Astronomy 304, STARS

Homework # 11 Due Wednesday, April 16, 2003

Show All Your Work

1. Describe the observations, experiments and their interpretation that show that neutrinos oscillate between three different types: electron, muon and tau neutrinos. This is the explanation why we only observe 1/3 of the electron type neutrinos predicted by solar models. (You may need to search the web for the answer or you might get the answer from the physics-astronomy colloquium Thursday, April 10 at 4 pm, room BPS 1415.)

   The Sudbury Neutrino Observatory (SNO) experiment that is sensitive to only electron neutrinos (as produced by hydrogen fusion in the Sun) measured only 0.35experiment which is also somewhat sensitive to the mu and tau neutrinos measured 46that were slightly sensitive to all three neutrino flavors also measured more neutrinos, consistent with the expected solar output of ^{8}B neutrinos if the electron neutrinos oscillated to equally to all three flavors. Both water experiments are able to detect the direction of the neutrinos and they definitely come from the Sun. In addition, SNO measured day/night differences, where the additional passage of the neutrinos through the material of the Earth further enhances their oscillations among the three flavors.

2. Explain why solar acoustic p-modes with more radial nodes (for the same angular structure) have a higher frequency (shorter period).

   Modes with the same angular structure (degree ℓ) but more radial nodes (larger n) have a shorter wavelength. A wave then takes a shorter time to go one wavelength and back so as to positively interfere with itself. Hence its period will be shorter and frequency higher.