Interaction-induced time-symmetry breaking in driven quantum oscillators

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We study parametrically driven quantum oscillators and show that, even for weak coupling between the oscillators, they can exhibit various many-body states with broken time-translation symmetry. In the quantumcoherent regime, the symmetry breaking occurs via a nonequilibrium quantum phase transition. For dissipative oscillators, the main effect of the weak coupling is to make the switching rate of an oscillator between its period-2 states dependent on the states of other oscillators. This allows mapping the oscillators onto a system of coupled spins. For identical oscillators, the stationary state can be mapped on that of the Ising model with an effective temperature. alpha h, for low temperature. If the oscillators are different and are away from the bifurcation parameter values where the period-2 states emerge, the stationary state corresponds to having a microscopic current in the spin system. Close to the bifurcation point the coupling cannot be considered weak and the system maps onto coupled overdamped Brownian particles performing quantum diffusion in a potential landscape.

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