This New Discovery Could Put Quantum Computers Within Closer Reach

Jaehyung Park

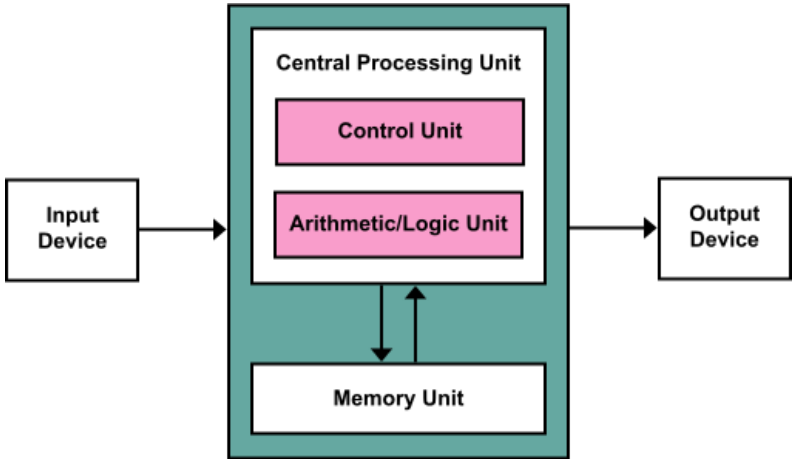
May 23, 2016

CS 35L

Lab 1: Josh Vaughen

Quantum computing architecture

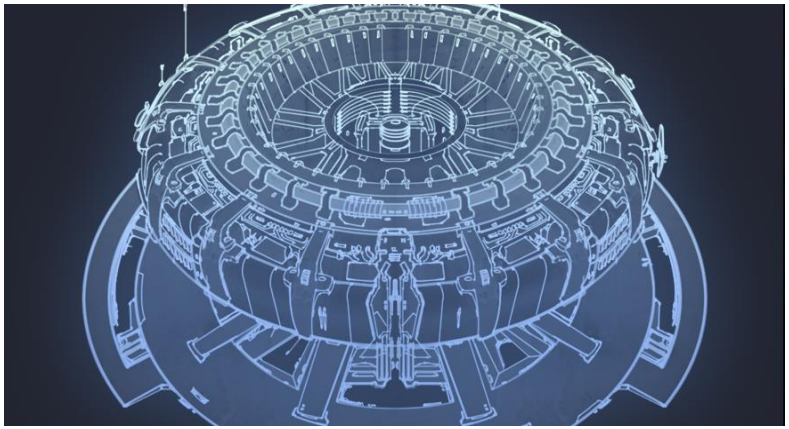
- Modern computers follow Von Neumann Architecure that heavily relies on memory.



What is a quantum computer?

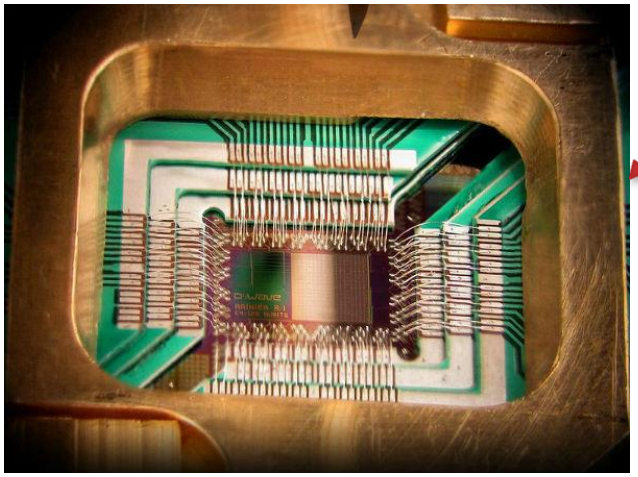
- Definition: A computer that makes use of the quantum states of subatomic particles to store information

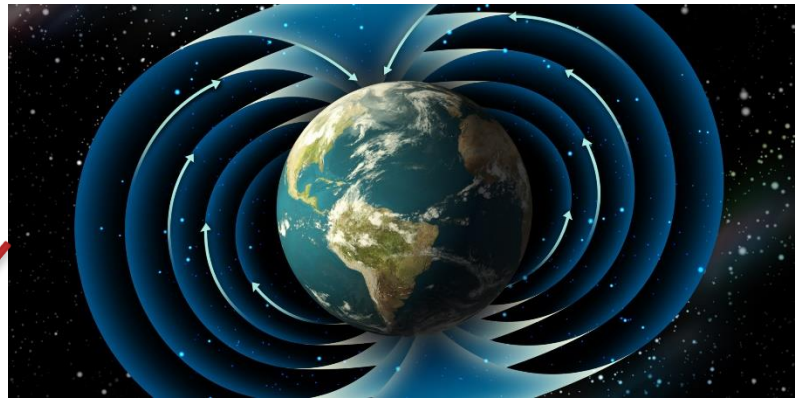
  (Reference:Oxford dictionary)

