DEFIANCE ETFs

QTUM

Investment Case for QTUM:

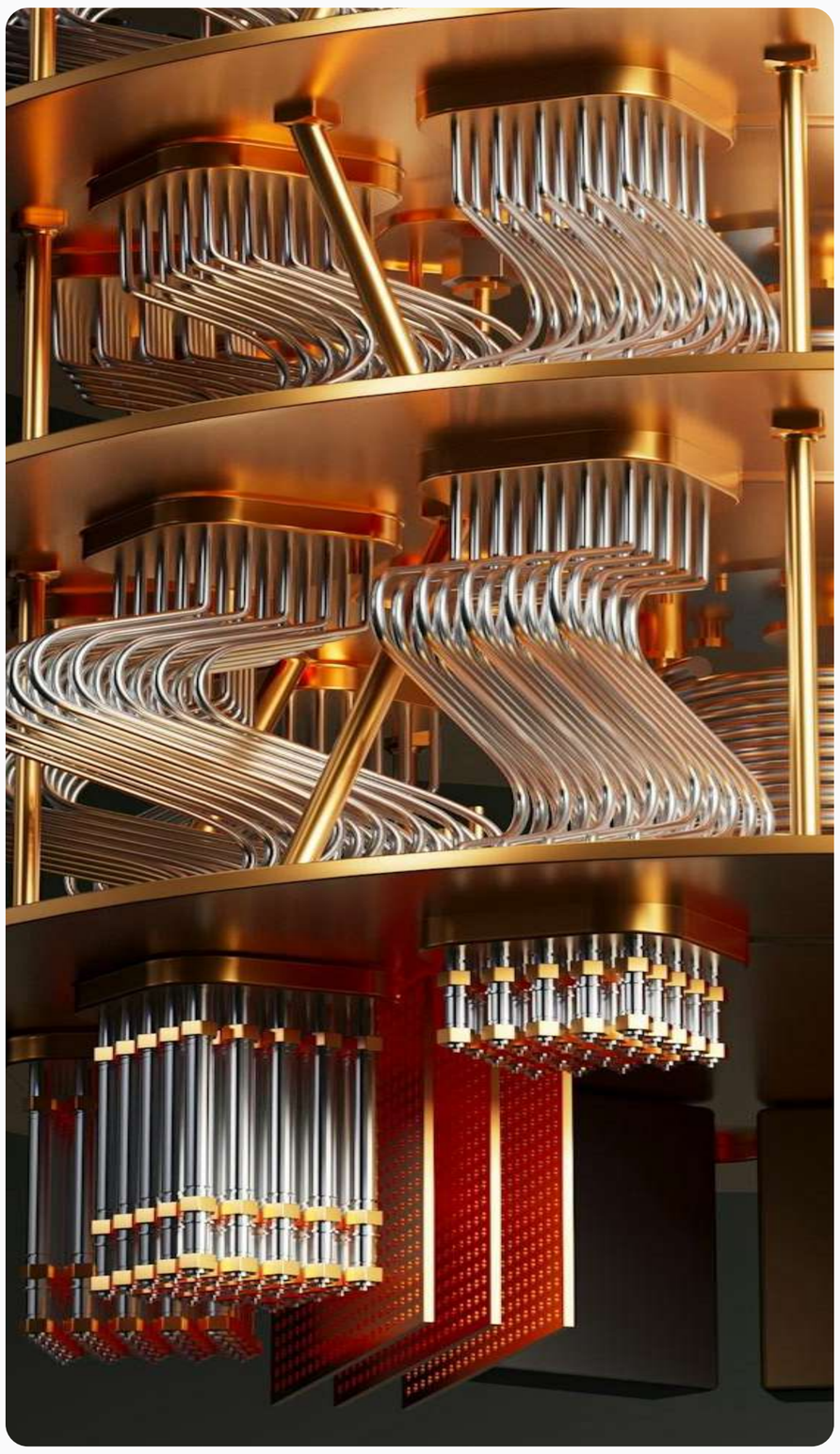
Quantum Computing, Machine Learning & AI

Investment Case for QTUM

Quantum computing (QC) and machine learning (ML) are transformative technologies reshaping the future. QC has moved from theoretical possibility to demonstrated reality, marking 2024 as a pivotal year for the technology.

Recent breakthroughs show quantum computers can now solve problems in minutes that would take traditional supercomputers millions of years, indicating the transformative potential this technology holds for machine learning (ML) and artificial intelligence (AI) applications [1].

QC harnesses the peculiar properties of quantum mechanics to process information in fundamentally different ways than classical computers. This was dramatically demonstrated in December 2024 when Google's Willow quantum chip solved a computational problem in under five minutes that would take today's fastest supercomputers an estimated 10 septillion years [2]. However, the significance extends beyond raw speed – quantum computers can explore data patterns and solve complex problems in ways that traditional computers fundamentally cannot approach [3].



