+ Artificial Intelligence

What if...

- → Your phone could predict weather for YOUR house, not just your city?
- → Doctors designed medicine just for YOUR body in hours, not years?
- → AI could learn 1000x faster than today?
- → We could crack problems that would take regular computers longer than the universe has existed?

This isn't science fiction. It's quantum computing + AI. And it's happening NOW.

The Next Computing Revolution

Classical → Quantum → Quantum + AI

01

💡 Regular Computers vs. Quantum Computers

🖥️ Classical Computer (Your Phone/Laptop)

Uses **BITS** — tiny switches that are either:

OFF (0) or ON (1)

Like a light switch — it's either on OR off. Never both.

Think of it like this: A regular computer reads a book one page at a time to find what you want.

⚛️ Quantum Computer

Uses **QUBITS** — quantum bits that can be:

0 AND 1 AT THE SAME TIME!

This is called **SUPERPOSITION**

Think of it like this: A quantum computer reads ALL pages simultaneously. Mind = blown! 🤯

The Spinning Coin Analogy

Classical Bit

A coin lying flat

Heads OR Tails
That's it. One answer.

Qubit (Superposition)

A coin SPINNING in the air

Heads AND Tails
Until you look at it!

Measurement

When you "look" at a qubit

It "collapses" to one answer
The magic is BEFORE you look

> *"Quantum mechanics is like having a magic coin that's spinning so fast it's both heads AND tails at the same time. Only when you catch it does it 'decide' which one to be."*
>
> — Simple Quantum Explanation

Why Superposition is a Superpower

The Math That Changes Everything

Each qubit doubles computing power. This creates EXPONENTIAL growth:

Qubits	States Processed Simultaneously	Equivalent
1	2	Two options
10	1,024	Small computer
50	1,000,000,000,000,000	More than any supercomputer
100	More than atoms in the universe!	🤯 Incomprehensible

$$2^n$$

The Quantum Advantage Formula

🎮 Gaming Analogy

Classical: Playing one game at a time

Quantum: Playing ALL possible games simultaneously and knowing which one you'll win!

🔗 Entanglement: Quantum's Other Superpower

The "Spooky" Connection

Einstein called it "spooky action at a distance" because he couldn't believe it was real. But it is!

🎭 What is Entanglement?

When two qubits become "entangled," they're connected in a special way. Whatever happens to one INSTANTLY affects the other—even if they're on opposite sides of the universe!

🧦 The Sock Drawer Analogy

Imagine magic socks: When you pull one out and it's red, you INSTANTLY know the other one (anywhere in the universe) is blue. No delay. No signal. Just... connected.

Entangled Qubits

Measure one → Know the other
Instantly. Always.

Why It Matters:
Entanglement lets quantum computers share information between qubits perfectly, making calculations WAY more powerful.

🥶 The Big Challenge: Qubits Are Drama Queens

Qubits Need Special Treatment

Quantum states are INCREDIBLY fragile. The slightest disturbance ruins everything.

❄️ Temperature

Most quantum computers need to be colder than outer space! We're talking -459.67°F (0.015 Kelvin). Space is "warm" at -454°F!

🔇 Silence

Any vibration—even someone walking nearby—can destroy quantum states. Labs use massive isolation systems.

⚡ Decoherence

Qubits only stay "quantum" for microseconds to milliseconds. Calculations must happen FAST.

-459°F

Temperature needed for most quantum computers

300x

Colder than outer space!

> *"Building a quantum computer is like trying to keep a soap bubble perfectly still while running a marathon."*

02

📊 Quantum Computing in 2025: By The Numbers

$3.77B
Invested in Q1-Q3 2025 (3x more than all of 2024!)

$10B
Government Investment by April 2025

448
Qubits in Harvard's Latest System

3000%
Stock Price Increase for Quantum Companies

🏆 2025 Nobel Prize in Physics

Three scientists won for their work on superconducting quantum circuits—the technology powering Google's and IBM's quantum computers. This proves quantum computing has "arrived."

🚀 The Verdict

We've moved from "Will quantum computing work?" to "When will it be useful?" The answer: **sooner than you think.**

🏢 The Big Players: Who's Building the Future?

