Universal scaling laws for correlated decay of many-body quantum systems

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A key challenge in scaling up quantum systems is the potential for correlated decay, which can significantly reduce the lifetime of states of interest. This talk answers the following question: what is the maximal decay rate of a quantum system, and how does it scale with system size? Addressing this question, especially for systems comprising a large number of particles, is challenging due to the exponential increase in complexity of the Hilbert space. I will present a method that circumvents this difficulty by reformulating the problem into finding the ground state energy of a generic spin Hamiltonian. By establishing strict upper and lower bounds on this energy, we discover universal scaling laws that depend solely on the system's size, dimensionality, and interaction range. These laws serve as upper limits on how fast any quantum state can decay, and offer valuable insights for research in quantum optics, metrology and sensing.