The quantum computing landscape has evolved significantly since 2021-2022 when early systems demonstrated initial capabilities. Today's leading players include [1, 2]:

Google: Achieved breakthrough quantum error correction with Willow chip

Microsoft Partnered with Atom Computing to create 24 working logical qubits

IBM: Doubled capacity with 156-qubit Heron processor

Quantinuum: Secured $300M investment at $5B valuation

IonQ: Advanced trapped-ion quantum systems

D-Wave: Released 4,400+ qubit Advantage2 processor

Rigetti Computing: Developing superconducting quantum processors

Investment in the sector has accelerated dramatically, with quantum computing funding reaching a record $1.5 billion in 2024, nearly doubling 2023's total [4]. Government support has also expanded, with the U.S. Department of Energy committing $65 million for quantum research projects and Congress considering a $1.8 billion reauthorization of the National Quantum Initiative Act [5, 6].

Industry adoption is gaining momentum, with 55% of quantum industry leaders reporting quantum use cases in production in 2024, up from 33% in 2023 [1]. Major financial institutions like JPMorgan Chase are making strategic investments in quantum technology, while research institutions like the Cleveland Clinic are already using quantum systems for molecular simulation and drug discovery [1, 7].

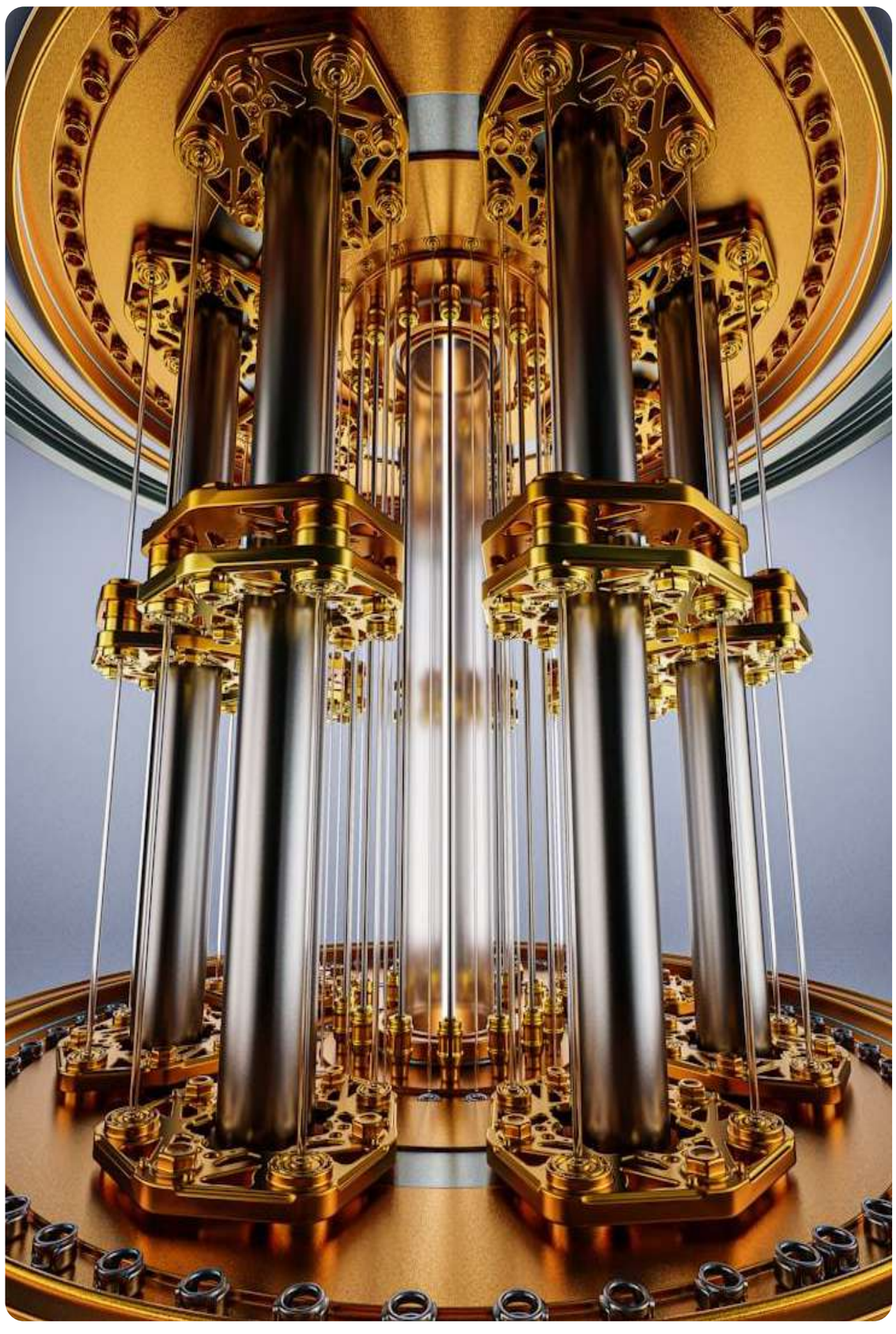
The Science Behind Quantum Computing

What is a quantum computer? A quantum computer leverages quantum mechanics to perform calculations far beyond classical computers. Unlike traditional bits, quantum computing bits (qbits) can exist in multiple states simultaneously through superposition and entanglement, enabling unparalleled computational power.

This ability enables quantum computers to process vast amounts of information in parallel, potentially revolutionizing fields from cryptography to drug discovery.

