



QUANTUM NEW MEXICO

New Mexico is a quantum state

Science Technology and Telecommunications Committee

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September 30, 2024



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NM will be tomorrow's quantum hotbed

The Quantum Insider
News Exclusives About Us Marketing Reports Newsletter

Tomorrow's quantum hotbeds? 7 U.S. cities that could incubate the next great quantum technology ecosystem

[Link](#)

Why?

- World Class Research Institutions
- Entrepreneurial Ecosystems
- Pro-Innovation Government
- Quantum Solutions for NM priorities

QNM RESEARCH
QUANTUM NEW MEXICO INSTITUTE (QNM-I)

JANUARY, 2024
The University of New Mexico launches the Quantum New Mexico Institute

Elevate Quantum

MARCH, 2024
Governor Polis and Governor Lujan Grisham urge the Department Of Commerce to fund the Regional Quantum Partnership

CNM
Central New Mexico Community College

MAY, 2024
New Mexico Community College receives federal funding to launch rare quantum learning lab and training program

Santa National Laboratories

July, 2024
EDA announces \$504 million in funding to 12 designated tech hubs across America

What is Quantum Information Science (QIS)?



- Emerging technology that will revolutionize computing, communication and sensing:
 - Quantum computers to **solve previously unsolvable problems**
 - Enable **provably** secure communications
 - Dramatically improve **sensing** and **detection**

The convergence two of the great scientific pillars of the 20th Century

Quantum Mechanics:

The physics of the microscopic world

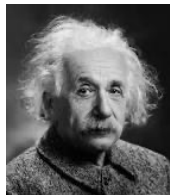
atom



electron



photon



Albert Einstein



Information Science:

Computers & communications



Claude Shannon

Quantum will supercharge the information economy



Quantum Computing

A new computing paradigm that will help us solve problems in completely new ways



- CREATE NEW BATTERIES
- DRUG DESIGN
- OPTIMIZE THE ENERGY GRID
- FRAUD DETECTION IN FINANCIAL MARKETS

Quantum Sensing

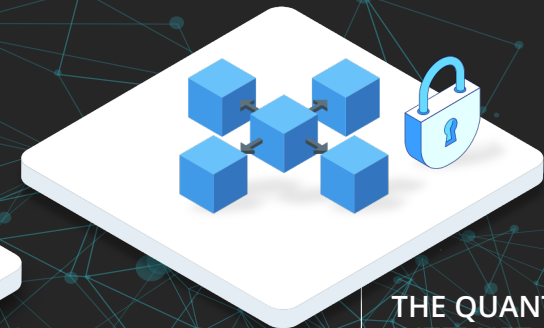
Atomic level sensors that will greatly enhance sensing capabilities



- QUANTUM ENHANCED NAVIGATION
- ENHANCED BIOLOGICAL SENSORS
- MINERAL AND OIL EXPLORATION

Quantum Communication

Provable secure communication and new communication protocols



- THE QUANTUM INTERNET
- ULTRA-SECURE COMMUNICATIONS
- ENERGY EFFICIENT COMMUNICATIONS

Quantum is one of the top emerging technologies in the world

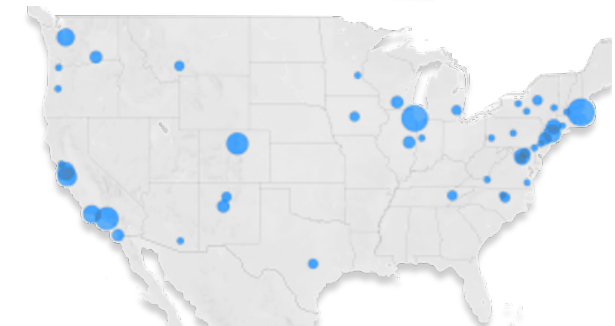
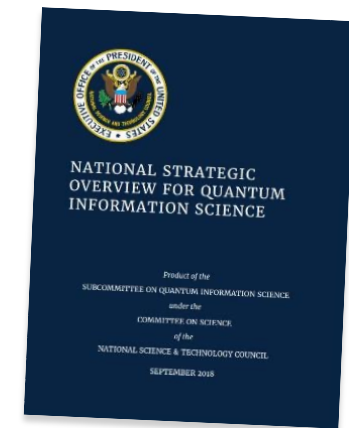


