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Quantum Darwinism, Amplification, and the Quantum Chernoff Bound

Amplification was regarded, since the early days of quantum theory, as a mysterious ingredient that endows quantum microstates with macroscopic consequences, key to the "collapse of the wavepacket", and a way to avoid embarrassing problems exemplified by Schrödinger's cat. This bridge between the quantum microworld and the classical world of our experience was postulated ad hoc in the Copenhagen Interpretation. Quantum Darwinism views amplification as replication, in many copies, of information about quantum states. We show that such amplification is a natural consequence of a broad class of models of decoherence, including the photon environment we use to obtain most of our information. The resulting amplification is huge, proportional to the environment size times the "typical" Quantum Chernoff Information, which quantifies the efficiency of the amplification. The information communicated through the environment is imprinted in the states of individual environment subsystems, e.g., in single photons. Multiple copies imprinted in the environment allow it to serve as a reliable witness to the states of the "systems of interest" to observers, and result in the emergence of the objective reality we are accustomed to in our effectively classical world.

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