Qubits are the Wrong Approach to Quantum Computing

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https://youtu.be/IhS6ecYZFdQ&lc=UgyLwwBgdrl2k-5EMl94AaABAg

A Comment on the Sabine Hossenfelder YouTube post:
Quantum Computers Could Solve These Problems (Apr 22, 2023)
https://youtu.be/IhS6ecYZFdQ?t=5m33s

5:33 *"Logical qubits are perfect cubits. They don't have any errors… These things don't exist in reality."* Even more troubling, logical qubits assume that *bits* are fundamental in the same way as, say, electrons. They are not. Bits-as-fundamental was an easy assumption for Manin and other early founders to make since spin 1/2 particles have precisely two states, up and down, that seem to represent a bit perfectly. The qubit then becomes the quantum superposition of these two perfectly knowable states.

However, believing that pure spin-up and spin-down states are an entirely quantum example of binary certainty contains a subtle but profound logical flaw that is the deeper source of the disparity between physical and logical bits. The problem is that the only way to define *which* way is up and which way is down is by using some huge, entirely classical device to make these two states approach classical, non-quantum perfection. Examples include magnets to define up and down bits and circuits for superconducting bits.

To put it bluntly, this means that the entirety of quantum computing — research and commercial development — is built upon a demonstrably false premise that reliable, stable binary states are a fundamental component of deep physics.

Why is the belief that bits are fundamental false? Creating an infinitely stable classical bit requires an *infinitely large* direction-definition instrument to ensure its up-down definition has *no* quantum uncertainty. We don't notice this because only a tiny amount of matter can create a storage bit so stable that it *appears* eternal.

However, anyone familiar with storage chip engineering knows designers play many games to overcome this quantum limit. Bits get lost more often than folks realize. Usually, it's due to radiation, but the quantum aspect does emerge in extremely densely packed storage chips.

If the idea of a fully reliable two-state device is necessarily classical and thus not fundamental, the concept of a qubit suffers from the same problem. No matter how many excellent articles exist that assume qubits form the deepest infrastructure of the universe, it's just not true. A qubit is instead based on infinitely classical devices and thus not fundamental. This unfortunate use of a profoundly non-fundamental concept is the deeper source of the disparity between logical and physical qubits.

So does quantum computing even exist?

Absolutely yes! As you read this, every photon landing on your retina has just performed an unbelievably energy-efficient, room-temperature, literally light-speed, bio-compatible

Fourier transform. Despite the photon's minimal energy, it could discern the entire shape of the vastly larger cornea and lens in your eye to guide the details of its calculation.

Now *that* is energy-efficient computing!

Unlike cubits, the ability of individual photons to perform remarkable calculations *is* fundamental. Shortest-path and Fourier transform dynamics are among quantum physics' most baffling and delightful features. They are also almost unbelievably energy efficient and reliable compared to bit-based computing, mainly because they use classical physics only as a controlling interface for setting up the calculation. This leveraging of deeper physics avoids forcing efficiency-damaging non-quantum classical concepts, such as an arbitrary belief in perfect binary certainty, into the quantum part of the process.

A final point is this: I have briefly assessed hundreds of emerging companies from my non-profit, US federally supported tech assessment roles. I have a track record of helping more than one company find their first product or expand successfully into a market they didn't know existed. I promoted using Google search in the late 1990s when most people did not know of the company's existence. I also strongly encouraged the adoption of FireEye in the US federal government long before it became a multi-billion-dollar company.

From that perspective, my best assessment is that there are substantial research and business opportunities in abandoning qubits entirely and moving to some new model that begins with genuinely fundamental examples of quantum computing. One example of a good starting point is the narrow yet astonishingly energy-efficient calculation efficiency of a single photon interacting with refractive and reflective classical calculation guides.

I have mentioned this lens-like model of quantum computing before in various comments, and folks are already working in this domain. Still, the research and funding focus on the non-fundamental concept of qubits has inadvertently but unavoidably limited funding and exploration of avenues of more physics-based approaches to quantum computation, in particular, how ideas such as Fourier transforms and least-path-based computation might also lead to innovative and practical products. Notably, this category of quantum computing is far less likely to suffer from a need for extreme cold. The entanglement issue needs better mathematics for lens-like quantum computing, but Sabine gave an excellent example of research in that area just in the past couple of weeks.

There are some fascinating possibilities here for research and business if the communities involved can overcome decades of counterproductive fascination with comfortably computer-like but ultimately non-fundamental qubits.

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