

ASTR121 Homework #8 – (Hamilton)
due Thursday Apr. 10 (15 Points)
Last Homework Before Exam II!

Finishing reading Chapter 21. These first problems are from that chapter.

35. The Crab Nebula has an apparent size of about 5 arcmin, and this size is increasing at a rate of 0.23 arcsec per year. (a) Assume that the expansion rate has been constant over the entire history of the Crab Nebula. Based on this assumption, in what year would Earth observers have seen the supernova explosion that formed the nebula? (b) Does your answer to part (a) agree with the known year of the supernova, 1054 A.D.? If not, can you point to assumptions you made in your computations that led to the discrepancies? Or do you think your calculations suggest additional physical effects are at work in the Crab Nebula, over and above a constant rate of expansion?

38. To determine accurately the period of a pulsar, astronomers must take into account the Earth's orbital motion about the Sun. (a) Explain why. (b) Knowing that the Earth's orbital velocity is 30 km/s, calculate the maximum correction to a pulsar's period because of the Earth's motion. Explain why the size of the correction is greatest for pulsars located near the ecliptic.

41. A neutron has a mass of about 1.7×10^{-27} kg and a radius of about 10^{-15} m. (a) Compare the density of matter in a neutron with the average density of a neutron star. (b) If the neutron star's density is more than that of a neutron, the neutrons within the star are overlapping; if it is less, the neutrons are not overlapping. Which of these seems to be the case for average neutrons within the star? Which do you think is the case at the center of the neutron star, where densities are higher than average?

46. In an X-ray burster, the surface of a neutron star 10 km in radius is heated to a temperature of 3×10^7 K. (a) Determine the wavelength of maximum emission of the heated surface (which you may treat as a blackbody). In what part of the electromagnetic spectrum does this lie? (See Figure 5-7.) (b) Find the luminosity of the heated neutron star. Give your answer in watts and in terms of the luminosity of the Sun, given in Table 16-1. How does this compare with the peak luminosity of a nova? Of a Type Ia supernova?

Finish reading Chapter 22. These next problems are from that chapter.

*36. An astronaut flies from the Earth to a distant star at 80% of the speed of light. As measured by the astronaut, the one-way trip takes 15 years. (a) How long does the trip take as measured by an observer on the Earth? (b) What is the distance from the Earth to the star (in light-years) as measured by an Earth observer? As measured by the astronaut?

37. In the binary system of two neutron stars discovered by Hulse and Taylor (Section 22-2), one of the neutron stars is a pulsar. The distance between the two stars varies between 1.1 and 4.8 times the radius of the Sun. The time interval between pulses from the pulsar is not constant: It is greatest when the two stars are closest to each other and least when the two stars are farthest apart. Explain why this is consistent with the gravitational slowing of time (Figure 22-7a).