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Quantum Information Science Licensing Opportunities

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Quantum Information Science

ORNL researchers are working with the US Department of Energy (DOE), industry, and academia to advance the burgeoning field of Quantum Information Science (QIS). QIS technologies are based on the notion that information can be coded, stored, computed, and transferred as quantum physical states, for faster decision-making based on processing larger amounts of data more securely. ORNL researchers are conceptualizing and building devices to manipulate the quantum states of light and matter, measuring their quantum behavior and investigating ways to harness existing telecommunications systems for quantum communications. Members of ORNL’s QIS Group, who provide profound technical expertise in both classical and quantum computing, are also building prototype quantum computers to investigate the best platforms for different kinds of quantum computing. The Laboratory also hosts a robust quantum materials research program that complements our QIS developments. It is projected that nearly every type of business will be impacted by quantum information technologies, and ORNL supports industry by positioning ourselves at the forefront of this high-risk research area. For a listing of ORNL quantum information inventions available for licensing, please visit quantumsciencetechnology.ornl.gov.

Quantum Hardware and Technology

QIS must be underpinned by specialized equipment and methods that enable scientists to investigate the quantum behavior of light and matter so they can deliver technological advancements. ORNL’s QIS Group focuses on interconnecting technologies that will enhance quantum sensing, communications, and computing capabilities. Group members work with industry partners to develop effective research tools and equipment components and have patented numerous quantum sensing devices and methods enhancing the sensitivity of quantum information measurements, including a recent patent on quantum-enhanced atomic force microscopy. ORNL also has a broad portfolio in quantum random number generators (QRNGs), which can be used to encode messages with truly random encryption keys that are impossible to decipher or predict, promising a stronger defense against cyberattacks. Our researchers are exploring squeezed-light, single-photon, and entangled-photon quantum light sources and their measurement systems, and quantum key distribution systems, in addition to QRNGs.

Quantum Communications

Developments contributing to effective transmission of quantum information will drive fundamentally new improvements in data security, computing, and optical networks. ORNL has supported basic research in quantum communications methodologies for nearly two decades, allowing our researchers to be the first to advance numerous new technologies, and many ORNL projects focus on real-world demonstrations of the technologies we develop in test beds. In addition to patenting apparatuses and methods for quantum communications—inducing multiparty quantum secret sharing, quantum enhanced sensors, and quantum key distribution for secure communications among them—the QIS Group plays an important role as advisor to small businesses that want to move quantum communications products to market. Our collaborations have led to real products listed for sale on company websites, and industry partners licensing ORNL-developed technologies have successfully procured small business funding grants. Our scientists also assist the federal government with technical proposal reviews, pinpointing feasible ideas for funding.

Quantum Computing

Computing serves an important role in scientific discovery and innovation, and quantum computers are expected to accelerate research capabilities well beyond today’s leading systems. ORNL is leveraging decades-long expertise in supercomputing and data sciences to propel the use of quantum computing for modeling, simulation, and analysis of rapidly growing data sources and cutting-edge artificial intelligence research. ORNL’s QIS Group has built hybrid quantum/classical systems, using them to conduct experiments that guide development toward fully quantum computers. Our researchers also create benchmarks for evaluating quantum devices and quantum computers built by industry partners such as IBM, Google, and Rigetti, advising DOE on the best uses for each. ORNL’s Quantum Computing Institute draws on the Laboratory’s broad scientific capabilities to accelerate the R&D needed to more quickly realize quantum computing’s benefits. We also serve as a regional hub for the IBM Q network, an international collaboration working to advance quantum computing, and operate the Quantum Computing User Program to provide early access to commercial quantum systems.

Licensing Success Story: Qrypt, Inc.

New York–based Qrypt, Inc., exclusively licensed a quantum random number generator (QRNG) developed at ORNL that promises a stronger defense against cyberattacks, including those posed by quantum computing, by providing encryption keys that are truly random and therefore cannot be generated more than once. Qrypt will incorporate ORNL technology into a suite of quantum-resistant encryption techniques and technologies.

The novel cybersecurity technology detects the presence and measures the quantum statistics of photons streaming from a light source, using the resulting data as the basis for creating truly unique encryption keys that are impossible to decipher or predict.

“Historically, patterns, predictability, and repetition are a critical flaw for many crypto systems, allowing them to fall to basic cryptanalysis,” Denis Mandich, Qrypt’s chief technology officer, said. “The cryptography we have developed… is mathematically proven to be unbreakable—even in theory.”

ORNL’s research is integral to Qrypt’s hybrid approach combining quantum physics hardware with postquantum cryptographic algorithms and software. “We anticipate a long and productive partnership with one of the nation’s premier labs as we continue to develop secure computing technologies,” he added.