Federal legislation

- **National Quantum Initiative (NQI):** Passed in 2018, authorized \$1.15B in funding to support an all of government approach to sustain national and economic security in quantum.
- **National Defense Authorization Act (NDAA):** Passed yearly, legislation authorizes the DOD to carry out QIST R&D
- **CHIPS and Science Act of 2022:** Authorizes additional funding for QIST infrastructure, R&D, and workforce development programs.

Federally supported quantum programs

- **National Science Foundation**
 - Quantum-Leap Challenge Institutes* (NM)
 - Technology, Innovation and Partnerships
- **Department of Energy**
 - NQI Science and Research Centers* (NM)
 - Office of Science - Reaching a New Energy Sciences Workforce (NM)
- **Department of Defense**
 - NDAA QIS Research Centers*
 - Defense Advanced Research Projects Agency (NM)



The 13 major NQI research centers and their affiliates ([quantum.gov](https://www.quantum.gov))

*Blue dots on the map correspond to "Federal Quantum Programs"

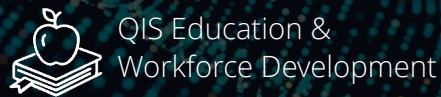
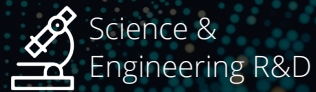
Quantum New Mexico (QNM)

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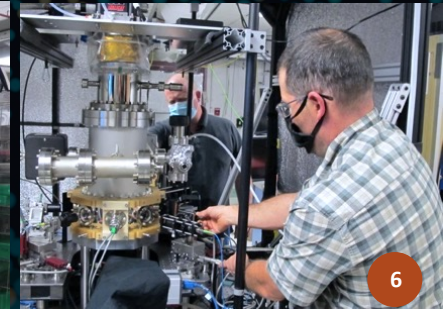
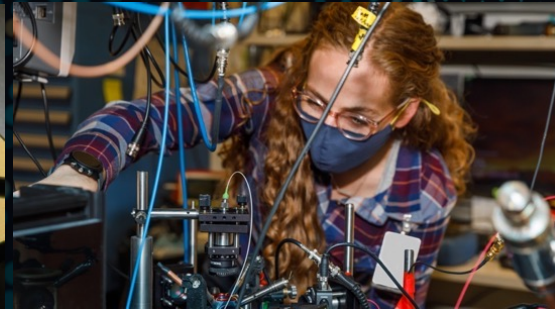
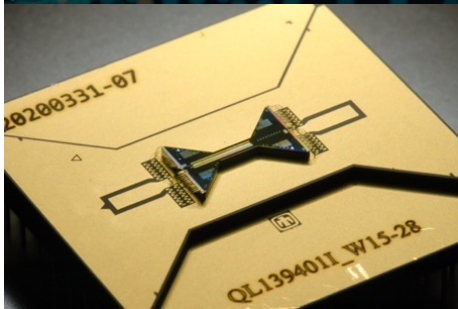
OBJECTIVE:

Make New Mexico a world-class quantum ecosystem by building on our historical strengths and expanding the impact of quantum technologies across the State:

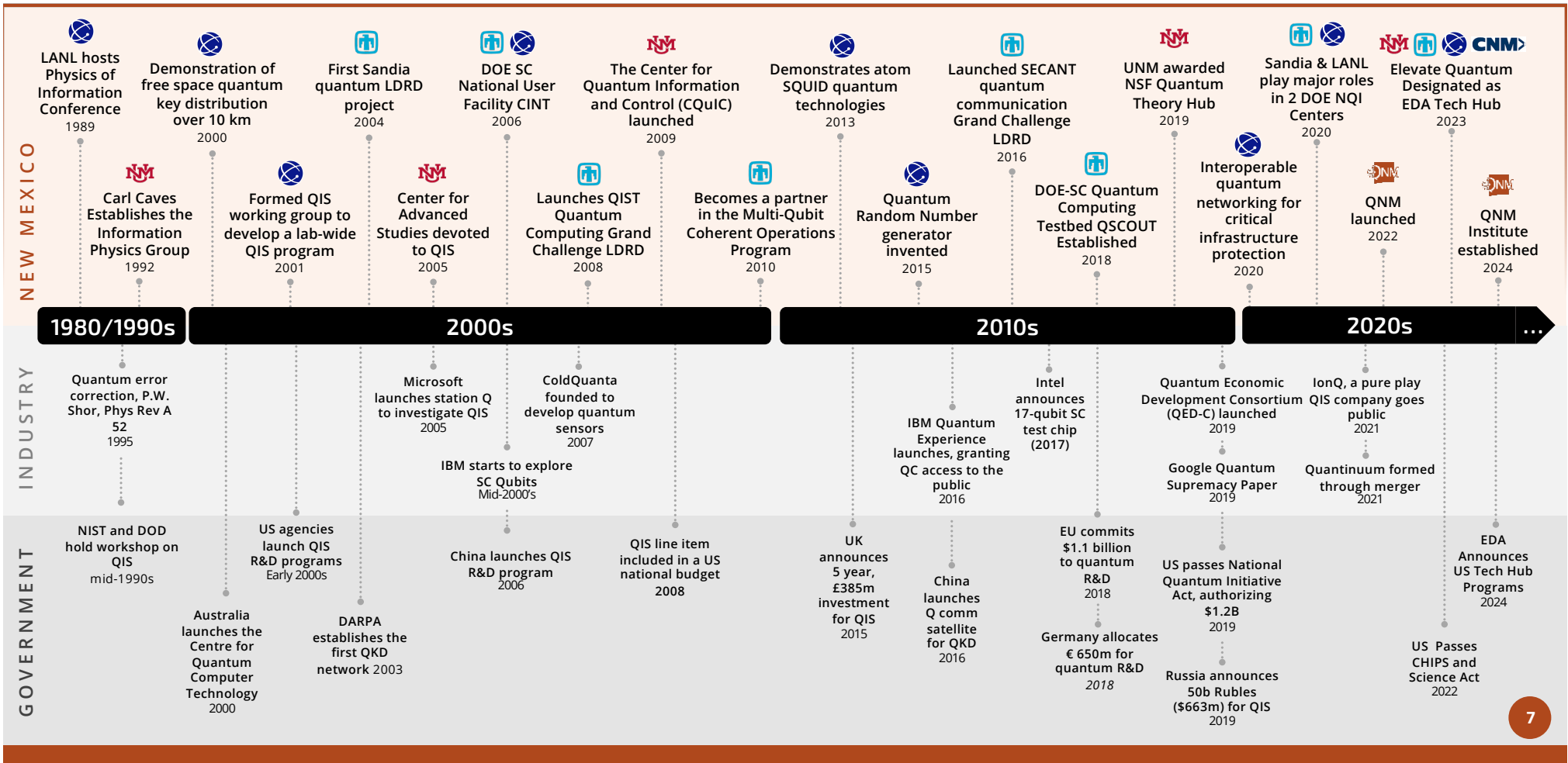


WHY:

To create a vibrant ecosystem and cement NM as a Quantum powerhouse in this critical emerging technology area



NM has been a leader in QIS technologies for decades



The QNM-Institute will strengthen NM's role as a premier R&D ecosystem



QNM-I is a research & education center that will make transformative, long-lasting quantum breakthroughs through the efforts of QNM scientists, engineers, and business professionals