🔵

IBM

Nighthawk Chip: 120 qubits with 30% more complex calculations. Targeting "quantum advantage" by 2026.

Strategy: Enterprise-ready quantum cloud

🟢

Google

Willow Chip: 105 qubits with 99.9% accuracy. First to show "quantum supremacy" in 2019.

Strategy: Pure quantum research leadership

🟦

Microsoft

Majorana 1: First topological qubit chip. Completely different approach with built-in error protection.

Strategy: Long-term fault-tolerant computing

Quantinuum

Helios quantum computer—claims "most accurate" commercial system. Partners: JPMorgan, Amgen, BMW.

IonQ

Trapped ion approach. 36 qubits outperformed classical computers by 12% on real medical simulations.

PsiQuantum

$1B funding for photonic quantum. Uses light instead of superconductors—could work at room temperature!

⚙️ Types of Quantum Computers

Type	How It Works	Pros	Cons	Who Uses It
Superconducting	Tiny circuits at near absolute zero	Fast operations, scalable	Needs extreme cooling	IBM, Google, SpinQ
Trapped Ion	Individual atoms held by lasers	Most accurate, long coherence	Slower operations	IonQ, Quantinuum
Photonic	Uses particles of light	Room temperature possible!	Hard to entangle photons	Xanadu, PsiQuantum
Neutral Atom	Atoms held by "optical tweezers"	Highly scalable	Still developing	QuEra, Pasqal
Topological	Uses exotic particles called "anyons"	Built-in error protection	Hard to make	Microsoft

💡 **Key Insight:** There's no "winner" yet! Different types may excel at different tasks. The race is still ON.

🎯 2025 Breakthroughs That Changed Everything

Harvard/MIT — November 2025

448-qubit fault-tolerant system demonstrated. First to combine ALL key components for scalable quantum computing.

Microsoft — 2025

Majorana 1 chip unveiled—first topological quantum processor. Brand new approach to error correction.

Stanford — December 2025

Room-temperature quantum device! Uses special materials (TMDCs) to maintain quantum states without super-cooling.

IonQ + Ansys — March 2025

First documented quantum advantage: 12% better than classical supercomputers on real medical simulation.

Vienna — June 2025

First quantum computer launched INTO SPACE! Photonic system orbiting Earth on a satellite.

120

Peer-reviewed papers on quantum error correction in 2025 (vs. 36 in 2024)

The Big Shift

"Building a useful quantum computer is no longer a physics problem—it's an engineering problem."

— Fred Chong, University of Chicago

03

🧠 Why AI Desperately Needs Quantum Computing

AI's Dirty Secret: It's Hitting a Wall

Training ChatGPT-4 used as much electricity as 1,000 American homes use in a YEAR. AI can't keep scaling like this.

⚡ Energy Crisis

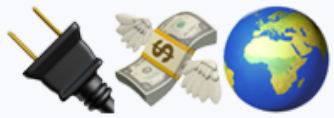
AI data centers now use 2% of global electricity. By 2030: possibly 8%! We need a better way.

🐢 Speed Limits

Some AI problems are "exponentially hard." Even if we built computers the size of Earth, some problems would STILL be unsolvable.

🧩 Pattern Limits

Classical AI can only find patterns in data it can actually process. What about patterns too



The AI Energy Problem

IBM's current quantum computers:

35W/qubit

A 10,000 qubit system = 3.5 MEGAWATTS

The Promise: Quantum AI could be 1000x more efficient while solving problems classical AI literally CAN'T touch.

🤖 Quantum Machine Learning (QML): The Game Changer

What is QML?

Using quantum computers to train AI models. Instead of processing data one piece at a time, quantum computers can process exponentially more data simultaneously.

🔍 Pattern Finding

Qubits in superposition can check MANY patterns at once—perfect for finding hidden connections.

⚡ Faster Training

Models that take weeks on classical computers could train in hours on quantum systems.

📊 Better Data

Quantum can handle high-dimensional data that's impossible for classical systems.

