

# Quantum New Mexico Institute – QNM-I

**Bob Ledoux**

Director

Fiscal Year 2024-2025 Annual Review of Category 3 Research Centers/Institutes | 4/15/2026

# Mission

The Quantum New Mexico Institute (QNM-I) advances quantum information science and technology through collaborative research, education, and workforce development. By uniting academia, national laboratories, industry, and government, the Institute accelerates innovation, strengthens the quantum workforce, and drives economic and societal impact – establishing New Mexico as a global leader in quantum information science and technology. The Institute seeks to accomplish transformative, long-lasting breakthroughs in Quantum Information Science & Engineering through the efforts of scientists, engineers, and business professionals at the University of New Mexico and in partnership with Sandia National Laboratories.

# FY 2024-2025 Goals and Status

## Research & Grants

- Secure renewal of the NSF Focused Research Hub in Theoretical Physics (CQuIC FRHTP) ahead of the 2026 deadline – In progress
- Submit and advance the NSF Innovation Engine "Quantum Moonshot" proposal in partnership with Elevate Quantum, Sandia, and Los Alamos – In progress
- Maintain 30+ active research assistantships for UNM students across multiple departments - ✓ Complete

## Institutional Development

- Finalize the MOU with Sandia National Laboratories to formalize the joint institute structure - ✓ Complete
- Successfully transition to a new permanent QNM-I Director by end of June 2025 - ✓ Complete
- Complete QNM-I staffing and establish shared administrative services – In progress

## Partnerships & Economic Development

- Expand the Elevate Quantum Tech Hub implementation, including new lab space and workforce development programming – In progress
- Grow the QNM-I partnership to formally include Los Alamos National Laboratory - ✓ Complete
- Build ties to industry partners to support quantum technology economic development in New Mexico - In progress?

## Education & Workforce

- Increase student participation in QISE research, with measurable diversity targets – In progress
- Continue PhD mentorship pipeline with students placed at national labs and in industry - ✓ Complete
- Expand outreach activities to broaden QISE participation across New Mexico – In progress

## Community & Policy

- Secure state legislative funding support through the RPSP stream – In progress
- Continue hosting national-level workshops and symposia to position UNM as a hub for the quantum information science community – In progress
- Support K-12 outreach with lab partners – In progress

# Membership of Advisory Committee

- Membership List:
  - Bob Ledoux – Director – QNM-I; Physics Astronomy Department
  - Ivan Deutsch - Regents' Professor: Physics & Astronomy Director: CQuIC Director: Physics Astronomy Department
  - Akimasa Miyake – Professor; Physics Astronomy Department
  - Francisco Elohim Becerra – Associate Professor; Physics Astronomy Department; Chair of the Colloquium; Physics Astronomy Department
  - Niklas Muller – Assistant Professor; Physics Astronomy Department
  - Milad Marvian – Assistant Professor; Electrical Computer Engineering Professor; Physics Astronomy Department
  - Susan R. Atlas - Associate Professor: Chemistry Department; Associate Professor: Physics Astronomy Department; Associate Dir. NSME: Chemistry Department
  - Tara Drake – Assistant Professor: Physics Astronomy Department
  - Martin Kirk – Distinguished Professor: Chemistry Department
  - Francisco Salces Carcoba – Assistant Professor: Physics Astronomy Department
- QNM-I meets with the above once a month.

# FY 2024-2025 Highlights

QNM-I — FY2024–25 highlights

University of New Mexico

**\$40.5M**

Elevate Quantum EDA grant

**30+**

Active UNM research assistants

**285**

SQulnT workshop participants

## ACHIEVEMENTS

- Elevate Quantum named national tech hub; \$40.5M grant covering CO, NM, WY
- QNM-I officially launched as a Category III institute at UNM
- NSF CQulC site visit returned a strong review; on track for 2026 renewal
- QNM Symposium drew 150+ attendees including the Governor and Senator Heinrich
- NSF Quantum Moonshot proposal submitted with Sandia, LANL, and Elevate Quantum
- Director search completed; four finalists brought to campus

