Problem Set #6

Astro 2: Spring 2012

Solutions

Problem 1 The HI line

The 21 centimeter line comes from the 'spin-flip' transition of a neutral hyrogen atom. You can read more about what that means here:

`http://en.wikipedia.org/wiki/Hydrogen_line`

. . . . . .

Problem 2

(a) There are a few ways to obtain the temperature. One is by using the peak transmission wavelength and Wein's Law. Another is by using the doppler-broadened width of the spectral lines, which increases as particles move faster (have higher temperatures).

(b) An X-ray image of the object can easily be converted into a diameter.

(c) The X-ray surface brightness (flux per solid angle) is a function only of size, temperature, and density. So once we know both size and temperature, we can use the surface brightness to determine density.

(d) We use both the extent and density to find the mass of a column of x-ray gas. And with temperature we can estimate pressure. With these two parameters found, we can use the same set up from HW5#7 to estimate the mass of the dark matter.

. . . . . .

Problem 3

We can assume that dark matter such as MACHOs will travel at velocities similar to the luminous mass in their neighborhoods. Hence they will have a rotation curve similar to Fig. 23-18. Note that this assumption comes from the idea that the dark matter will interact with the luminous mass around it to reach an equilibrium velocity. If the MACHO is moving faster than the material around it, it will be slowed by the material it hits in front of it. If travelling slower, than objects will hit it from behind, causing it to speed up.

In the case of weakly interacting massive particles (WIMPs), this would not be the case. This will be elaborated upon in the next assignment.

. . . . . .