POINTS OF INTEREST

BARRY SANDERS

Compute-intensive problems, once thought unsolvable, and heightened encryption security, once thought unachievable, are within arm's reach thanks to one of science's smallest units of information.

The qubit, the basic unit of quantum information, is one of the building blocks behind quantum information science. Quantum information science applies the principles and technologies of quantum physics to advance information and communication science and technology.

Barry Sanders, Director of the University of Calgary's Institute for Quantum Information Science (IQIS), explores the enabling technologies, implementation of protocols, and foundational issues behind quantum information science.

"Our work transcends the spectrum from mathematical physics to collaborations on practical experiments," says Sanders.

Quantum information science is a new and rapidly growing multidisciplinary field, notes Sanders, who is also an iCORE Professor of Quantum Information Science. The work being done at IQIS is contributing to the understanding and methodology of the field as well as realizing, through collaboration, experimental firsts in underpinning technologies and protocols. The group has broken new technological ground in the areas of detectors and quantum memory, as well as undertaking advanced research in protocol areas of quantum state sharing and quantum fingerprinting.

The importance of this kind of research is growing as the realm of information and communication science is destined for change. To date, growth in computational power has been aided by advancements in miniaturization. However, the quantum barrier remains a bridge that technology must inevitably cross. Eventually, and some predict by the year 2020, we will reach a point where quantum effects will become dominant. Computer technology and Internet security are two areas susceptible to these effects and yet also have the potential to benefit from them.

"Quantum information science may provide guaranteed unbreakable encryption for secure communication, and computers that can solve problems that are not solvable without quantum information technology," says Sanders.

A portion of Sanders' work is dedicated to informing and educating decision-makers, students and the public about the salient points of quantum information science and technology. Cyberinfrastructure tools come into play here, as Sanders and IQIS employ sophisticated 3D immersive visualization technology to share and explore the concepts of quantum information science with the outside community. Networks like NeteraNet will play a future critical role for Sanders and IQIS.

"Our plans are to create a quantum secure network in Alberta, which would require dedicated dark fibre in the future optical fibre infrastructure," Sanders says.

A dark fibre network, is a privately operated optical fibre network that is run directly by its operator. The dark fibre requirement is essential to provide quantum secure communications between distant points in Alberta, Sanders says. The alternative would be expensive and highly challenging satellite technology.

"Visualization over long distance will be critical to our capability of explaining this nascent and important technology," Sanders says.

As the field of quantum information science continues to evolve, so do the opportunities for innovations in computation, encryption and mathematical physics. Much of the work being performed by Sanders and IQIS at the University of Calgary will provide the keys to opening these new doors of possibility.