Effect of disorder on charging a quantum battery by collision model

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Quantum batteries are a relatively new area of research that explores the possibility of more efficient energy storage using quantum effects[1]. Several theoretical models have been proposed to investigate the potential of quantum batteries, and figures of merit, such as charging power and maximum unitarily extractable energy [2], have been analyzed. The effects of noise, imperfections, and non-markovian effects have also been studied. Quantum phase coherence and entanglement have been explored as useful resources for improving the performance of quantum batteries. One promising method for charging quantum batteries is through collision model charging [3-5], where the battery repeatedly interacts with a charging particle. However, the role of disorder [6-8 in the efficiency of collision model charging remains a largely unexplored area of research. In this study, we investigate the effect of disorder on the efficiency of the collision model [9] charging of a quantum battery and examine its impact on the optimal charging time. We model the quantum battery and the charger as (non)interacting two-level spin systems. The charging process is then simulated using the time-dependent Schrödinger equation. We investigate different strengths of interactions and their effect on the efficiency of the battery. We then investigate the impact of the degree of disorder on the efficiency of collision model charging. Finally, we investigate the effect of disorder on the optimal charging time for the quantum battery. Our study highlights the importance of controlling disorder in order to optimize the charging process and improve the efficiency of quantum batteries. In summary, our study provides a comprehensive investigation of the impact of the disorder on the efficiency of collision model charging of a quantum battery and sheds light on the optimal charging time in the presence of disorder.

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