1000x

Expected improvement in ML efficiency by 2030

Already Happening

- → ORCA Computing: Hybrid quantum-AI systems
- → Google: Quantum-enhanced neural networks
- → IBM: AI-assisted quantum error correction

> *"Quantum Machine Learning is projected to contribute $150 BILLION to the quantum computing market."*
>
> — Industry Analysis, 2025

⟷⟷🌍

Two-way quantum communication unlocked!

Next Step

Testing with drones & balloons before full satellite deployment

🔄 Plot Twist: AI is Also Helping BUILD Quantum Computers!

It's a Two-Way Street

🔧 Error Correction

AI can predict when qubits will fail and correct errors before they happen. AI pattern recognition is perfect for spotting "noise" in quantum systems.

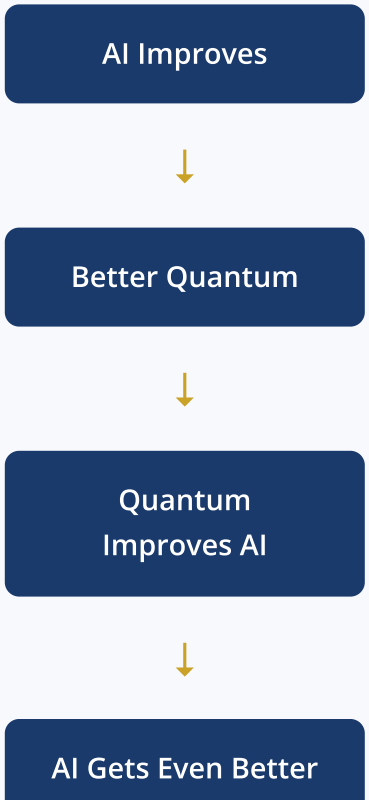
🎛️ System Optimization

AI automatically tunes quantum computers—adjusting thousands of parameters to keep qubits stable longer.

📐 Algorithm Design

AI helps design better quantum algorithms by exploring millions of possibilities humans could never test.

THE FEEDBACK LOOP



💊 Real Quantum + AI Applications (Happening NOW)

Drug Discovery

Google + Boehringer Ingelheim simulated Cytochrome P450 (key enzyme in drug metabolism) with quantum computers.

Impact: Drug development could drop from 10+ years to months.

Finance

JPMorgan + IBM exploring quantum algorithms for risk analysis. 80% of top 50 banks now investing in quantum.

Impact: Better fraud detection, faster trading, more accurate risk prediction.

Climate Modeling

Hybrid quantum-AI systems are being developed for complex atmospheric simulations.

Impact: Predicting climate change effects with unprecedented accuracy.

The Common Thread: Quantum computers do what classical can't—while AI makes sense of the results and improves the process.

04

🛰️ Breaking News: A Quantum Computer is Orbiting Earth!

June 23, 2025

First quantum computer launched to space

📍 The Details

Who: University of Vienna team
Type: Photonic quantum computer
Size: Just 3 liters (tiny!)
Power: Only 10 watts

Why It Matters

This proves quantum computers CAN work in space. The harsh conditions were handled successfully.

Quantum in Orbit

✓ Hardware operational
✓ Demonstrations coming
✓ Proof of concept: SUCCESS

🌌 5 Reasons Space is Perfect for Quantum Computers

1. 🥶 It's Already Cold

Space is -454°F. Quantum computers need extreme cold. In space, you get it for FREE!

2. 🚀 Natural Vacuum

Space is the ultimate vacuum. No air molecules to bump into qubits.

3. 📡 Global Quantum Internet

Satellites can beam quantum signals anywhere on Earth.

4. 🔐 Unhackable Communication

Quantum Key Distribution from space = perfectly secure global communication.

12,900 km

Longest quantum link
(China to South Africa!)

The Vision: A network of quantum satellites creating a global quantum internet.

