Phys 375 – Monday/Wednesday sections – Prof. Fuhrer
Homework #5, due in class week of October 29-31, 2007

1) Pedrotti, problem 8-1.

2) Pedrotti, problem 8-5.

3) The He-Ne lasers (λ = 632.8 nm) in the laboratory tend to emit light in a few modes that are separated in frequency by about 1.5 GHz. Suppose your laser hops rapidly back and forth between two modes separated in frequency by 1.5 GHz. Suppose that your Michelson interferometer is set up such that both modes interfere constructively. How far would you need to move the mirror such that one mode experiences constructive interference and the other destructive (i.e. the fringe pattern on the screen becomes washed out)? Is this likely to happen in the lab setup?

4) Suppose that the Ether Theory is true, and the speed of light is c measured relative to the Ether, which happens to be at rest with respect to the Sun. Estimate whether you could observe the motion relative to the ether with your lab interferometer, as follows. Imagine that your Michelson interferometer is oriented so that one arm points in the direction of earth's motion around the sun (i.e. points West at Noon), and that the other arm is transverse to the earth's motion (i.e. points North). The interferometer is illuminated with a He-Ne laser, with wavelength 633 nm, and you can take the length of each arm as 10 centimeters. Six hours later (6 P.M.), both arms are perpendicular to the earth's motion, because the earth has rotated. If the speed of light for motion parallel to the earth's velocity is $c + v_e$ (and anti-parallel is $c - v_e$), and the speed of light perpendicular to the earth's motion is simply c, how many fringes should be observed to pass by the detector during the six hours? c is the speed of light in vacuum = 3.0×10^8 m/s, and v_e is the Earth's orbital velocity around the sun, take this to be 3.0×10^4 m/s.