Error correction emerged as a crucial breakthrough in 2024. Years of research culminated in several significant developments:

- **Google's Willow chip** demonstrated the first-ever exponential reduction in error rates as the system scaled up [2]
- **QuEra** achieved a logical qubit using only eight physical qubits [8]
- **Nord Quantique** achieved a 14% improvement in qubit reliability [9]
- **IBM's 156-qubit Heron processor** achieved 5,000 two-qubit gate operations [1]



These advances address quantum computing's greatest challenge – maintaining stable quantum states. Most quantum systems require temperatures near absolute zero, though some new approaches, like RIKEN and NTT's room-temperature optical quantum computer, suggest alternative paths forward [1].

Recent Advances in Error Detection

A significant breakthrough in error detection came from Sandia National Laboratories and the University of New Mexico, who demonstrated a practical way to detect "leakage errors" for neutral atom platforms. Their circuit-based method achieved 93.4% accuracy, enabling researchers to flag and correct errors without disturbing the quantum state. This development is crucial because atom loss – where qubits silently vanish from the system – can corrupt data and spoil calculations [10].

The ability to detect and correct errors becomes increasingly critical as quantum systems scale up. As Sandia's atomic physicist Yuan-Yu Jau notes, "If we don't have a solution for this, I don't think there's a way to keep moving forward" [10]. The development of reliable error detection methods helps address what could otherwise become an insurmountable challenge in building large-scale quantum computers.

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Current State of Quantum Computing

The quantum computing industry has entered a new phase characterized by increasing commercial viability. While a Boston Consulting Group analysis suggests broad quantum advantage may not arrive until 2030-2040, the technology is already finding early applications [11]. Current timeline projections indicate:

2024-2030: Noisy Intermediate-Scale Quantum (NISQ) era

2030-2040: Broad quantum advantage period ($80-170 billion in annual value creation)

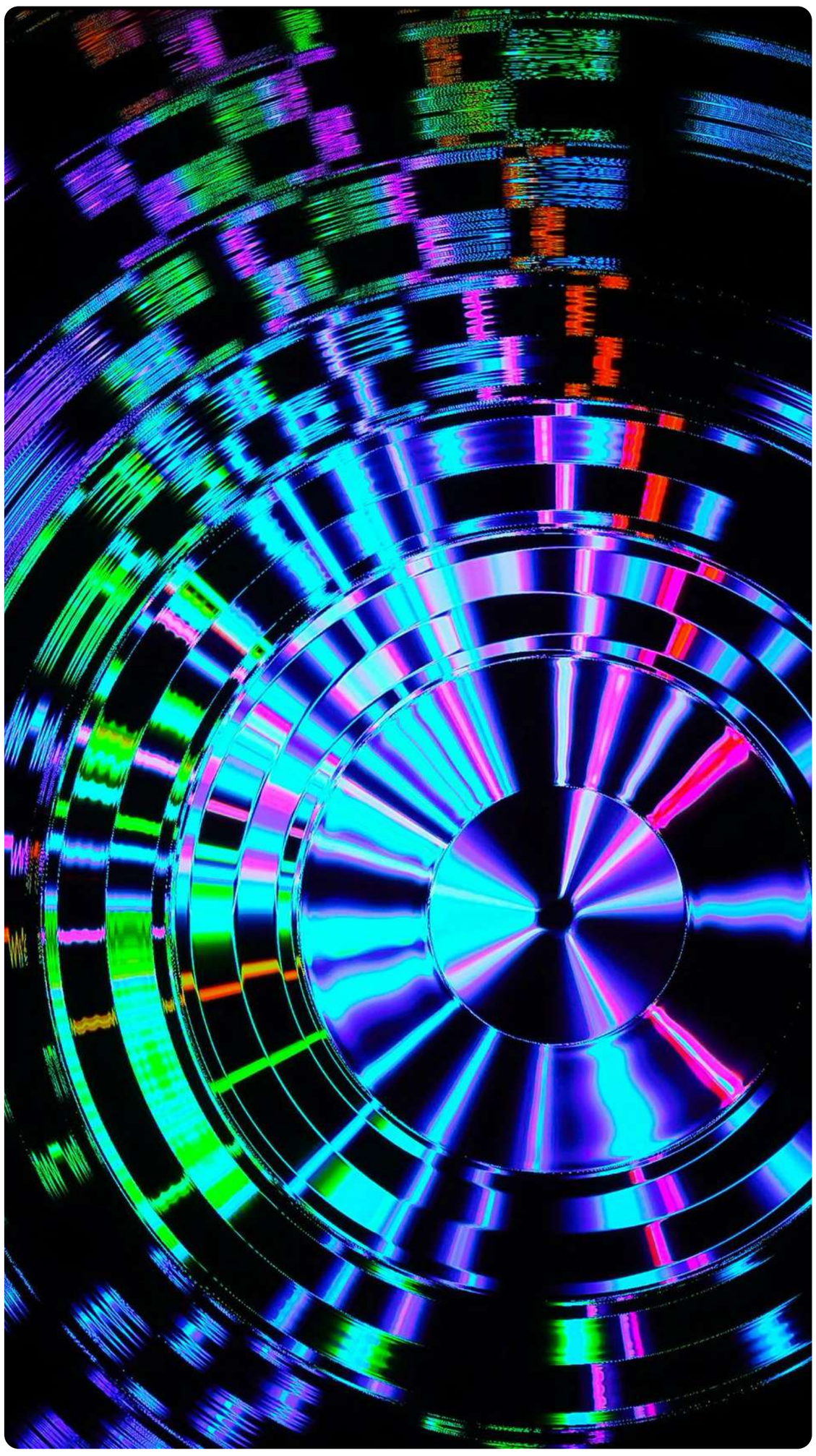
Post-2040: Full-scale fault tolerance ($450-850 billion in annual value creation) [11]

