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Extreme bosonic channels

Abstract: The set of all channels with fixed input and output is convex. We first give a convenient formulation of necessary and sufficient condition for a channel to be extreme point of this set in terms of complementary channel, a notion of big importance in quantum information theory. This formulation is based on the general approach to extremality of completely positive maps in an operator algebra due to Arveson. We then apply this formulation to prove the main result: under certain nondegeneracy conditions, purity of the environment is necessary and sufficient for extremality of Bosonic quasi-free channel. It follows that Gaussian channel between finite-mode Bosonic systems is extreme if and only if it has minimal noise (quantum-limited).



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