

Illinois Department of  
Innovation & Technology

# Unlocking the Quantum Realm: How Illinois is Building a Superhighway for the Next Generation

Cross-Boundary Collaboration

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Initiation Date: 06.27.2023  
End Date: 05.17.2024

## EXECUTIVE SUMMARY

The Illinois Department of Innovation and Technology (DoIT), the University of Illinois Urbana-Champaign (UIUC), the University of Chicago (UC) and Kankakee Community College (KCC) have partnered to advance Quantum Information Science (QIS) research and testing. This collaboration aims not only to push the boundaries of QIS, but also to expand access to this revolutionary field. KCC is positioned to become a regional center of excellence and training for QIS, directly benefiting its students. Local schools are also expected to benefit from access to the quantum technology at KCC through collaborative efforts. This initiative has the potential to create a pipeline of future quantum engineers and scientists throughout Illinois.



*Kankakee Community College (KCC) has joined forces with DoIT to propel research and testing in Quantum Information Science*

## IDEA

One of the key challenges of quantum networking, an application of QIS, is to address the distance supported for information transfer. To realize quantum networking for commercial applications, the distance for information transfer should be similar or better than current distances supported by traditional communication methods. Research scientists at UIUC and UC lacked access to long-distance, high-quality fiber strands to allow testing and characterization for quantum network information transfer.

Once DoIT was aware of these quantum networking challenges, DoIT's idea was to leverage its assets to help. Specifically, DoIT provided access to 12 strands of high-quality fiber between Champaign and Chicago and provided access to a data room at KCC, a facility strategically located on the path. Leveraging DoIT relationships, it quickly became clear to KCC that access to quantum expertise at UIUC and UC and having quantum equipment located at KCC would enable quantum-based curricula to be established to support workforce training for quantum skills. KCC rapidly developed a plan with the goal of becoming a regional hub of QIS expertise and workforce development and training.

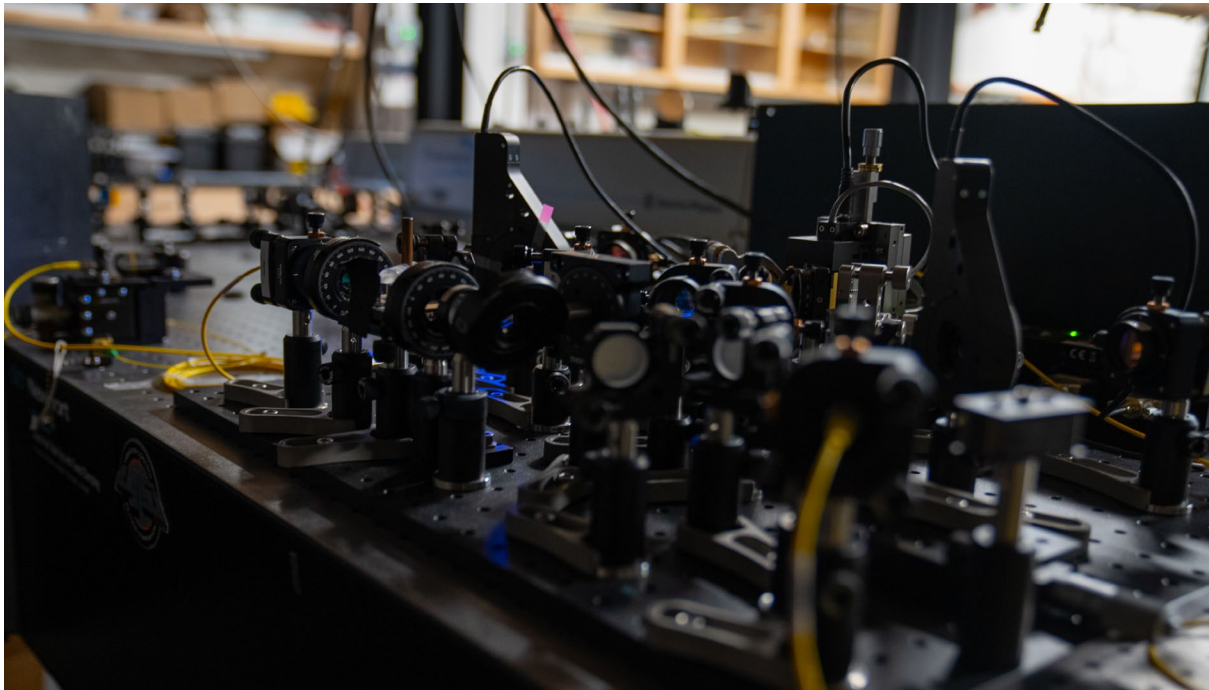
The Quantum Networking project supports QIS as a national priority. Indeed, Illinois has received over \$280M as part of the National Quantum Initiative [www.quantum.gov](http://www.quantum.gov), an act of Congress calling for a coordinated federal program to accelerate quantum research and development for the economic and national security of the United States. By providing access to the DoIT fiber and leveraging assets at KCC, this project accelerates quantum research and development, in line with the federal goal.

