Elementary Particles II   Problem Set #9   due 6/2/03

Neutrino Oscillations

1. Prove eq. (6.41). Argue that, when one integrates over different energies of neutrinos, the interference term is negligible if $\Delta m^2 \gg 10^{-10}\ eV^2$ in case of real experiments where the neutrino energies span a range of at least a few MeV's.

2. Derive eq. (6.42). The argument for the limiting case of $P_{\mathrm{LSZ}} = 0$, $\theta_m^{\mathrm{p}} = \pi/2$ has been presented in the text. If a neutrino is produced in the far half of the sun so that it undergoes resonance twice, once on the way towards the core and once on its way out, show that

$$P_{\nu_e \to \nu_e} = \frac{1}{2}\left[1 + (1 - 2P_{\mathrm{LSZ}})^2 \cos 2\theta_m^{\mathrm{p}} \cos 2\theta\right].$$