



| QUANTUM NEW MEXICO >

New Mexico is ~~a~~ Quantum State
the

Ellen R. Fisher
Vice President for Research
University of New Mexico
April 1, 2022

Some Symposium Highlights & Kudos

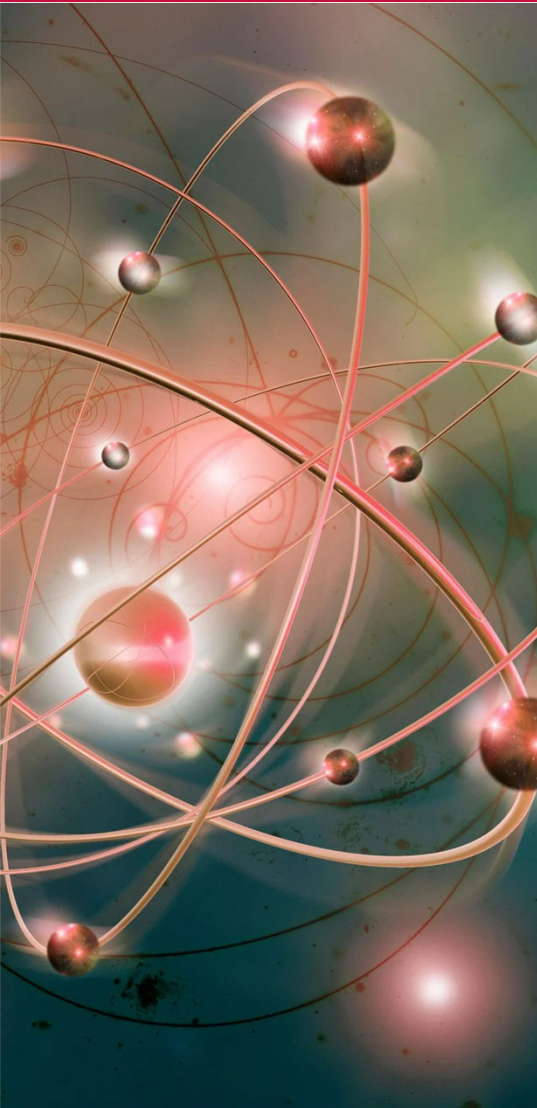
- Amazing efforts of our organizing committee
- Fantastic attendance
 - ~125-150 participants in person on Day 1
 - Over 225 registered
 - Numerous dignitaries and partners
 - Government leadership/representatives
 - University leadership
 - National Labs (SNL, LANL, AFRL)
- Outstanding, informative tours
 - Quantum experiments in action



QUANTUM NEW MEXICO >

New Mexico is ~~the~~ Quantum State
the

Senator Martin Heinrich
Sandia CRO Susan Seestrom
Los Alamos Deputy Director
John Sarrao



Quantum 2.0 – A revolution, a renaissance, an evolution

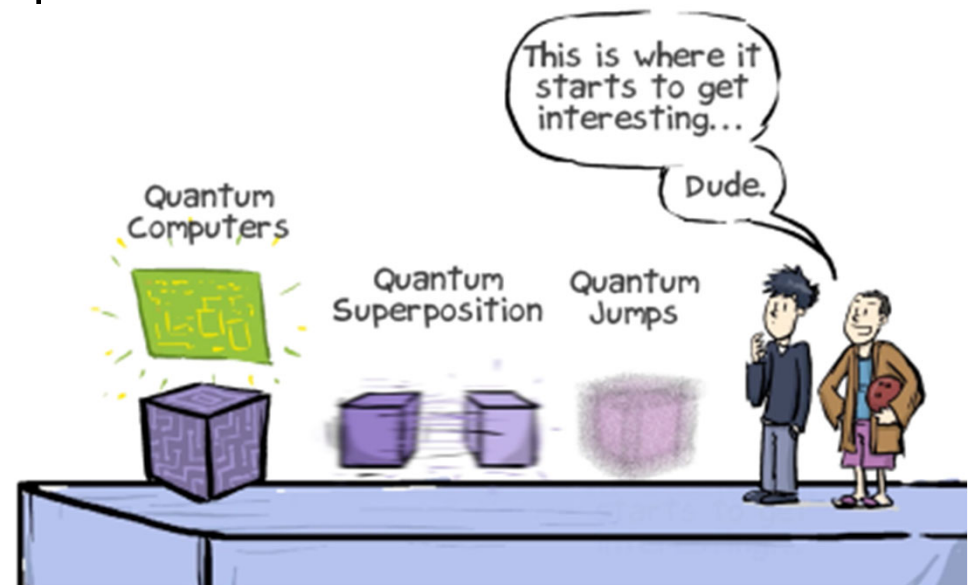
- Quantum 1.0: deep understanding of quantum mechanics
 - New Mexico institutions pioneering innovations
 - Quantum Information Science (*and Technology*)
- Quantum 2.0: How do we harness the full power of QIS?
 - Acceleration of technology developments
 - Managing expectations
 - Financial investments by government, industry
 - Enhanced and targeted workforce development
- Why New Mexico?
 - Rich history and thriving quantum ecosystem
 - Extant assets, collaborations, expertise, workforce

Quantum 2.0 – A revolution, a renaissance, an evolution?



