

Galaxies and Extragalactic Astronomy

Exercise 3: Suppose that we have a spiral galaxy with a flat rotation curve for all radii: $v(r) = v_c$

If we add a black hole of mass, M_{BH} , in the galaxy centre,

1) At what radius the galaxy kinematics passes from being dominated by the black hole to being dominated by the whole galaxy. That is, at what radius $\frac{\Delta v}{v} = 1$ where $\Delta v = v(\text{black hole} + \text{galaxy}) - v(\text{galaxy})$?

If the galaxy has a velocity of $v_c = 250$ km/s and it is at a distance of 10 Mpc

2) What is the minimum black hole mass, M_{BH} , that can be detected with a telescope that can resolve 1''?

Useful numbers and constants:

$$G = 6.67 \times 10^{-11} \text{ m}^3 \text{ Kg}^{-1} \text{ s}^{-2} = 6.67 \times 10^{-8} \text{ cm}^3 \text{ g}^{-1} \text{ s}^{-2}$$

$$1 \text{ Mpc} = 3.086 \times 10^{22} \text{ m} = 3.086 \times 10^{24} \text{ cm}$$

$$1 \text{ M}_\odot = 2 \times 10^{30} \text{ kg} = 2 \times 10^{33} \text{ g}$$