How To Manage The Quantum Bubble

Pravir Malik

Pravir.malik@qiquantum.com

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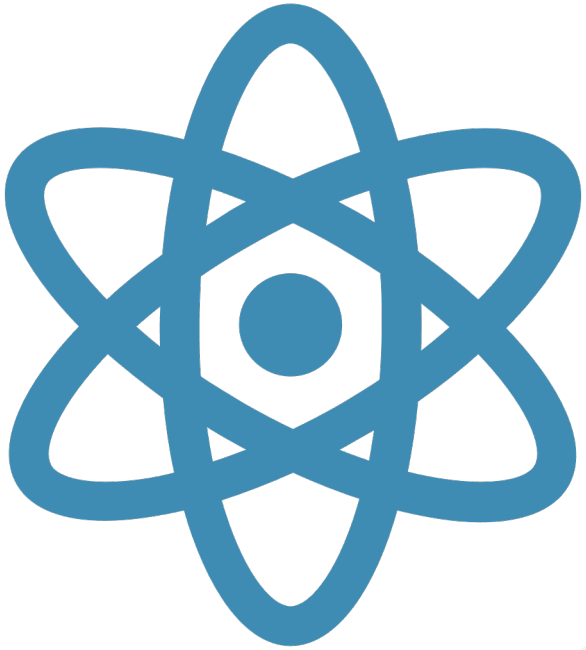
QIQuantum

Overview

- Objectives
- Today’s Quantum Computing Industry
- Basis of the Bubble
- Redirecting the Quantum Computing Industry
- Thinking Ahead

Objectives

- Understand the basis of the quantum computing bubble
- Address the important questions:
  - What's the basic idea behind currently conceived quantum computers?
  - Why are superposition and entanglement considered to be so important?
  - On what basis can the quantum computing industry be meaningfully redirected?
  - What is a feasible alternative approach to develop meaningful quantum computers?
  - Why is quantum computing so important?
  - What are the implications of getting quantum computing wrong or right?

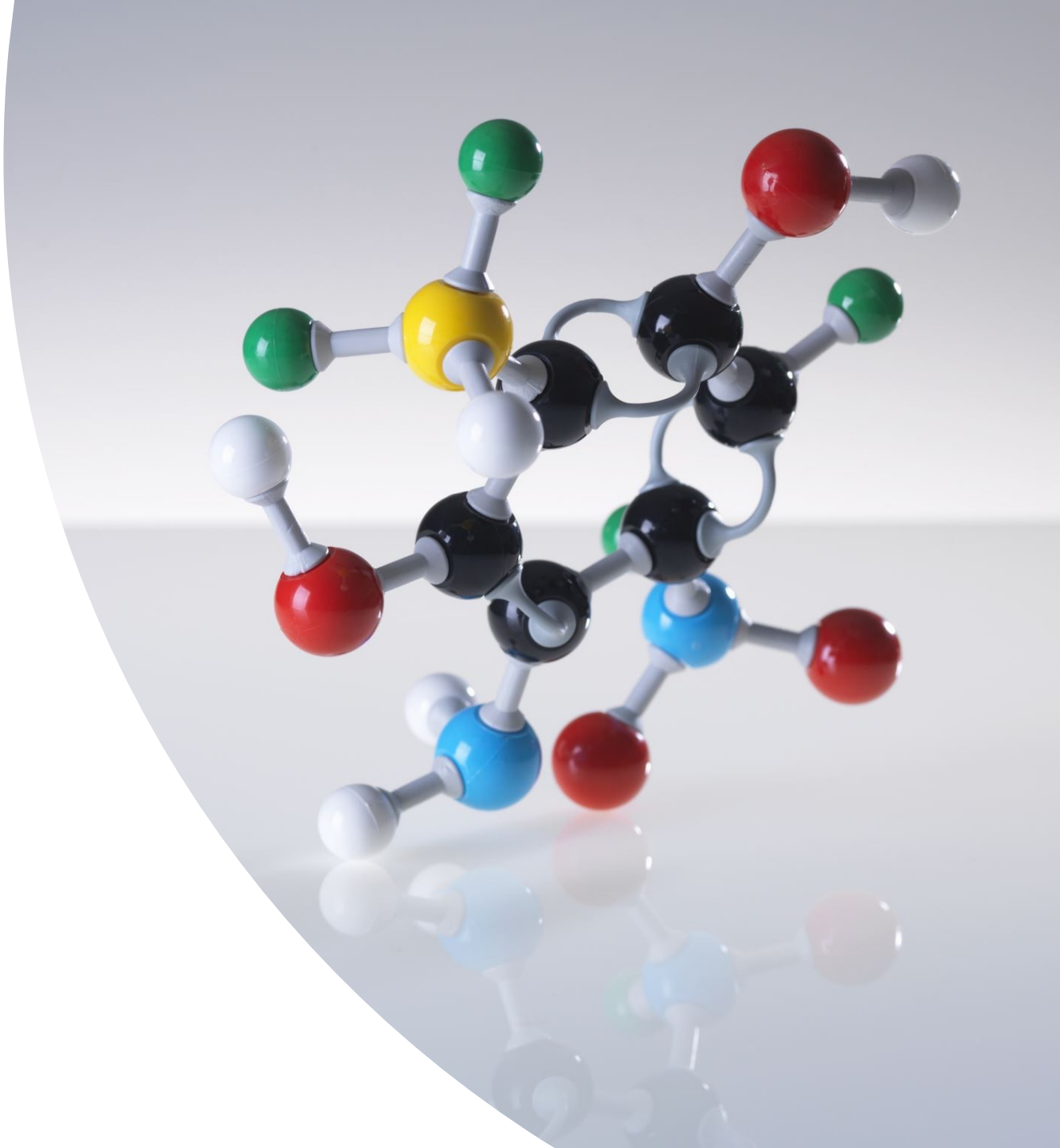


Today’s Quantum Computing Foundation

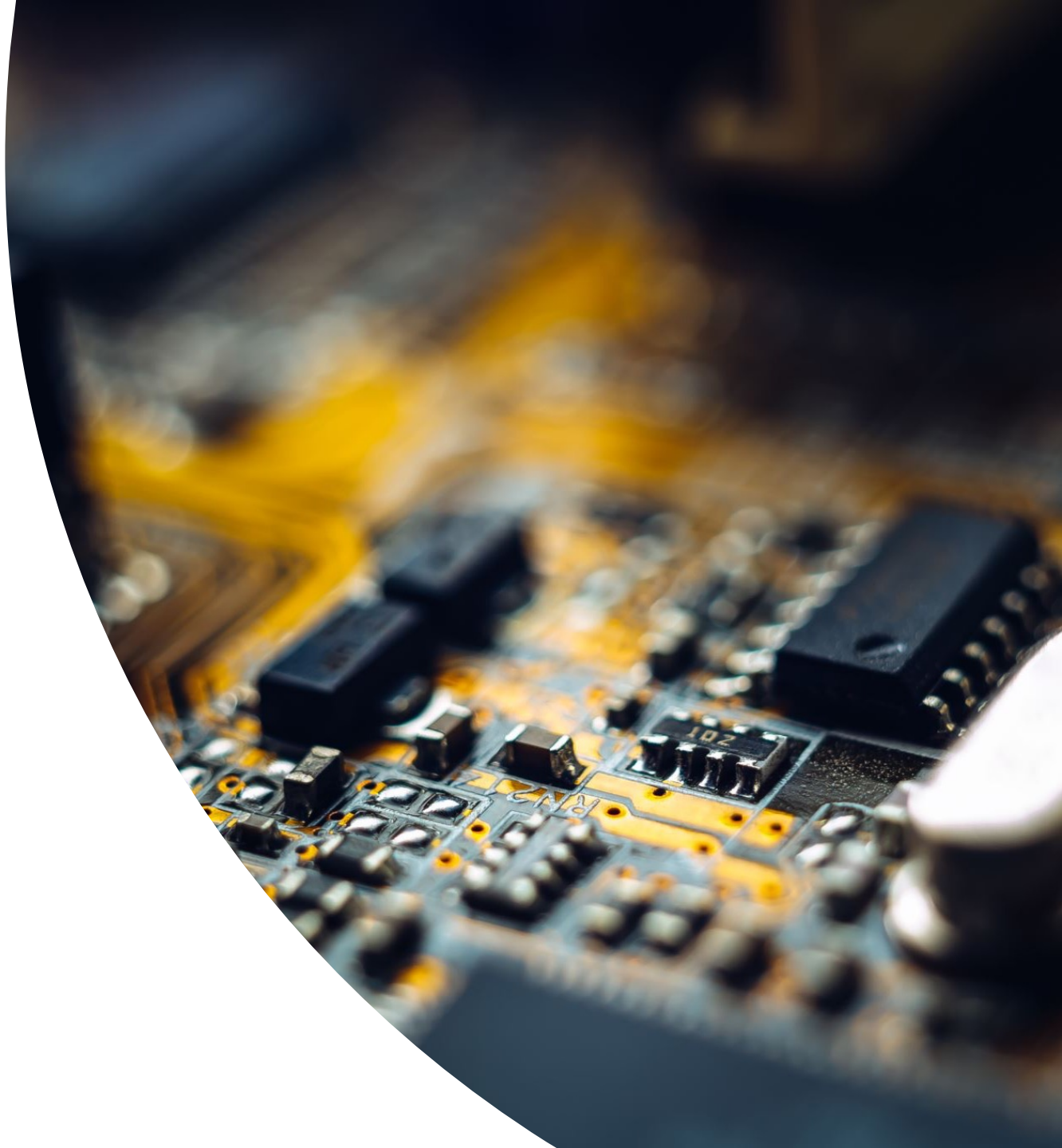
Q: What are some of the ways in which Quantum Theory has been / is projected to be used?

