Cosmology Tutorial 11

Howard Kinsman

April 17, 2017

1

$$M = V\rho$$
$$V = \frac{4}{3}\pi r^3$$
$$r = \left(\frac{M}{\frac{4}{3}\pi\rho}\right)^{\frac{1}{3}}$$
$$r = \left(\frac{2\times 10^{45}}{\frac{4}{3}\pi 10^{-26}}\right)^{\frac{1}{3}}$$
$$r = 6.2\times 10^{22} m$$
$$= 11.7 Mpc$$

2

$$R_{200,m} = \left(\frac{2\times 10^{45}}{\frac{4}{3}\pi 2\times 10^{-24}}\right)^{\frac{1}{3}}$$
$$= 6.2\times 10^{22} m$$
$$= 2 Mpc$$

$$R_{200,m} = \left(\frac{2\times 10^{44}}{\frac{4}{3}\pi 2\times 10^{-24}}\right)^{\frac{1}{3}}$$
$$= 2.88\times 10^{22} m$$
$$= 0.9 Mpc$$

3

The four main ways to detect galaxy clusters are:
X-ray emission from hot gas - space X-Ray telescopes e.g. Chandra. Disadvantage of this method is that it is distance dependent, so better for closer galaxies.
Sunyaev-Zel'dovich effect - galaxy clusters cause inverse Compton scattering of CMB photons. Advantage of this method is that it is independent of redshift and so best for more distant galaxies.
Optical - galaxy clusters can be observed directly in the optical. Disadvantage of this is that there may be galaxies within the line of sight which are not part of the cluster and have to be removed. Also distance dependent.
Gravitational lensing - galaxy clusters bend light from galaxies behind the cluster - both strong and weak lensing effects can be used. Also distance dependent i.e. harder to observe the more distant a galaxy cluster is.