The QNM Project: This is where it starts to get interesting...

- “Leveling up” – public/private partnership
 - Optimizing coordination
 - Ensuring shared vision(s)
 - Increasing visibility
- Multipronged approach
 - QNM Institute (QNM-I)
 - Trainee opportunities
 - Visibility
 - QNM Coalition (QNM-C)
 - Broadening partnerships
 - Industry impacts
 - Infrastructure investments
 - Broadband
 - High performance and cloud computing
 - Advanced manufacturing

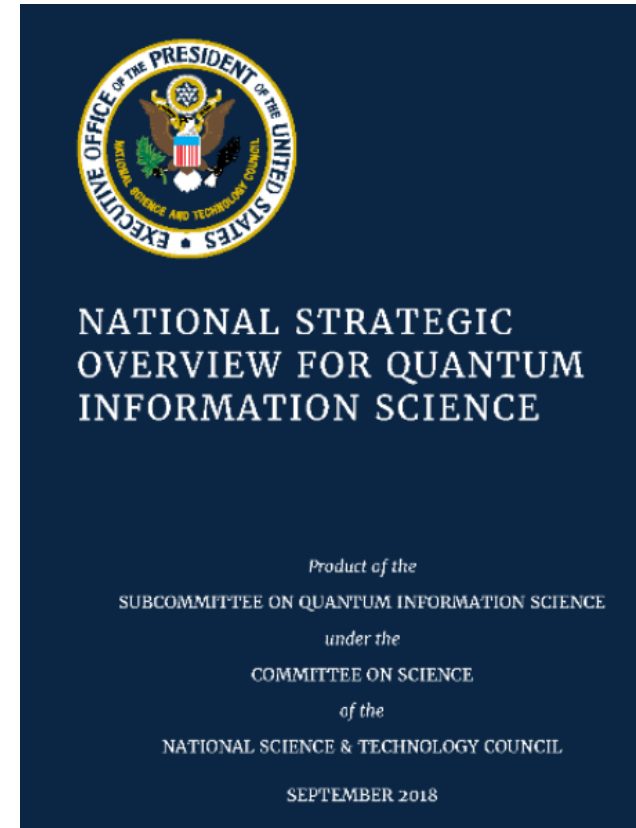


The new joint QNM Institute between UNM and Sandia in Quantum Information Science will be a multiplicative factor.

Quantum Advancement: A National Priority

- ✓ **Choose a Science-First Approach**
- ✓ **Create a Quantum-Smart Workforce**
- ✓ **Deepen Engagement**
- ✓ Provide Critical Infrastructure
- ✓ Maintain National Security & Economic Growth
- ✓ Advance International Cooperation

QNM represents an ideal ecosystem in which these key policy opportunities could be implemented!



Promise of Enormous, Broad Impact Across Multiple Sectors

- Quantum technologies are broad, with radical new paradigms
 - Computing
 - Communications,
 - Cyber security
 - Sensing
 - Arts, Film & Digital Media
- Standing up quantum technologies needs broad development, engagement
 - Quantum materials development,
 - IT infrastructure (e.g., broadband, cloud computing)
 - Advanced manufacturing



Challenges Facing a Quantum Economy: Managing Expectations

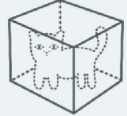
- Translating theory into practice
- Scale up
- Resources
- Socio-economic and ethical challenges

QNM will help provide viable solutions!