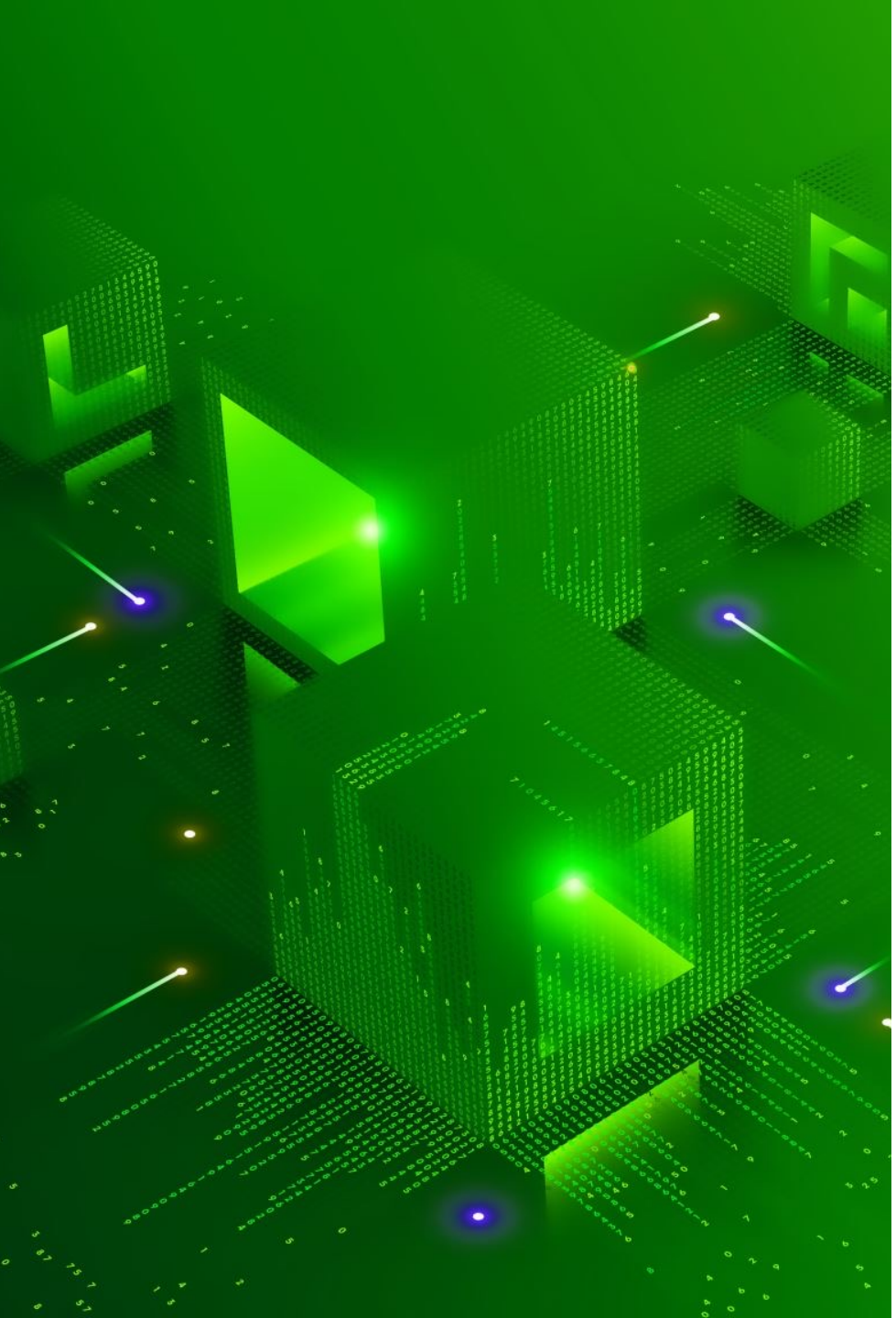
Promise of Quantum Theory

- Quantum theory has proven to be one of the most fruitful scientific theories in that it has resulted in technology that much of the modern world is indisputably built from it
  - Concrete devices such as transistors and semiconductors that are at the base of telecommunication and computing technology,
  - Applications such as GPS, MRI, and Laser
  - Disciplines such as chemistry have emerged from an understanding of quantum mechanics
- Quantum mechanics is about the rules governing how atoms behave, interact with each other, and interact with light
- There continue to be huge investments in the quantum computing industry, and the market—hardware, software, infrastructure and generated end-user value—is estimated to be in the tens of billions by 2030, with a compound annual growth rate between 2025 and 2030 pegged at approximately 40%



Q: What is the basic idea behind currently conceived quantum computers?



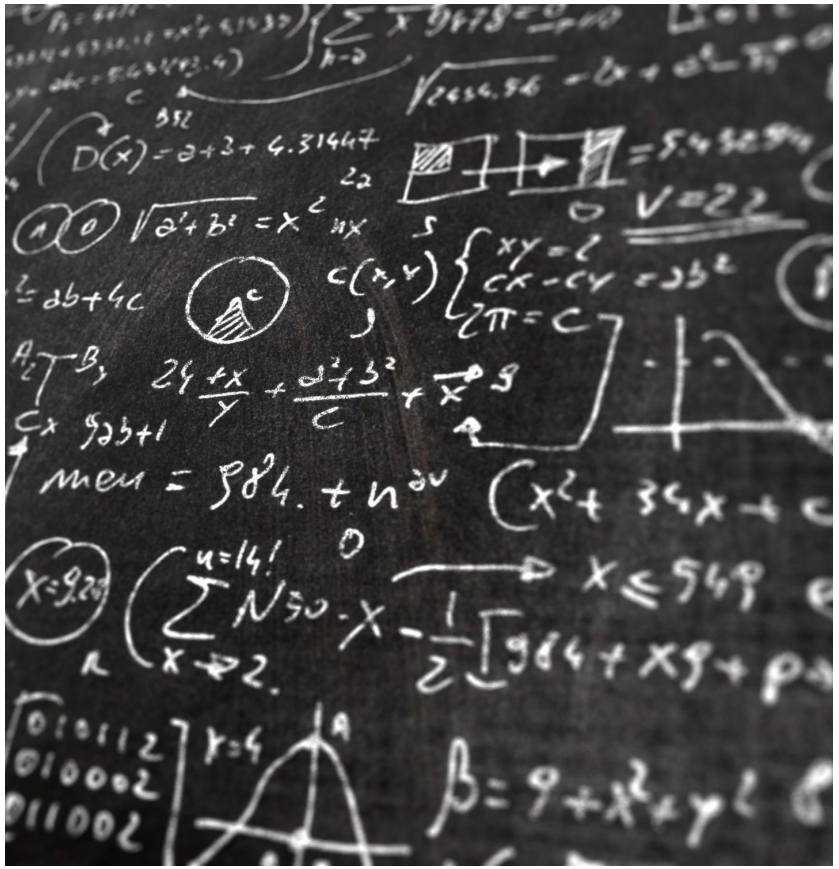


Basic Idea Behind Currently Conceived Quantum Computers

- Quantum computers, fundamentally different from digital computers, aim to imitate nature
  - Nature operates randomly, therefore, necessitating a “probabilistic” quantum computer
  - A Copenhagen Interpretation of Quantum Mechanics-based “superposition” in which unknowable infinite possible states collapse into one single state when measured
  - “Entanglement” that has to be created
- Imagined computing power of quantum computers is based on this triple foundation

The Importance of Superposition

- As per the existing theory, quantum objects (aka phenomenon that arises at the quantum levels) can exist in a state of superposition—infinite different possible states—until it is measured, at which point it collapses into something that is measurable
- How might it be applied?
  - There could be many different skills that exist latently or as a possibility, and due to deliberate computational focus, the desired subset of these is manifested or made real in a target employee group.*
  - This could become invaluable if a company is entering a new market, is faced with an unexpected challenge, is trying to get a new hire class up to speed or just requires a particular type of change to be worked through faster, for example

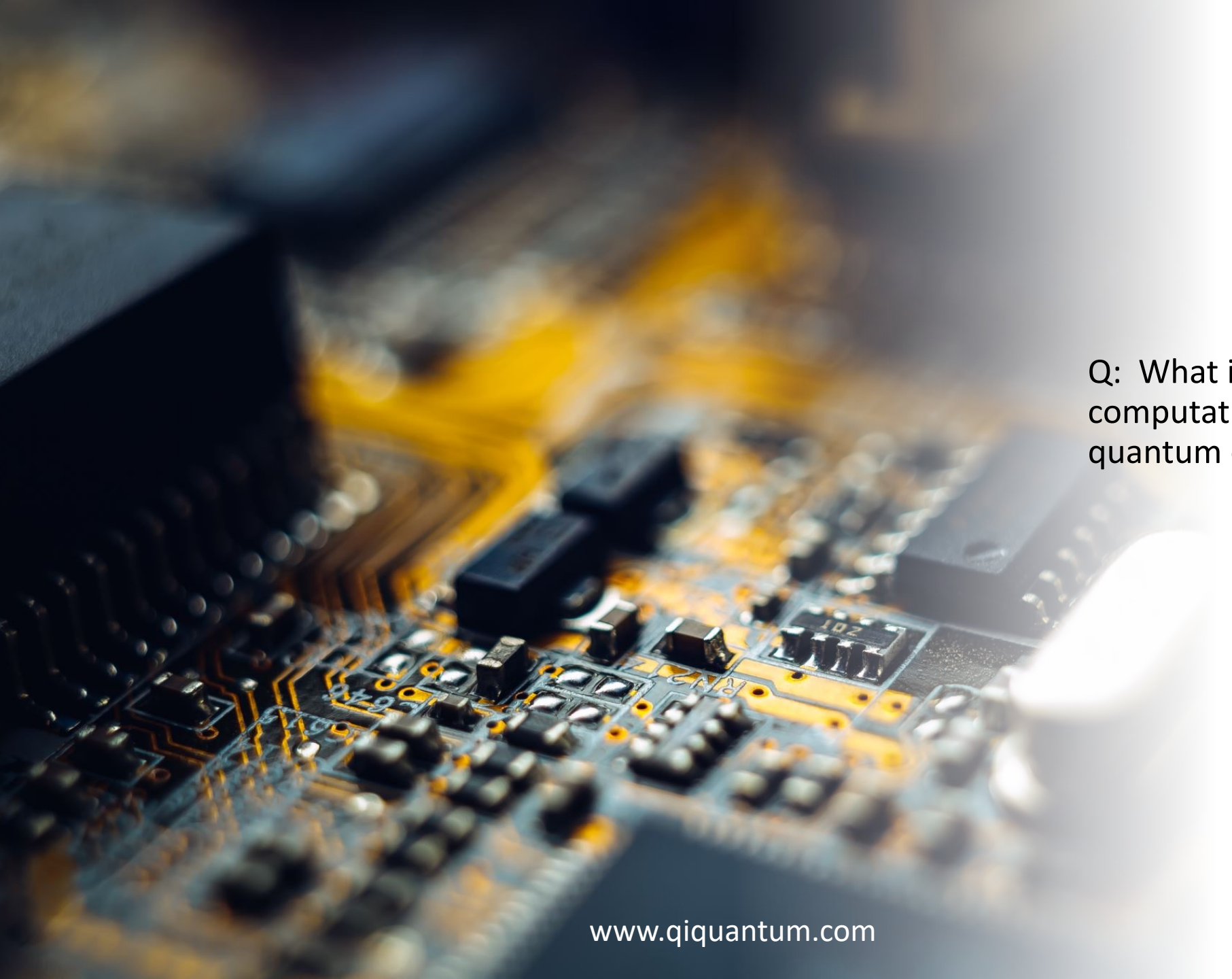


*The Potential Impact Of Quantum-Level Dynamics On Human Resources (Forbes article)