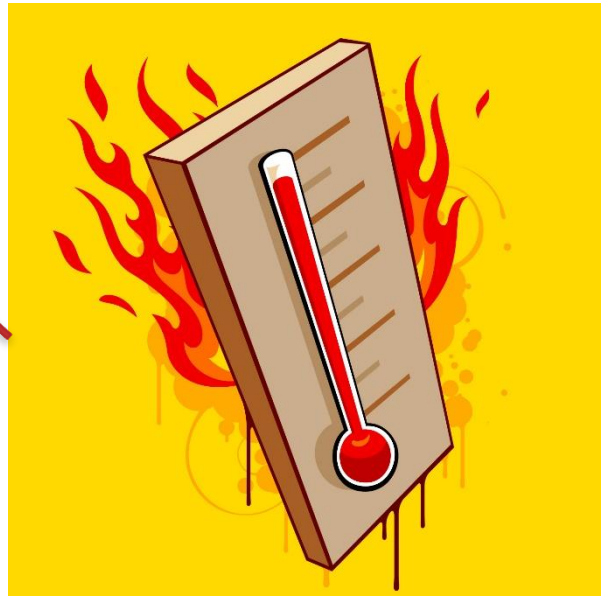


- 2 Qubits => Four superposition states (00, 01, 10, 11)
- N qubits == 2^N classical bits

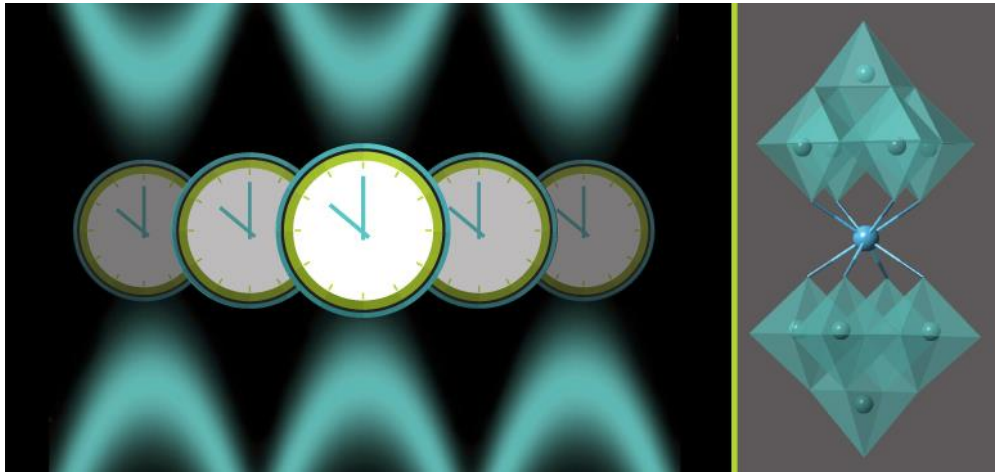
Quantum computers are prone to magnetic fields and heat





