

QUANTUM

Colorado School of Mines Research



COLORADO SCHOOL OF
MINES

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CHALLENGES DON'T WAIT.

NEITHER DOES
COLORADO SCHOOL
OF MINES.

Quantum technologies are no longer a distant dream. They are the foundation of tomorrow's breakthroughs. From ultra-secure communications to transformative computing and sensing capabilities, quantum systems promise to redefine industries and push the boundaries of what's possible in computing, communication and measurement. As global efforts to harness quantum potential accelerate, the need for collaboration, rapid advancement and a skilled workforce has never been more critical.

The quantum future is here. An established leader in quantum science, Colorado School of Mines is developing the systems and insights that will drive the next era of technological breakthroughs.

As an R1 institution according to the Carnegie Classification and among the top five percent of research universities in the U.S., we combine 150 years of rigorous research with practical applications, tackling challenges that demand both technical excellence and interdisciplinary insight. Our quantum research spans experimental development, advanced instrumentation and applied quantum systems, supported by state-of-the-art facilities such as Quantum Commons and Edgar Experimental Mine. We established the first quantum systems engineering bachelor's degree program in the nation and were one of the first universities to offer a quantum engineering master's degree to prepare students to meet the rapidly evolving demands of the quantum workforce.

Our faculty, students and partners are advancing secure, scalable and transformative quantum technologies. By bridging disciplines and industries, we are solving today's challenges and anticipating tomorrow's needs. At Mines, we lead with purpose, precision and a commitment to shaping a quantum-powered future.



Explore how Mines is leading quantum innovation at mines.edu/quantum-research.

Ceramic engineering student Aiden Walla inspects the Reflection High Energy Electron Diffraction (RHEED) beam on the Molecular Beam Epitaxy (MBE) thin-film growth chamber.

SHAPING A

FUTURE

OF OPPORTUNITY

At Mines, we leverage top talent, collaborative partnerships, key projects and hands-on education to take quantum solutions to the next level. By connecting students, researchers and industry partners, we're preparing the next generation of quantum innovators while turning cutting-edge quantum discoveries into real-world impact.

QUANTUM COMMONS

A 70-acre site owned by Mines, Quantum Commons is a purpose-built, open-access campus advancing quantum technology. Strategically located between Boulder, Golden and Denver, Colorado, it provides labs, fabrication facilities and collaborative spaces to accelerate R&D and manufacturing. Opening in 2026, it will feature a 17,000-square-foot open-access quantum lab, a 10,000-square-foot fabrication and cleanroom building for prototyping and low-volume manufacturing and ample space for startups, scale-ups and future expansion.

→ Read more about Quantum Commons on [page 6](#).

COLORADO UNDERGROUND RESEARCH INSTITUTE (CURIE)

CURIE converts the Edgar Experimental Mine into a shallow-underground lab, providing a naturally shielded environment for ultra-sensitive experiments in quantum sensing and low-background physics, enabling testing of high-sensitivity quantum devices that surface labs cannot support.

→ Learn more about CURIE on [page 10](#).

OPEN QUANTUM FRONTIER INSTITUTE

Led by Mines, the Open Quantum Frontier Institute is working alongside other leading universities and national labs to push the boundaries of quantum research. OQFI aims to create open, collaborative frameworks for advancing foundational quantum science while promoting education, workforce training and technology translation.

→ Learn more about OQFI at [mines.edu/OQFI](#).

SHARED INSTRUMENTATION FACILITY (SIF)

Mines' Shared Instrumentation Facility (SIF) centralizes access to advanced scientific and engineering equipment and technical staff for nanofabrication, microscopy, materials analysis and more, supporting quantum researchers and industry partners in device fabrication, characterization and prototype development.

→ Connect with SIF at [mines.edu/shared-facilities](#).

THE NEXT ERA OF QUANTUM TECHNOLOGY

Quantum science isn't just for the lab—it will power the next purpose-built quantum systems. These emerging technologies promise to unlock capabilities not possible with today's tools, powering breakthroughs in:

Quantum computing: Rather than using linear systems to solve problems like today's computers, quantum computing can explore many possible solutions at once, enabling faster and more complex computing.



