Quantum Age Begins: Potential and Challenges

The Next Great Leap in Human Civilization

Hariprasad Narayanan

For High-School Students

August 9, 2025

From Stone Age to Quantum Age

Human History Through Ages

- **Stone Age** → Tools
- **Bronze Age** → Weapons and Art
- **Iron Age** → Agriculture and Warfare
- **Industrial Age** → Work and Life Transformation
- **Digital Age** → Global Information Connection
- **Quantum Age** → Redefining Possibilities

What is Quantum Computing?

- Classical bits: ON (1) or OFF (0)
- Quantum bits (qubits): ON **AND** OFF simultaneously
- **Superposition**: Like a spinning coin - both heads and tails
- Google's achievement: 200 seconds vs 10,000 years

The Quantum Age has officially begun!

Revolutionary Potential

Healthcare

- Drug discovery: Months instead of 10-15 years
- Personalized cancer treatments
- Vaccines in weeks, not years

Artificial Intelligence

- Unimaginable data processing
- Smart city optimization
- Investment portfolio analysis

Cybersecurity

- Quantum encryption
- Physically impossible to hack
- Laws of physics protect data

Climate Solutions

- Better solar panels and batteries
- Accurate climate modeling
- Optimized renewable energy grids

Major Challenges

Technical Fragility

- **Quantum decoherence**: Qubits lose properties instantly
- Operating temperature: Colder than outer space
- Expensive and complex maintenance

Energy Consumption Crisis

- Single quantum computer = Power of small town
- Massive cooling systems required
- Current reality: **80% fossil fuel dependence**
- Challenge: Build renewable infrastructure with minimal CO_2 lifecycle

Security Implications

- Current encryption becomes obsolete overnight
- Race against time for quantum-resistant security
- Every password, transaction at risk

Societal Impact & Current State

Societal Challenges

- New digital divide
- Job displacement
- Privacy concerns
- Need for international regulations

Where We Stand Today

NISQ Era: Noisy Intermediate-Scale Quantum

- Working but experimental
- Practical advantages: 5-15 years
- Full-scale quantum: 20-30 years

New Career Opportunities

- Quantum software engineers
- Quantum security specialists
- Quantum algorithm designers

Timeline

2025 $\rightarrow$ **2040** $\rightarrow$ **2055**

Today Practical Full-scale

Our Quantum Future

Our Generation's Role

- We are the **quantum generation**
- Strong foundations: Math, Physics, Computer Science
- Critical thinking about ethical implications
- Advocate for responsible quantum policies

The Balance

Greatest Opportunity vs **Complex Challenge**

Solve climate change & disease vs Privacy & security risks

Call to Action

The quantum future isn't predetermined—it's ours to shape.

The quantum age has begun.

Are we ready to help lead it responsibly?

Thank You

Questions?