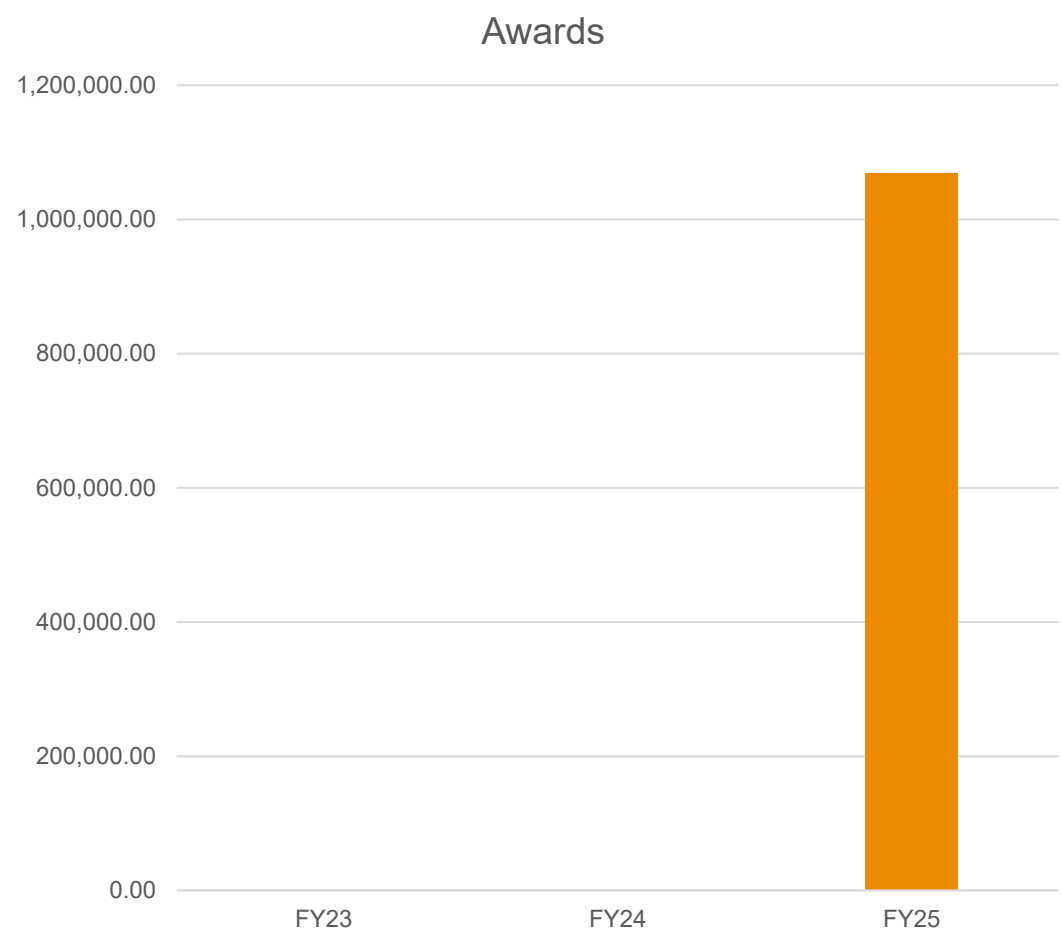
## EDUCATION & RESEARCH

- 3 PhDs graduated May 2024 — placed at national labs and in industry
- A. Zhao awarded best dissertation in Physics & Astronomy
- 30+ UNM student research assistants supervised across multiple departments
- SQulnT workshop: 285 participants, ~50% students, 10 invited talks, 35 contributed talks
- QSA All Personnel Meeting and Joint Quantum Algorithms workshop hosted at UNM
- Admin staff hired: Corwin Beckner and Aaliyah Turrietta