Quantum computing is progressing steadily toward commercial readiness, with early adopters beginning to identify niche use cases that demonstrate tangible value. Industries such as pharmaceuticals, logistics, and materials science are likely to see significant breakthroughs within the next decade, as quantum technology continues to outpace classical systems in specific optimization problems. While broad-scale quantum advantage remains a longer-term milestone, these emerging applications signal the industry's shift from theoretical potential to actionable outcomes.

Government Developments: Leading the Quantum Race

Governments worldwide are recognizing the strategic importance of quantum computing and investing heavily to ensure leadership in this transformative field. These efforts span funding initiatives, workforce development, and policy frameworks aimed at accelerating quantum advancements and safeguarding national interests.

- According to reports, 91% of global business leaders are investing or planning to invest in quantum computing; 70% are developing real-life use cases and 61% are planning to spend $1 million or more over the next three years. [8]
- Global spending on AI-centric systems is forecasted to surpass $300 billion by 2026. [9]
- The global ML market was valued at $15.5 bn in 2021 and will grow at a CAGR of 38.6% between 2021 and 2028. [10]
- About 92% of large companies are achieving returns on their investments in artificial intelligence, and the same percentage are increasing their AI investment. [11]



The U.S. Department of Energy: Pioneering Quantum Research

The U.S. Department of Energy (DOE) has established **five** National Quantum Information Science Research Centers (NQISRCs) to advance quantum computing, communication, sensing, and materials science. These centers, involving over 1,500 experts across 115 institutions, focus on groundbreaking research and innovation [12].

Key accomplishments include:

- Developing quantum processors and sensors at DOE national labs and universities.
- Training over 1,000 students and early-career researchers.
- Establishing the U.S. Quantum Information Science Summer School to foster a quantum-ready workforce.

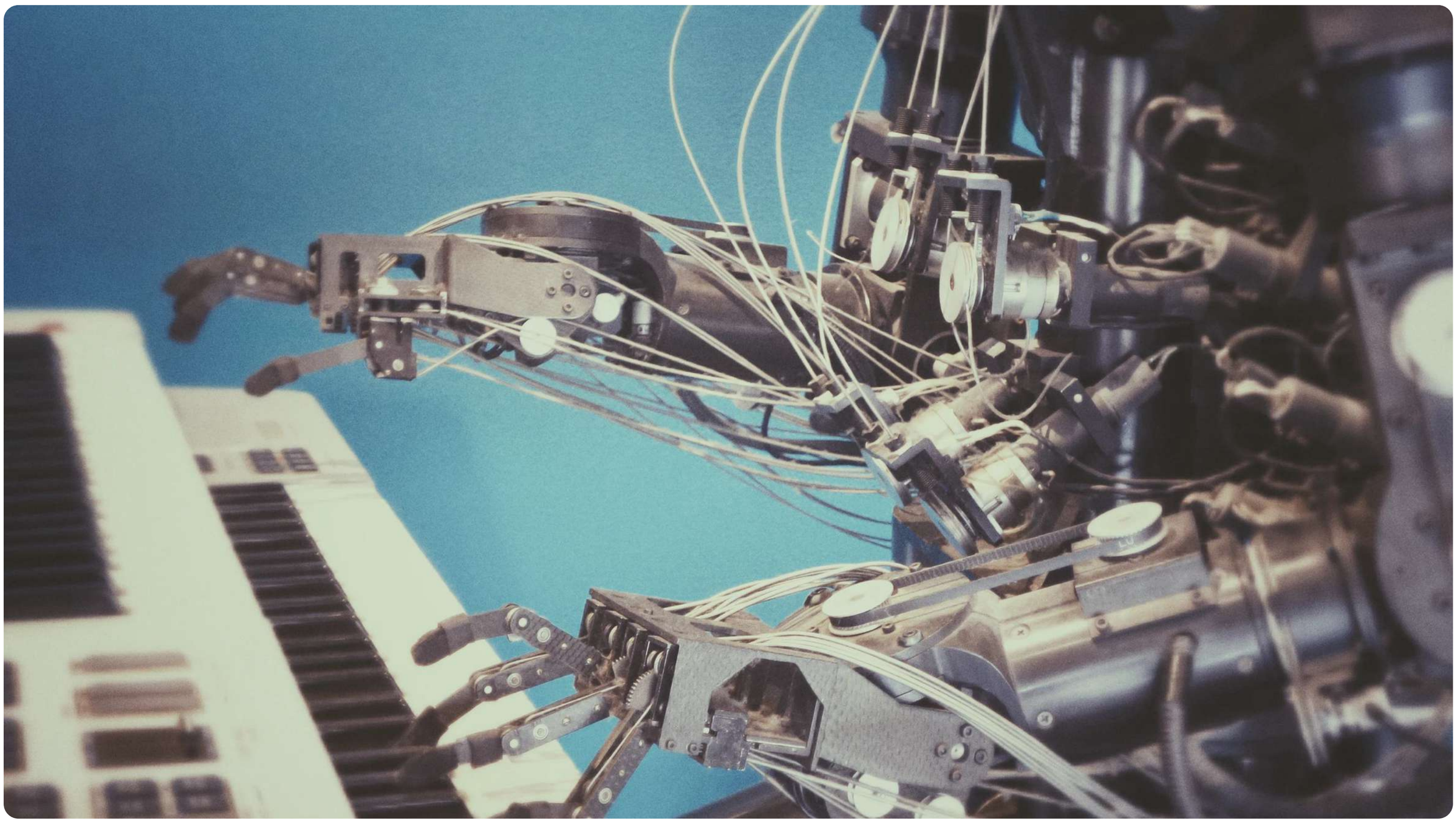
These initiatives demonstrate the DOE's commitment to bridging academic, industrial, and governmental expertise to tackle critical challenges in quantum information science.

