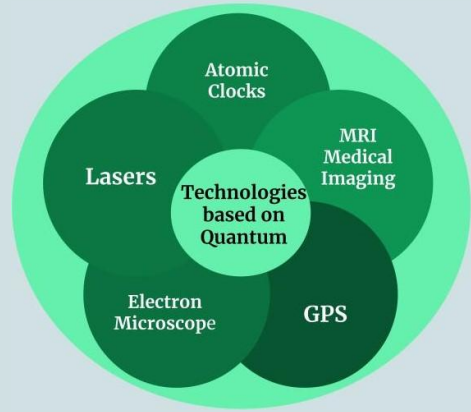
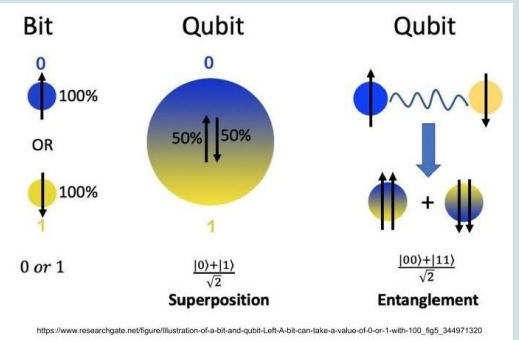


The Next Records Challenge: Quantum Information Science and Technology (QIST)

What is QIST?

QIST is the merger of quantum physics and information theory. Information theory is the study of quantification, storage, and communication of information. Quantum physics describes nature at an atomic and subatomic level.



1900 - 1920s	Development of Quantum Theory
1948	Claude Shannon "A Mathematical Theory of Communication."
1976	Office of Science and Technology Policy established
1981	Richard Feynman "Simulating Physics with Computers"
1994	Peter Shor factoring algorithm NIST First Quantum Workshop
1996	Lov Grover quantum search algorithm
2018	National Quantum Initiative Act (NQI) passed

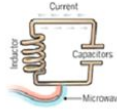
64 bit encryption 1.8×10^{19} combinations	
Classical	Quantum
3.1 GHz processor processes 64 bits 3.1 billion times a second	64 qubits in superposition of all combinations of 64 bits
189 years	Seconds

Quantum records = intermediary records

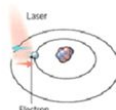
- Create a subsequent record for use by a classical computer
- Copying causes superposition to collapse & changes the record

Approaches for Quantum Computing


A bit of the action
In the race to build a quantum computer, companies are pursuing many types of quantum bits, or qubits, each with its own strengths and weaknesses.



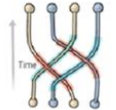
Superconducting loops
A resistance-free current oscillates back and forth around a circuit loop. An injected microwave signal excites the current into superposition states.



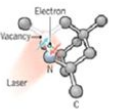
Trapped ions
Electrically charged atoms, or ions, have quantum energies that depend on the location of electrons. Tuned lasers cool and trap the ions, and put them in superposition states.



Silicon quantum dots
These "artificial atoms" are made by adding an electron to a small piece of pure silicon. Microwaves control the electron's quantum state.



Topological qubits
Quasiparticles can be seen in the behavior of electrons channeled through semiconductor structures. Their braided paths can encode quantum information.



Diamond vacancies
A nitrogen atom and a vacancy add an electron to a diamond lattice. Its quantum spin state, along with those of nearby carbon nuclei, can be controlled with light.

Popkin, Gabriel. "Quest for Qubits: How Small Startups are Vying with Corporate Behemoths for Quantum Supremacy." Science, 364(6438) (2018): 1090-1092. doi:10.1126/science.1264.6318.1090.

RM Implications	Cryptography	Search & Retrieval	Storage	Post Quantum Encryption
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