ASTRO 358 (49520): HOMEWORK 4

Assigned on Tu Apr 22, 2008. Due in class by noon on Tu Apr 29, 2008

Instructions: In order to get full credit, you must show the method that you used to derive the answer. The number of points for each question is indicated in brackets, and the total score is 50 points.

1. Consider a galaxy whose bulge has a velocity dispersion of 300 km s^{-1}. Estimate the Eddington luminosity for mass accretion onto the central black hole. **[15 pts]**

2. Ionized gas in a galaxy is observed to be moving at a speed of 10,000 km s^{-1} at a radius of 2 pc. Assuming that the gas is on a circular orbit, estimate the mass enclosed inside this radius. Why is this massive central object considered to be a black hole rather than a massive compact stellar cluster? **[10 + 10 = 20 pts]**

3. A galaxy has an apparent blue magnitude $m_B \sim 11$, an inclination of 30 degrees, and an observed linewidth of 200 km s^{-1}. Use the Tully-Fisher relation to estimate the distance to the galaxy in Mpc. For this problem, use the plot of the Tully-Fisher relation shown in class (Figure 3.19 in lecture 21, which is posted on the class website). **[15 pts]**

Values of physical constants

Wien's constant $W = 2.9 \times 10^{-3}$ m K
σ = Stefan-Boltzmann constant = 5.7×10^{-8} J s^{-1} m^{-2} K^{-4}
G = Gravitational constant = 6.7×10^{-11} N m^2 kg^{-2} = 4.5×10^{-3} (km s^{-1})^2 pc ${M_\odot}^{-1}$
k_B = Boltzmann constant = 1.38×10^{-23} J K^{-1}
Hubble's constant $H_0 = 70$ km s^{-1} Mpc^{-1}
Planck's constant $h = 6.6 \times 10^{-34}$ J s
Proton mass = 1.67×10^{-27} kg
1 $M_\odot = 2 \times 10^{30}$ kg
1 parsec (pc) = 3×10^{16} m
1 Joule = 10^7 erg

END OF ASSIGNMENT