Question:

Problem: 3. Our neighbor galaxy, Andromeda, has a luminosity (intrinsic brightness) 3 times as bright as the Luminosity of our Milky Way galaxy, LAndromeda = 3LMW, and is at a distance of dAndromeda = 0.7 Mpc. The flux we observe from the Andromeda galaxy (apparent brightness) is 10,000 times brighter than the flux observed from a distant quasar, fAndromeda = 104fquasar. This quasar has a luminosity that is 1000 times the luminosity of our Milky Way galaxy, Lquasar = 103LMW. What is the distance d to the quasar? (4 points)

A. 1.28 × 10−1Mpc

B. 3.85Mpc

C. 1.28 × 103Mpc

D. 2.36 × 106Mpc

E. 3.85 × 1012Mpc

Solution:

We can use the formula:

$$f \propto \frac{L}{d^2} \text{ or } f = \mathrm{C} \times \frac{L}{d^2}$$,where C is a constant.

So we can write:

$$\frac{f(Andromeda)}{f(Quasar)} = \frac{L(Andromeda)}{L(Quasar)} \times \frac{d^2(Quasar)}{d^2(Andromeda)}$$

$$\frac{d^2(Quasar)}{d^2(Andromeda)} = \frac{f(Andromeda)}{f(Quasar)} \times \frac{L(Quasar)}{L(Andromeda)}$$

$$\frac{d(Quasar)}{d(Andromeda)} = \sqrt{\frac{f(Andromeda)}{f(Quasar)} \times \frac{L(Quasar)}{L(Andromeda)}}$$

$$\frac{d(Quasar)}{d(Andromeda)} = \sqrt{10^4 \times \frac{10^3 L_{MW}}{3L_{MW}}}$$

$$d(Quasar) = \sqrt{\frac{10^7}{3} \times 0.7Mpc} = \sqrt{1856 \times 0.7Mpc} = 1.28 \times 10^3 Mpc$$

Answer: 1.28×10^3 Mpc (C)