New Funding Initiatives

The DOE recently announced $65 million in funding for 38 quantum research projects. These initiatives target advancements in software, control systems, and algorithms to demonstrate quantum computing's practical applications in fields like scientific research and national security. By enhancing the software ecosystem and addressing quantum resilience through error correction, these projects are paving the way for scalable quantum systems [5].

Policy Frameworks to Secure Leadership

The National Quantum Initiative Act, originally passed in 2018 and reauthorized in 2024, underscores the United States' long-term commitment to quantum technologies. By authorizing billions in funding for research centers and workforce programs, this legislation positions the U.S. as a leader in global quantum innovation. Panel discussions at the **Palm Beach County Quantum Policy Talks** emphasized the Act's importance in maintaining the nation's technological edge and warned of losing ground to rivals like China, which is reportedly investing ten times more in quantum technologies [13].



Quantum Computing and Machine Learning Applications

The quantum-ML convergence is creating opportunities across multiple sectors, with early applications emerging in computationally intensive fields. Cybersecurity represents a particularly urgent focus area, as quantum computers could eventually break current encryption methods.

Experts estimate that a quantum computer with approximately 13 million qubits could theoretically break Bitcoin's encryption in a single day [14]. Major industries are actively exploring quantum applications:

Financial Services:

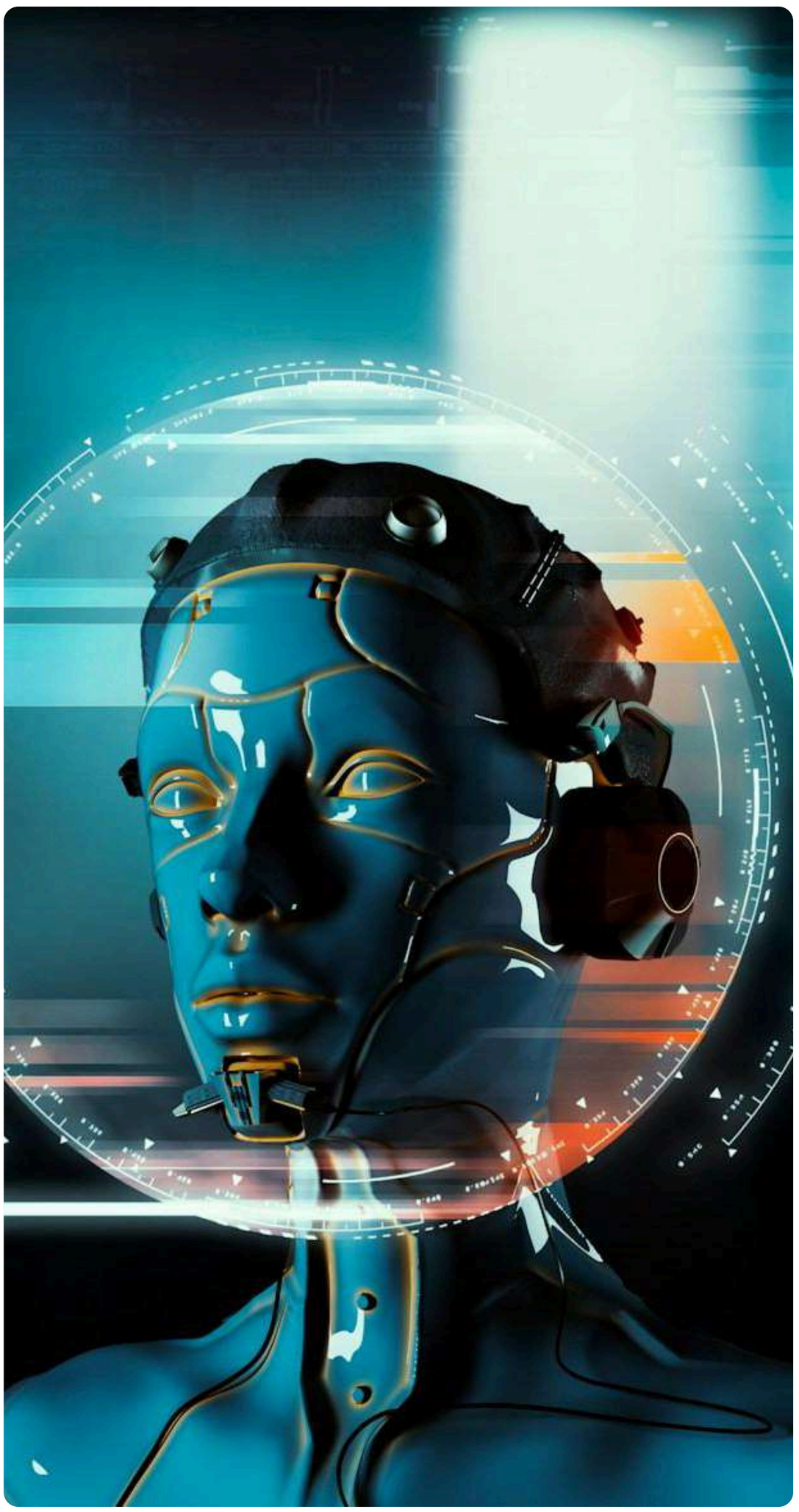
- JPMorgan Chase led Quantinuum's $300 million investment round [7]
- Citigroup is experimenting with quantum portfolio optimization through Amazon Braket [15]
- Banks are preparing for quantum-resistant cryptography [16]

