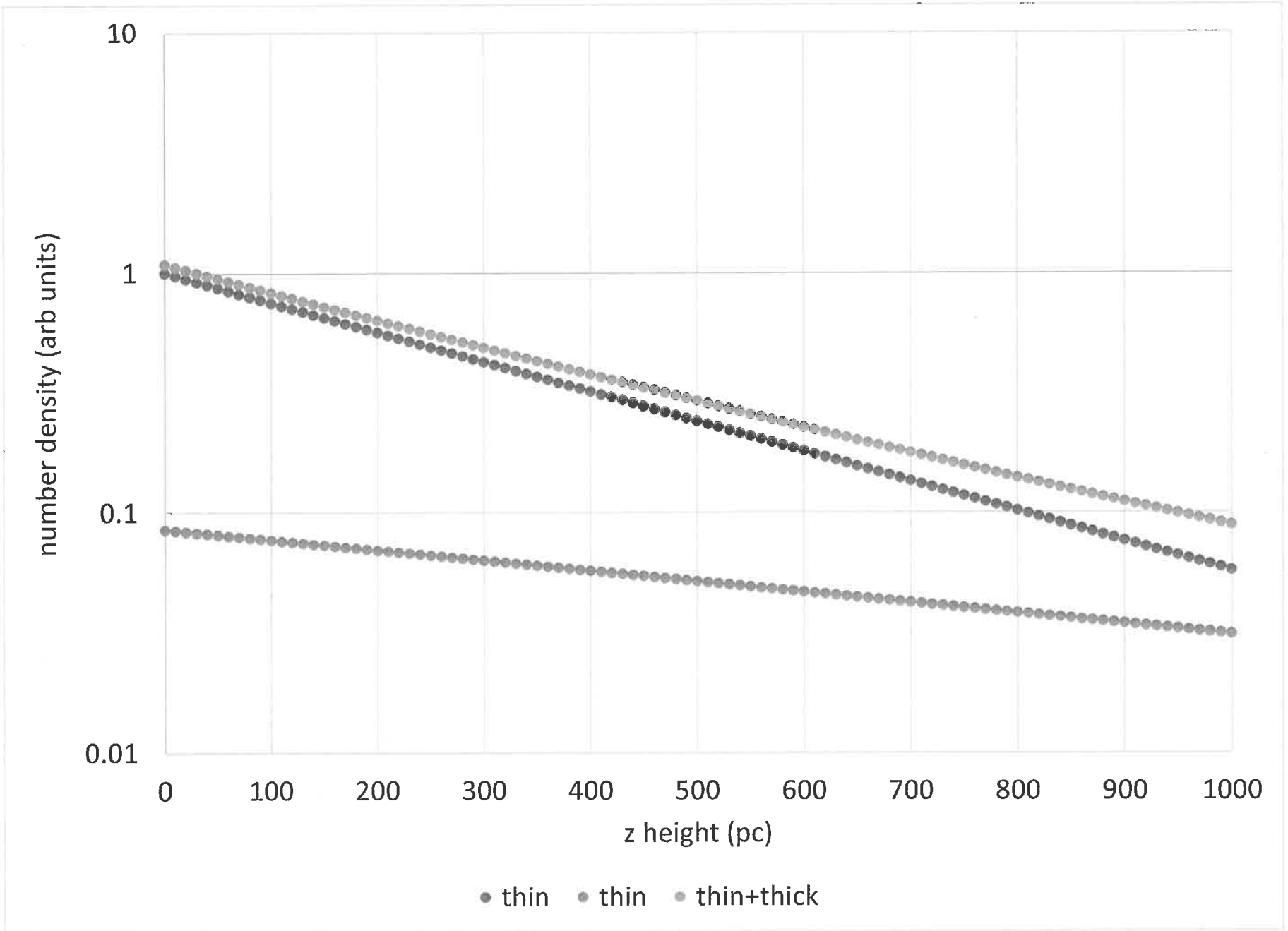
ASTR368

HW #2

1) See plot


10
1
0.1
0.01
number density (arb units)
0
100
200
300
400
500
600
700
800
900
1000
z height (pc)
thin
thin
thin+thick

2) a) $\frac{L_B}{L_\odot} = 10^{0.4(M_\odot - M_B)}$ ← magnitude, not mass!

or

$$M_B = M_{\odot,B} - 2.5 \log_{10} \frac{L_B}{L_\odot} \qquad M_\odot = 4.74$$

Thin: $L_B = 1.8 \times 10^{10} L_\odot \Rightarrow M_B = -20.9$

Thick $L_B = 0.02 \times 10^{10} L_\odot \Rightarrow M_B = -16.0$

Bulge $L_B = 0.3 \times 10^{10} L_\odot \Rightarrow M_B = -18.9$

Halo $L_B = 0.1 \times 10^{10} L_\odot \Rightarrow M_B = -17.8$

b) $L_{B\,tot} = 2.3 \times 10^{10} L_\odot \Rightarrow M_B = -21.2$

c) B-V = +1.15, so

-22.1, -17.2, -20.1, -19.0

d) -22.2

e) Bulge should be less blue, so B-V for bulge higher than for disk.

3) NFW profile

$$\rho(r) = \frac{\rho_0}{(r/a)(1 + r/a)^2}$$

a) If $r \ll a$, squared values of $r/a \to 0$

$$\rho(r) = \frac{\rho_0}{(r/a)(1 + 2r/a + r^2/a^2)}$$

$$= \frac{\rho_0}{r/a + 2r^2/a^2} \propto \frac{1}{r}$$

b) If $r \gg a$, highest powers of r/a dominate

$$\rho(r) = \frac{\rho_0}{r/a + 2r^2/a^2 + r^3/a^3} \propto r^{-3}$$

c) $$M = \int_0^\infty \rho(r) \cdot 4\pi r^2 dr \propto \int_0^\infty \frac{r}{(1 + r/a)^2} dr$$

For $r \gg a$, $M \propto \int_{r \gg a}^\infty r^{-1} dr \propto \ln r \Big|_{r \gg a}^\infty$

this is unbounded