Astronomy Reading and Discussion for Tuesday, June 15th (meet in Nunn room)

Chapter 18.

Astronomy Problem Set 12 for Tuesday, June 15th

From Chapter 17

(1) On the following two pages is a problem on superluminal apparent velocities for quasars. By the time you are done with it, I hope you can see that a jet moving in roughly our direction might appear to be moving faster than the speed of light, but its actual velocity is well under the speed of light.

From Chapter 18

Problem 9 on p. 583. HINT: If the Hubble constant is given as 71km/s/Mpc, and something is 1 Mpc apart from something else, that means it is expected to be receding at 71km/s from it. You have a distance and a velocity. Just use these to calculate the time it took for them to get 1 Mpc apart traveling at this velocity. It is just a rearrangement of $v = d/t$ and a lot of conversion factors.

Your answer to Problem 9 will require you to convert Mpc to km. It will also require to convert an answer in seconds to years. Your final answer will be in billions of years.

Problem 42 on p. 585. HINT: Ignore the silly answers (d) and (e). All that is being asked is to compare $3000 with πr^2 times Edwin's rate. If $3000 is more than expected, you are in a hyperbolic space. If it is the expected amount, you are in Euclidean space. If it is less than the expected amount, you are in a spherical space.

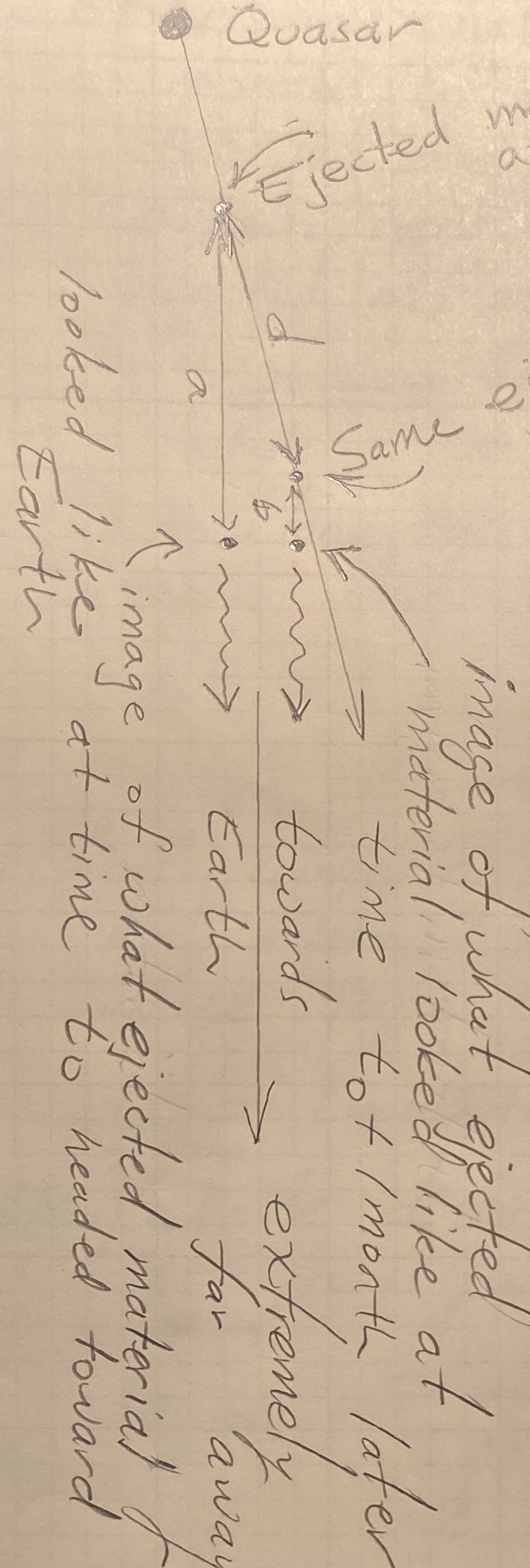
Problem 45 on p. 585. Use 70 km/sec/Mpc as the Hubble constant to get the expected distance to galaxy Lemaître.

Problem 49 on p. 585. This problem is asking you to think carefully about the terms isotropic and homogeneous. They are not the same. Pasachoff and Filippenko are asking for the situation that is isotropic but not homogeneous.

Problem 51 on p. 585. This is really easy, but if there are just two facts to remember about how modern cosmology made its great leaps forward, first in the early 1900s thanks to the work of Leavitt, Lemaître, and Hubble, and then in the early 2000s with the High-z Supernova Search Team and the rival Supernova Cosmology Project, this question summarizes them.

I should add that a tremendous confirmation of the Big Bang theory happened in the 1950s, but that we won't study until our final class and Chapter 19.

1. Superluminal Quasar Jets



1(a) To nearest centimeter, measure distances a, b, and d:

a = __ cm = __ l-mo

b = __ cm = __ l-mo

d = __ cm = __ l-mo

and convert to light-months by using

5 cm = 1 light-month

1(b) Knowing that d represents one month of traveled distance for the jet and using your value for d from part (a), how fast is the ejected material actually moving?

$$V_{actual} = \frac{\_\_\_\_ \text{ light-months}}{1 \text{ month}} = \_\_\_\_ c$$

1(c) How long does light need to travel the distances a and b?

$\Delta t_a = \_\_\_\_$ months

$\Delta t_b = \_\_\_\_$ months

1(d) By comparing Δt_a vs. 1 month + Δt_b, how much behind is the later image going to arrive at Earth?

$$\Delta t_{arrival} = 1 \text{ month} + \Delta t_b - \Delta t_a = \_\_\_\_ \text{ months}$$

1(e) Divide d from part (a) by $\Delta t_{arrival}$ from part (d).

$$V_{apparent} = \frac{d}{\Delta t_{arrival}} = \frac{\_\_\_\_ \text{ light-months}}{\_\_\_\_ \text{ months}}$$

$$= \_\_\_\_ c$$

This is the "superluminal" velocity.