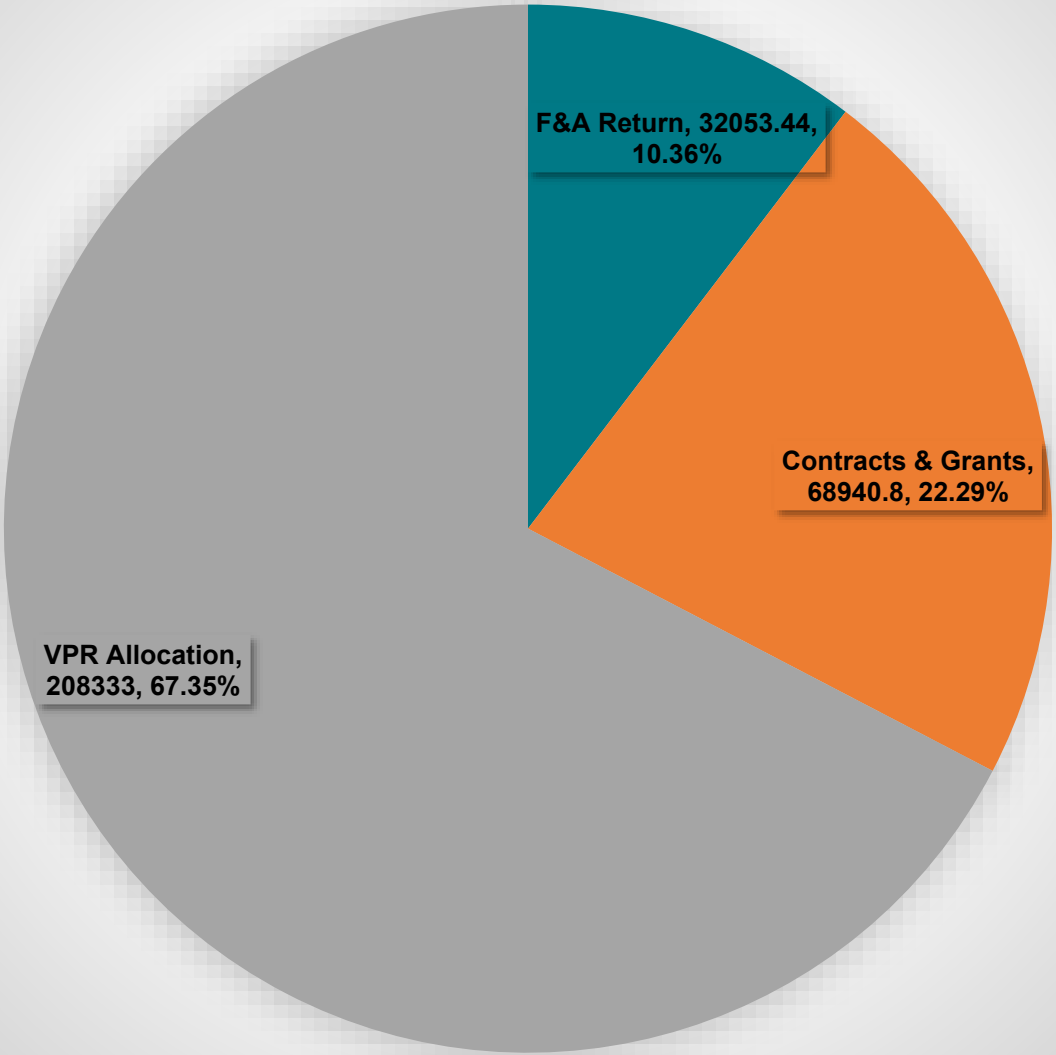
## CHALLENGES & RISKS

- Sandia MOU not yet finalized — joint governance terms still unresolved
- Faculty bandwidth strained after departures of Crosson and Albash
- CQulC Program Director Dwight Zier departed — operational gap to fill
- Federal funding uncertainty; NCE approval at risk
- Elevate Quantum Tech Hub implementation — workforce development and lab build-out complexity

