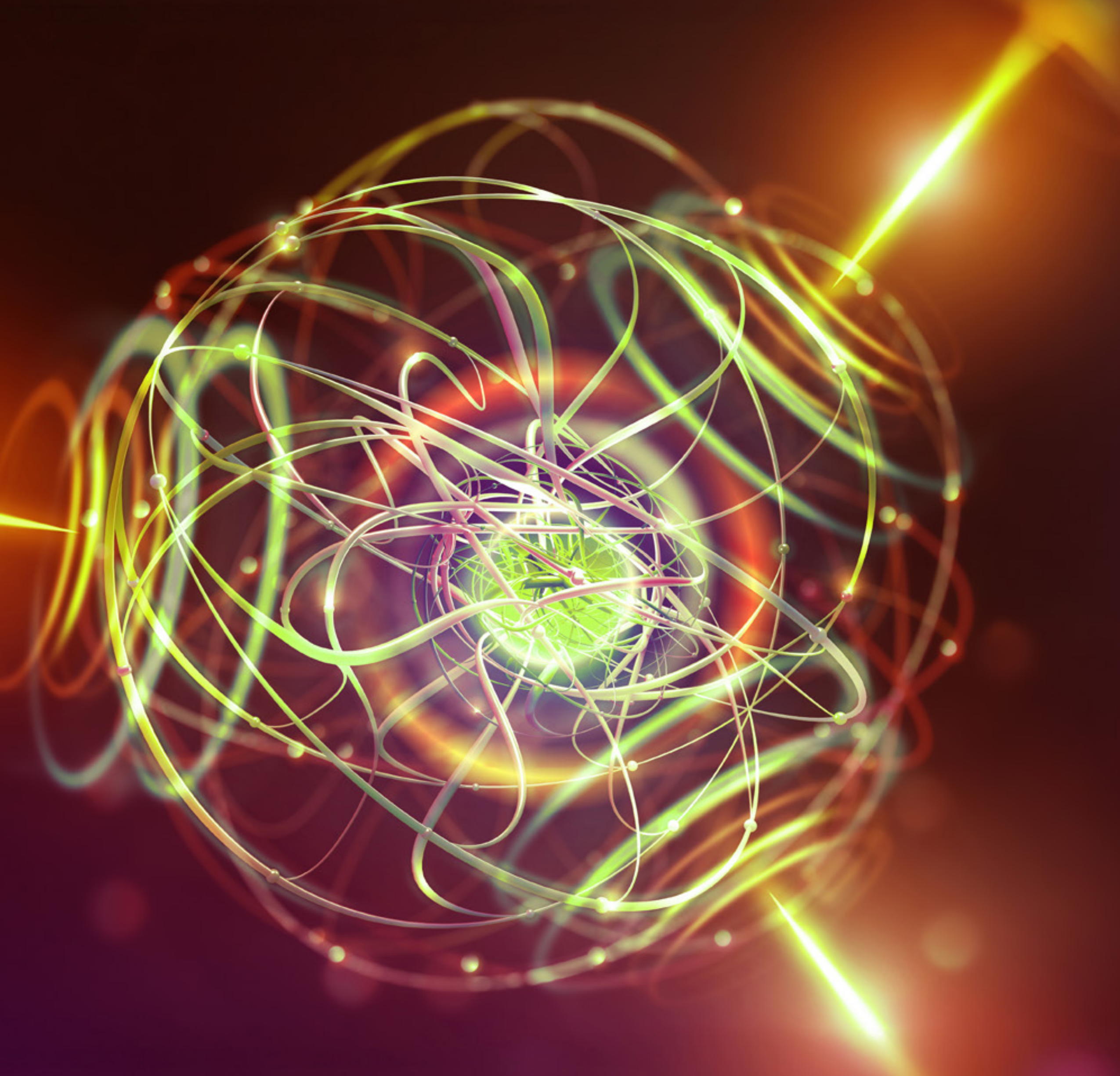
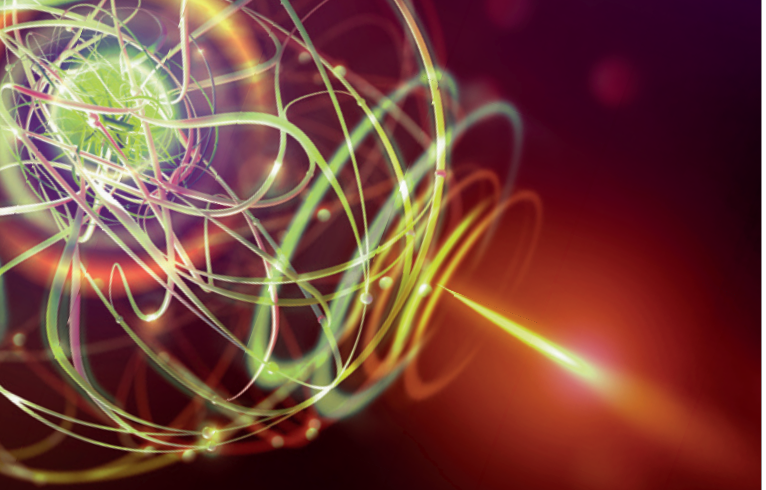
EVIDEN