🌐 Global Quantum Satellite Race

Project	Country	Status	Goal
Micius	🇨🇳 China	✅ Launched 2016	First quantum satellite
Jinan-1	🇨🇳 China	✅ Active 2025	12,900 km intercontinental link
QEYSSat	🇨🇦 Canada	🚀 Launching 2025	3 LEO satellites for QKD
Eagle-1	🇪🇺 Europe	🚀 Launching 2024-25	First European space QKD
DOE Quantum-in-Space	🇺🇸 USA	📋 Growing 2025	IonQ, Honeywell, Boeing, NASA

The U.S. Response

DOE expanded Quantum-in-Space collaboration with major tech companies. Race is ON!

Why It Matters for AI

Space-based quantum networks could create distributed quantum AI supercomputers.

🚀 Space + Quantum + AI: The Ultimate Combo

Why All Three Together?

🛰️ Real-Time Earth Observation

Satellites generate MASSIVE data. Quantum + AI can process it instantly.

🧭 Deep Space Navigation

Quantum computers can calculate optimal trajectories. AI makes real-time decisions.

🔒 Quantum-Secured AI

AI systems in space need unhackable communication. Quantum encryption ensures security.

The Convergence

= 🌟

Autonomous, intelligent, unhackable space systems

📡 2025 Breakthrough: Earth-to-Space Quantum Links

The "Impossible" is Now Possible

Scientists just proved we can send quantum signals FROM Earth TO satellites—not just the other way around.

Why This Matters

- → Ground equipment = unlimited power
- → Easier to upgrade & maintain
- → Satellites can be smaller & cheaper
- → More bandwidth for quantum internet

Expert Quote

"The uplink method could provide the bandwidth needed to connect quantum computers."

— Prof. Simon Devitt, UTS

Next Step

Testing with drones & balloons

05

The Quantum + AI Roadmap

2025-2027 — NOW

NISQ Era: Noisy Intermediate-Scale Quantum. Hybrid quantum-classical systems. Early commercial pilots in finance and pharma.

2028-2030 — Near Future

Quantum Advantage: Quantum computers outperform classical on specific problems. QML becomes mainstream. 1M+ qubits projected.

2030-2035 — The Revolution

Fault-Tolerant Era: Large-scale error-corrected quantum computers. Drug discovery in months. Quantum AI 1000x more efficient.

2035+ — The Future

Full Scale: Global quantum internet via satellites. Room-temperature quantum. AI-quantum systems everywhere.

$97B

Projected quantum tech revenue by 2035 (McKinsey)

250,000

Quantum professionals needed by 2030

90%

Optimization tasks where quantum beats classical by 2030

🏭 Industries That Will Transform

Healthcare & Pharma

Timeline: 3-5 years

Drug development from 10 years to months. Personalized medicine. AI-designed treatments for YOUR DNA.

Finance

Timeline: 3-5 years

Portfolio optimization, fraud detection, risk modeling. 80% of top banks already investing.

Cybersecurity

Timeline: NOW

Post-quantum cryptography is urgent. "Harvest now, decrypt later" attacks are real threats.

🚗 Transportation

Self-driving cars with quantum AI. Real-time route optimization for entire cities. Space mission planning.

🔋 Energy

Better batteries through quantum simulation. Optimized power grids. Nuclear fusion research acceleration.

🌱 Climate

Precise climate models. Carbon capture optimization. Sustainable materials discovery.

🔓 The Quantum Threat: Cryptography at Risk

Why This Matters to YOU

Everything online—banking, messages, passwords—is protected by encryption. Quantum computers could break it ALL.

⚠️ "Harvest Now, Decrypt Later"

Bad actors are ALREADY collecting encrypted data today. When quantum computers are powerful enough, they'll decrypt it. Your 2024 messages could be read in 2035.

✅ Post-Quantum Cryptography (PQC)

New encryption methods that quantum computers CAN'T break. NIST has already standardized the first algorithms. Migration is underway.

