

"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. 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.

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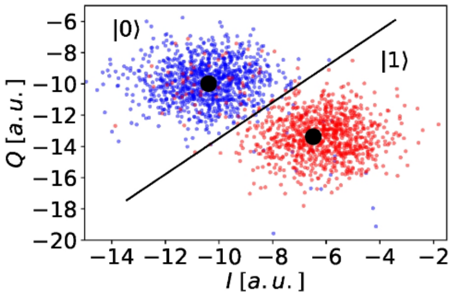

Fig. 1: Example of data distribution associated to the measurements of the state $|0\rangle$ (blue dots) and $|1\rangle$(red dots) in the (I,Q) plane (in arbitrary units) of the Armonk single-qubit device. Big black dots indicate the centers of the two distributions, while the black line separates them. The efficiency of the considered separation is roughly 97.4% for the ground state and 92.7% for the excited state.

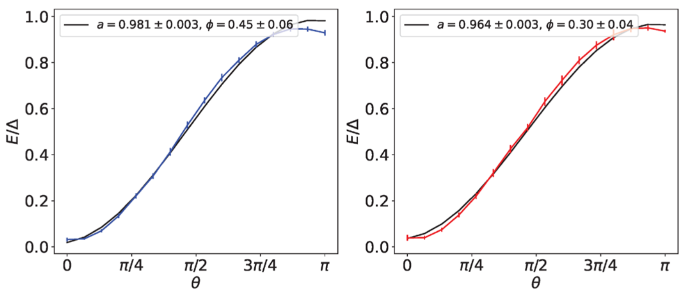

Fig. 2: Best fit of the energy stored into the QB (in units of Δ) as a function of θ (black curves). Data correspond to Gaussian pulses with σ=tm/, being tm=600ns (blue curve in the left panel) and tm=135ns (red curve in the right panels).