Problem 1

Nagaoka bags

January 28-29, 2017

Let's use Caldeira-Leggett equation:

$$\frac{d}{dt}\rho_S(t) = -\frac{i}{\hbar}\left[H_S, \rho_S(t)\right] - \frac{i\Gamma}{2\hbar}\left[x, \{p, \rho_S(t)\}\right] - \Lambda\left[x, [x, \rho_S(t)]\right] \tag{1}$$

Where

$$\Lambda = \frac{2m\Gamma k_B T}{\hbar^2} \tag{2}$$

Second part of ham. responds to diagonal decoherence, and third responds to non-diagonal

$$[x, [x, \rho_S]] = [x, x\rho_S - \rho_S x] = xx\rho_S - x\rho_S x - x\rho_S x + \rho_S xx = x^2\rho_S - 2xx'\rho_S + {x'}^2\rho_S = (x - x')^2\rho_S \tag{3}$$

In a first approximation, we can solve eq (1) using part of hamiltonian

$$\rho_S(t, x, x') \simeq \exp\left[-\Lambda(x - x')^2 t\right]\rho_S(0, x, x') \tag{4}$$

$$\tau_D = \frac{1}{\Lambda\Delta x^2}, \Delta x = |x - x'| \simeq L \tag{5}$$

Finally,

$$\tau_D = \frac{\hbar^2}{2m\Gamma k_B T L^2} \tag{6}$$