Quantum copies do new tricks

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One of the strange features of quantum information is that, unlike almost every other type of information, it cannot be perfectly copied. For example, it is impossible to take a single photon and make a number of photons that are in the exact same quantum state. This may seem minor, but it's not. If perfect copying was possible, it would, among other things, be possible to send signals faster than the speed of light. This is forbidden by Einstein's theory of relativity.

For years, scientists have been experimenting with the idea of approximate quantum copying. A recent paper published in *Physical Review Letters* (PRL), by Sadegh Raeisi, Dr. Wolfgang Tittel and Dr. Christoph Simon of the Institute for Quantum Information Science at the University of Calgary takes another step in that research.

They showed that it is possible to perfectly recover the original from the imperfect quantum copies. They also proposed a way that his could be done in practice.

"Copying classical information is very important in our daily lives," says paper co-author Simon. "Think of the prevalence of photocopiers, faxes, scanners. It was quite surprising for physicists when they realized that the same thing is not possible for quantum systems, at least not perfectly. It is then important to study what exactly is possible and what isn't."

The research can be used in a variety of ways. First, it shows clearly that quantum information is preserved when copied. Even though the copies may be imperfect, the original quantum state can be recovered. In practical terms, it might lead to a precision measurement technique based on quantum physics for samples that have very low contrast, such as living cells.

The Institute for Quantum Information Science is a multidisciplinary group of researchers from the areas of computer science, mathematics and physics.

"At the fundamental level our world is governed not by classical physics, but by quantum physics," says Simon. "We are trying to understand the consequences of that for fundamental concepts such as information and trying to use this understanding to develop new kinds of quantum technology."

Provided by University of Calgary