

AST 250 – Spring 2019
Homework Due: Wednesday April 17

36. In the 1933, Fritz Zwicky measured the mass of the Coma Galaxy Cluster using the Virial Theorem and the peculiar velocity dispersion of the galaxies ($\langle v \rangle \sim 1500$ km/s). The cluster is at a distance of 100 Mpc and has over 1000 galaxies within a radius of ~ 2 Mpc and a total luminosity of $\sim 10^{13} L_{\text{sun}}$. Calculate the mass to light ratio M/L (in units of $M_{\text{sun}}/L_{\text{sun}}$) and compare your number to the $M/L \sim 3 M_{\text{sun}}/L_{\text{sun}}$ observed in the solar neighborhood of the Milky Way. This classic calculation was the first evidence for Dark Matter. Hint: Assume that galaxies are distributed uniformly within the Coma cluster.



Figure 1: Hubble Telescope image of NGC 7331

37. Assume you measure the rotation curve of a galaxy and find that gas is moving at 200 km/s at a distance of 10 kpc (assume circular orbits). The total gas mass interior to this radius is measured to be $5 \times 10^9 M_{\text{sun}}$ and the total mass in stars is $2 \times 10^{10} M_{\text{sun}}$. What fraction of the mass is dark matter in this galaxy within 10 kpc?