

Dual Channels and Dual Codes: Using Heisenberg uncertainty to achieve Shannon capacity

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The dual of a linear code is a well-defined and very useful notion in coding theory. Except for the erasure channel, however, there is no satisfactory notion of a dual channel in the sense that the performance of a channel under a given code is directly related to the performance of the dual channel under the dual code. In this talk I'll describe how this problem can be overcome by constructing a dual channel which is not a usual "classical" channel, but rather a channel with quantum outputs. The performance of the channel and its dual are closely related by the Heisenberg uncertainty principle, a fact that Hassani, Sutter, and I recently used to study the alignment of polar coding sets. In particular, I'll show how recently-formulated entropic uncertainty relations can be used to link the capacity and EXIT functions of the two channels, so that a threshold in the EXIT function for a given classical channel and linear code must occur at capacity.