- Established January 2024 as a Category-III university-wide institute at UNM.
- Planned joint institute between UNM, Sandia, and LANL
- Sustain innovation cycle in R&D to catalyze and grow New Mexico's quantum economy.
- Broaden participation with new opportunities for New Mexicans across the State



UNM, Sandia, Los Alamos Collaboration



- Years of Collaborative Research in QIS going back to the 1990s.
- Center for Integrated Nanotechnology (CINT) jointly operated by Sandia/LANL with UNM users
- Joint projects, externally funded and in partnership with Laboratory Directed R&D
- Center for Quantum Information and Control (CQuIC), in the NSF Focused Research Hub for Theoretical Physics, hosting convergence workshops or collaboration.
- New Mexican QIS researchers are at core of the National Quantum Initiative Centers
- Sandia and LANL host New Mexico Small Business Assistance (NMSBA) and Technology Readiness Gross Receipts (TRGR)

DOE NQI Research Centers



QUANTUM SYSTEMS ACCELERATOR

Catalyzing the Quantum Ecosystem

SNL, UNM



QUANTUM
SCIENCE
CENTER

LANL

NSF Quantum Leap Challenge Institutes



UNM, LANL, SNL

UNM Student Researchers at National Labs



J. Anderson



D. Bradshaw



C. Cesare



B. Chase



A. Chowdhury



A. Hankin



A. Orozco



H. Partner



A. Rakholia



C. Ryan-Anderson



T. Scholten



B. Tabakov



J. Bainbridge



M. Brickson



K. Campbell

**Graduated
PhDs**



M. Chow



S. Dimitroff



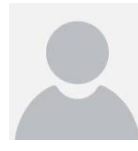
S. Goodwin



J. Gonzales



A. Hernandez



J. Kwok



B. Morrison



J. Nelson



C. Rayudu



M. Rhodes



P. Wysocki



Ziyad

**Current
PhDs**

NM QIS workforce development across the spectrum



- QCaMP has introduced quantum to hundreds of high school teachers and students
- Launching a **first of its kind** quantum technician training program led by CNM
- Summer schools and internships have engaged hundreds of undergrad & graduate students

Traditional higher education pathways: UNM, NMSU, NMT, CNM



Highschool

Associates &
Certificates

Bachelors

Graduate

Postdoc

Additional QIS workforce opportunities

QU-REACH
Quantum Undergraduate
Research Experience At
CHTM

QPAQT
Quantum Photonics and
Quantum Tech Graduate
program

**QNM Quantum
Fellowships**

Qu-Drive: Quantum material summer program

**Gil Herrera Postdoctoral
Fellowship in QIS**

Quantum Computing Summer School Fellowships

QIS Internship Programs

**QCaMP High
school teacher &
student camps**

Quantum Learning Lab (QuLL)
Hands on training for NM students

Elevate Quantum Workforce Collaborative (EQWC) - Full spectrum workforce collaborative



Industry engagement is critical for QNM


- Drive economic development by supporting **entrepreneurs** and through **strategic industry partnerships**
- Expand capacity by supporting large-scale **quantum infrastructure** initiatives and projects
- Ensure **equitable access** to information and new technologies through intentional community engagement and outreach
- Capitalize on the **Elevate Quantum** Economic Development Administration (EDA) Tech Hub funding to establish a quantum industry anchor tenant in NM for a potential **multitrillion-dollar** industry

“As the established leader in quantum computing, Quantinuum finds a perfect match in New Mexico. The state offers a vibrant technology ecosystem and a talented workforce that fits naturally with our needs,” said Dr Rajeeb Hazra, CEO of Quantinuum. “New Mexico is a key collaborator and leader in developing integrated photonics for ion traps, with a community that is among the most advanced in quantum algorithms development and error correction techniques. The partnership between Quantinuum and New Mexico will further strengthen the Mountain West’s position as a leader of this revolutionary technology.”