Near-Term
(1-3 Years)

Gaps in Fundamental Science

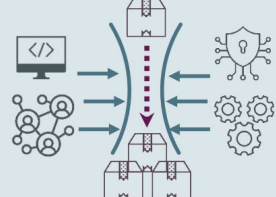
Quantum science is still a developing field with existing gaps in knowledge that limit tech-readiness. For example, it is not yet clear which tasks quantum computers will handle better than classical computers. The primitive quantum systems of today need to reduce “noise” in their hardware, scale up, and prove their superiority.

$$i\hbar \frac{\partial}{\partial t} |\psi(t)\rangle = \hat{H}|\psi(t)\rangle$$


Mid-Term
(3-10 Years)

Bottlenecks to Increased Growth

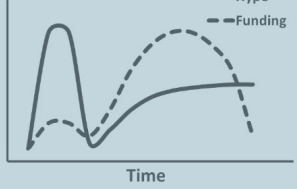
Quantum computers require the development of related software, programming, networking, and security systems, all of which rely on the development of quantum systems. Similarly, scale-up of manufacturing processes is an expected problem as production chains cannot be developed before the technology.



Long-Term
(10+ Years)


Maintenance of Financial Support

As with any new and developing market, funding levels go through cycles. Upfront hype and public funding often decline into a “valley of death.” As time advances, ongoing challenges arise from the uncertainty of government support and hesitance of companies to invest due to a broad landscape of technology choice.



Long-term Ramifications

Once fully developed, QIST sectors will face several socio-economic and ethical challenges. The complexity and expected cost of systems will mean unequal access by nations and local users. Ethical issues are anticipated as ownership will have to be assigned to the private or public sector, despite funding received from both.



Quantum Workforce Development: National Perspective

Building the Nation’s QIST workforce will require coordination among U.S. Government agencies, academic institutions, professional societies, non-profit organizations, industry, and international partners. There are also important roles for STEM educators and institutional experts on diversity, equity and inclusion, to ensure that training in QIST will position more individuals for rewarding careers, and expand America’s capacity for high-tech innovation.

QIST WORKFORCE DEVELOPMENT



QUANTUM INFORMATION SCIENCE AND TECHNOLOGY WORKFORCE DEVELOPMENT NATIONAL STRATEGIC PLAN

A Report by the
SUBCOMMITTEE ON QUANTUM INFORMATION SCIENCE
COMMITTEE ON SCIENCE
of the
NATIONAL SCIENCE & TECHNOLOGY COUNCIL

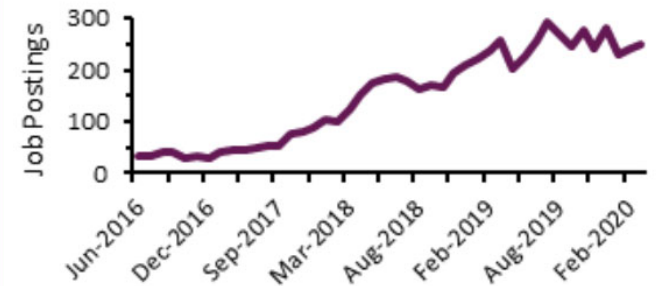
February 2022

Workforce & Economic Development: NM Quantum Ecosystem

- Increased emphasis on multi-disciplinary programs and research efforts
- Collaboration among academia, industry, agencies
- Integration of research and academic programs
- High profile computational science programs
- Education pathways/networks from K-12 through postsecondary and graduate programs
- High demand from NM National Labs
- Highly diverse population

Current State of Hiring in QIST

The number of new quantum computing jobs has **increased eight-fold** since 2016.¹



Even with the hiring increase, many companies struggle to find skilled employees.²



55% need to provide additional training to new hires



65% find it challenging to hire employees in QIST

Energy.gov/technologytransitions
[August 2020 newsletter]

7654 jobs in Quantum Computing

An observation from today's LinkedIn...

UNM "alums"