Healthcare and Life Sciences:

- Cleveland Clinic utilizes IBM's quantum systems for molecular simulations [1]
- Quantum computers could accelerate drug discovery through improved molecular modeling
- Personalized medicine could benefit from quantum analysis of genomic data [17]

Manufacturing and Defense:

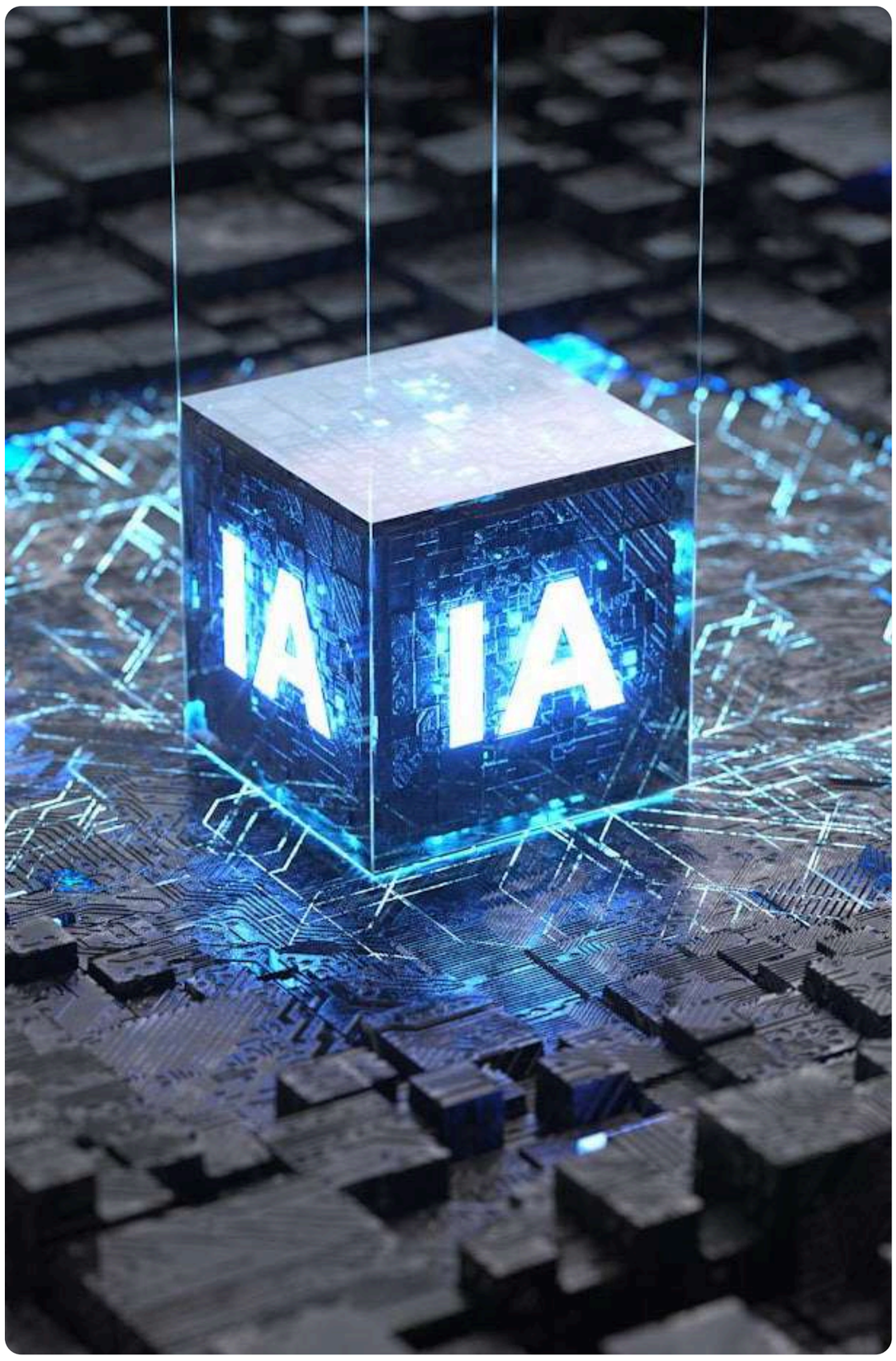
- The UK Ministry of Defence invested in its first quantum computer in 2022 [18]
- Aerospace and defense establishments are exploring quantum sensors and imaging [19]
- Materials science applications could revolutionize battery and semiconductor development [20]