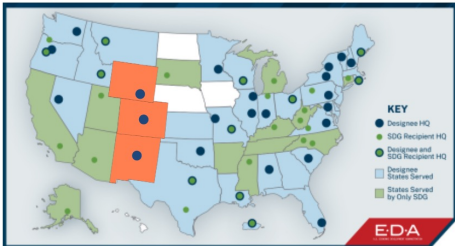
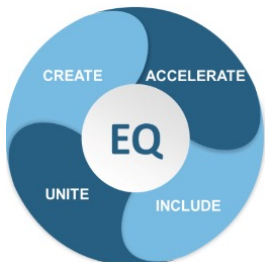
Elevate Quantum EDA Tech Hub

Keep the Mountain West on top for the quantum century

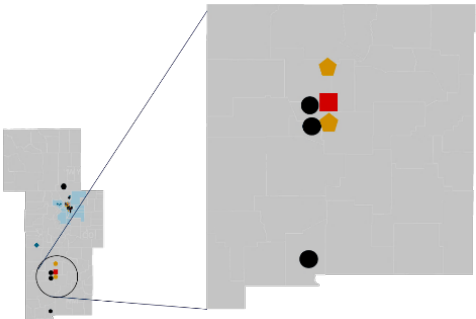
- **An EDA Technology and Innovation Hub**
 - Elevate Quantum is a Mountain West regional tech hub led by Colorado and made up of 120+ partners focused on advancing Quantum Technologies
- **Selected as 1 of 12 Phase 2 participants, unlocking \$127M of funding for the region:**
 - \$40.5M in EDA funding, \$5M from TEF, \$5M pending from State of NM, and \$76M in State of CO State incentives
- **Established the Mountain West as THE Quantum Tech Hub for the United States**
 - We beat out Chicago despite the \$500M investment by IL
 - May unlock future funding opportunities from EDA
- **NM will play key roles across the project**
 - NM will establish a lab/fab aimed at accelerating quantum tech commercialization
 - NM will co-lead workforce development programming
- **Wouldn't have been possible without support from the State of NM**










Designated Tech Hubs Map

EQ Partners	
Category	No.
Industry	24
Higher Education	32
Economic Development	25
Labor, workforce training	17
State, local, tribal gov	10
Federal Labs	5
Other	3
Total	116

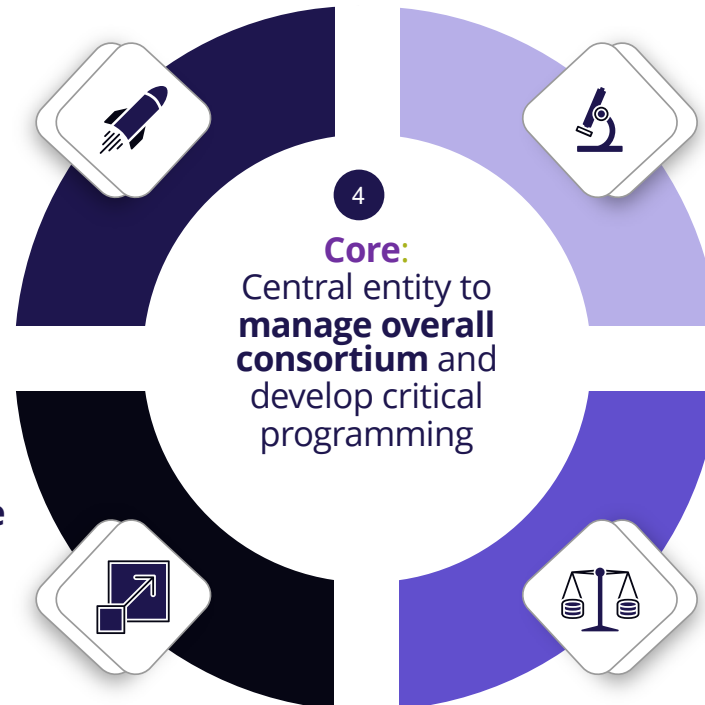


Elevate Quantum focused on four key projects to support a highly integrated ecosystem



