

Lecture 6 — The Expanding Universe

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- Olber's Paradox: Why is the Sky Dark?
 - Absorbing Matter \rightarrow doesn't work since matter would heat up
 - Finite Size
 - Finite Time (and Finite Speed of Light)
 - Dimming of Light (“redshift”)
- Universe had some beginning (“Big Bang”) around 13.7 billion years ago
- Some units:

$$1[\text{light year}] = 9.5 \cdot 10^{15}[\text{m}]$$

$$1[\text{yr}] \approx \pi \cdot 10^7[\text{s}]$$

$$c \approx 3 \cdot 10^8 \left[\frac{\text{m}}{\text{s}} \right]$$

$$1[\text{pc}] = 3.26[\text{light years}]$$

- If $\theta = 1[\text{arcsec}]$, then $d = 1[\text{pc}]$

$$1[\text{pc}] = 2.1 \cdot 10^5[\text{AU}]$$

- The Cosmological Principle
 - Copernicus: the Sun, not the Earth, is the center of the Universe
 - Cosmological Principle: There is no center to the Universe
 - * The Universe is statistically isotropic (same in all directions) and homogenous (same everywhere)
- Expanding Universe

- All observers see things moving away from them
- Statements are all statistical! Distinguish between structure in the universe and the geometry of the homogenous universe (about 100[Mpc] scales for homogeneity)
- We don't experience the FLRW metric
 - * Homogenous/geometry
 - * Structure