The Importance of Entanglement

- Quantum objects can also be entangled; that is, two quantum objects, say a photon, for example, can be entangled so that as one changes, the other "knows" about the change instantaneously, no matter how far away it may exist
- Think of it this way—nobody ever has to tell the water in a bottle, whether in China or the U.S., how it should exist in different circumstances. Yet the water, regardless of where it is, will react in the same way in similar situations. One can say that the water in the bottle has been entangled
- How might it be applied?
  - Now consider consistency in expressed behavior in possibly controversial or legally volatile issues. If entanglement between remote teams or employees has taken place, then lessons learned in one place would instantaneously be available in another*

*The Potential Impact Of Quantum-Level Dynamics On Human Resources (Forbes article)

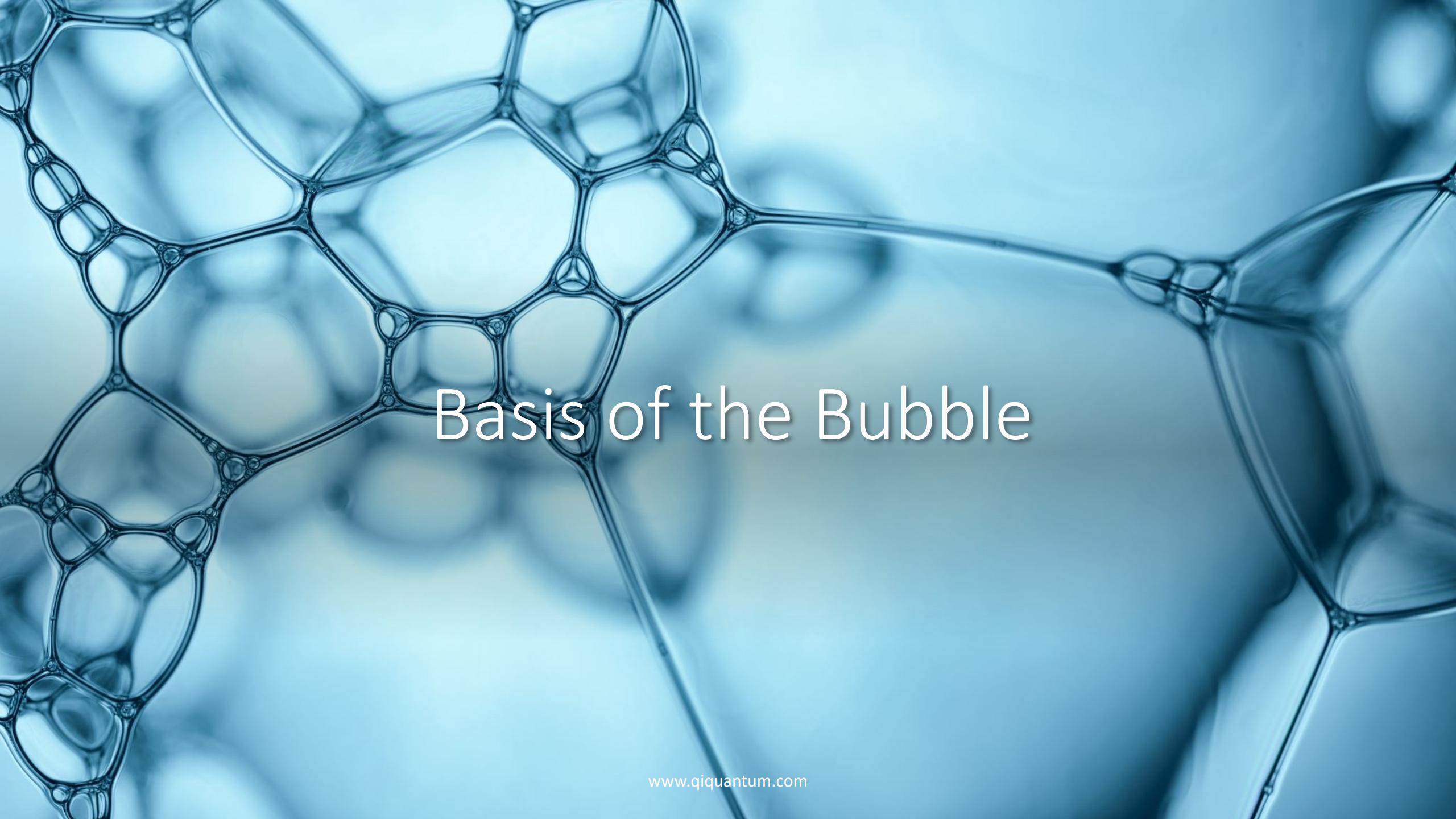


Q: What is a possible computational scenario using quantum computers?

A Computational Scenario: Future Impact Employee May Have on the Company

- A company is going to hire a new employee
- The hiring team would like to be able to get a sense of the future impact that the employee may have on the company
- There are many variables to consider in this situation, especially since the circumstance itself is going to change as the employee advances through their employee lifecycle
- Questions have to do with how the employee will get along with others, what kinds of impacts they may have on different situations, and how they may be able to influence other potential leaders in the company so that they, in turn, may have an impact on the market, and so on
- Pretty quickly, the complexity of the shifting scenarios, with a large number of micro and macro variables to be considered, and their potential outcomes becomes overwhelming.
- This is where quantum computation could potentially make a difference in processing all the complexities, working through many possible solutions, to come up with the likely future impact of the employee and, therefore, whether they should be hired*

*The Potential Impact Of Quantum-Level Dynamics On Human Resources (Forbes article)



Basis of the Bubble

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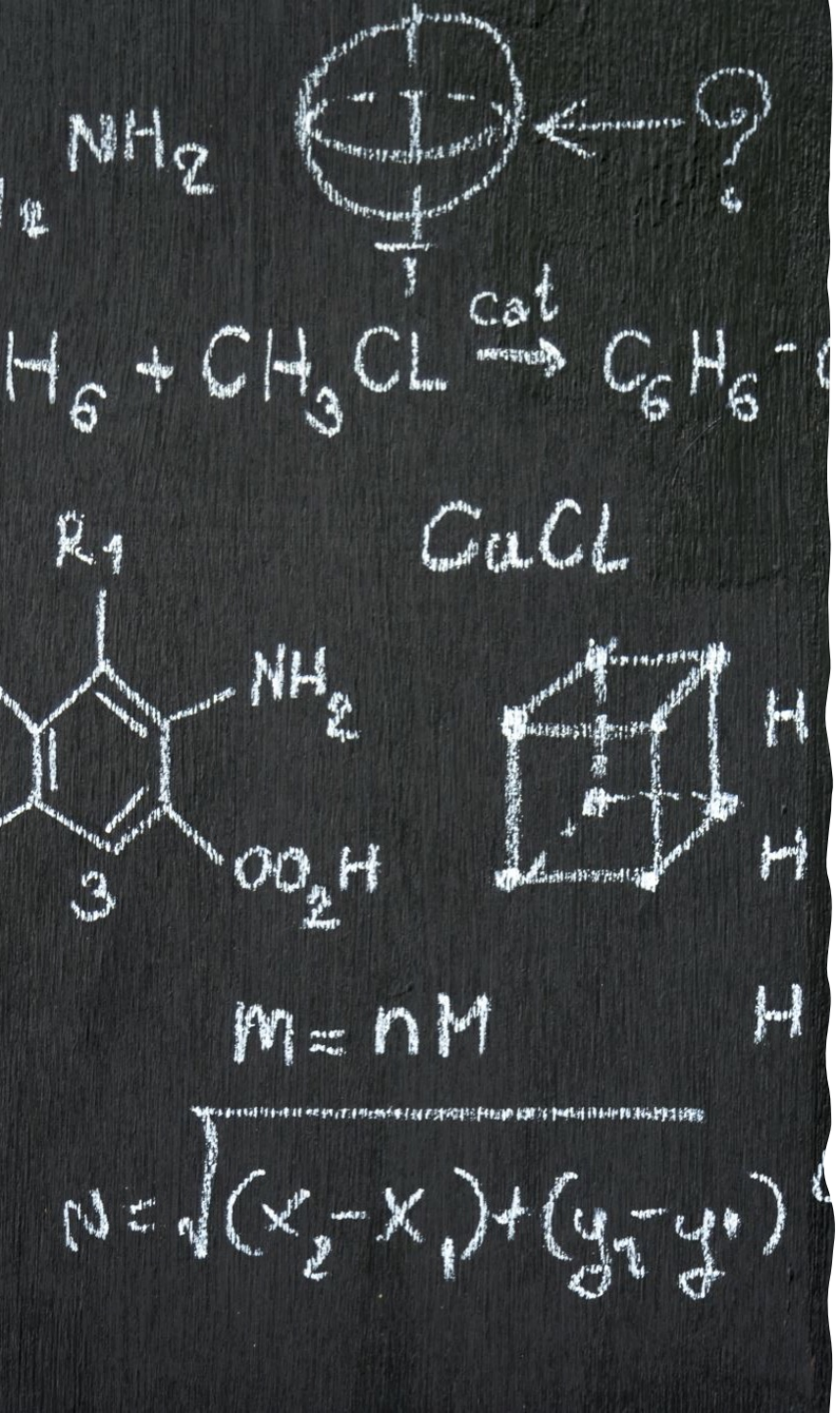
- But what if superposition and entanglement, in fact, work differently than imagined?
- As per Copenhagen Interpretation of Quantum Mechanics unknowable infinite possible states collapse into one single state when measured, implying that all the complexity of the quantum levels can never truly be known
- May be entanglement never has to be created, since matter may be already entangled by virtue of arising from a single source—a.k.a. the quantum levels. This could be why no two snowflakes or no two thumbprints, for example, are alike
- May be superposition is suggesting that there is indeed some order to nature, or it may be the case that a cohesive individual or collective intent may act as a quantum meta-function of sorts that then influences how quantum objects show up
- May be Nature is not entirely probabilistic
- Then currently conceived probabilistic quantum computers will simply never deliver
- Since the imagined computing power of quantum computers is based on this triple foundation, it behooves us to ask what can be done differently to ensure a more viable base, future and end-value from the quantum computing industry*

*Managing the Quantum Bubble (Forbes article)



A Non-Probabilistic Nature?

