Physics and Computation

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1 Disclaimer

Yes, chatgpt essay writing skill is a piece of shit. But I used it to proof-read and polish my essay.

2 Quantum Computation: A plagued technology

Quantum computers possess the capability to solve certain problems with greater efficiency than classical computers. Shor's algorithm, for instance, can factor large integers N in $\mathcal{O}(log(N)^2 loglog(N))$ time, whereas the most efficient classical algorithm is $\mathcal{O}(e^(1.9log(N)^(1/3)loglog(N)^(2/3)))$ [Sho,]. Consequently, quantum computers have the potential to provide exponential speedup for factoring large integers. However, modern encryption techniques that rely on the difficulty of factoring integers are unlikely to be compromised anytime soon.

One of the most significant challenges in quantum computing is noise. In essence, noise refers to a disruptive force that perturbs the qubits used for computation. It is analogous to a mischievous imp that upsets the abacus one uses for arithmetic operations. In other words, computation results from a noisy quantum computer are no longer precise. These noises arise from unwanted physical interactions between the qubits undergoing coherent evolution and their environment or poorly calibrated operations used for computation.

Although techniques such as quantum error correction code can protect data in a fault-tolerant quantum memory, they rely on relatively good physical operations[Girvin,]. Presently, our technology is still struggling to keep up. Consequently, there is a need to develop a naturally robust computing approach that is immune to unwanted interactions causing noise.

3   Topological Invariant: Physical Motivation

As Rolf Landauer said, "Information is Physical". When we do computation, we first encode the information on physical systems and evolve those systems to carry out computation.

4   Majorana Zero Mode: Physical Realization

5   Bibliography

5.1   References

References

[Sho,] Shor's algorithm.

[Girvin,] Girvin, S. M. Introduction to Quantum Error Correction and Fault Tolerance.