Quantum Physics

Dynamical evolution of quantum oscillators towards equilibrium

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A pure quantum state of large number N of oscillators, interacting via harmonic coupling, evolves such that any small subsystem n<<N of the global state approaches equilibrium. This provides a novel example where equilibration emerges as a natural phenomena under quantum dynamics alone, with no necessity to bring in any additional statistical postulates. Mixedness of equilibrated subsystems consisting of 1, 2, ..., n<<N clearly indicates that small subsystems are entangled with the rest of the state i.e., the bath. Every single mode oscillator is found to relax in a mixed density matrix of the Boltzmann canonical form. In two oscillator equilibrated subsystems, intra-entanglement within the `system' oscillators is found to exist when the magnitude of the squeezing parameter of the bath is comparable in magnitude with that of the coupling strength.

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