# Proposals and Awards



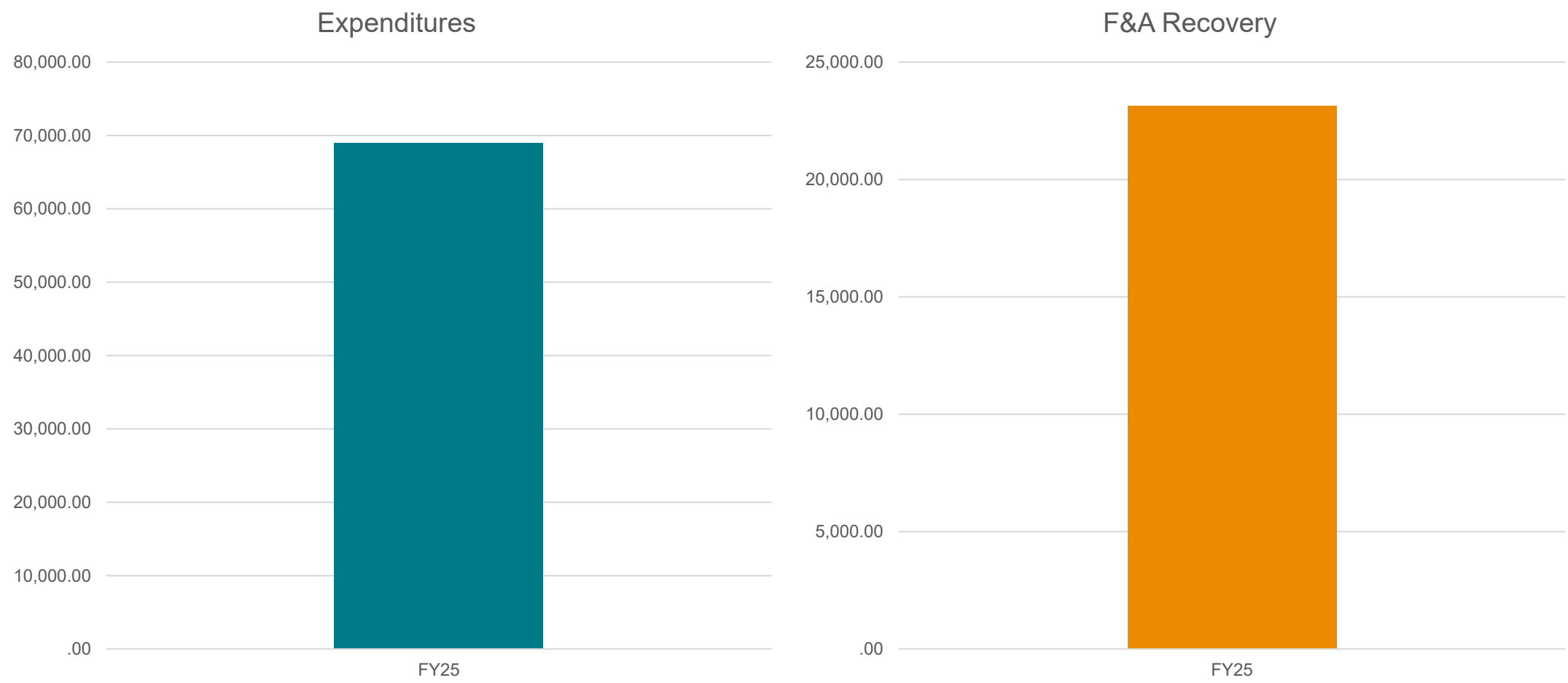
### QNM-I Revenue Details FY25



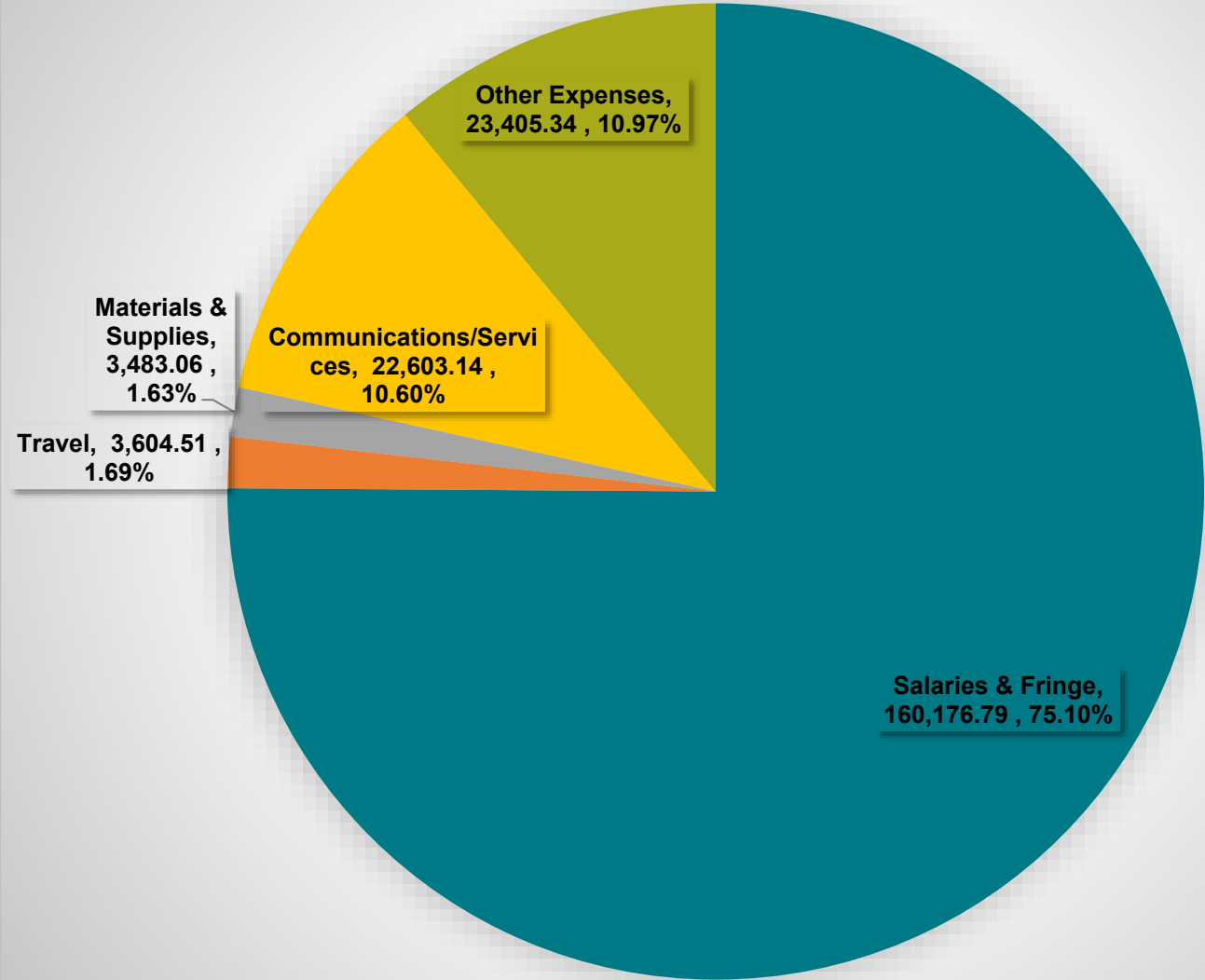
#### FY25 Sources of Revenue

|                    |            |
|--------------------|------------|
| F&A Return         | 32,053.44  |
| Contracts & Grants | 68,940.80  |
| VPR Allocation     | 208,333.00 |
| Total              | 309,327.24 |

# Research Expenditures and F&A



### QNM-I Expenditure Details FY25



|                         |            |
|-------------------------|------------|
| FY25 Expenditures:      |            |
| Salaries & Fringe       | 160,176.79 |
| Travel                  | 3,604.51   |
| Materials & Supplies    | 3,483.06   |
| Communications/Services | 22,603.14  |
| Other Expenses          | 23,405.34  |
| Total                   | 213,272.84 |

# Research Center Impacts

- **Regional Economic Development**

QNM-I anchored the Mountain West’s designation as a national quantum technology hub, securing a \$40.5M Elevate Quantum Tech Hub award (part of a \$127M regional investment under the CHIPS & Science Act), backed by an additional \$10M state match from New Mexico’s Economic Development Department.

- **Research Excellence**

Through partnerships with Sandia National Laboratories and participation in major federally funded initiatives — including NSF's largest quantum computing project (STAQ, \$17M/year) — QNM-I faculty supervise more than 30 UNM student researchers across multiple disciplines, producing an active record of peer-reviewed scholarship.

- **Workforce & Education**

QNM-I is cultivating New Mexico's quantum workforce pipeline through graduate research training, doctoral education, and outreach programs including QCaMP, a summer program serving high school students and educators across the state.

