

AST 250 Spring 2010

HOMEWORK #7

Due Friday April 23

- (1) An observer studies a cluster containing several Sun-like (G2V) stars. If an extinction of $A_v = 1$ mag is measured toward the cluster and the Sun-like stars have an observed apparent magnitude of $m_v = +10.0$, what is the true distance to the cluster?
- (2) If the Sun is moving 250 km/s at 8.5 kpc from the center of the Milky Way, calculate the rotation period of the Sun around the Galaxy (assume $e=0$). Estimate the mass of the Galaxy interior to the Sun's orbit. How many orbits has the Sun made around the Galaxy over its 4.5 billion year lifetime?
- (3) In the 1930s, Fritz Zwicky measured the mass of the Coma Cluster using the observed **radial** velocity dispersions of the galaxies ($\langle v_r \rangle = 700$ km/s).
(a) What is the 3-dimensional velocity dispersion? (b) If the cluster radius is approximately 3 Mpc, calculate the mass of the Coma Cluster using the Virial Theorem. (c) If the observed total luminosity of Coma galaxies is $3 \times 10^{13} L_{\text{sun}}$, what is the M/L ratio for the Coma Cluster. (d) Compare this number to the observed M/L ratio in the solar neighborhood of the Milky Way ($M/L \sim 3 M_{\text{sun}}/L_{\text{sun}}$). This classic calculation was the first evidence for Dark Matter!



- (4) An observer wants to observe the CO molecule (to constrain the star formation rate) in the distant quasar J1148+5251 ($z = 6.419$) with the VLA. If the rest frequency of the CO J=2-1 rotational line is 230.538 GHz, what frequency should the VLA observer tune to observe the quasar?
- (5) The $H\alpha$ line is identified in a Galaxy spectrum at a wavelength of 6740.3 Angstroms. If the $H\alpha$ rest wavelength is 6562.8 Angstroms, what is the redshift, velocity (km/s), and distance (Mpc) to the Galaxy?