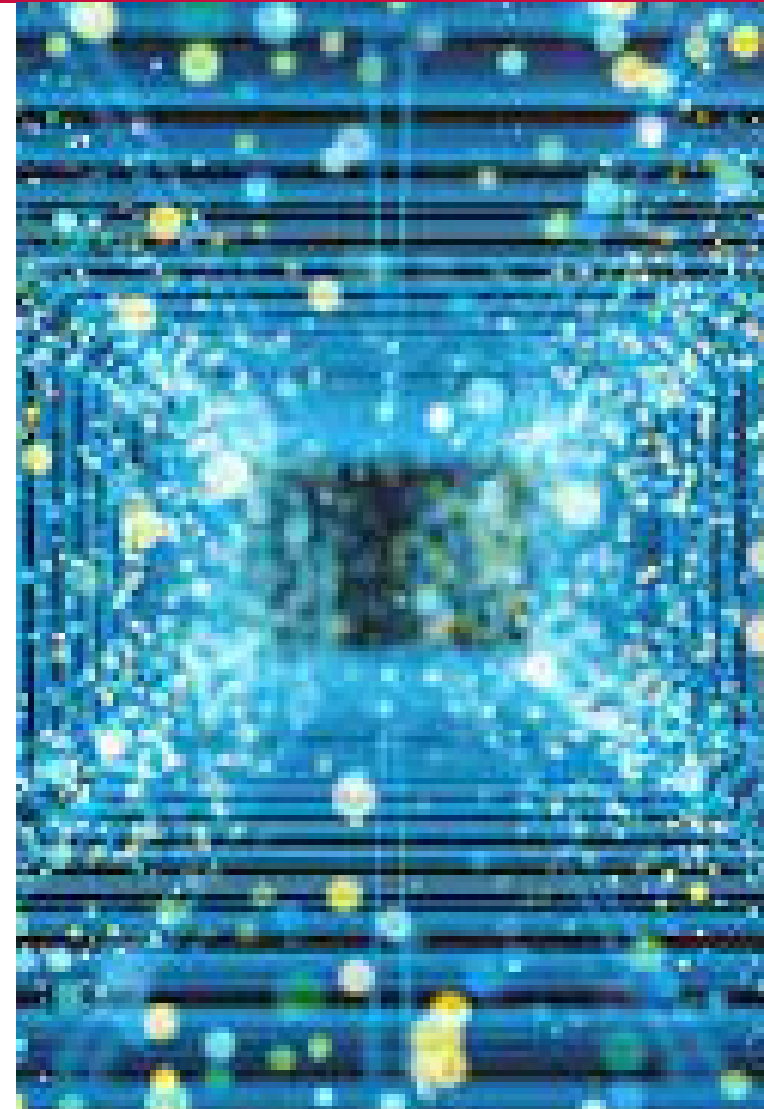
The screenshot shows LinkedIn search results for 'Quantum computing in United States' with 7,654 results. Three job listings are visible, each with a red circle around the 'UNM' logo and the number of alumni who work there:

- Principal Research Scientist, AWS Center for Quantum Computing** (AWS, Pasadena, CA): 19 company alumni work here. Promoted · 5 applicants.
- R&D FLARE Research Lead in Quantum Computing and Quantum** (JPMorgan Chase & Co., New York, NY (On-site)): 7 company alumni work here. Promoted · 10 applicants.
- Quantum Hardware Development Engineer – Device Fabrication (Lithography), Quantum Computing** (Amazon, Pasadena, CA): 64 company alumni work here. Promoted.