- **Policy & Institutional Leadership**

QNM-I has secured bipartisan state and federal support for quantum as a New Mexico priority — engaging Governor Lujan Grisham, Senator Heinrich, and key legislative stakeholders — **contributing to the historic 2026 NM Legislature quantum investment of \$265M+ statewide, including direct QNM-I appropriations and major competitive funding pools.**

# Return on Investment

- **14 active grants** totaling **\$3.6M** in FY24–25
- 15 peer-reviewed publications in FY24–25; 60+ PhDs and postdocs trained since 1995
- **\$3M** direct QNM-I state appropriation (2026); **\$49.3M** DARPA Quantum Benchmarking Initiative administered by QNM-I
- **\$40.5M** Elevate Quantum Tech Hub; QNM-I positioned as lead for **\$38M** statewide quantum user facility
- **[X] U.S. patents filed/issued or Prelim IP Disclosures**; active industry partnerships: QuEra, Quantinuum [add others]
- Graduate placement: students placed at Sandia, LANL, and quantum industry firms
- 20 Peer-reviewed publications: 17 published, 3 pre-print/in press. Full publication list on next 2 slides

# Publications

## 2024:

- A. Fischer, and A. Miyake, "[Hardness results for decoding the surface code with Pauli noise](#)", *Quantum*, **8**, 1511 (2024). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)
- M. A. Rodríguez-García, and F. E. Becerra, "[Adaptive Phase Estimation with Squeezed Vacuum Approaching the Quantum Limit](#)", *Quantum*, **8**, 1480 (2024). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)
- M. M. Changhao Yi, "[Faster Randomized Dynamical Decoupling](#)", *arXiv e-prints*, 2409:18369 (2024). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)
- S. Omanakuttan, V. Buchemmavari, J. A. Gross, I. H. Deutsch, and M. Marvian, "[Fault-tolerant quantum computation using large spin cat-codes](#)", *PRX Quantum*, **5**, 020355 (2024). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)
- T. G. Thurtell, and A. Miyake, "[Optimizing one-axis twists for variational Bayesian quantum metrology](#)", *Phys. Rev. Res.*, **6**, 023179 (2024). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)
- M. A. Alhejji, and E. Knill, "[Towards a Resolution of the Spin Alignment Problem](#)", *Communications in Mathematical Physics*, **405**, 119 (2024). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)
- P. D. Blocher, K. Chinni, S. Omanakuttan, and P. M. Poggi, "[Probing scrambling and operator size distributions using random mixed states and local measurements](#)", *Physical Review Research*, **6**, 013309 (2024). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)
- A. K. Forbes, P. D. Blocher, and I. H. Deutsch, "[Modeling local decoherence of a spin ensemble using a generalized Holstein-Primakoff mapping to a bosonic mode](#)", , (2024). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)
- C. Kelson-Packer, and A. Miyake, "[Phase transitions in  \$\(2 + 1\)\$ D subsystem-symmetric monitored quantum circuits](#)", (2024). [\[bibtex\]](#) [\[pdf\]](#)
- R. S. Piera, J. B. DeBrot, M. B. Weiss, G. B. Lemos, J. S. Araújo, G. H. Aguilar, and J. L. Pienaar, "Synthesizing the Born rule with reinforcement learning", (2024). [\[bibtex\]](#)

## 2025

- S. T. Bijjala, S. R. Atlas, and P. Kumar, "[Elastic tensor-derived properties of composition-dependent disordered refractory binary alloys using DFPT](#)", *Modelling and Simulation in Materials Science and Engineering*, **34**, 015006 (2025). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)
- B. Corbett, and A. Miyake, "[Scaling up the transcorrelated density matrix renormalization group](#)", *Physical Review Journals, Physical Review B*, **112**, 165120 (2025). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)
- S. T. Bijjala, S. R. Atlas, and P. Kumar, "[Elastic tensor-derived properties of composition-dependent disordered refractory binary alloys using DFPT](#)", *arXiv e-prints, cond-mat.mtrl-sci*, (2025). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)
- M. M. Evan Borrás, "[A quantum algorithm to simulate Lindblad master equations](#)", *Phys. Rev. Research* **7**, 023076, **7**, 040340 (2025). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)
- C. Kelson-Packer, and A. Miyake, "[Phase transitions in  \$\(2+1\)\$ D subsystem-symmetric monitored quantum circuits](#)", *Phys. Rev. B*, **111**, 075109 (2025). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)

# Publications (cont'd)

2025

S. T. Bijjala, S. R. Atlas, and P. Kumar, "Elastic tensor-derived properties of composition-dependent disordered refractory binary alloys using DFPT", *Modelling and Simulation in Materials Science and Engineering*, **34**, 015006 (2025). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)

