

ASTR367 - HW7

October 20, 2023, Due October 27, 2023

2 pts each question part

1) Sirius B is about an Earth radius and a Solar mass. What is the radius of a more common $0.5 M_{\odot}$ white dwarf (don't look it up!)?

2) The maximum mass of a (non-rotating) white dwarf is $1.4 M_{\odot}$.

a) How fast would it need to be rotating for the minimum mass to be 50% higher?

b) Assuming the Solar core is rotating at the same speed as the bulk of the Sun, what is the maximum mass for the white dwarf that will be formed from the Sun?

3) a) During a glitch, the period of the Crab pulsar decreased by $|\Delta P| \simeq 10^{-8} P$. Assuming this was due to contraction of the neutron star, estimate the change in the star's radius assuming an initial radius of 10 km.

b) Suppose that the Sun were to collapse down to the size of a neutron star (10 km radius). Assuming that no mass is lost in the collapse, find the rotation period of the neutron star.

c) Find the magnetic field strength of the neutron star.

d) The Sun will of course become a white dwarf and not a neutron star. What do you think the white dwarf rotation speed will be?

4) Because your friends and family are going to ask at Thanksgiving...

a) 1 tsp of white dwarf weighs as much as how many elephants (fully explain all assumptions)?

b) Neutron stars have radii of about 10 km. 1 tsp of neutron star weighs as much as how many elephants (fully explain all assumptions)?

c) If a white dwarf were made entirely out of elephants, how many elephants would you need to crush together to make a white dwarf?