ECE 656: Fall 2009
Lecture 19 Homework
(Revised 10/27/09)

1a) Assume isotropic elastic scattering in 1D (i.e. equal probability of forward and backward scattering). Show that the momentum relaxation rate is equal to the scattering rate.

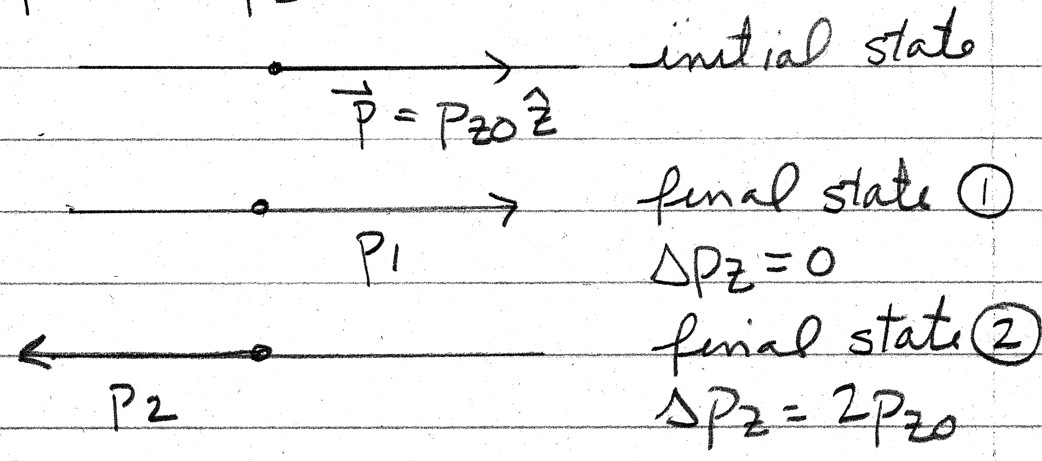
1b) Repeat problem 1a) but this time assume that the scattering is inelastic.

1a) assume elastic scattering

$$\frac{1}{\tau} = \sum_{\vec{p}\,'} S(\vec{p},\vec{p}\,') = \sum_{\vec{p}\,'} S_0$$

same for forward & backscattering

$$\frac{1}{\tau_m} = \sum_{\vec{p}\,'} S_0 \frac{\Delta p_z}{p_{z0}}$$



$$\frac{1}{\tau} = \sum_{p'} S_0 = 2S_0$$

$$\frac{1}{\tau_m} = \sum_{\vec{p}} S_0 \frac{\Delta p_z}{p_{z0}} = S_0 \times 0 + S_0 \times 2\frac{p_{z0}}{p_{z0}} = 2S_0$$

$$\frac{1}{\tau} = \frac{1}{\tau_m} \checkmark$$

1)

1b)

assume phonon emission

$|\vec{p}| \rightarrow |\vec{p}| - \Delta p$

final state ① $\Delta p_z = \Delta p$

final state ② $\Delta p_z = 2p_{z0} - \Delta p$

$$\frac{1}{\tau_m} = S_0 \cdot \frac{\Delta p}{p_{z0}} + S_0 \frac{(2p - \Delta p)}{p_{z0}} = 2S_0$$

so $\frac{1}{\tau_m} = \frac{1}{\tau}$ again ✓

2)