Qaptiva

Empowering innovation and unlocking quantum technology possibilities begin today with computing emulation

Quantum Computing (QC) is an emerging technology that harnesses the power of quantum mechanics to tackle incredibly complex problems beyond the reach of conventional computers. The rise of quantum computers promises to dramatically boost computing power, enabling the simulation of intricate systems in mere seconds. Quantum Computing has the potential to transform digital capabilities across various fields and revolutionize industries, scientific research, and technology.





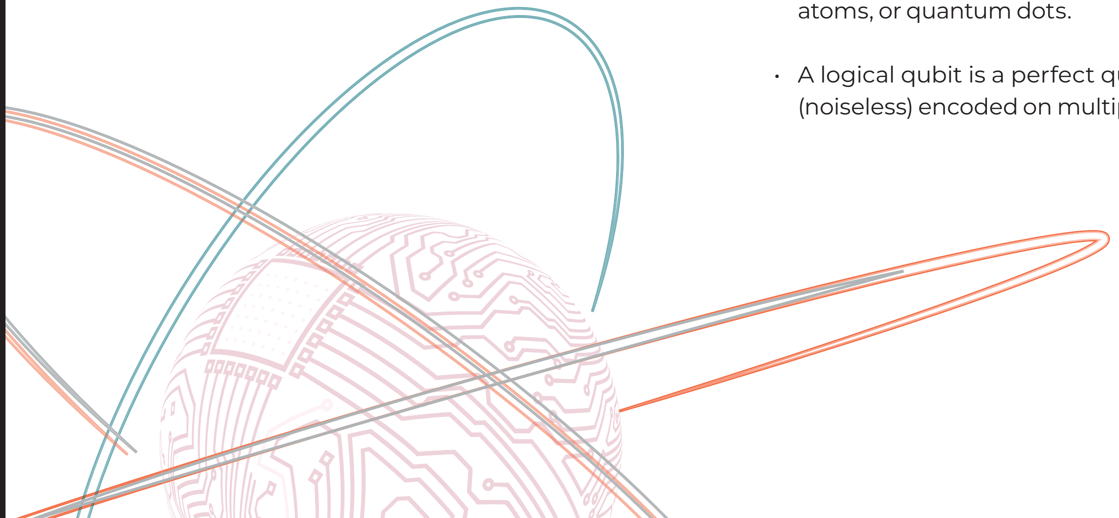
Quantum computing is progressing quickly; however, at present, no quantum computer can effectively tackle complex problems because existing technologies still have numerous errors that cannot be corrected. We are in a phase known as the NISQ (Noisy Intermediate-Scale Quantum) Era, characterized by devices prone to errors and noise. FTQC, or Fault-Tolerant Quantum Computing, is the subsequent stage in this evolution. It refers to the ability of a quantum computer to function correctly even in the presence of errors or noise, ensuring reliable and scalable quantum computations.

Discussions with academics and industry leaders reveal that, according to a recent insight communication from McKinsey, more than 65 percent anticipate the arrival of fault-tolerant quantum computing (FTQC) by 2030.

There's no need to hold out for the era of advanced quantum computers

Quantum emulation is an excellent option for entering the field of quantum computing today, as it is already accessible. This technology allows users to simulate the behavior of quantum computers, serving as a valuable resource for tasks such as programming, optimizing, compiling, and emulating code. Thanks to quantum emulation, developers and researchers can begin working with quantum technology to solve complex problems without the limitations related to QPU availability, accessibility costs, and computing power.