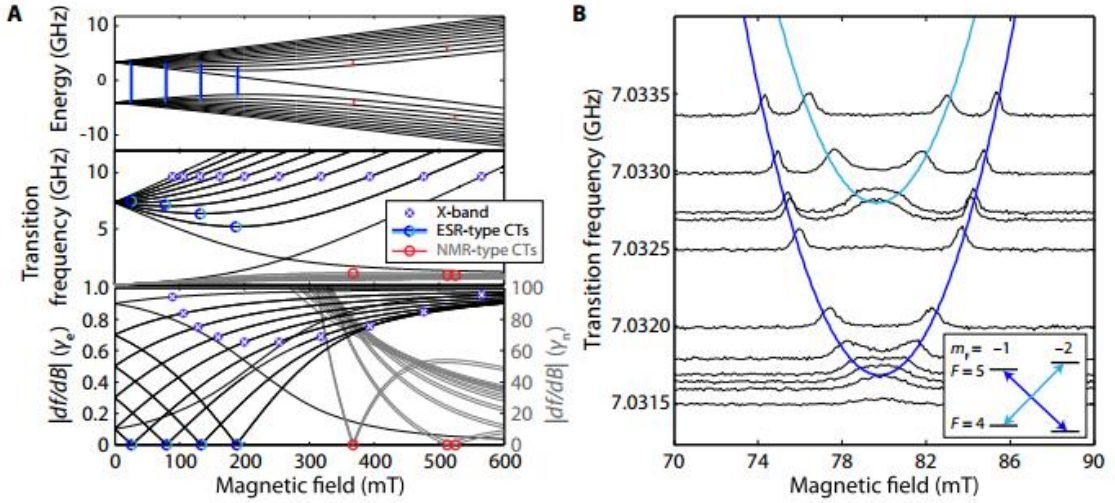


Discovery: Atomic Clock Transitions



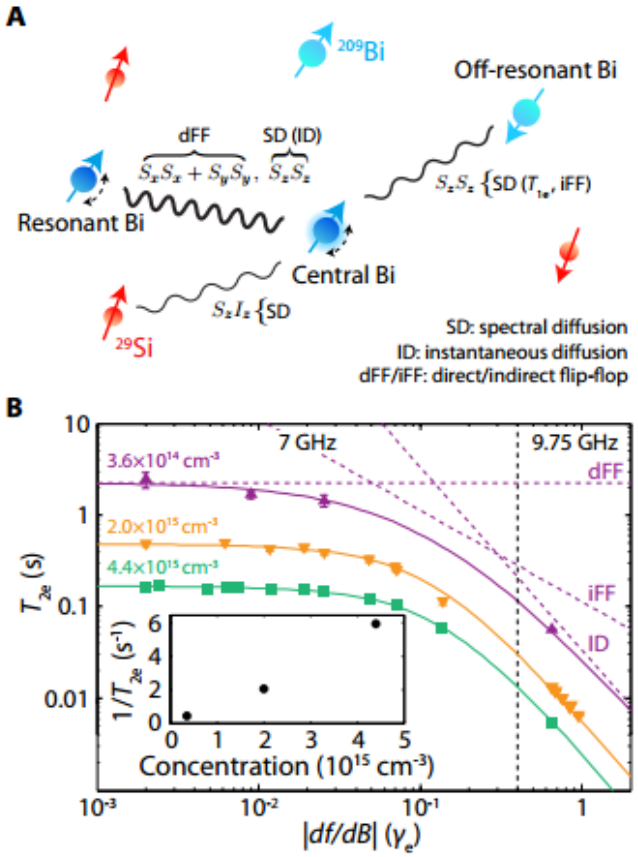
- Katherine Noyes quotes “Working with carefully designed tungsten oxide molecules that contained a single magnetic holmium ion, the MagLab team was able to keep a holmium qubit working coherently for 8.4 microseconds” (Noyes, 2016)

Background/Research



- Electron spin resonance (ESR)-type clock transitions (CTs) of Si:Bi (Wolfowicz, 2013)

How is this going to work? Results?



- Decoherence mechanisms of Bismuth (Bi) donors in Silicon (Si) and their dependence on df/dB. (Wolfowicz, 2013)

Future applications and Possibilities

- Parallel computing
- Military use
- Artificial Intelligence
- Optimization
- Encryption and code breaking
- Web search and Robotics

RSA SECURITY™

Reference

- Noyes, K., Mar 16 2016, “This new discovery could put quantum computers within closer reach”, Computerworld <http://www.computerworld.com/article/3045046/high-performance-computing/this-new-discovery-could-put-quantum-computers-within-closer-reach.html>
- Wolfowicz, G. et al., June 23 2013, “Atomic clock transitions in silicon-based spin qubits”, Nature technology, 8, pp.561-564
- Shiddiq, M. et al., January 05 2016, “Enhancing coherence in molecular spin qubits via atomic clock transitions”, Nature, 531, pp.348-351
- Hagar, A. and Cuffaro, M., June 2015, “Quantum Computing”, The Stanford Encyclopedia of Philosophy, <http://plato.stanford.edu/archives/sum2015/entries/qt-quantcomp/>
- Meter, R.V., Horsman, C., October 2013, “A Blueprint for Building a Quantum Computer, Communications of the ACM”, Vol. 56 No. 10, pp 84-93
- Weinberger, S., November 18 2014, “Why Google and the Pentagon want ‘quantum computers’”, BBC, <http://www.bbc.com/future/story/20130516-big-bets-on-quantum-computers>