PHYS455 Homework set VII, Wednesday, March 9, 2005

(Due at 11am, March 16, 2005)

Fluctuations in 3D cubic crystals

1)(25pt) Following the steps outlined in the lecture notes, estimate the fluctuations of a particle in a 3d crystal at $T = 0$. Hint: use the following identity

$$<< U^2(\mathbf{R}) >>= \frac{1}{V_L} \sum_Q << U^2(\mathbf{Q}) >> . \tag{1}$$

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2)(35pt) Estimate the fluctuations of a particle in the presence of phonons excited at temperature kT (so you can neglect the zero point fluctuations). You need to present results in two limits: a) $kT \gg \hbar\Omega_D$ and b) $kT \ll \hbar\Omega_D$.