Recent developments suggest quantum computing may achieve practical applications sooner than previously expected. Planckian unveiled a new superconducting quantum chip architecture designed to solve critical wiring problems, while IBM's roadmap targets a fully error-corrected system by 2029 [21].

Quantum Computing, Machine Learning and AI Global Value Chain

The quantum computing market is demonstrating robust growth across multiple metrics. The global quantum computing market reached $1 billion in 2024 and is projected to grow to $1.5 billion by 2026, with research and development remaining the primary driver [22]. The quantum AI market, valued at $256.0 million in 2023, is projected to grow at a CAGR of 34.4% through 2030 [23].



Investment activity has surged dramatically. Venture capital funding in quantum computing hit $1.5 billion in 2024, nearly doubling the previous year's total [1]. Government commitments have also expanded significantly, with the U.S. Department of Energy's national quantum centers uniting more than 1,500 experts across 115 institutions in North America and Europe [12].

The five national quantum centers have achieved multiple successes in quantum research and technology development [12]. Notable accomplishments include:

- Advanced understanding of quantum device physics
- Enhanced quantum device performance
- Built and deployed new quantum processors
- Developed quantum algorithms
- Trained over 1,000 students and researchers
- Launched the first U.S. Quantum Information Science Summer School
- Connected 1,600+ job seekers with industry opportunities

Investment Landscape Evolution

Analyst perspectives on quantum computing stocks have evolved significantly through 2024. The success of companies like IonQ, which saw its stock rise 173% through December 2024, demonstrates growing investor confidence in quantum pure-plays. However, established technology leaders like Alphabet maintain significant advantages through their ability to fund quantum initiatives while generating revenue from core businesses [24]. Major 2024 funding developments include PsiQuantum's $940 million Australian government investment, Quantinuum's $300 million raise at a $5 billion valuation, and D-Wave's completion of $175 million in equity offerings [26, 27]. Notably, Quantinuum's valuation is expected to reach $20 billion in the near term, reflecting growing market confidence [28].

QTUM into the future

The Defiance Quantum ETF (QTUM) has emerged as a compelling investment vehicle by providing exposure to both pure-play quantum companies and established technology leaders developing quantum capabilities. QTUM tracks the BlueStar® Machine Learning and Quantum Computing Index (BQTUM).

As noted by market analysts:

When a new technology captures the imagination of investors, there's almost no limit to what they'll do to capture a piece of it" [25].

The fund's structure allows investors to participate in quantum computing's growth while maintaining exposure to proven technology companies implementing quantum solutions.

QTUM has captured the industry’s momentum, surpassing $400 million in assets under management with year-to-date performance exceeding 40% as of December 2024 [29]. The fund's success reflects growing investor recognition of quantum computing's potential to revolutionize multiple industries.

While quantum computing technology is still advancing, market confidence and investment momentum have accelerated significantly. As demonstrated by Google's Willow chip and Microsoft's achievements with logical qubits, the field is progressing from theoretical potential to practical implementation. The recent surge in QTUM's assets to $598.76 million reflects growing investor recognition of this transition [30].

Defiance Next Gen Computing ETF – QTUM

QTUM provides exposure to companies on the forefront of transformative computing technologies, including quantum computing, machine learning, cloud computing, and other disruptive technologies. The fund has demonstrated strong performance, with a total return NAV of 50.69% YTD (as of 12/31/2024) and 195.87% since inception [31].

Past performance is no guarantee of future results. To view the fund’s most recent performance, click here.

Index Description:

The BlueStar® Machine Learning and Quantum Computing Index (BQTUM) tracks liquid companies in the global quantum computing and machine learning industries, including products and services related to quantum computing or machine learning, such as the development or use of quantum computers or computing chips, superconducting materials, applications built on quantum computers, embedded artificial intelligence chips, or software specializing in the perception, collection, visualization, or management of big data.

Key features of QTUM include:

74
Holdings across global markets

0.40%
Expense ratio

Semi-annual
Rebalancing

Equal-weight methodology
Offering exposure to growth opportunities

As of December 2024, top holdings include innovative companies like:

- Rigetti Computing (12.46%)
- D-Wave Quantum (11.77%)
- IonQ (5.04%)
- MicroStrategy (2.58%)
- Marvell Technology (1.53%)

View the list of the fund's current holdings.