- If nature were probabilistic, why, in fact, is there abundant order in matter and life?
- When we probe into layers of matter and life, we see order at the level of quantum particles, atoms and cells
  - The Periodic Table, for example, is not so much about the table as about the system behind the table
- Elaborating further
  - All quantum particles exist in one of four categories—quarks, leptons, bosons and the Higgs-boson
  - All known atoms exist in one of four categories—p-Shell, s-Shell, f-Shell and d-Shell atoms
  - All living cells comprise four molecular plans—nucleic acids, polysaccharides, lipids and proteins.
- Further, is it possible that this fourfoldness across different levels is, in fact, related?
  - Could it be that quarks at the quantum particle level, p-Shell atoms, and cell-based nucleic acids share something in common or even are built on the same root pattern that emanates from the quantum-levels itself?
- These are fundamental questions that need to be objectively addressed to truly build a quantum computer with the supposed aim of imitating nature*

*How the Quantum Computing Industry Can Ask Necessary Questions (Forbes article)

Nature as a Single System

- All nature is a single system
  - All quantum particles are sourced from the quantum levels
  - All atoms are sourced from quantum particles
  - All molecules are sourced from atoms
  - All molecular plans—the basis of living cells—are sourced from molecules
  - it is evident that there is a tight integration between one layer of nature and the next.
- So, the question is, why don't we study it as a single system when trying to get insight into one layer or another?
  - Such an effort executed at a different scale—from organisms to cities and economies—is summarized in Geoffrey West's book, Scale
  - Sheds insight into the power of systems analysis conducted across many seemingly disconnected layers
- If there is a correlation between living cells and the quantum level, then why wouldn't understanding, observations and experimentation at the level of cells provide insight into fundamental dynamics that exist at the quantum level?
- Further, why wouldn't it be possible to manipulate the quantum level by manipulating the cell?
- If this were the case, then it would imply a whole different way to perceive and build quantum computers
- In our attempt to imitate nature, this could become an important practical approach to building a different genre of quantum computers*

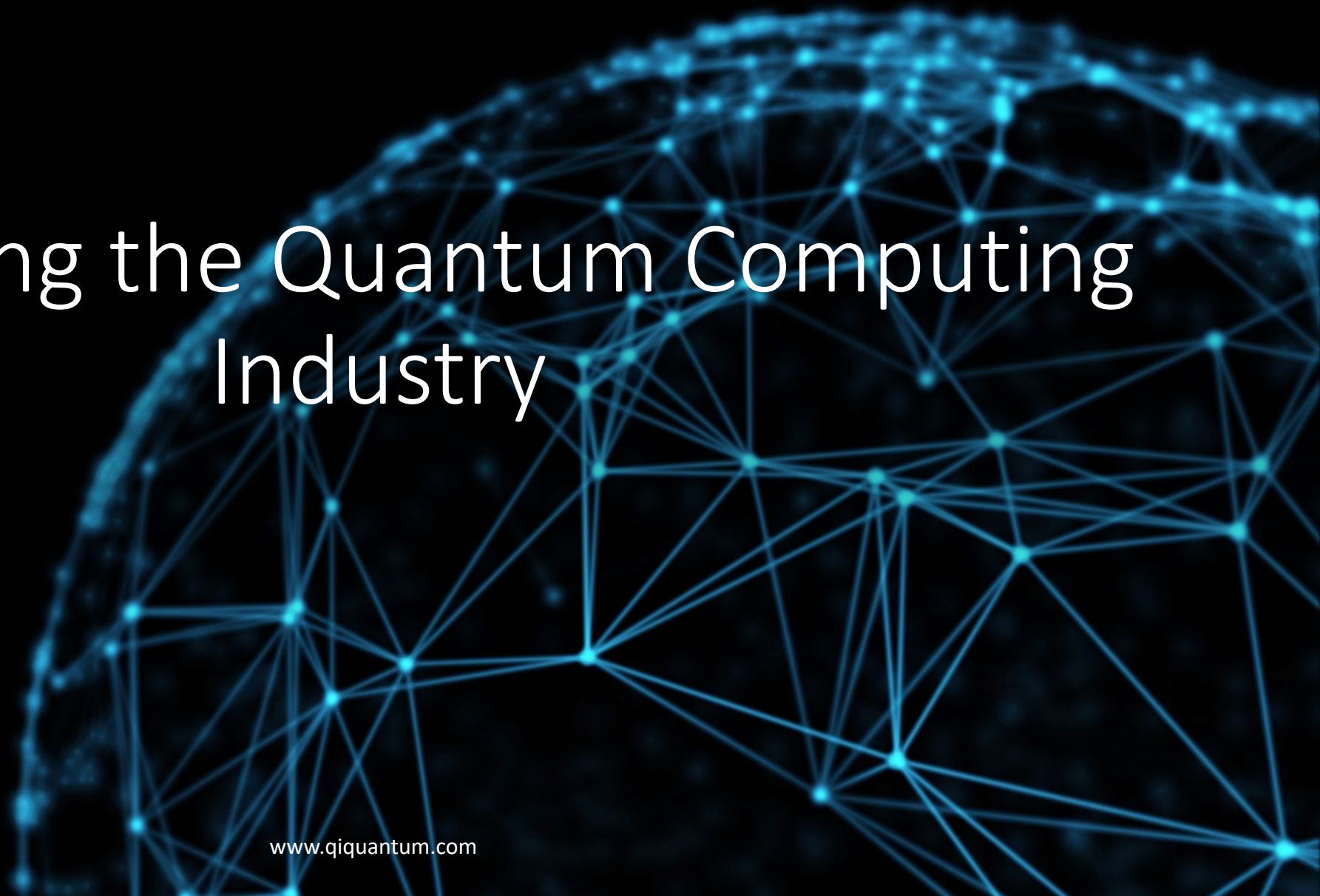
*How the Quantum Computing Industry Can Ask Necessary Questions (Forbes article)

Q: So, what could be the basis of a Quantum Computing bubble?

The Basis of the Quantum Computing Bubble

- The premise on which quantum computation is based is questionable
  - The problem arises in interpreting or modeling nature
- How one sees nature and what active dynamics one attributes to it will likely determine the design and possibilities of any imitating quantum computer
  - The widespread belief today is that nature operates probabilistically
  - Superposition and entanglement are believed to operate in a certain way
- But if probability, superposition and entanglement work differently than imagined then the very basis of what is considered to be the foundation of building a probabilistic quantum computer is called into question
- If all hardware and software efforts and all conceived quantum-based applications are driven by the commonly accepted interpretation of quantum dynamics, then nothing that is actively being projected these days is going to work since the quantum computer is not going to imitate nature
- It becomes important to understand the application claims of quantum computers and the rationale of the hardware and software that is going to drive the applications
- There continues to be huge investments in the quantum computing industry based on a questionable foundation

