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The Future of Quantum Computer

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Abstract : *Quantum Computer is a machine that is used for Quantum Computation with the help of using Quantum Physics properties. Where classical computers encode information in binary "bits" that can either 0s or 1s but quantum computer use Qubits. Like the classical computer, the Quantum computer also uses 0 and 1, but qubits have a third state that allows them to represent one or zero at the same time and it's called "Superposition". This research paper has presented the Basics of Quantum Computer and The Future of Quantum Computer. So why Quantum Computer can be Future Computer, Because Quantum Computer is faster than any other computer, as an example, IBM's Computer Deep Blue examined 200 million possible chess moves each second. Quantum Computer would be able to examine 1 trillion possible chess moves per second. It can be 100 million times faster than a classical computer. The computer makes human life easier and also focuses on increasing performance to make technology better. One such way is to reduce the size of the transistor and another way is to use Quantum Computer. The main aim of this paper is to know that how Quantum Computers can become the future computer.*

Keywords *-Computation, Entanglement,Quantum Bits, Superposition, Transistor*

I. INTRODUCTION

Why we need Computers because computers reduce human effort and make human life easier. However, there arechallenges that today's systems can't solve, therefore we need Quantum Computer. To solve some of these problems, we need a new type of computer.Quantum computers using quantum phenomena superposition and entanglement create highly variable values in the number of qubits. Quantum computers can spur the development of new scientific advances, life-saving drugs, rapid diagnostic techniques, high-performance equipment and materials, retirement financial strategies, and quick-tracking algorithms for resources such as ambulances.

With the advancement of Science and Technology, they have focused on the architecture of Quantum Physics to build technology more advanced. Quantum Computer is a machine used by Quantum Computation by the help of usingproperties of Quantum Physics.The possibilities of quantum computing were first introduced by the scientist Richard Feynman in 1982. Quantum physics has challenged logic since atom was first studied in the earlier 20th century. It turns out atoms don't follow the conventional rules of physics. Quantum particles can move forward or backward simultaneously, double placing simultaneously, or "teleport." It is these strange behaviors that quantum computers are designed to be used for their own benefit.

In 1994, mathematician Peter Shaw demonstrated how quantum computing can be used to crack the common encryption standards that existed at the time, which can find key features of large numbers well, which can find key features of large numbers expertise.Here, the definition of "expertise" is in the realm of practical value, beyond the power of state-of-the-art classical algorithms. While this may seem confusing, it is impossible to convey the significance of Shor's understanding.The security of almost all online transaction today rely on RSA cryptosystem system which relies on the possibility of data encryption algorithm.

II. QUANTUM CIRCUIT

2.1 Definition

The existing model of quantum computation represents the calculation of in terms of quantum logic gateway network. [1]This model can be thought of as a typical linear-algebraic production of the old circuit. In this circuit model build quantum mechanics, a quantum computer able to effectively manage this circuits believe that they are physically visible.

A memory containing of n bits of data has 2^n possible states. A vector representing all memory states thus has 2^n entries (one for each state). This vector is recognized as a vector of opportunity and explains the fact that memory is specially obtained situation. [2]

In the old way, a single entry will have 1 value (e.g. 100% chance of being present in this case), and all other entries will be zero. In quantum mechanics, opportunities vectors are designed for frequency providers. This is technically accurate the mathematical basis of quantum logic gates, but the medium quantum condition vector formalism is often introduced first because it is conceptually simple. This paper focuses on quantum state vector formalism of purity. [2]

We begin by monitor a simple memory containing only one. This memory could be found in one of the two say: state of zero or one. We may describe the state of this memory using Dirac notation so that

$$|0\rangle := \binom{1}{0}; \qquad |1\rangle := \binom{0}{1}$$

A quantum memory may then be found in any quantum superposition$|\psi\rangle$ of the two classical level $|0\rangle$ and$|1\rangle$:

$$|\Psi\rangle := \alpha|0\rangle + \beta|1\rangle = \binom{\alpha}{\beta}; \quad |\alpha|^2 + |\beta|^2 = 1$$

2.2 Quantum algorithms

Progress in finding quantum algorithms usually focuses on this quantum circuit model, even if something similar to the existing quantum adiabatic algorithm. [3]Quantum algorithms can be categorized almost by the type of speed gained above the corresponding classical algorithms.Quantum algorithms offer more than a polynomial speed over a well-known classic algorithm that includes Shor algorithm for generating algorithms and quantum algorithms related to using ambiguous logarithms, solving Pell's equation, and solving group problems hidden abelian finite. [3] These algorithms are based on the classics of the Fourier quantum modification. No mathematical evidence has been found to indicate that the fast classical algorithm cannot be detected, although this is considered impractical. [4] Certain oracle problems such as Simon's problem and Bernstein's problem - Vazirani offers unstructured speed, even though this is a quantum query model, which is a restricted model where lower limits are much easier to prove, and does not mean translating into speedups to work problems.

