About Hubble’s Law—21 Oct

- Velocity $V$ is proportional to distance $D$
  $$V = H \times D$$
  $H$ is Hubble’s constant
- Why are most galaxies moving away from us?
- Why are some galaxies moving toward us?
- What is expanding?
- Is Hubble’s Constant a constant?

Why do most galaxies move away & a few move toward us?

- Andromeda & two companions are moving toward us at 200km/s.
- Imagine a history
  - In Big Bang, material follows Hubble’s Law strictly. An explosion that happens at the same instant
  - I push against my neighbor; my neighbor pushes against me & my next-door neighbor. Therefore my next-door neighbor moves away faster.
  - Our local group was slightly more dense than surroundings.
  - Gravity overcame motion.

First Hubble Diagram

- A few galaxies are moving toward us.
  1. Do any distant galaxies move toward us?

Universe is expanding. What is expanding?

- Hoag’s Galaxy is 300 Mpc from us.
  2. Why did Hoag’s Galaxy move from 200Mpc to 300Mpc? Did that require some force?
Is everything expanding?

3. Is the Earth expanding?

Is Hubble’s Constant Constant?

- At the present, the value of Hubble’s constant is $18,000\text{km/s}/(300\text{Mpc}) = 60\ \text{km/s/Mpc}$
  (Hoag’s Object is moving at 18,000km/s, and it is 300Mpc distant.)

5. When Hoag’s Object was 150Mpc from us, what was the value of Hubble’s constant?

Is everything expanding?

4. What prevents Earth from expanding? Why did the material on earth forget about the outward-movement of the Big Bang?