Generalizations of von Neumann and Schrödinger Equations for Open Quantum-Optical Systems

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In the conventional quantum mechanics of conserved systems, Hamiltonian is assumed to be a Hermitian operator. However, when it comes to open quantum systems, strict Hermiticity is no longer necessary. In fact, it can be substantially relaxed: the non-Hermitian (NH) part of a Hamiltonian is allowed, in order to account for effects of some dissipative environments, whereas its Hermitian part would be describing subsystem's energy. Within the framework of the quantum-statistical approach, utilizing both NH Hamiltonians and Lindblad's quantum jump operators, we derive various generalizations of the von Neumann equation for reduced density operators, also known as hybrid master equations. Using those we derive the generalization of the Schrödinger equation, which can be used for describing pure states, as well as for deriving effective Hamiltonians of dissipative systems, which take into account both NH Hamiltonian corrections and quantum jumps. If time allows, we consider the application of the approach to some simple quantum-optical system as an example.