Redirecting the Quantum Computing Industry



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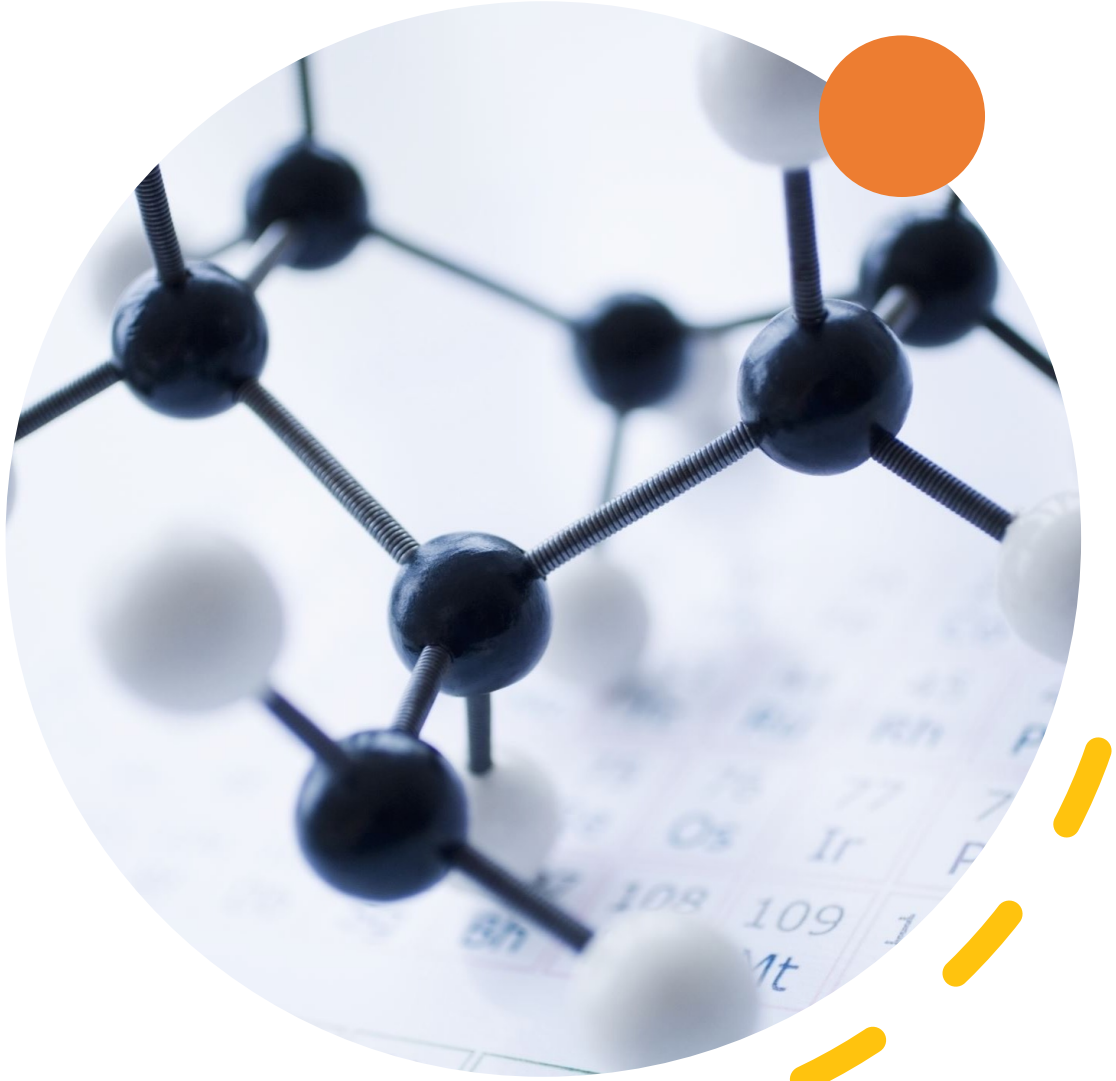
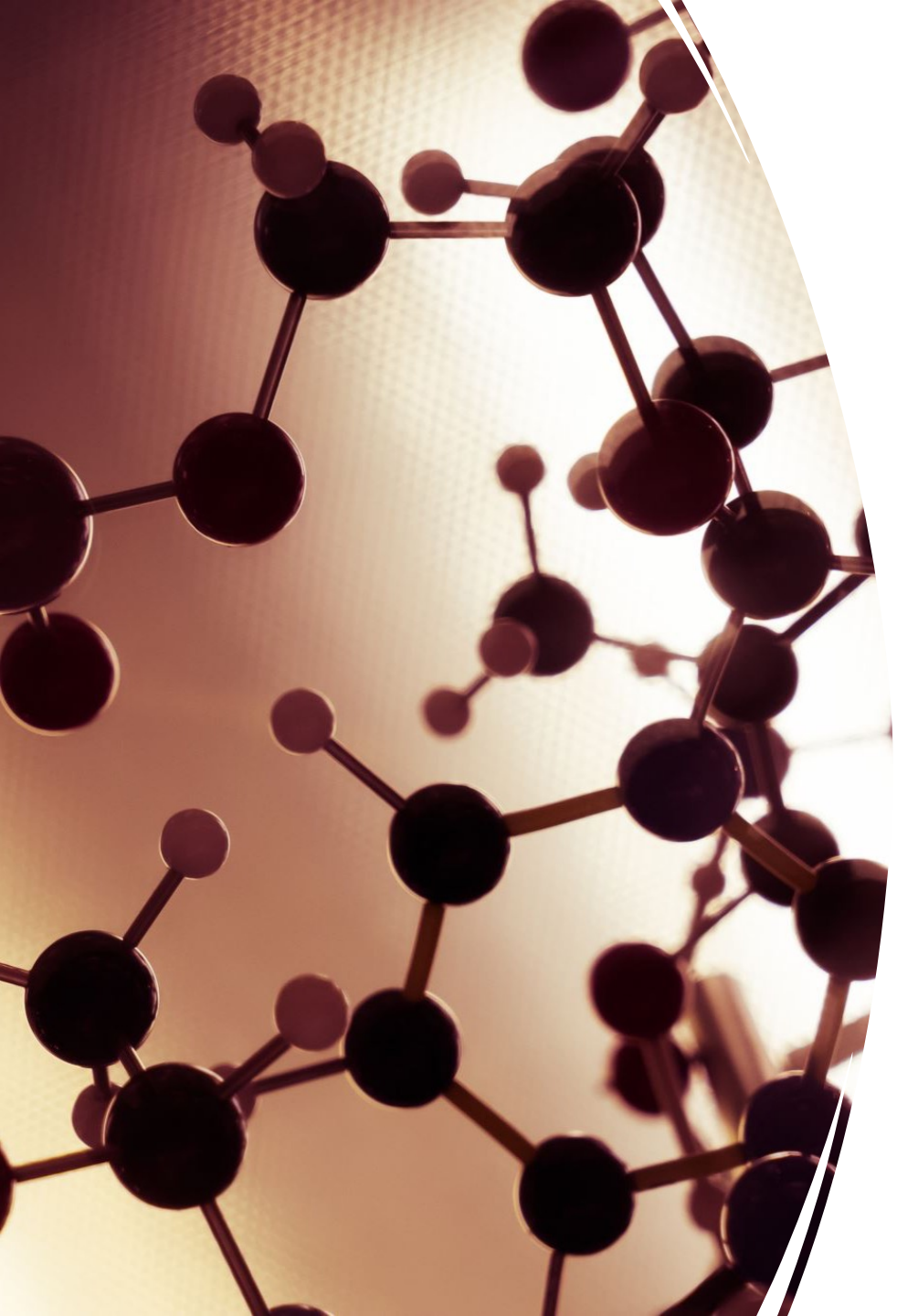
The Most Successful of Known Quantum Computers

- The Atom!
- Atoms are comprised of quantum particles
  - Their nuclei are made from quarks bonded together through the action of bosons
  - Electrons, another type of quantum particle, exist in stable orbits around the nucleus
  - Electrons may exist in multiple superposed states
  - All atoms of the same atomic number exhibit the same properties regardless of where in the universe they exist reinforces the quantum phenomenon of entanglement
  - This also suggests that the lifetime of quantum states - such as superposition and entanglement, amongst others – do endure
- But this stable entity is in a continual state of change due to interaction with or releasing photons
  - In other words, the atom is subject to persistent dynamics of quantum computation as light (a.k.a photons) continually changes its state
- The atom, then, is perhaps the most stable of quantum computers*
  - Robustly operates in a range of environments
  - Not subject to decoherence while easily connecting with other atoms to create complex chains of molecules – therefore proving, again and again, that scalability of quantum computers is the natural law of things



*Learning from the Atom-Based Quantum Computer (Forbes article)



Why Can’t Leading Companies Build a Stable, Scalable Quantum Computer?

- Nature can easily and abundantly scale atom-based quantum computers that continually exhibit superposition and entanglement and remain stable and beyond the vagaries of decoherence
- So, what’s the problem?
- The possible answer, simply, is that we are approaching quantum computation with restrictive biases
- Proven success with digital computation, where we continue to witness a plethora of useful applications, has framed our thinking about how to think of computation
- We continue to approach computation happening in a fundamentally different medium with the same thinking and goals
- But quantum computation, necessarily dealing with the realm that separates the invisible from the visible, has to offer something different, where there is surely something new and fundamentally creative that continues to take place

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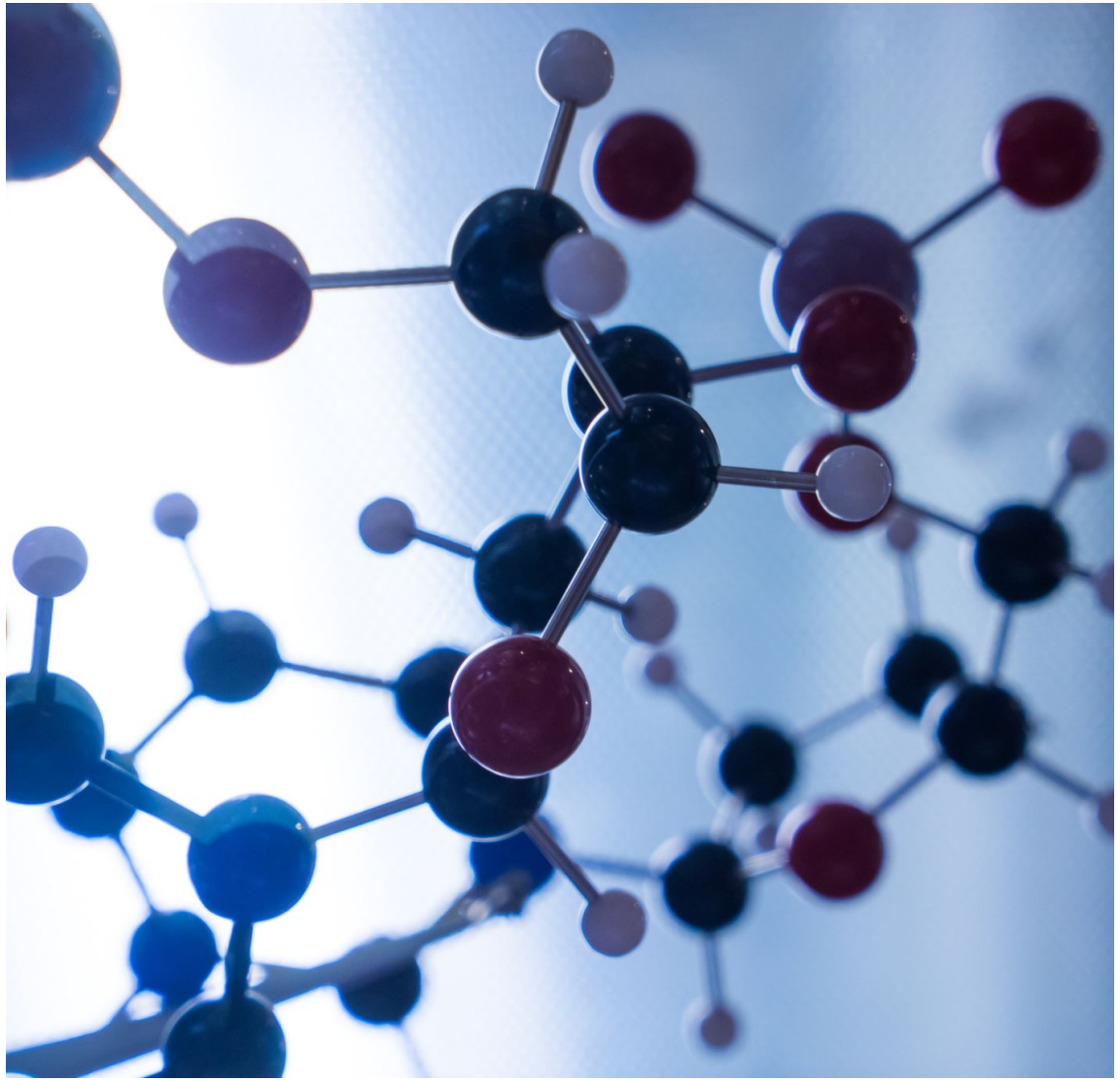
Learning from the Atom*

- The scalability of atom-based quantum computers combining together to form chains of functional molecules suggests
  - The very mathematics and logic of what is happening at the quantum-level needs to be thought of differently THAN the probability-based qubit-enabled approach at the center of the conceived quantum computation foundation today
- The visible does not appear magically out of the invisible
- The logic of *reverse extrapolation*, whereby the "function" embodied by different atoms combining to form molecules, hints at a very different set of dynamics of function preceding the form taken in atoms that must exist at the quantum levels
- There is a different quantum-level language that becomes visible when focusing on the function of atoms
  - After all, an atom with an atomic number of 47, in contrast to 26, say, defines possible behavior – or function - of silver regardless of where it may exist



