

# Celebrating the Choi-Jamiołkowski Isomorphism



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## Higher-order quantum processes and quantum causal structures

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One of the most profound insights of the Choi-Jamiołkowski isomorphism is that quantum processes can be treated as quantum states. Following this idea, it is natural to consider a kind of super-processes that transform quantum processes into quantum processes, in a similar way as ordinary processes transform quantum states into quantum states. This construction can be iterated recursively, generating an infinite hierarchy of processes of increasingly higher orders. Physically, this hierarchy corresponds to an extension of the framework of quantum circuits, including the ordinary acyclic circuits considered in quantum computing, as well as a new type of quantum circuits with cycles. In this talk I will present the main notions in the study of higher order quantum processes, discussing their application to quantum information and their connection with the study of causal structure in quantum mechanics.

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