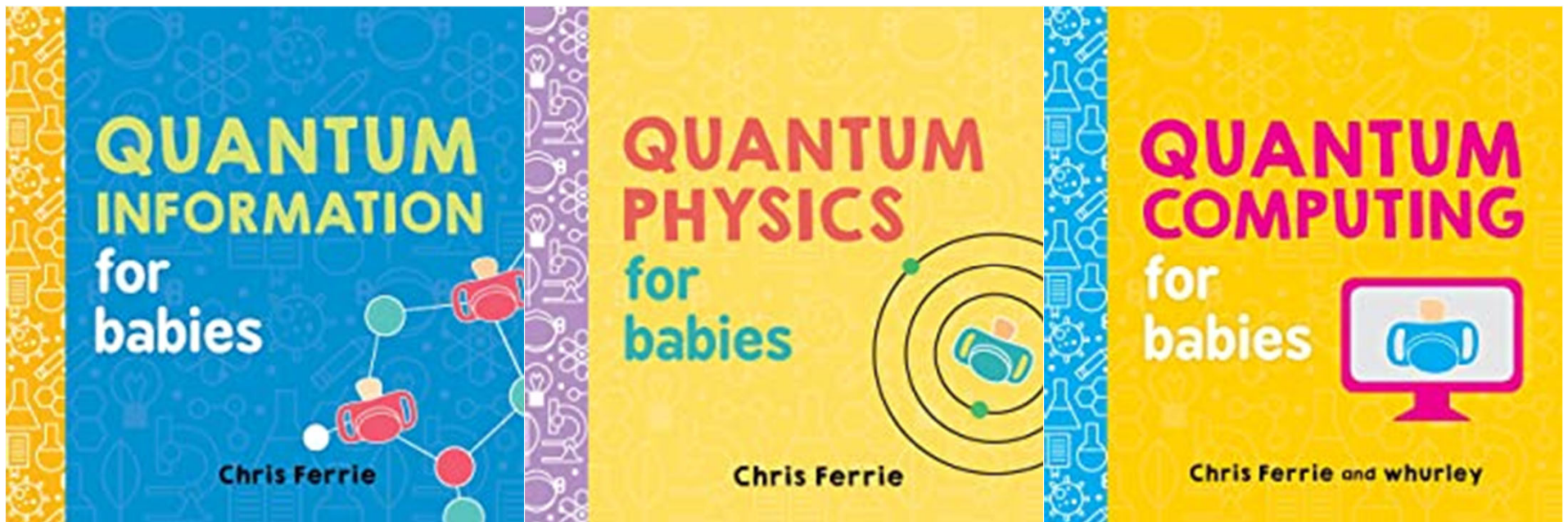
(Q) Research IV Education

As evidenced by our amazing UNM alum

- **Foster** critical thinking, effective communication, and analytical skills through hands-on learning
- **Define** academic, career and personal interests
- **Expand** knowledge and understanding
- **Develop** one-on-one connections
- **Build** community with peers, faculty and organizations on- and off-campus
- **Create** mechanisms for succeeding through failure
- **Enhance** student outcomes



It's never too early to start developing the quantum workforce of tomorrow...



Quantum: Truly a foundational and enabling technology

Engage with the QNM Ecosystem

Some Next Steps for QNM-C

Participate: Technical Exchange Workshop

- Summer 20222
- Programmatic updates on technical goals
- Lightning talks
- Breakout sessions

Build: NM Educational Network

- QIS working group
- Create education ecosystem to support/sustain programs
- Assessment of current state
- Pursue joint funding

Create: Regional Quantum Cluster

- Highlight successful history
- Identify key tactics for ongoing engagement
- Identify leaders and influencers

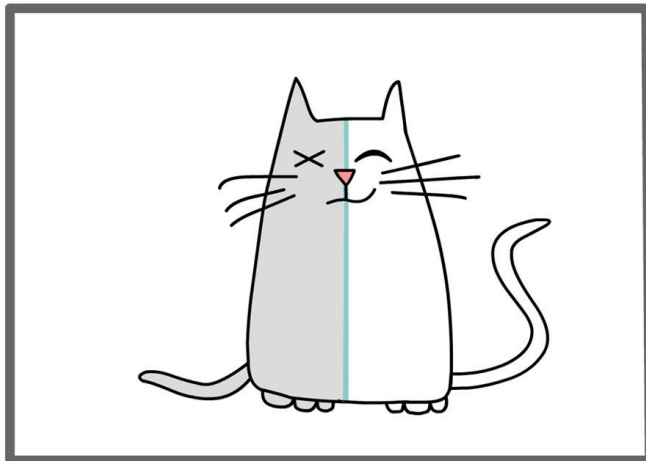


Interested in learning more??

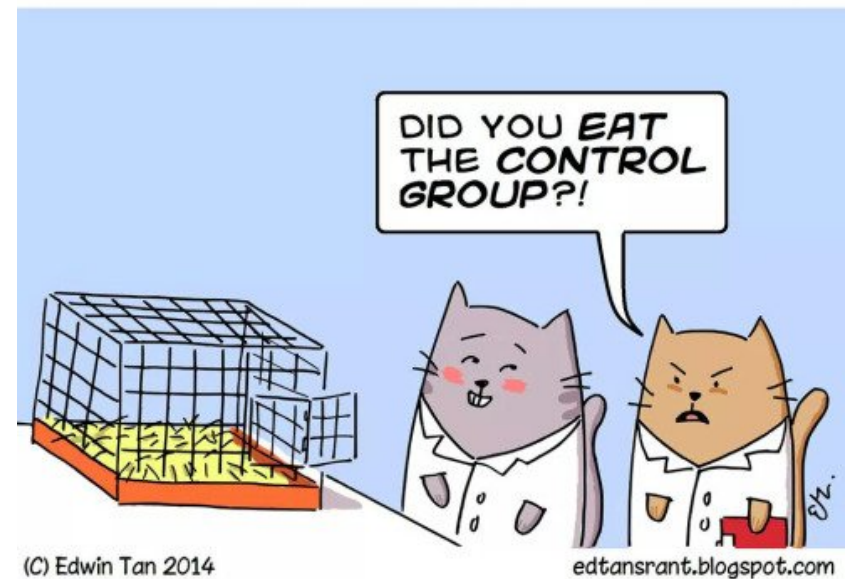
- Summer schools and other community outreach events
- Coordinated briefings to state government and economic development stakeholders
- Questions or suggestions:
 - qnm@unm.edu
 - quantum@sandia.gov

A last comment on Theoretical vs. Experimental Cats...

Schrödinger's Cat



WHY CATS MAKE BAD SCIENTISTS



Thank
you

World Quantum Day:
April 14, 2022!



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