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Stability of Quantum Statistical Ensembles with Respect to Local Measurements

Abstract: We introduce a stability criterion for quantum statistical ensembles describing macroscopic systems. An ensemble is called "stable" when a small number of local measurements cannot significantly modify the probability distribution of the total energy of the system. We apply this criterion to lattices of spins-1/2, thereby showing that the canonical ensemble is nearly stable, whereas statistical ensembles with much broader energy distributions are not stable. In the context of the foundations of quantum statistical physics, this result justifies the use of statistical ensembles with narrow energy distributions such as canonical or microcanonical ensembles.