PHYS 200: Problem Set VII

Due: 4:30 pm March 22, 2005

1. [4] Neon atoms in a helium-neon laser have typical speeds on the order of 600 m/s. One of the electromagnetic waves emitted by these atoms has a wavelength (in the rest frame of the molecule) of 632.8 nm. What is the approximate width (in nanometers) of this spectral line due to Doppler broadening? (Hint: Calculate the largest and smallest wavelengths that result from the moving atoms. The difference in these wavelengths is the approximate wavelength width of the spectral line.)

2. [4] An electron with kinetic energy 1 MeV enters a uniform magnetic field $B = 0.1$ T (perpendicular to the electron's velocity). What is the radius of the resulting circular orbit? Don't forget that you need to express p in the proper SI units, which are kg·m/s.

3. [2] The lifetime of a subatomic particle is 6.25×10^{-7} s on the earth's surface. Find its lifetime at a height of 500 km above the earth's surface.