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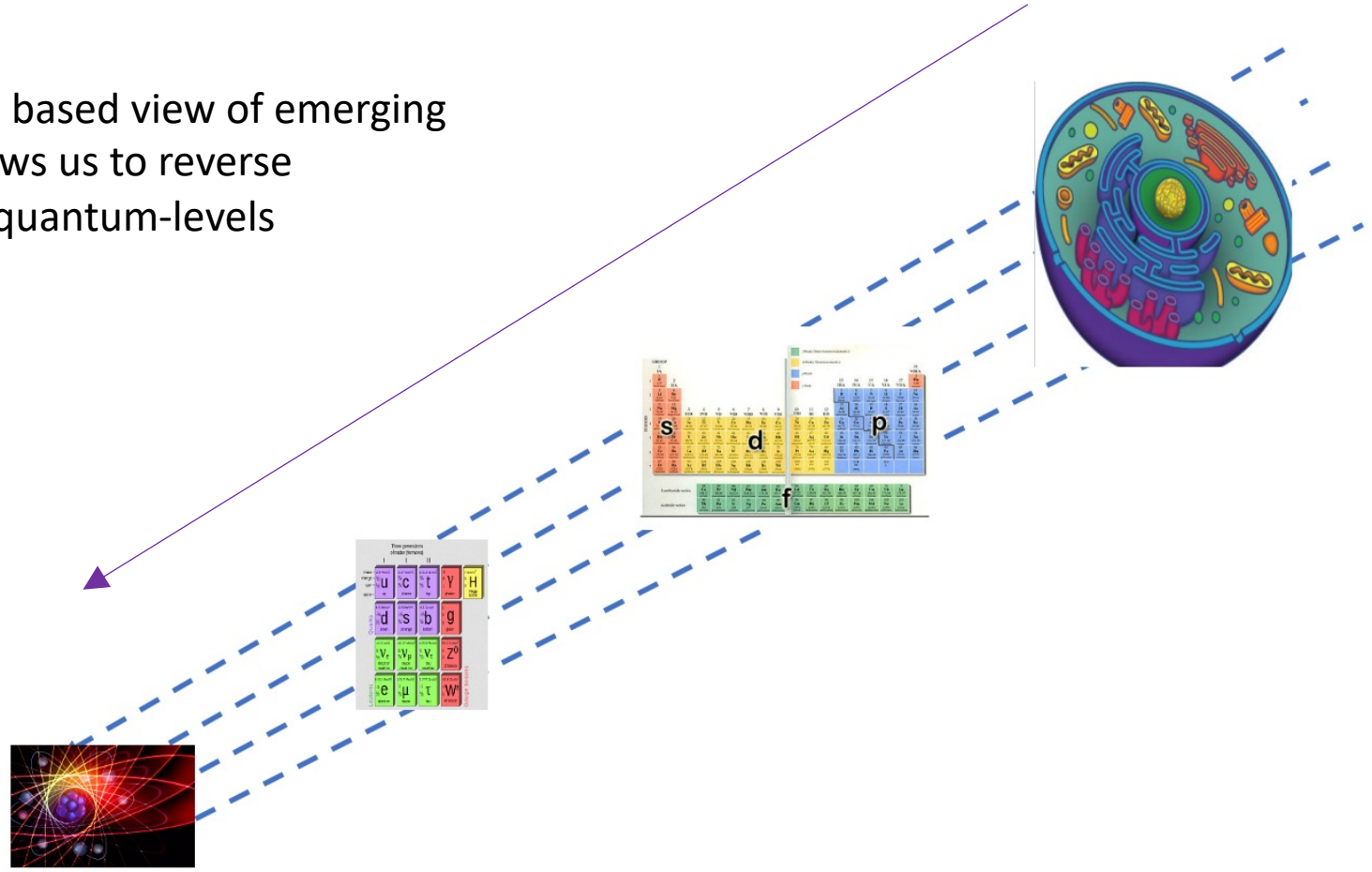
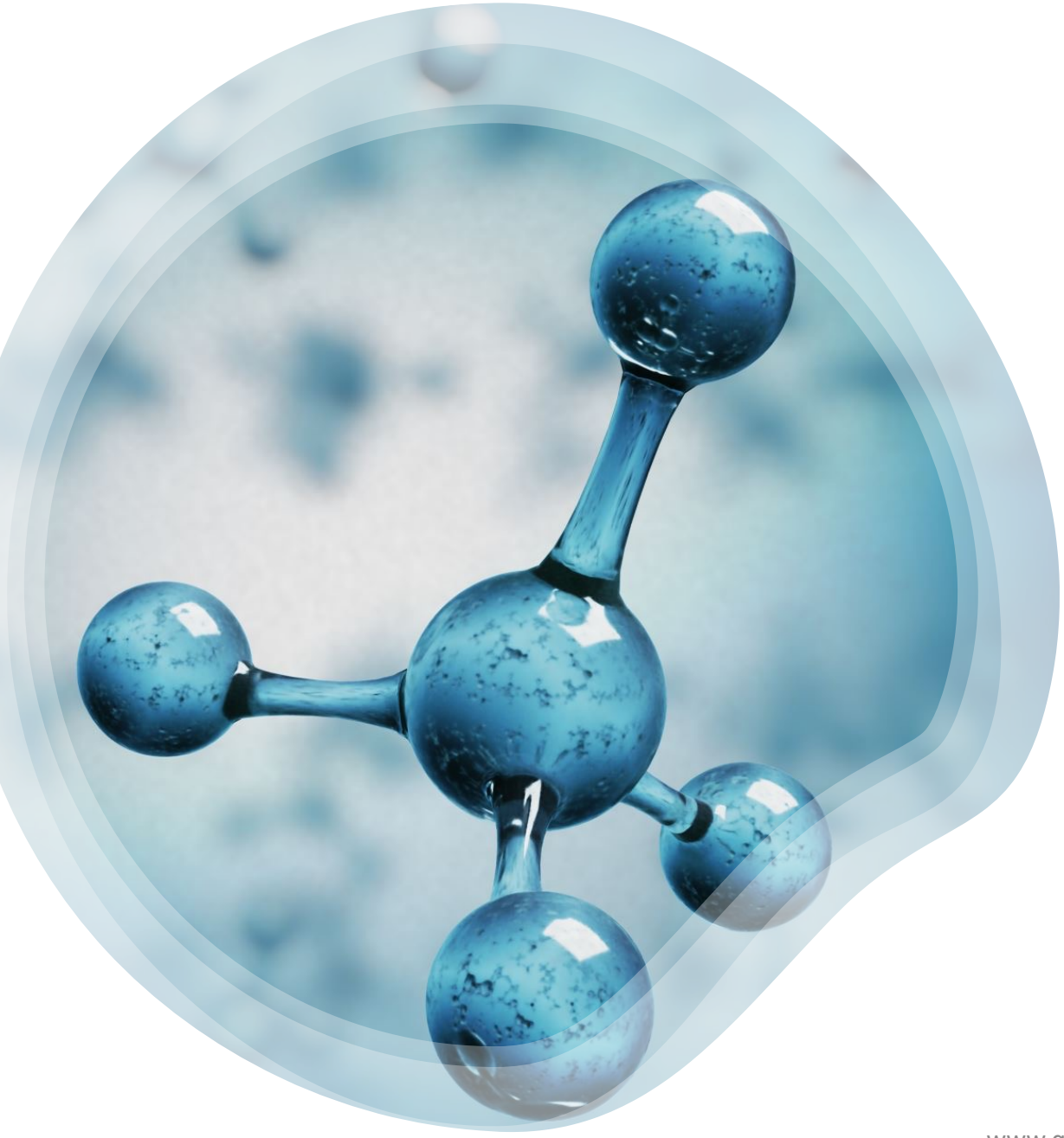
Reverse Extrapolation

Taking a “function” based view of emerging life and matter allows us to reverse extrapolate to the quantum-levels





Breaking Through Existing Technological Barriers

- **Size** of quantum computer can be radically larger: based on photons that can operate at room temperatures, and atom-based computational units that are also stable at room temperatures
- Quantum-states **lifetime** is now based on stable atoms and will far exceed qubit-lifetime
- **Gates** are built using photons and atoms
- Functional mathematics (F^3MOL) built on **preexisting entanglement and superposition**, as opposed to trying to manufacture from the bottom-up thereby also being open to high-levels of decoherence
- Atoms and molecules known to have **100% accuracy in operations**, as opposed to manufactured qubits with ~95% accuracy or so

Thinking Ahead

- Q: What are some implications of leveraging atoms, reverse extrapolation, and breaking technological barriers?

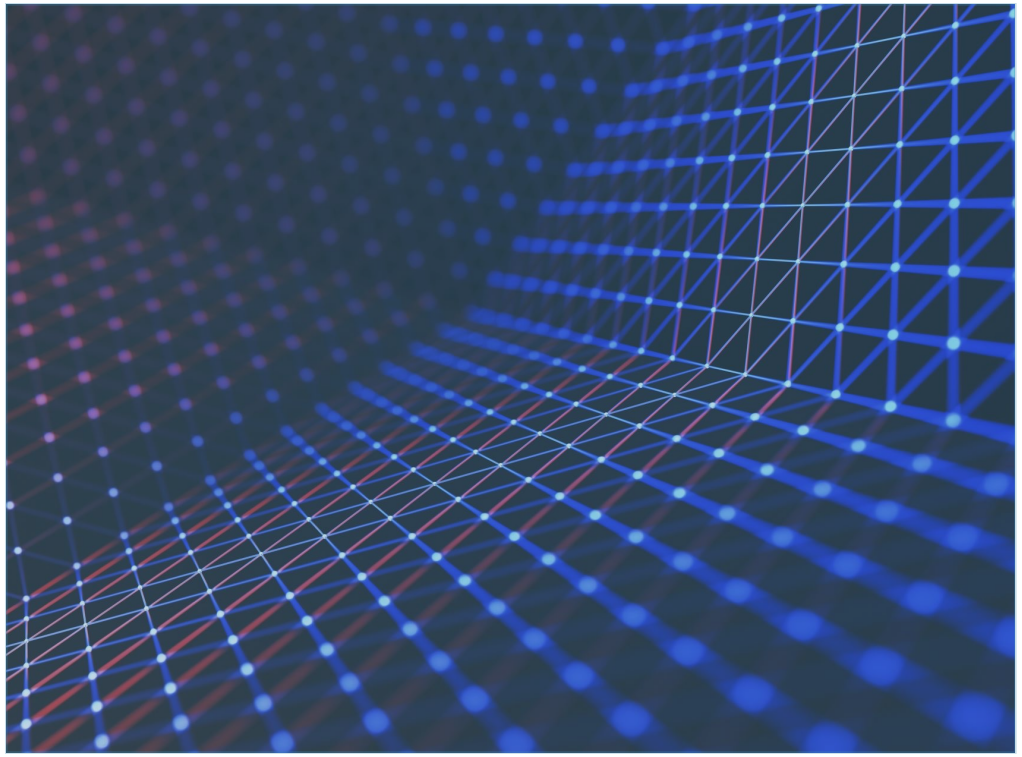
The New Technology Stack

Level 4: Application interface to allow generation, interpretation, testing of quantum phenomenon