PQC Market: $1.9B in 2025 → $12.4B

What Quantum Breaks

- ❌ RSA encryption
- ❌ Bitcoin/crypto wallets
- ❌ HTTPS (website security)
- ❌ Most current encryption

What Quantum Enables

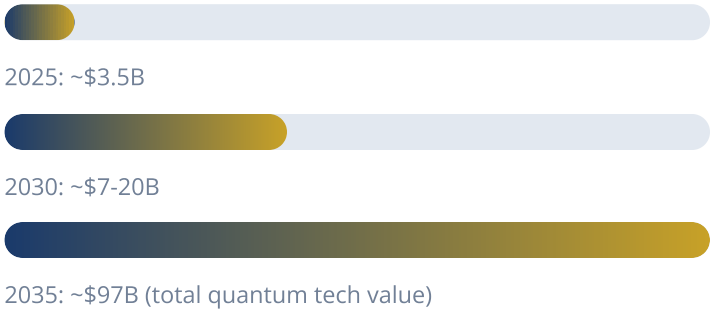
- ✓ QKD (unbreakable keys)
- ✓ Post-quantum algorithms
- ✓ Tamper-proof communication
- ✓ Future-proof security

📈 The Numbers: Quantum Computing Market

$3.5B	$7.3B	$20B	$97B
Market Size 2025	Projected 2030	Optimistic 2030	Total Value 2035

Growth Rate: 34-42% CAGR

One of the fastest-growing technology sectors in history.



2025: ~$3.5B

2030: ~$7-20B

2035: ~$97B (total quantum tech value)

Where the Money Goes

- → Hardware: Quantum processors, cooling systems
- → Software: QML algorithms, development tools
- → Cloud: Quantum-as-a-Service platforms
- → Security: PQC and QKD solutions

Note: ~80% of value will go to END USERS (pharma, finance, etc.), not quantum companies themselves.

06

💼 The Quantum Job Market

3:1

Ratio of quantum jobs to qualified candidates

250,000

Quantum professionals needed by 2030

3x

Job postings growth since 2011

Hot Quantum Careers

🔬 Quantum Researcher

PhD level. Pushing the boundaries of what's possible.

💻 Quantum Software Engineer

Building algorithms and applications. High demand NOW.

🤖 Quantum ML Engineer

Where quantum meets AI. The hottest intersection.

🔐 Quantum Security Specialist

Implementing PQC and QKD. Urgent need across industries.

The Secret: You don't need a physics PhD! Companies desperately need people who understand BOTH quantum AND business/software/security.

🎓 How to Get Started (Even at 15!)

1

Learn the Foundations

- → Math: Linear algebra, probability
- → Physics: Basic quantum mechanics
- → Coding: Python is essential
- → AI/ML: Start with basics now

Free resources: Khan Academy, 3Blue1Brown (YouTube)

2

Try Real Quantum Code

- → IBM Qiskit (free, Python-based)
- → Google Cirq (open source)
- → Microsoft Q# (different approach)
- → BlueQubit (beginner-friendly)

IBM Quantum: Run code on REAL quantum computers for free!

3

Take Online Courses

- → IBM Quantum Learning
- → Coursera: Quantum Computing
- → edX: Quantum programs
- → MIT OpenCourseWare

Pro tip: Many have free audit options!

🌟 **The Best Time to Start is NOW**

🧰 Skills That Will Matter Most

Technical Skills

Skill	Why It Matters
Python	All major quantum frameworks use it
Linear Algebra	Quantum states ARE linear algebra
Machine Learning	QML is the hottest intersection
Cloud Computing	Quantum runs on cloud platforms
Cryptography	PQC is urgent for every company

Soft Skills (Just as Important!)

🌉 Bridge Building

Translate quantum concepts for business people. HUGE value.

🧩 Problem Framing

Knowing WHICH problems quantum can solve is half the battle.

🔄 Adaptability

The field changes monthly. Continuous learning is essential.

🤝 Collaboration

Quantum needs physicists, engineers, AND business minds working together.

🏠 Your Life in 2035: A Day with Quantum + AI

☀️ 7:00 AM — Wake Up

Quantum-AI optimized your sleep cycle. Your alarm went off at the perfect moment.

☕ 7:30 AM — Breakfast

Your fridge used quantum-enhanced AI to order groceries based on your health data.

🚗 8:00 AM — Commute

Self-driving car uses quantum optimization. All city traffic lights coordinated in real-time.

💊 12:00 PM — Doctor Visit

You get medication designed for YOUR specific genetics. Development took weeks, not years.

