IntroCosmo24

Homework problems #3

Due November 7, 2024

1. Estimate the energy that a proton will acquire while freely falling from infinity onto a typical neutron star of mass $1.4M_\odot$ and radius of 20 km. If 10% of this energy is released and carried away by one photon, what would be its wavelength ?

2. Estimate how much energy is released during a supernova explosion when the iron core of a highly evolved star collapses and forms a neutron star. Assume that the iron core can be treated as a white dwarf of mass $1.4M_\odot$ and radius of 6000 km. In the first approximation mass is conserved during the collapse. Assume that the final neutron star has a radius of 20km.

3. Estimate how many neutrinos are released during a supernova explosion when the iron core of a highly evolved star collapses and forms a neutron star. Assuming that the average energy of these neutrinos is about 12 MeV estimate how much energy they are carrying away.

4. Estimate the maximal mass that can be ejected during a supernova explosion that leads to formation of a typical neutron star. Assume that the explosion is spherically symmetric and about 5% of the released energy is used to expel the outer envelope of the exploding star.