Quantum sensing: Quantum sensors are more sensitive and don't require calibration, providing ultra-precise measurements of gravity, motion and magnetic fields. For example, measurements would be possible in GPS-denied environments like space or deep within mines.



Quantum communication: Communication channels can become more secure—information can be transmitted in a way that makes eavesdropping physically impossible. These technologies could reshape cybersecurity for government, finance and critical infrastructure.



Quantum imaging: Surpassing classical limits in resolution and sensitivity, these techniques promise advances in medical imaging, non-invasive diagnostics and the detection of objects or features that are otherwise invisible using conventional methods.



ELEVATING THE QUANTUM ECONOMY



The quantum era is taking off in the Mountain West, and Mines is leveraging its leadership and partnerships to shape that future. Alongside Elevate Quantum, the university is turning advancements in quantum systems, devices and applications into real-world impact—building labs, supporting startups and preparing the next generation of quantum-skilled engineers. With a 70-acre Quantum COmmons hub and programs to rapidly grow the quantum workforce, Mines is transforming Colorado into the nation's premier quantum ecosystem and setting the stage for discoveries that promise to change the world in exciting new ways.



Read about Mines' collaboration with Elevate Quantum at mines.edu/elevatequantum.

Quantum COmmons, owned by Mines, is a key asset for advancing quantum technology in Colorado, with open-access labs and a collaborative community design.



BUILDING THE QUANTUM WORKFORCE

STORY BY JEN A. MILLER

As quantum technology moves from the theoretical to real-world application, Mines is preparing the next generation of engineers and scientists to close critical skill gaps in the emerging quantum workforce. With programs spanning every degree level and industry-focused certificate options, Mines is providing hands-on training that equips graduates to innovate and lead across sectors. Uniting education, research and industry, Mines is helping ensure the U.S. has the talent needed to power the quantum revolution.



Read the full story and learn more about Mines' quantum educational opportunities at mines.edu/quantum-workforce.

PhD students Sam Saiter, center, and Bradley Lloyd, right, work with Physics Associate Professor Meenakshi Singh on the dilution refrigerator in one of the quantum labs on the Mines campus.

Supporting the quantum workforce with the Quantum Engineering Fellowship

Supported by the National Science Foundation, Mines' Quantum Engineering Fellowship is helping shape the future of quantum workforce by training the next quantum leaders. Fellows dive into hands-on, interdisciplinary research that bridges materials, physics, computing and more. They work alongside faculty, industry partners and national labs to turn emerging quantum technologies into real-world impact. They develop technical expertise, professional skills and leadership experience through collaborative projects that prepare them for careers across academia, industry and government.

By combining cutting-edge research with mentorship and industry engagement, Mines' Quantum Engineering Fellowship is equipping students to build—and lead—the quantum revolution.

Learn more about the Quantum Engineering Fellowship at mines.edu/qef.