1 **Create:** An **open-access commercial quantum fab/lab** providing outreach and access to hardware, software, compute, and expertise



2a **ACCELERATE (Launch):** A E2E set of **accelerator programs from TTO, studio, and accelerator** designed to commercialize technology and form new successful quantum businesses in CO

3 **Include:** An **industry-informed, accessible, skilled, and inclusive quantum innovation and education ecosystem** that prioritizes activated diversity and equity within the quantum workforce

2b **ACCELERATE (Scale):** A program to facilitate scaleups by offering **loan guarantees and multi-dimensional support** to grow partners

What is coming to New Mexico?



- **CREATE** will help attract industry, ***this is the missing piece for quantum in New Mexico***
 - Physical location with advanced instrumentation in a user-facility
 - Elevate Quantum will have a New Mexico location and they will:
 - Use ~\$1M of EDA funds to rent space at UNM's Science and Technology Research Park
 - allows UNM Real Estate to customize the space
 - Use ~\$2M of EDA + ~\$1M TEF funds to purchase equipment for the user facility
 - Creates a heterogeneous integration and packaging facility - noted as the largest limitation for private sector
 - Personnel to operate facility, engage with partners, and grow industry use
 - Personnel hired in NM using ~\$1M EDA funds + ~\$2M TEF funds
 - Additional \$5M being pursued through legislation in cooperation with the Governor's office and NM EDD.
 - Potential use is the proposed photonics user facility and collaborative space

What is coming to New Mexico?



- **INCLUDE** will train New Mexican's for high paying jobs!
 - \$2.7M from EDA and \$2M from TEF
 - Establish Quantum Learning Lab (QuLL) program at CNM-Ingenuity
 - Practical, hands-on training that blends practical experience with theoretical knowledge and helps fill quantum workforce gaps
 - SNL, CNM, and UNM are current partners, evaluating pathways to partner with NMT and NMSU
 - Year 1: Develop QuLL program and establish physical space for the learning lab at CNM's Fuze Makerspace
 - Year 2: Pilot program with initial cohort of students; refine program contents.
 - Years 3-5: Host NM camps and expand QuLL to regional EQ partners.

Slide on companies in Elevate



Elevate Quantum Industry Partners



The EQ Consortium hosts members from full stack quantum computing companies to the enabling technology partners

CO based startups Infleqtion, Quantinuum, Atom Computing, & LongPath all already among the **top 20 most-invested quantum companies in the US**

The consortium is also partnered with large scale companies working on Quantum Technologies



Google Quantum AI



NSF REGIONAL INNOVATION ENGINE OPPORTUNITY



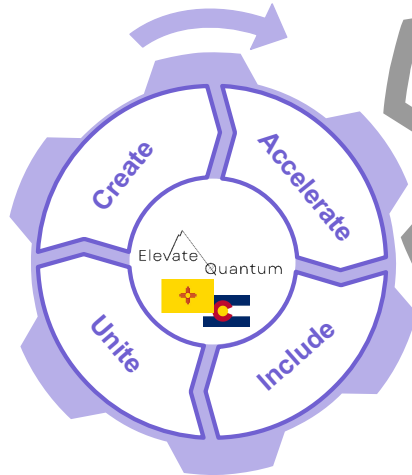
NSF funding of up to 10 new Engines, with expected funding of **\$160 million** over ten years.