Level 3: F^3MOL Algorithms are basis of software

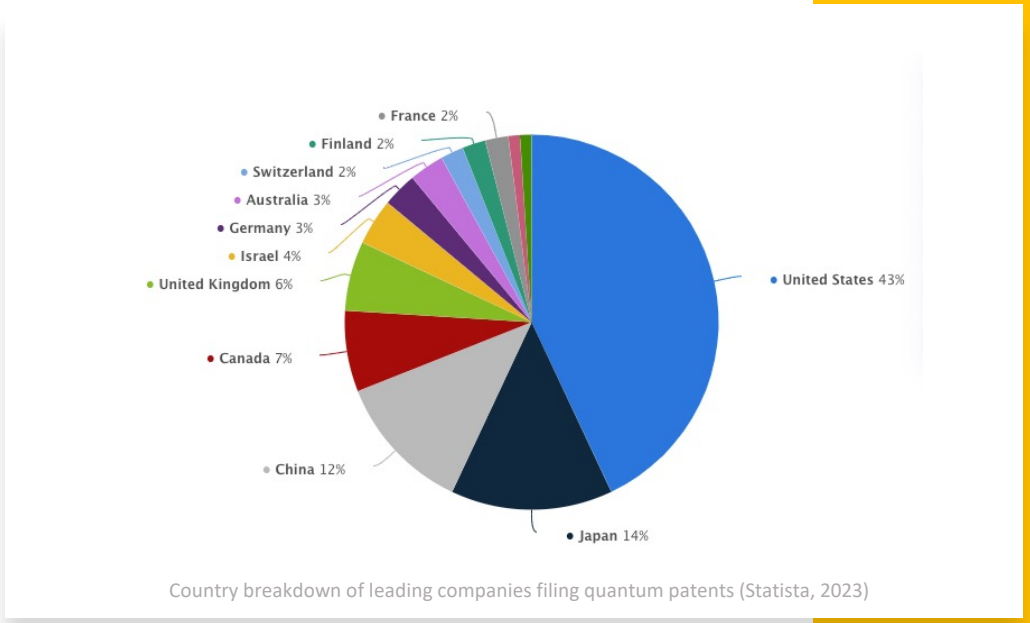
Level 2: Control systems provide ample readability by maintaining integrity of F^3MOL circuits

Level 1: Hardware is radically more precise, and based on interpretation of a range of stable atom-based quantum-computers, all set in a silicon substrate, and leveraging proven approaches used in LED, MRI, Laser, and GPS, amongst others

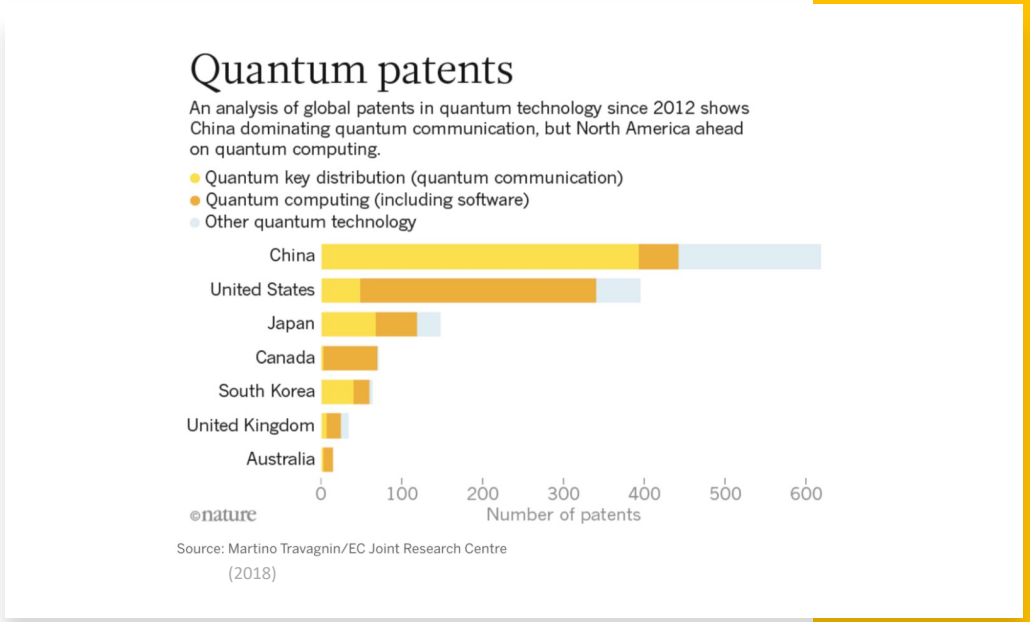


The New Possible

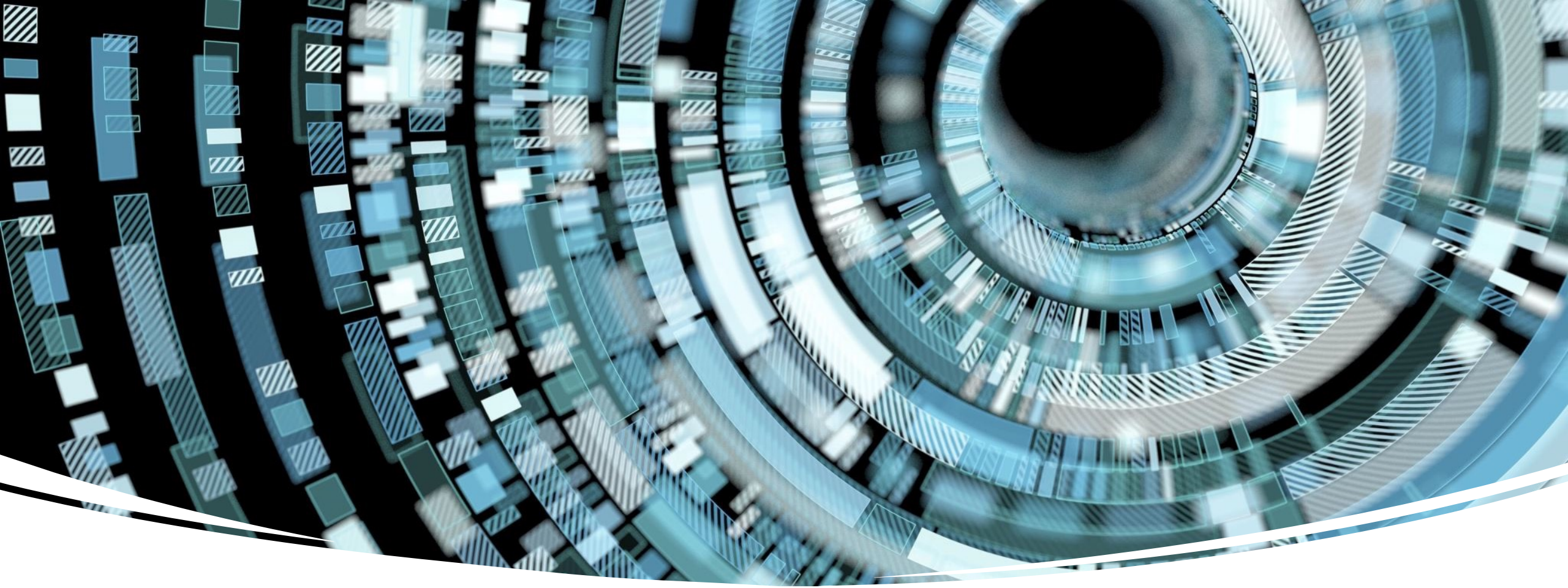
- Patent families have been built around ”blackbox” (aka Copenhagen Interpretation) approach
- Opportunity for new quantum patents based on different technology stack
- Applications in Genetics, Medical Technologies, Material Sciences, Artificial Intelligence, Transhumanism



Country breakdown of leading companies filing quantum patents (Statista, 2023)



Source: Martino Travagnin/EC Joint Research Centre (2018)



- Q: What is the importance of Quantum Computing?

Importance of Quantum Computing

Quantum technology dealing with the smallest measurable units possible is, by definition, flirting with possibilities that escape the eye

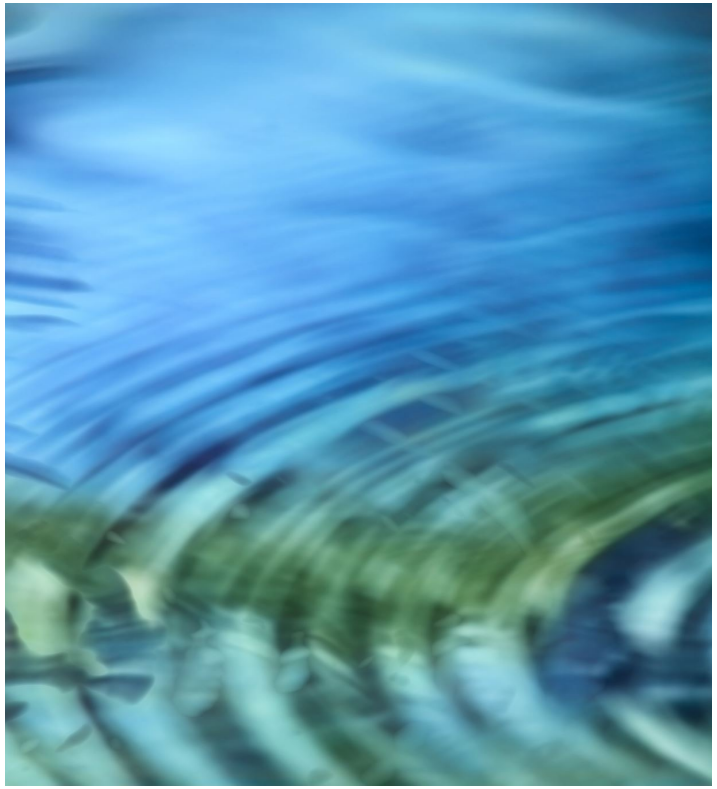
It is on the borderline of what can be considered mysterious