Other problems, including the limit of quantum physical processes from chemical and solid-state physics, the limitations of certain Jones polynomials, and the quantum algorithm of the corresponding systems of equations have quantum algorithms that appear to provide -super-polynomial speedups and finishes with BQP. Because these problems are complete with BQP, a fast classical algorithm for them would mean that there is no quantum algorithm that offers high polynomial speeds, which they believe is impossible.

Other quantum algorithms, such as the Grover algorithm and amplitude amplification, offer polynomial speeds over similar classical algorithms. Although these algorithms offer the same quadratic speed, they are too effective and thus provide speedups for a many variety of problems. Many examples of quantum speedups for questioning problems are related to Grover's algorithm, including Brassard, Høyer's algorithm, and Tapp for two to one collision, using Grover's algorithm, and Farhi, [5] Goldstone, and Gutmann's NAND test algorithm trees, [6] different from the search problem.

III. FUNDAMENTALS OF QUANTUM COMPUTING

All computing systems depend on a fundamental ability to store and manipulate information. Current computers use individual bits, which is store information such as binary zero and one provinces. Quantum computers use mechanical devices to process data. To do this, they depend on quantum bits (qubits). [7]

3.1 Quantum Properties

There are three main quantum mechanical properties which is the superposition, entanglement, and the interference which is applied to a quantum computer to control the state of qubit bit.[7]

3.1.1. Superposition

Superposition means quantum objects where the quantum system can represent many levels simultaneously.

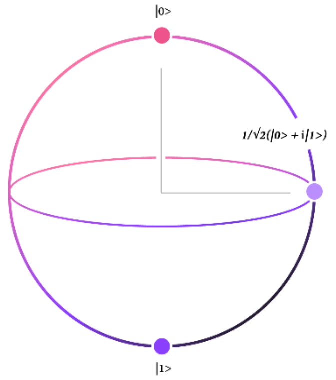

Fig.1 Superposition

3.1.2. Entanglement

In quantum physics, the entanglement of particles defines relationships between their basic structures that are not accidental. This may refer to provinces such as their momentum, position, or division.

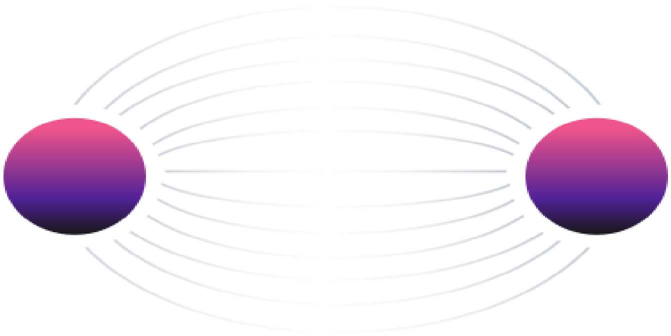

Fig.2 Entanglement

3.1.3. Interference

Quantum statecould be affected by something known as a phase. Quantum interference could be understood like to wave interference; when two waves are in phase, their amplitudes increase, and when they are out of phase, their amplitudes will be cancelled.

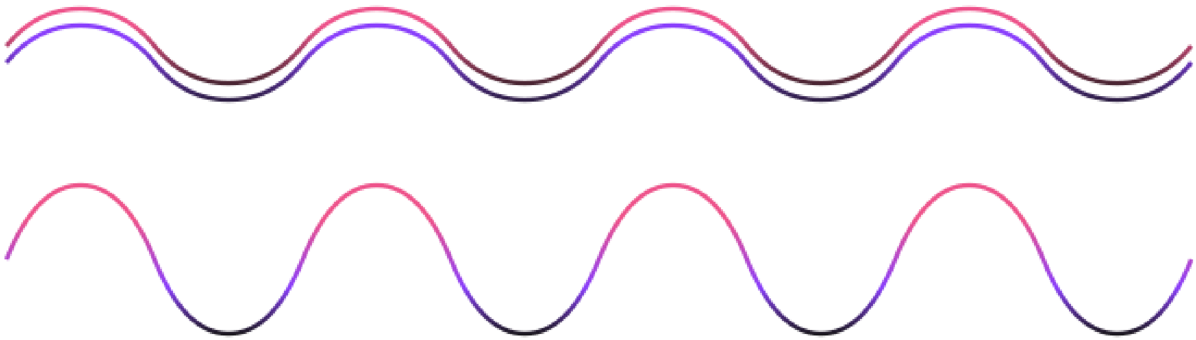

Fig.3 Interference

3.2 Quantum Computation

There are some different ways quantum systems use quantum properties to compute. Let's examine one type of algorithm designed for present quantum hardware, which uses quantum computing to find the "best" solution among various possible solutions. [7]

