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Physicists Daniel Ebler, Sina Salek, and Giulio Chiribella have published a paper on this unusual property of quantum channels and its potential advantages for quantum communication in a recent issue of Physical Review Letters.

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As the physicists explain, the results may seem paradoxical because exchanging the order of two identical channels does not appear to have any effect in an ordinary quantum circuit. However, quantum channels are inherently noisy, and so each channel can be decomposed into a random mixture of different processes. Some of these processes do not commute with each other—that is, using the processes in different orders produces different outcomes—and so these differences carry over to the channels themselves.

This underlying randomness leads to the ability to create a channel that transmits information—information that is contained neither in the state of the system alone nor in the state of the control alone, but rather in the correlations between...
The physicists calculated the maximum amount of information that can be transmitted by switching two identical channels, and they expect that it may be possible to communicate more information by using additional copies of these channels. In collaboration with the group of Professor Philip Walther in Vienna, they are now planning to implement their communication protocol with photons.

"The goal is to develop a full theory of communication, extending Shannon's theory to situations where different transmission lines can be combined in a quantum way," Salek said.


Also at: [arXiv:1711.10165](https://arxiv.org/abs/1711.10165) [quant-ph]

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