Describing Open Quantum Systems using Lindblad Master Equation

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Recall Quantum Mechanics

We are familiar with closed systems that is described using Schrödinger equation:

$$\frac{\mathrm{d}\left|\psi\right\rangle}{\mathrm{d}t} = -i\hat{H}\left|\psi\right\rangle \implies \left|\psi(t)\right\rangle = e^{-i\hat{H}t}\left|\psi(t=0)\right\rangle$$

where $\hat{H}$ is not time dependent.

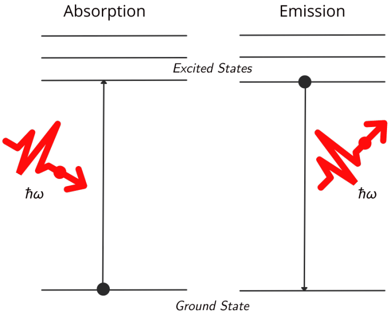
Incorporate Mixed States

Schrödinger equation can be written in terms of density matrix (von Neumann equation) instead:

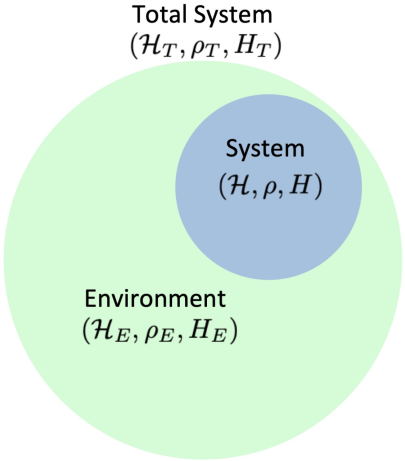
$$\frac{\mathrm{d}\hat{\rho}}{\mathrm{d}t} = -i\left[\hat{H}, \hat{\rho}\right]$$

where $\hat{\rho} = |\psi\rangle \langle\psi|$ for pure state.

No, in practice we loose information. Decoherence happens



So, what do we need to do then? We need to incorporate environment in our equations



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We start from the von Neumann equation

$$\frac{\mathrm{d}\hat{\rho}_T}{\mathrm{d}t} = -i\left[\hat{H}_T, \hat{\rho}_T\right] \tag{1}$$

where $\hat{H}_T = \hat{H} \otimes \hat{\mathbb{1}} + \hat{\mathbb{1}} \otimes \hat{H}_E + \alpha \hat{H}_{SE}$

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Any Questions?

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