Quantum emulators are based on classical hardware with a specific software environment. Quantum emulation involves developing and refining quantum algorithms on classical computers to prepare for execution on Quantum Processing Units (QPUs).



Not all qubits are created equal

A common question is the difference between quantum emulation and execution on a real quantum computer. Quantum emulation involves perfect qubits, whereas Quantum Processing Units (QPUs) work with physical qubits. Therefore, we should not assume that these two types of qubits are directly equivalent in a 1:1 comparison.

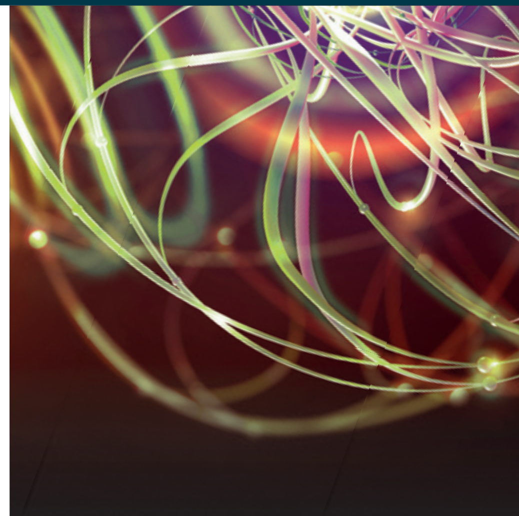
Additionally, it's important to note that there are various types of qubits. Certain considerations need to be taken into account when assessing the quality of qubits or interpreting the number of qubits announced by hardware manufacturers or software emulator vendors.

- Physical qubits are, by nature, noisy qubits prone to errors, and they are associated with the different types of qubits used to encode and process quantum information, such as photons, neutral atoms, or quantum dots.
- A logical qubit is a perfect qubit without errors (noiseless) encoded on multiple physical qubits.

Logical qubits are envisioned as perfect qubits in quantum computing theory, essential for achieving exponential speedups. However, due to the inherent nature of quantum physics, no real-world physical qubit can attain this perfection. Although physical qubits currently fall short of the quality of logical qubits required by quantum computing theory, engineering advancements hold the potential to create perfect quantum processing units (qubits), bringing us closer to realizing the promise of quantum computing.

Quantum error correction is the primary engineering approach to constructing these logical qubits. It involves assembling physical qubits into complex structures to create virtual logical qubits. In other words, this technique involves using multiple qubits (known as physical qubits) to encode the state of a single qubit (referred to as a logical qubit). The number of physical qubits required to generate a logical qubit depends on the qubit technology, error correction code, and physical qubit quality.

The number of physical qubits required to create logical qubits varies greatly depending on the technology used. For instance, superconducting technology can necessitate approximately 50 (cat qubits) to 1,000 (transmon qubits) physical qubits to produce a single logical qubit.



Bridging the Gap with Qaptiva™

As organizations increasingly prioritize innovation, the adoption of quantum emulation becomes crucial. Quantum emulation not only allows businesses to explore and understand the complexities of quantum computing but also prepares them for the transition to fault-tolerant quantum computing (FTQC). By integrating quantum emulation into their strategies now, organizations can effectively simulate quantum algorithms and processes, gaining valuable insights that will enhance their competitive edge and ensure they are well-equipped to navigate the challenges and seize the opportunities that the quantum landscape presents in the future.

Qaptiva enables enterprises and institutions to anticipate the availability of advanced quantum computers and implement real-world use cases by harnessing innovation through quantum computing technology. Qaptiva offers developers a comprehensive NISQ computing environment, comprising all essential tools and resources to program using popular quantum programming paradigms such as gate-based, annealing, and analog. This environment enables developers to optimize, compile, and emulate code that replicates the behavior of ideal quantum technologies, run code on a Quantum Processing Unit, and leverage hybridization.

Eviden Qaptiva can emulate hundreds of logical qubits depending on the product and algorithm, a larger capacity than any existing QPU can handle today. This capability enables businesses, institutions, and HPC centers to elevate their computational capabilities and unlock new possibilities for innovation for the upcoming FTQC era of quantum computing.

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