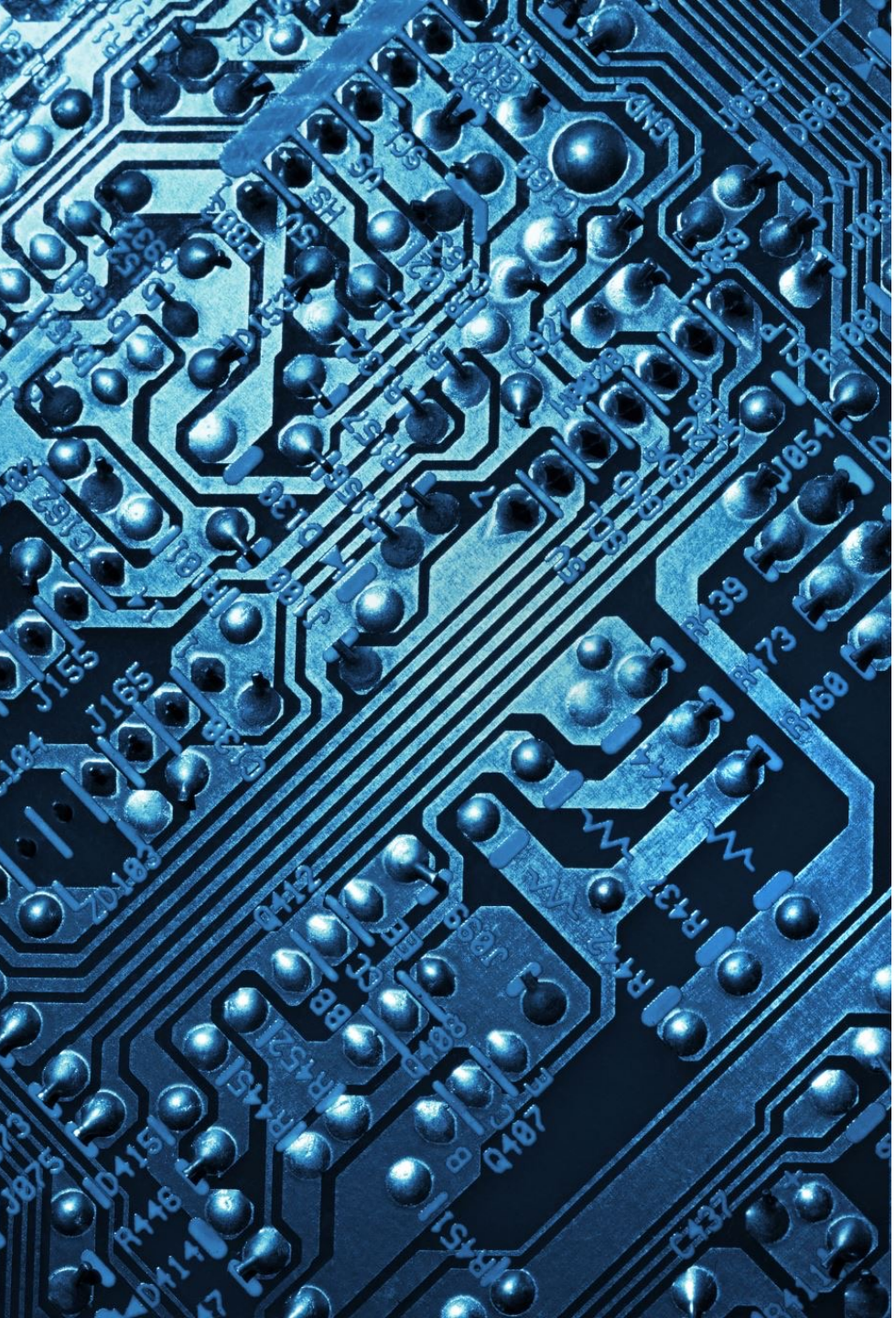
This is where its biggest impacts could come from

Digital computing has already dealt with the plethora of applications that can be reasonably conceived by playing with and even shifting visible reality

There are many such processes of nature that challenge our understanding, but they clearly exist and have been around for a long time

With phenomena such as superposition and entanglement, we are beginning to make that which was considered invisible and magical, visible and understandable





Summary

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- Why are superposition and entanglement considered to be so important?
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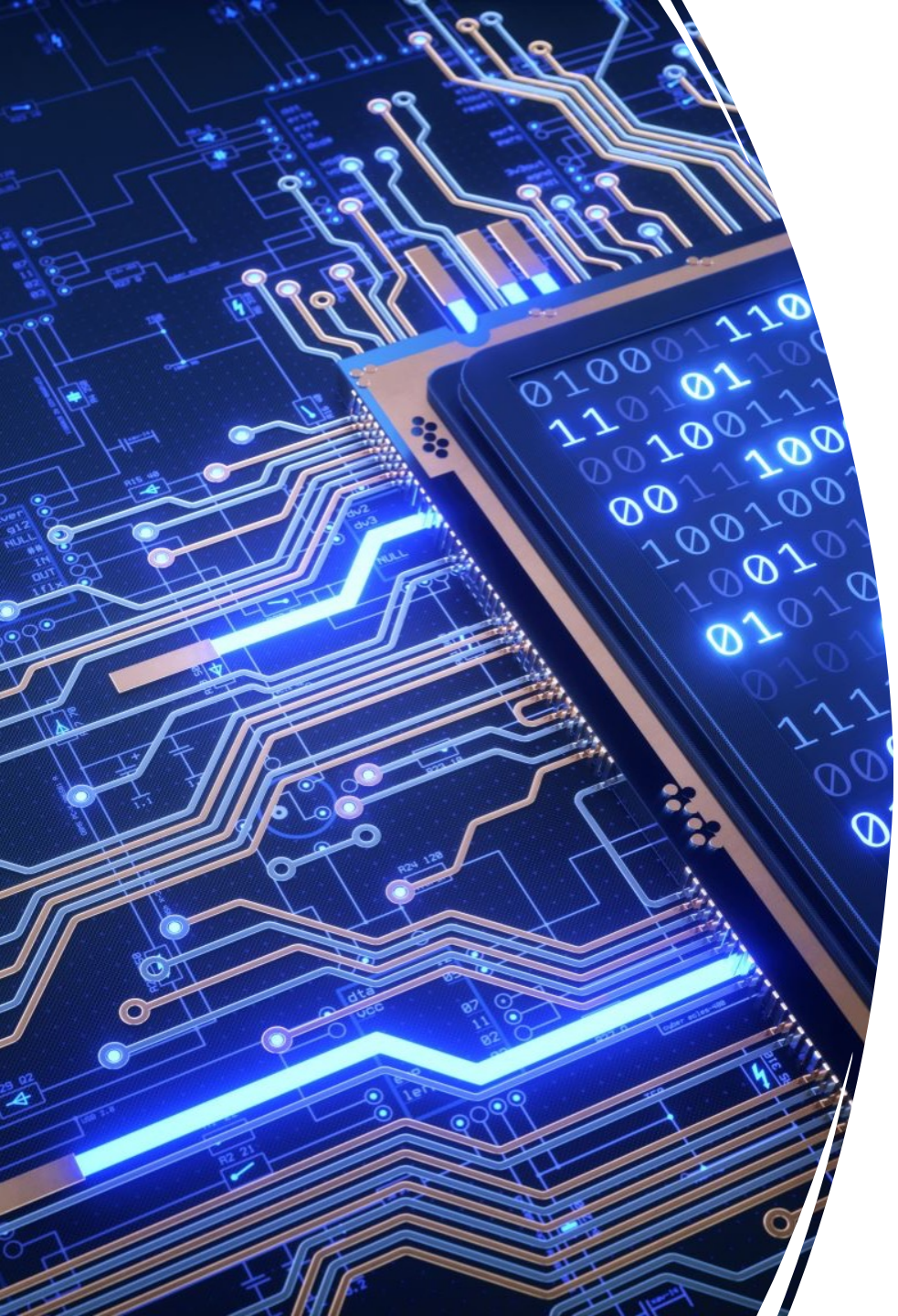

Take-Aways

- The Quantum Computing Industry's current trajectory will lead to an inevitable bubble
- There is a lot that can be learned from the most prolific, successful of Nature's quantum computers – the atom
- We have not even begun to touch the surface of what is possible with quantum computation - ranging from technology stack implications to leveraging mysteries hidden by the quantum veil

“We are at the very beginning of time for the human race. It is not unreasonable that we grapple with problems. But there are tens of thousands of years in the future. Our responsibility is to do what we can, learn what we can, improve the solutions and pass them on”

Dr. Richard Feynman

Appendix

Forbes Articles

- Managing the Quantum Bubble
- How the Quantum Computing Industry Can Ask Necessary Questions
- The Potential Impact Of Quantum-Level Dynamics On Human Resources
- Learning from the Atom-Based Quantum Computer

Representative Technical Publications and Awards

- IEEE Xplore, CCWC (03/14/19): An Algorithm for the Emergence of Life Based on a Multi-Layered Symmetry-Based Model of Light
- IEEE Xplore, CCWC (03/12/20): Light-Based Interpretation of Quanta and Its Implications on Quantum Computing
- IEEE Xplore, IEMTRONICS (10/08/20): A Light-Based Quantum-Computational Model of Genetics
- IEEE Xplore, IEMCON (12/22/20): Fourfold Properties of Light and Its Relevance to Quantum Computation
- IEEE Xplore, IEMCON (12/22/20): Limits of AI as Established by a Multi-Layered Symmetry-Based Model of Light
- IJSSST (1/1/21) [Freely Accessible Online]: The Emergence of Quaternary-Based Computational-Strata from a Symmetrical Multi-Layered Model of Light
- IEEE Xplore, IEMTRONICS (5/14/21): A Light-based Interpretation of Schrodinger's Wave Equation and Heisenberg's Uncertainty Principle with Implications on Quantum Computation
- AJEC (7/1/21) [Freely Accessible Online]: A Light-Space-Time Quantum-Computational Model of Subtle-DNA and Genetics
- IEEE Xplore IEMCON (12/22/21): A Light-Based Interpretation of Euler's Identity with Implications on Quantum Computation
- IEEE Xplore CCWC (01/26/22): The Role of a Light-Based Quantum-Computational Model in the Creation of an Oscillating Universe
- IEEE Xplore IEMTRONICS (06/20/22): Envisioning a Light-Based Quantum-Computational Nano-Cyborg
- IEEE Xplore IEMCON (11/22/22): Enhancing Feynman's Quantum Computational Positioning to Inject New Possibility into the Quantum Computing Industry

Cosmology of Light Books