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Limits on classical communication from quantum entropy power inequalities

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Almost all modern communication systems rely on electromagnetic fields as a means of information transmission, and finding the capacities of these systems is a problem of significant practical importance. The Additive White Gaussian Noise (AWGN) channel is often a good approximate description of such systems, and its capacity is given by a simple formula. However, when quantum effects are important, estimating the capacity becomes difficult: a lower bound is known, but a similar upper bound is missing. Here we present strong new upper bounds for the classical capacity of quantum additive noise channels, including quantum analogues of the AWGN channel. Our main technical tool is a quantum entropy power inequality that controls the entropy production as two quantum signals combine at a beam splitter. Its proof involves a new connection between entropy production rates and a quantum Fisher information, and uses a quantum diffusion that smooths arbitrary states towards gaussians.