The EQ Team Approach

Couple rapid capacity building with a large research cluster in quantum to sustainably drive innovation in the Mountain West

Place-Based Capacity Building

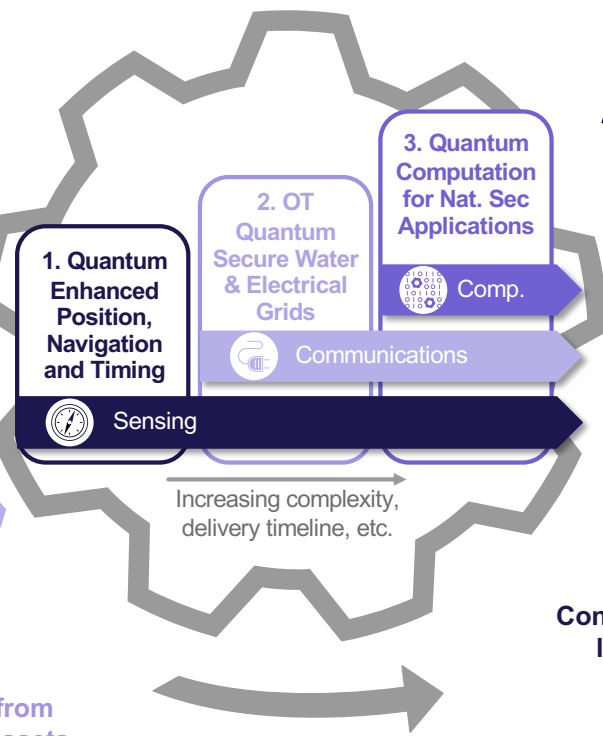
- Create** | Tech translational infrastructure
- Accelerate** | Entrepreneurial support
- Include** | Workforce support
- Unite** | Strong governance



Tech Hub run from CO; Engine run from NM leveraging similar framework of assets

Grand Challenges

+ =



Results

- Accelerated Quantum Tech Commercialization
- High value, high tech jobs in NM & CO
- US quantum leadership

Continuous, sustainable engine of lasting, generational growth

The time is now to establish a NM Quantum Campus

We have the opportunity to capitalize on the momentum of recent success, establish a new high value sector for NM, and create a competitive advantage that unlocks future funding streams



Why is this critical for our success ?

Complete the NM translational ecosystem

- House the **QNM Institute**
- Serve as the convener for **quantum ecosystem development** across NM
- Provide **high value jobs** for communities across NM

Sustainable global competitive advantage

- Expands access to the **massive national security markets** and customers in NM
- Unlocks world leading expertise and capabilities in **packaging and heterogeneous integrations**

Unified location for QIS workforce programming

- Leverage **leading edge** quantum education programs pioneered in NM
- Home to **advanced facilities** for hands on workforce development programs across the educational spectrum

Enables entrepreneurial and industry growth

- **Pathfinding QIS user facility** for NM will lower barriers of entry to QIS and help de-risk QIS technologies
- Provide a platform to **deploy entrepreneurial programs**
- Build a robust **industry presence** in NM



What is next for QNM?



Launch the QNM Institute

- Finalize partnerships and realize the QNM Institute vision
- Chart a pathway to establish a NM Quantum Campus



Expand the industrial base in NM

- Bring the community together to create a supportive ecosystem for industrial partners
- Expand the industry base in the state through targeted engagements



Build a diverse and inclusive local quantum workforce

- Scale our current programs and expand partnerships
- Support new job creation and training programs for communities across NM



Establish NM as a leader in QIS across the world

- Deliver on the Elevate Quantum EDA Tech Hub commitments
- Pursue additional opportunities through the NSF Regional Innovation Engines

Capitalize on our foundation and realize New Mexico's potential as an economic leader in quantum technology for decades to come



QUANTUM NEW MEXICO

New Mexico is a Quantum State



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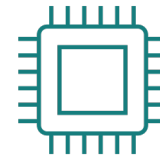
APPENDICES

We are exploring what quantum can do



Energy

Mineral & oil exploration, oil well optimization, energy distribution, battery & solar cell design



Information Technology

Cybersecurity, machine learning, AI, search, software verification & validation



Chemistry & Pharma

Catalyst & enzyme design, drug discovery, bioinformatics, genomics, patent diagnosis, improved MRI



Finance

Portfolio optimization, asset pricing, risk analysis, trading strategies, fraud detection, market simulation