🌙 10:00 PM — Home

Your home's energy was optimized all day. Bills are 50% lower thanks to quantum grid management.

What Changed?

- ✓ Personalized everything
- ✓ Optimized cities
- ✓ Faster medicine
- ✓ Lower costs
- ✓ Climate solutions working
- ✓ Unhackable privacy

The Key Insight: You won't "use" a quantum computer directly. It'll power the AI that runs everything, invisibly making life better.

⚠️ The Challenges We Still Face

🔧 Technical Hurdles

- → Error rates still too high
- → Qubits need extreme conditions
- → Scaling beyond 1000s is hard
- → Quantum algorithms are limited

💰 Economic Reality

- → Quantum computers cost millions
- → ROI unclear for many uses
- → Classical keeps improving too
- → Only ~300 systems by 2030

👥 Human Factors

- → Massive talent shortage
- → Education can't keep up
- → Hype vs. reality confusion
- → Geopolitical competition

> *"Nvidia CEO Jensen Huang said quantum computing is 15-30 years from being 'really useful.' The industry spent 2025 trying to prove him wrong."*
>
> — Network World, 2025

The Balanced View

Quantum + AI WILL change the world. But timelines vary. Some applications: 3-5 years. Others: 15-20 years. Stay excited but realistic!

🤔 What the Skeptics Say (And Why They Might Be Wrong)

Common Criticisms

❌ "It's all hype"

Reality: 2025 Nobel Prize, $3.77B investment, real commercial pilots. The hype has substance now.

❌ "Classical will always catch up"

Reality: For SOME problems, yes. But quantum solves problems that are fundamentally impossible for classical—no matter how fast.

❌ "It's decades away"

Reality: Finance and pharma are seeing benefits NOW. Full fault-tolerance may be 2029-2035, but useful applications are here.

The Honest Assessment

What's TRUE:

- → Quantum WON'T replace classical computers
- → Most problems don't need quantum
- → Timelines are uncertain
- → Some claims are overhyped

What's ALSO TRUE:

- → For specific problems, quantum is transformative
- → Progress in 2025 exceeded expectations
- → The physics WORKS—it's now engineering

🎯 The 10 Things You NEED to Remember

1. Qubits use **superposition** to be 0 AND 1 simultaneously—exponential power.

2. Entanglement connects qubits in ways that defy classical physics—instant correlation.

3. 2025 is a turning point: record investment, breakthroughs, and the first quantum computer in SPACE.

4. Quantum + AI is the ultimate combo—each makes the other more powerful.

5. Space offers natural vacuum and cold—perfect for quantum systems.

6. Drug discovery, finance, and security will transform first (3-5 years).

7. Post-quantum cryptography is URGENT—current encryption is at risk.

8. 250,000 quantum professionals needed by 2030—massive opportunity.

9. You can start learning NOW with free tools like IBM Qiskit.

10. Quantum won't replace classical—it will solve the IMPOSSIBLE problems.

❓ The Big Question for YOU

If quantum + AI could solve ONE problem in your world, what would it be?

Cure a disease?

Fix climate change?

Explore space?

The problems YOU care about might be the ones quantum + AI solves.
Will you be part of building that future?

📚 Resources to Keep Learning

🎓 Free Courses

IBM Quantum Learning
learn.quantum.ibm.com

Qiskit Textbook
Free, interactive, Python-based

Microsoft Quantum
quantum.microsoft.com

Coursera
Quantum computing courses

🛠️ Hands-On Tools

IBM Quantum Lab
Real quantum computers, free

Google Cirq
Open source framework

Amazon Braket
AWS quantum computing

BlueQubit
Beginner-friendly platform

📖 Stay Updated

The Quantum Insider
thequantuminsider.com

Nature Physics
Latest research

YouTube: Qiskit
Video tutorials

YouTube: 3Blue1Brown
Math visualization

Pro Tip: Start with IBM Qiskit. It's free, beginner-friendly, and lets you run code on REAL quantum computers!

Starts With YOU

The future isn't something that happens to you.
It's something you BUILD.

bit.ly/jjshay