This algorithm could be used to impact a molecule by resolve the lowest energy level within the maximum length of molecular bonds. For the only lengths available, the components of the power levelare defined in the quantum processor. Then, features of the quantum state are measured and related back to energy in the molecule, to the provided electronic configuration. Repetition of this process of various inter-atomic spaces ultimately led to the length of the bond and the lower energy level, which explains the formation of equilibrium cells. In addition to algorithms for short-term computer systems, researchers have developed future algorithm systems, often associated with quantum-tolerant quantum computers. These systems will need to implement many sequential quantum operations and run for long periods of time. [8]

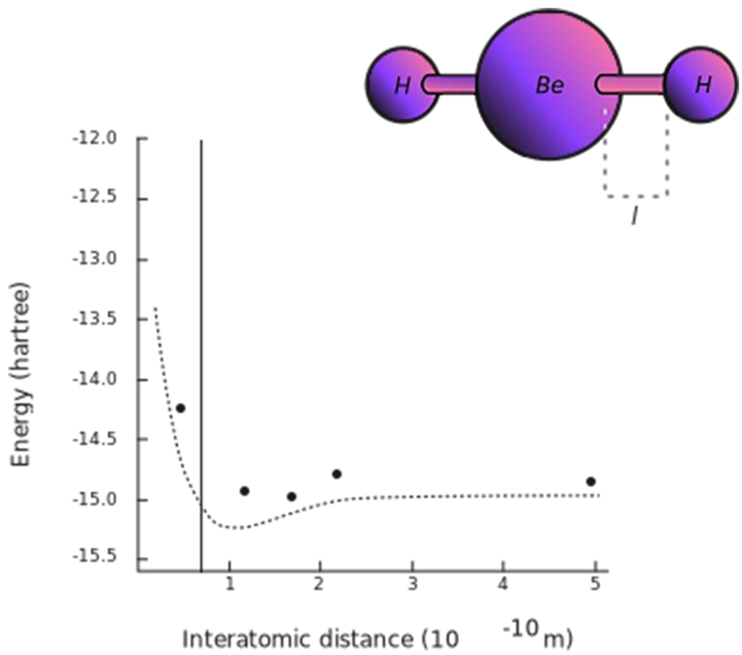

Fig.4 Experimental results (circles) and the exact energy values (dotted line) for different interatomic distances of BeH2

IV. QUANTUM COMPUTER : FUTURE COMPUTER

4.1. Quantum Computer vs Classical Computer

- Quantum computers can solve problems that may or may not take billions of years for old computers to solve. [9]

- Quantum computers will change the data security environment. Or quantum computers will be capable to break many of the modern encryption methods.
- Existing computers can perform better than quantum computers in some task (email, spreadsheets, and more). The purpose of quantum computers is to be a unique tool for solving various problems, not replacing older computers. [9]
- Quantum computers is bigger than Classical Computer solving optimization problems. Google claims to have a computerized quantum 100 times faster than any older computer.
- Every day, we produce 2.5 Exabytes of data. That number corresponds to the content of 5 million laptops. Quantum computers can make it possible to process the amount of data we create in big data time.

4.2. Why Quantum Computer?

According to the report, Quantum Computer is 100 million faster than an old computer. For example, as well as IBM's Deep Blue chess champion who defeated chess champion, Mr. Garry Kasparov in the year 1997. It managed to gain a competitive advantage because it calculates about 200 million trips per second. Quantum computer will be able to monitor 1 billion moves per second![9]Rather than using more electricity, quantum computers would reduce power consumption anywhere from 100 to 1000 times because quantum computers use quantum tunnelling. [10] [11]There are various algorithms already developed for quantum computers including Grover's random database search and Shor's for making large numbers. [12] [13]Once a stable quantum computer has been built, expect that machine learning will obviously encourage and reduce the time to solve problems from hundreds and thousands of years to seconds. [14]

The goal of computer-assisted quantum computing is to make Shor's algorithm for large numbers a major incentive to advance the quantum computational field. [15]To develop a broad view of quantum computing, however, it is necessary to understand that they are likely to bring about great speed with certain types of problems. Researchers are both researching to understand which problems are due to quantum acceleration and developing self-certification algorithms. As always, it is believed that quantum computers will be of great help in problems related to efficiency, which plays an very important part in everything from security to financial trading.Many additional computer applications quantum bit software programs also exist and are active research areas, but they are not beyond this overall view. [16]The two most prominent areas are the first of which is quantum sensitivity and metrology, which uses excessive sensitivity of qubits in nature to detect excessive classical-noise sensitivity, and secondly by quantum and network networks, which can monitor theformative information sharing.

V. CONCLUSION

In this research paper we have explainQuantum Computer and why it could be a future computer. The aim of thispaper is to know that how quantum computers can exceed existing classical computers in the future. This paper will help the reader to know about quantum computers. We also concentrated on quantum computing and quantum algorithms which included quantum calculations, quantum structures and properties - Superposition, Entanglement, and Interference.

In the future, there is a great need for Quantum Computers and at present, many companies and scientists are researching Quantum computers to launch it commercially in market. Because a quantum computer can do those things which are impossible or would take billions of years for any othercomputer.

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