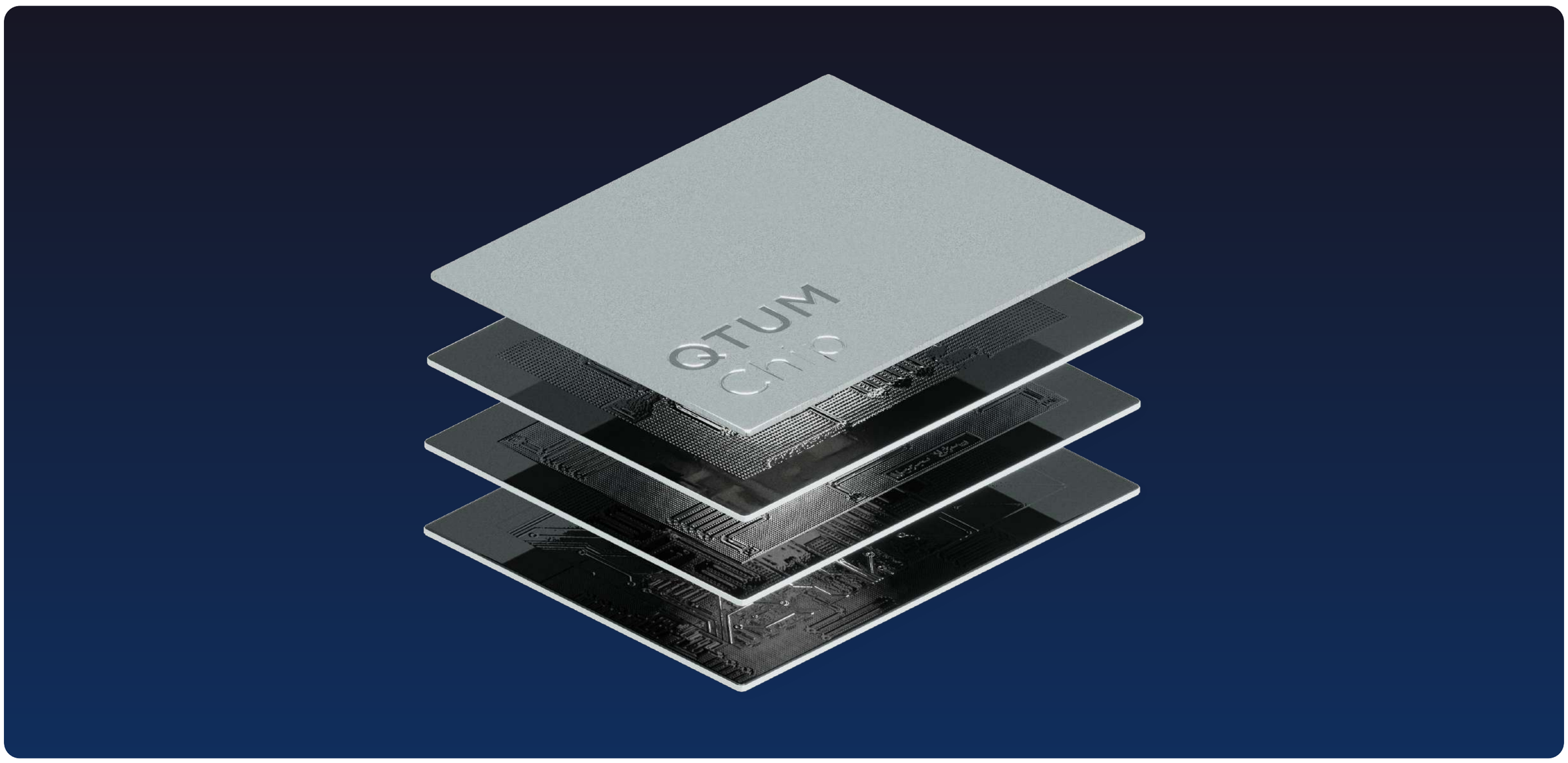
Looking Ahead:
Quantum Opportunity in 2025 and Beyond

As 2024 marked a pivotal year for quantum computing's transition from theory to practical implementation, the technology's disruptive potential is set to accelerate in 2025 and the years ahead. Key developments to watch include:

- Continued breakthroughs in error correction and logical qubit stability, paving the way for more reliable, scalable quantum systems
- Expanded industry partnerships and pilot projects leveraging quantum computing for real-world applications in finance, healthcare, materials science, and beyond
- Growing investment from governments, corporations, and venture capital firms to fuel quantum hardware and software innovation
- Advancements in quantum machine learning techniques to supercharge AI capabilities in complex optimization, simulation, and pattern recognition tasks

While broad quantum advantage may still be several years away, the accelerating pace of progress and growing ecosystem of quantum technology providers, researchers, and end-users point to a transformative decade ahead. As quantum computing continues to evolve and mature, investors have an opportunity to participate in this groundbreaking technology revolution through vehicles like the Defiance Quantum ETF (QTUM).

By providing diversified exposure to quantum pure-plays and established tech leaders, QTUM offers a compelling way to capture the quantum opportunity while mitigating individual company risk. As the quantum landscape unfolds in 2025 and beyond, QTUM is well-positioned to benefit from the technology's far-reaching potential to reshape industries and drive long-term growth.



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