ECE 656: Fall 2009
Lecture 21 Homework

1) Problem 1.1 in Lundstrom

L21 - Lundstrom 1.1

$$H_{p'p} = \int_{-W/2}^{+W_2} \frac{e^{-ik_x' x}}{\sqrt{L}} \Delta U \frac{e^{ik_x x}}{\sqrt{L}} dx$$

$$= \frac{\Delta U}{L} \int_{-W/2}^{+W/2} e^{i(k_x - k_x')x} dx$$

$$= \frac{\Delta U}{L} \frac{e^{i(k_x - k_x')W/2} - e^{-i(k_x - k_x')/W_2}}{i(k_x - k_x')}$$

$$= \frac{2\Delta U}{L} \cdot \frac{\sin(k_x - k_x')W/2}{(k_x - k_x')}$$

$$S(p,p') = \frac{2\pi}{\hbar} \cdot \frac{4\Delta U^2}{L^2} \frac{\sin^2(k_x - k_x')W/2}{(k_x - k_x')^2} \delta(E - E')$$

$$S(p,p') = \frac{2\pi}{\hbar} \cdot \frac{2\Delta U^2}{L} \cdot \left(\frac{W}{L}\right) \cdot \left(\frac{\sin x}{x}\right)^2 \delta(E - E') \quad //$$

$$x = (k_x - k_x')W/2$$

if $k_x' = k_x$ $(\sin x/x)^2 \to 1$ but it didn't scatter

$k_x' = -k_x$ $(\sin 1)^2$ it reflected

1) if ΔU changes sign, no change in $S(p,p')$

this is a problems that can be solved exactly. For small ΔU, FGR will give the correct answer, but for large ΔU, differences occur and the sign of ΔU matters.