Exact solution for the quantum and private capacities of bosonic dephasing channels

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The capacities of noisy quantum channels capture the ultimate rates of information transmission across quantum communication lines, and the quantum capacity plays a key role in determining the overhead of fault-tolerant quantum computation platforms. In the case of bosonic systems, central to many applications, no closed formulas for these capacities were known for bosonic dephasing channels, a key class of non-Gaussian channels modelling, e.g., noise affecting superconducting circuits or fiber-optic communication channels. Here we provide the first exact calculation of the quantum, private, two-way assisted quantum, and secret-key agreement capacities of all bosonic dephasing channels. We prove that that they are equal to the relative entropy of the distribution underlying the channel to the uniform distribution. Our result solves a problem that has been open for over a decade, having been posed originally by [Jiang/Chen, Quantum and Nonlinear Optics 244, 2010].