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C. Kelson-Packer, and A. Miyake, "Phase transitions in  $(2+1)\text{D}$  subsystem-symmetric monitored quantum circuits", *Phys. Rev. B*, **111**, 075109 (2025). [\[bibtex\]](#) [\[pdf\]](#) [\[doi\]](#)

**\$3M direct state appropriation + \$49.3M DARPA Quantum Benchmarking Initiative** (QNM-I-administered)

NSF, DARPA, and DOE alignment; **participation in NSF's largest quantum computing project (STAQ, \$17M/year)**

30+ active research assistantships; **60+ PhDs and postdocs trained since 1995 — deepest quantum talent pipeline in the Mountain West**

Anchor of \$40.5M Elevate Quantum Mountain West Tech Hub; deep partnerships with Sandia (MOU pending) **and LANL expansion underway**

Industry engagement: QuEra, Quantinuum; **commercialization pathway actively developing**

## STRENGTHS

**\$38M statewide open quantum user facility** (2026 HB2) — QNM-I natural lead institution; national lab-compatible, hybrid classical-quantum workspace

**\$49.3M DARPA Quantum Benchmarking Initiative** — QNM-I-administered; positions NM as national quantum testbed

**\$40M quantum share** of \$110M NM R&D deployment fund (performance-contingent); \$10M endowed faculty/postdoc positions for NM higher education

**NSF NQNI:** \$500K–\$2M/yr university user facility award (5 yr renewable) — proposals due May 14, 2026

**DOE Genesis Mission:** \$6M–\$15M Phase II for quantum algorithms + hardware — due April 28, 2026

Formal LANL partnership expansion; new facilities: Roadrunner Quantum Lab, PAIS AMO Lab

## OPPORTUNITIES

Leadership transition underway — new permanent Director on track for June 2025

Sandia MOU finalization in progress — structure agreed; execution pending

Federal renewal dependency — partially offset by 2026 state appropriations

Faculty bandwidth under pressure — new hires and administrative staffing in progress

## WEAKNESSES

**Federal discretionary funding volatility** (NSF, DOE renewals at risk in current budget climate)

**Competition from established quantum hubs** (Chicago, Maryland, CU Boulder) for talent and federal designation

**Talent retention risk** as national labs and industry scale quantum hiring aggressively

Execution risk at scale given rapid ramp-up of legislative investment

Workforce pipeline gaps in quantum-ready graduates — **regional constraint despite CNM and QCaMP efforts**

## THREATS

# Looking Ahead to Fiscal Year 2026 and 2027

## 2026 NM Legislature — HB2 Quantum Appropriations (Source: HB2 SFC, Section 5)

- **Direct to QNM-I:**
  - **\$3M** — QNM-I direct state appropriation (Line 95)
  - **\$49.3M** — DARPA Quantum Benchmarking Initiative, QNM-I-administered; primary recipients LANL & SNL (Line 86)
- **Direct to UNM:**
  - **\$5M** — UNM Health Sciences quantum computing and HPC upgrades (Line 276)
- **Competitive — QNM-I well-positioned:**
  - **\$10M** — Quantum computing access — state-procured systems (Line 84; Governor modified language from “cloud” to “quantum computing”)
  - **\$38M** — Statewide open quantum user facility; must house quantum computer, hybrid classical-quantum workspace, national lab collaboration (Line 94)
  - **\$40M** — Quantum share of \$110M R&D deployment fund (performance-contingent) (Line 96)
  - **\$10M** — Endowed faculty positions and postdocs for NM higher education institutions (Line 88)

## Active Federal Opportunities:

- **New Partnerships & Facilities:**
  - Roadrunner Quantum Lab | PAIS AMO Lab build-out
  - QuEra & Quantinuum industry partnerships
  - Sandia MOU completion | Formal LANL partnership agreement

# Summary: QNM-I — FY25 at a Glance

- \$1.8 direct state appropriation + \$10.8M DARPA Quantum Benchmarking Initiative (QNM-I-administered)
- 15 peer-reviewed publications; 30+ active student researchers; 60+ PhDs and postdocs trained since 1995
- Anchor institution of the Mountain West Quantum Tech Hub; active industry partnerships with QuEra and Quantinuum and Roadrunner Quantum Lab
- FY26 priorities: Sandia MOU, formal LANL partnership, Roadrunner Quantum Lab, PAIS AMO Lab, NSF NQNI proposal (due May 14)