Physics 125 Eighth Problem Set

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1. Griffiths, 6.13

2. In class, we estimated the $|\Delta M^2|$ necessary to describe the ^{37}Cl neutrino result (that only 1/3 of the expected solar ν_e's were seen) by assuming that $\sin^2 2\theta = 2/3$, and assuming that the Sun-to-Earth distance corresponded to the first minimum in the probability $P(\nu_e \to \nu_e)$. Now assume that $\sin^2 2\theta = 1$, and assume that the first minimum in $P(\nu_e \to \nu_e)$ occurs at a distance greater than the Sun-to-Earth distance, and re-evaluate $|\Delta M^2|$. Assume the typical ν_e energy is 7 MeV.

3. Suppose the MSW effect occurs for neutrinos penetrating normal rock, which has $\rho \approx 3\,\mathrm{gm/cm^3}$, and $\overline{Z}/\overline{A} \approx 1/2$. Assume that the typical ν_e energy is 1 GeV (that is, 1000 times bigger than the energy of solar neutrinos). For what approximate value of $|\Delta M^2|$ could the MSW effect stimulate a neutrino flavor transition? The energy here, 1 GeV, occurs when neutrinos are produced through the interaction of cosmic rays with the Earth's atmosphere.