Defense

Inertial guidance, radar, imaging, cyber, autonomy, command & control



Other Industry

Materials, OLEDs, composites, logistics, scheduling, semiconductor device design, chip layout

Quantum technologies are still under development, but some applications are here now

Quantum New Mexico



Bringing stakeholders together to build the QIS ecosystem in NM

QNM THRUST AREAS



Science & Engineering R&D

- Broaden basic and applied research programs
- Support QNM partner R&D priorities and strategies
- Partner to advance QIS technology advancement



QIS Education & Workforce

- Develop new QIS pathways across all education levels
- Support growing QIS academic programs
 - Identify opportunities for Internships, fellowships, and apprenticeships

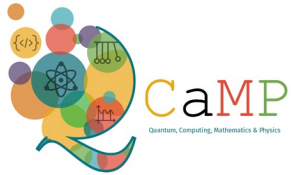


Economic Development

- Build QIS Infrastructure
- Support QIS industry engagements in NM
- Establish unified economic development strategy
- Create resource for QIS business & policy coordination

STATEWIDE IMPACT

- Support quantum program development at UNM, NMSU, NMT, NTU, CNM & More
- Maximize program impact at Sandia, LANL, and AFRL
- Expand QIS R&D to new partners in the ecosystem
- Support university capacity building efforts
- Expand K-career workforce development programs
- Expand QIS jobs via expanding partnerships with industry and national lab partners
- Collaborate with quantum computing and industry partners
- Work with NMEDD on statewide QIS coordination
- Work with tech transfer offices to use state of NM and lab-led partnership programs including NMSBA and TRGR



Quantum, Computing, Mathematics, & Physics Summer Camp



WHAT IS QCaMP?

- Summer camps that introduce high school teachers and students to quantum technologies



2024 Camps
Teachers: June 10-12, 2024
Students: July 1-26, 2024

QCaMP GOALS AND GUIDING PRINCIPLES

Goal: Serve as a launching point for communities to get engaged in quantum

Goal: Break down barriers. Stipends for all. No prerequisites. Hands-on activities throughout.

Goal: Give teachers tools to introduce quantum topics to their students, allowing us to **reach more students from underrepresented communities.**

Goal: Provide exposure to and get students excited about a career in quantum

• Sandia & LBNL participate in ORISE's JSTI program (2021)
 • 10 Students

• QCaMP team expands to a hybrid program (2023)
 • 42 Students & 16 Teachers

• 2024 Teacher QCaMP expands to other regions
 • 83 teachers & participants

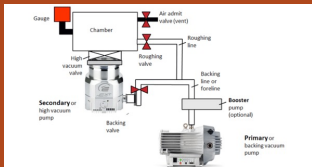
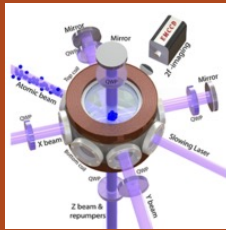
2021: 10 Participants (cumulative) **2024: 200+ Participants (cumulative)**

• QCaMP team creates virtual pilot program (2022)
 • 32 Students & 20 Teachers

• 2024 Student QCaMP expands to 4 weeks with DOE grant
 • 43 Students

Quantum Learning Lab (QuLL)

- Led by CNM and Sandia National Labs
- Training lab for Quantum Workforce Development located at the FUSE Makerspace in downtown ABQ
- Provide hands-on quantum experience for University and Community College students across the state
- Enhance knowledge of early-stage researchers and entrepreneurs



- Skills applicable to adjacent industries
Semiconductor, Solar Cell, Opto-Electronic Manufacturing



- Immersive Hands-On Workforce Training (10-weeks)

Built on the success of CNM Ingenuity's Deep Dive Bootcamps
No prior math/science needed

- Focus

Optics and Photonics
Ultra-High Vacuum Systems
Quantum Phenomenon
Problem Solving, Documentation, Math, Statistics