Chapter 2
Advancements in Battery Technology: Quantum Computing Perspectives

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ABSTRACT

The main focus of this chapter is on the Armonk single-qubit processor, and the authors give a full account of what IBM's quantum chips can do, specifically as quantum batteries. The goal is to find the best balance between charging time and stored energy by using the Pulse functionality offered by some IBM Quantum processors through the Qiskit package. To do this, the authors look at the pros and cons of several common drive profiles used to charge these small batteries. They also look at how different starting factors can change how quantum batteries work. This research shows that the mistakes that happen naturally at the start of qubit activation don't have a big impact on how energy is sent or stored. On the other hand, these effects may slow down apps that use quantum computing. Interestingly, this could make things run more smoothly. This is strong proof that IBM's quantum devices meet the requirements to be called stable quantum batteries, similar to the cutting-edge devices that were just published in scientific journals.

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INTRODUCTION

Battery technology has come a long way, which has helped create more safe energy options and made electric power useful in many fields. Batteries are important to modern life because they power portable electronics, make it easier for electric cars (EVs) to run, and store a lot of energy for use in the grid. Even though a lot of progress has been made in these areas in recent years, modern battery technologies still face problems like low energy density, long charging times, worries about resource supply, and environmental impacts (McLean et al., 2017).

Bringing together battery technology and quantum computing could be a good way to solve these problems and create new opportunities. The concepts of quantum physics are used in quantum computing to make computers that are much faster than regular computers. The use of quantum computing could completely change the way researchers and developers work on batteries. This technology speeds up the search for and improvement of new materials and designs, which could make batteries more effective, efficient, and long-lasting (Wecker et al., 2013).

This research looks into how quantum computing and battery technology can work together. It focuses on how quantum algorithms and models can be used in designing materials, improving electrolytes, and making electrodes. The article also talks about how quantum computing might be able to help with the problems of correctly reproducing complicated quantum phenomena in batteries and other places where regular computer methods don't work (Babbush et al., 2018).

In addition, the research looks at the current trends that focuses on how quantum computing and battery technology are coming together, highlighting important progress and ongoing efforts. This research talks about how adding quantum computing to the process of making batteries will require more computing power, better algorithms, and proof through experiments. Additionally, it talks about the possible pros and cons of this combination (Ananth, 2022).

Scientists and engineers want to use quantum computing to totally change battery technology. This would open the door to new energy storage technologies that are both environmentally friendly and very fast. The goals of this talk are to give useful insights into this exciting new field and to encourage people working together in the area where quantum computing and battery research meet.

RELATED WORK

P.S. Ranjit 2012, William DeGroat 2023 Quantum batteries, or QBs, are a new and interesting discovery in quantum technology. Traditional ideas about how to change energy come from electrochemical ideas that were formed in the 18th and 19th centuries and are the basis of modern technology. These small energy storage devices challenge those ideas. When you use non-classical features like quantum superposition, entanglement, and many-body collective activity, you can store more energy, charge it faster, make it more powerful, and get more work out of it than with traditional methods. These should be the most important things to talk about and improve when describing and improving the skills of these gadgets. Quantum batteries have a lot of potential for powering quantum devices and sensors that are getting more complicated, which could lead to amazing technological growth.

S. Sharma 2014 Over time, the research became more and more focused on making suggestions that emphasized doing experiments. A lot of different problems were talked about, including systems for cavity and circuit quantum electrodynamics, arrays of artificial atoms, and easy-to-use