Homework 5

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****Question 1:****

**(a)**

Let the rotation speed of the earth and the moon be, the revolution speed be, the mass of earth and moon is, the radius of earth and moon is, the distance between moon and earth is.

From Kepler law we know:



Assume the earth and the moon is a particle in orbital momentum, then the total angular momentum can be divided into four parts:

1.The spin angular momentum of earth and moon:

,

2.The orbital angular momentum of earth and moon:

,

Putin we get:

,

Put the parameter in, the ratio between four parts is:



So that the orbital angular momentum of the Earth and the spin angular momentum of the Moon are small compared to the other terms.

**(b)**

As we know from (a), the orbital angular momentum of the Earth and the spin angular momentum of the Moon are small compared to the other terms, so the total angular momentum is:



Using conservation of angular momentum:



Assuming the radius of the earth change little with the spin velocity change:





As the orbital radius of the moon increased:



That will cause:



Which means that the Earth is slowing down its rotation at a rate proportional to the increase in the orbital radius of the moon.

**(c)**

**Put the number in and we can get the slowing down speed of the earth:**



****Question 2:****

**(a)**

**From** conservation of **the energy:**



**From virial theory:**



**Which means:**



**So, the luminosity could be described by:**



**(b)**

**Assume the radius of the star as:**



**Because the star can be described by a polytrope of index n=1.5, so the star is self-similar, so that the gravitational energy can be written as:**



**By (a) we know that for only gravitational energy:**



**So that:**



**Using****:**



**So:**



**(c)**

**The density of the core**:



**Where** **is a constant.**

**The**of :



**Where** **is a constant.**

**Assuming the core of the pre-main sequence star is ideal gas:**



**So that:**



**From (b) we know:**



**So:**



**where****.d**

**(d)**

**Using uniform sphere, the initial gravitational energy is:**



**Finally put****into the result of (b) and (c), the figures are shown in below:**

****Question 3:****

**(a)**

By the conservation of momentum:



Treating neutrinos as relativistic particles:

,

Whereis the asymmetry energy, is the speed of light.

So the kick velocity of the neutron star is (assuming the mass of the neutron star is 1.4 solar mass):



**(b)**

The energy of the pulsar is:



Since



Then:



So that:



**(c)**

Let the mass of a man be

The fatal nuclear radiation is about

So, the radiation through that man is larger than

In the other hand, the radiation a man got from the neutrino is:

Whereis the flux of that distance:



is the total cross-section area:



Put the function together:





**Thanks to my roommate Pan Zhiwei.**

I got thefrom the website: cupp.oulu.fi/neutrino/nd-cross.html



Put the parameter in this function:



****Question 4:****

**(a)**

Letbe the number ofrespectively;

Using the decay constant:

The equations are:



**(b)**

Assume the initial number of Ni is.

Then the solution of Ni is:



So, the function of Co is:



Multiply, using the equation of integration by parts:



So, the solution of Co is:



Using, the solution of Co is:



**(c)**

The luminosity is the sum of the energy release from Ni and Co:



Using the solution in (b):



**(d)**

The total number of Ni is:



The figure is shown in below:

