Problem Set #6

Astro 2: Spring 2012

Due: May 17, 2012 (in class)

Problem 1 The HI line

What process produces the '21 centimeter line' of hydrogen, which we use, in spiral galaxies, for mass measurement via the rotation curve?

. . . . . .

Problem 2

Very hot gas ($\approx 10^7$ K) fills the space between the stars in Ellipitical galaxies and great galaxy clusters. We can get the total mass based entirely on X-ray images of the hot gas filling the space between the stars.

It is similar to getting the mass of Earth from its atmospheric properties, as done in a previous homework and in class. That is, we can use the observed properties of the hot gas 'atmosphere' of the galaxy or cluster to get its associated mass, and thus identify the dark matter mass of that galaxy or cluster. Unlike in the case of Earth however, we do not know the values for the mass (or density) and pressure of the gas ahead of time.

Hint: Together the density and height (or extent) of the hot gas tell us the mass of a 1 square meter vertical column of the atmosphere.

(a) How can we determine the temperature of the very hot gas in the elliptical galaxies and great galaxy clusters?

(b) How can we determine the extent of this gas?

(c) How can we determine its density? Do not go into full detail, but rather talk about what is needed to find density, and how density changes as your measured quanity changes.

(d) And finally, how does all of this give us the mass (in words only)? (Hint: Look back to HW5#7.)

. . . . . .

Problem 3

We do not know what comprises the dark matter within our own Milky Way. Nevertheless, make an educated guess as to the speeds of the dark matter orbiting the Milky Way. (Hint: Roughly how fast are the stars moving in the region composed mostly of Dark Matter?)

. . . . . .