TAKING QUANTUM RESEARCH TO NEW DEPTHS

STORY BY ASHLEY SPURGEON

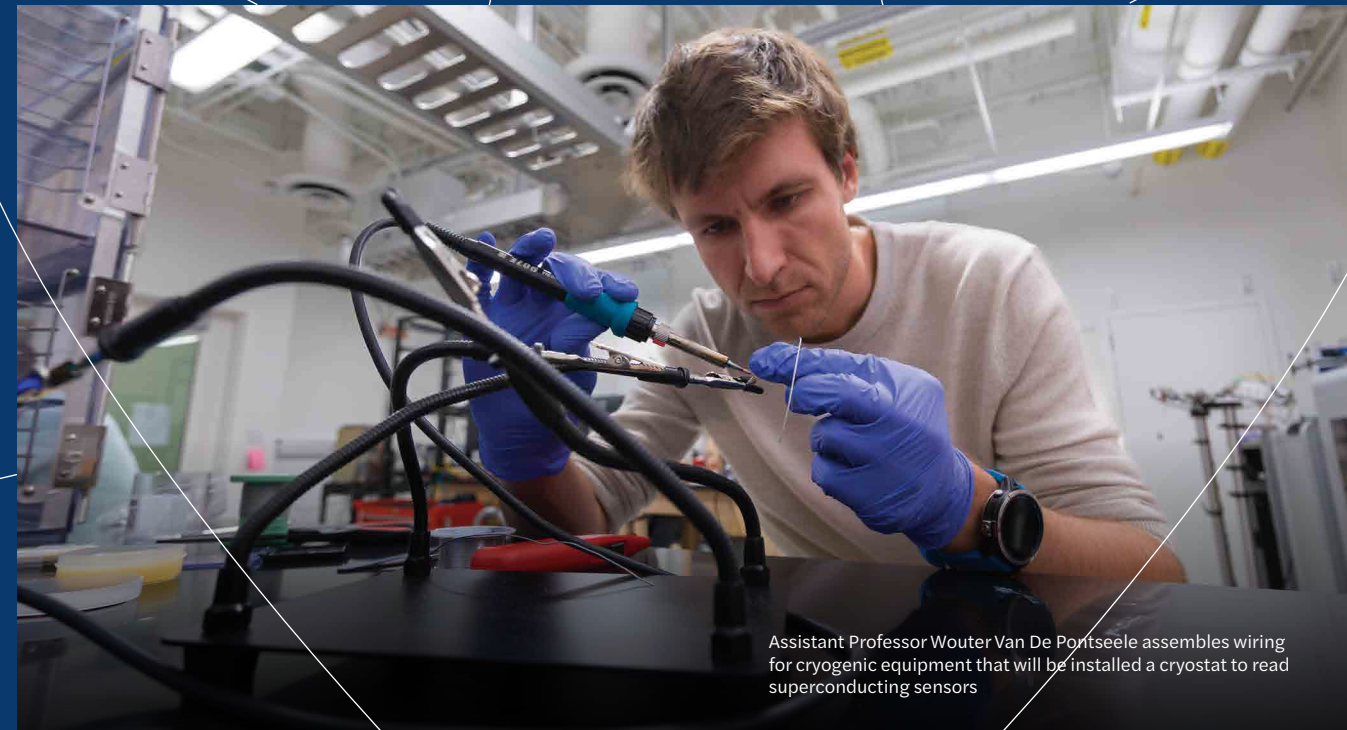
In the depths of the historic Edgar Experimental Mine, Mines researchers are building the future of quantum science. The Colorado Underground Research Institute (CURIE) is using this first-of-its-kind underground quantum laboratory as an ultra-quiet environment ideal for developing quantum detectors, studying dark matter and neutrinos and testing superconducting systems near absolute zero. By bringing physicists, engineers and computer scientists together in this unique space, Mines is pushing the boundaries of quantum sensing, precision measurement and next-generation technology.



Read the Q&A with Kyle Leach, CURIE's science director, to learn more about CURIE's development, the research it will enable and the interdisciplinary collaboration that is fueling the next steps in quantum discovery at mines.edu/CURIE-QA.



Physics PhD candidate Dakota Kehlbeck works in the Subatomic Particle Hideout in Edgar Experimental Mine, where the underground space provides a stable environment for sensitive equipment used in particle physics and quantum computing.



Assistant Professor Wouter Van De Pontseele assembles wiring for cryogenic equipment that will be installed in a cryostat to read superconducting sensors

UNLOCKING COSMIC MYSTERIES AND IMPROVING QUANTUM COMPUTERS

STORY BY JENN FIELDS

Rare particle interactions could hold the keys to understanding the universe and what limits quantum computing. The challenge? These particles are difficult to detect and require incredibly sensitive quantum instrumentation and specialized environments to be studied. At Mines, Assistant Professor Wouter Van De Pontseele and his team are preparing two unique underground laboratories to explore these mysteries and push the boundaries of fundamental physics and quantum technology.



Explore how Mines researchers are uncovering the universe's secrets, one particle at a time, at mines.edu/quantum-particles-research.



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At Colorado School of Mines, research transforms ideas into impact.

As a leading public R1 university in applied science and engineering, Mines delivers the talent, innovation and collaboration that move industry and society forward. Our researchers are advancing discoveries in quantum systems, energy, materials and more, tackling complex, real-world challenges with practical solutions. With an approach that connects technical excellence to economic, social and environmental insight, Mines research delivers impact that lasts. Explore our discoveries and solutions at research.mines.edu



View this publication digitally and explore more content about how Mines is leading quantum innovation at mines.edu/quantum-research.

Cover: Wide angle abstract view of quantum waves intertwining in a futuristic setup.