Physics 491 Fall 2016

Recitation 10 Solution

(1) $\mu = \frac{e}{2mc} \propto \frac{1}{mass}$ so $\mu_N = \frac{1}{1800}\mu_e$

neutron $g \neq 2$ because it has structure (quarks)

(2) Intensity at D is $\frac{1}{2}$ spin up and $\frac{1}{2}$ spin down. Consider spin up.

$$|\psi_D^+\rangle = \frac{1}{\sqrt{2}}\left(|\psi_B\rangle + |\psi_C\rangle\right)$$

$$|\psi_B\rangle = |+z\rangle \quad |\psi_C\rangle = e^{-i\omega_0 t/2}|+z\rangle$$

$$P^+ = |\langle\psi_D^+|\psi_D^+\rangle|^2 = \frac{1}{2}\left|1 + e^{-i\omega_0 t/2}\right|^2 = \left(1 + \cos\frac{\omega_0 t}{2}\right)$$

same for spin down, so equal mixture $= \left(1 + \cos\frac{\omega_0 t}{2}\right)$ with period of modulation $\frac{\omega_0 T}{2} = 2\pi$

(3) $t = \frac{L}{v} = \frac{Lm\lambda}{h}\Big| \frac{10^{-2}m\,(940\,MeV)\,10^{-10}m}{(3\times10^8 m/s)^2(4.1\times10^{-21}MeV\cdot s)}$

$L = 1cm,\ \lambda = 1Å$

$= 2.55\,\mu s$

$\frac{\omega_0 t}{4\pi} = \frac{1.91\,\mu_N B t}{h}\Big|_{B=100G} = \frac{1.91\,(3.15\times10^{-14}MeV/T)\,10^{-2}T\,(2.55\times10^{-6}s)}{4.1\times10^{-21}MeV\cdot s}$

$= 0.374$

Reading $B = 60$ G from figure 3, with $l = 2.7$, $\lambda = 1.445$ Å

$\frac{\omega_0 T}{4\pi} = (0.374)(0.6)(1.445)(2.7) = 0.91$

which paper claims is one within exp. error