## IMPLEMENTATION

The project participants include the leading professors of QIS at UIUC and UC, the IT Director and related personnel at KCC, and DoIT staff. The project was led by DoIT staff, and required coordination between network engineering, scientists and legal staff at UIUC and UC, network engineering at KCC, and network engineering and legal staff at DoIT. The first deliverable was a signed memorandum of understanding between DoIT, UIUC, and UC for the use of 12 strands of DoIT fiber between Champaign and Chicago, at no charge for UIUC and UC, for the purpose of QIS research and testing. In addition, DoIT facilitated the “last mile” connection between the 12 DoIT fiber strands and the physics laboratories by implementing fiber splices between DoIT fiber and third-party fiber in both Champaign and Chicago.

DoIT tested and characterized the fiber to ensure low signal loss as required by the quantum researchers. Quantum requires high quality fiber (i.e., low signal loss) between Champaign and Chicago. UIUC has continued to characterize and test the fiber by performing polarization stability testing and as a result of the testing will be implementing polarization correction on the fiber path.

A visit to KCC by UIUC and UC professors was facilitated by DoIT to strengthen the relationship between the universities and KCC, and to begin preparing for the install of quantum technology in the data room. The partners also discussed and planned for how the professors could help with the workforce development at KCC.



*Testing Fiber for KCC's Quantum Future: Preparing high-quality fiber optics for KCC's quantum technology. integration.*

**How a quantum network enables information transfer:** A quantum network enables secure transmission of data by using the unique properties of particles of light, called photons. One unique property is that of entanglement, where two photons can be associated with each other, such that a measurement of one affects the outcome of a measurement of the other, irrespective of the distance between the two photons if the state of entanglement is maintained.

If two photons are entangled, and one is sent to another location (via, for example, a high-quality fiber optic strand), after an initialization and measurement process on the two photons, information transfer can occur between the photons such that information at the source photon is “magically” seen at the destination photon, without having the information transferred in the traditional sense via 1s and 0s! Among quantum researchers, this transfer of information is known as quantum teleportation.

## IMPACT

The impact of this partnership is significant. An end-to-end fiber path between the quantum labs at UIUC and UC was established as a result of this initiative, and testing has begun to characterize the fiber for quantum networking. This involves DoIT network engineers working with UIUC and UC engineers engaging in quantum research. In addition to fiber characterization testing, UIUC is developing a cost-effective photon source that can be placed at KCC. With quantum technology at KCC, courses will be created in quantum information science, where students can participate in the laboratory and get to “touch” the equipment. The goal is for KCC to become a regional hub for K-12 Science, Technology, Engineering and Mathematics (STEM) and higher education learning and workforce development for quantum skills.

Enabling long distance quantum networking aligns with the National Quantum Initiative and Illinois’ quantum priorities as stated by Governor Pritzker. The long-term goal is to expand access to QIS to other universities, community colleges and K-12 schools in Illinois via the state network. The state network is directly connected to these institutions and the intent is to expand the quantum network and bring QIS to students and the community throughout Illinois.



*“Kankakee Community College is extremely excited to be a participant in this endeavor. The quantum network will provide a myriad of opportunities for the College but will also bring about opportunities for the surrounding community. We realize that we are on the forefront of something big, something that will be as game changing as the Internet itself.”*

**- Michael O’Connor, Information Technology Services Sr. Director**

KCC, with available funding for QIS, intends to build a laboratory that complies with the strict environmental conditions required for QIS technology, ensuring KCC remains a regional leader in QIS technology and workforce development. The goal is for KCC to become a model that can be replicated by other community colleges in Illinois and throughout the nation that want to develop QIS technology and skills.

It's an incredible motivator for DoIT staff to be involved with the pioneers of QIS, and leveraging the state network to support quantum communication opens a whole new world – a world that DoIT staff had a hand in creating. The future is looking bright!