Open Quantum Systems: Exercise session 6

Kay Schwieger, Paolo Muratore-Ginanneschi,
Dmitry Golubev and Brecht Donvil

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Exercise 1

Consider a nucleus with spin 1/2 and with the absolute value of magnetic moment γ in magnetic field with the components (B_x, B_y, B_z), which has relaxed to the equilibrium state at temperature T. Find the equilibrium components of the spin $\langle s_x \rangle_{\text{eq}}, \langle s_y \rangle_{\text{eq}}$ and $\langle s_z \rangle_{\text{eq}}$.

Exercise 2

At negative times $t < 0$ the spin is at equilibrium with the environment with the temperature T, and the magnetic field points to z-direction, $\boldsymbol{B} = (0, 0, B)$. At time $t = 0$ the magnetic field very quickly switches to x-direction and takes the form $\boldsymbol{B} = (B, 0, 0)$. Find the time evolution of all three components of the spin for $t > 0$ by solving Bloch equation.

Exercise 3

Consider a nucleus with spin 1/2 in magnetic field $(0, 0, B_z)$ and find the equilibrium correlator $\langle \sigma_y(\tau)\sigma_x(0) \rangle$. Time evolution of the spin is described by Lindbald equation with relaxation times T_1 and T_2, and the temperature of the environment is T.