Driven-dissipative quantum systems and hidden time-reversal symmetries

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Quantum systems subject to both driving and dissipation often have complex, non-thermal steady states, and are at the forefront of research in many areas of physics. For classical systems, microscopic time-reversal symmetry leads to open systems satisfying detailed balance. In this talk, I'll discuss a new way to think about detailed balance in fully quantum settings, based on the existence of "hidden" time-reversal symmetry. This symmetry is intimately connected to thermofield double states, is present in a number of experimentally-relevant systems. and has clear experimental signatures. Most importantly, it has a direct operational utility: it provides a direct way to find exact, analytic descriptions of highly complex systems. I'll try to give a gentle introduction to these ideas, with a particular focus on an exactly-solvable many-body driven-dissipative Bose Hubbard model (as can be realized directly in superconducting circuits and a variety of quantum optical platforms).