Lecture 1

Thursday, July 23, 2015 3:16 PM

Phys 4247 Cosmology

What is this course about?

Units: astronomical (Mpc, $L_\odot$, $M_\odot$, erg, etc.) Review these!

Recall: $1\ pc = 3.261\ ly = 3.086 \times 10^{18}\ cm$

$\rightarrow 1\ Mpc = 3.086 \times 10^{24}\ cm$

$1\ M_\odot = 1.989 \times 10^{33}\ g$, etc.

Olber's Paradox (1826)

Why is the night sky dark?

Lets compute how bright we expect the night sky to be in an infinite universe.

n = avg. number density of stars

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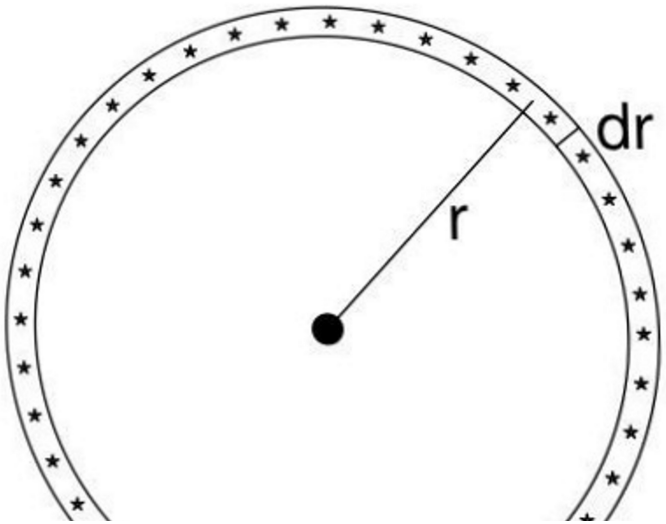
L = avg. stellar luminosity

$$f = \frac{L}{4\pi r^2}$$ flux @ Earth from one star

Now consider a thin shell of stars w/ radius r and thickness dr centered on us.



The intensity of radiation at Earth from this shell is $dJ(r) = \frac{L}{} n r^2 dr$

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[erg/s/str]

Intensity only depends on thickness, not on distance

$\therefore$ Intensity from all stars

$$J = \int_{r=0}^{\infty} dJ = \frac{nL}{4\pi} \int_0^{\infty} dr = \infty \; !$$

What went wrong?

Problem: Won't be able to see all stars. Ones closer will block more distant ones

- OK, answer no longer infinite, but all lines of sight would end on stellar surface

Obscuring matter in the way.

- doesn't work b/c in an infinitely old universe, dust would be heated to stellar temps.

Universe is not infinitely large.

$$J \sim \frac{nL r_{max}}{4\pi}$$

The biggest problems (or, solutions to the paradox)

1) the Universe is expanding
   - helps b/c light will not always be in visible band

2) the Universe is not infinitely old (speed of light is finite)

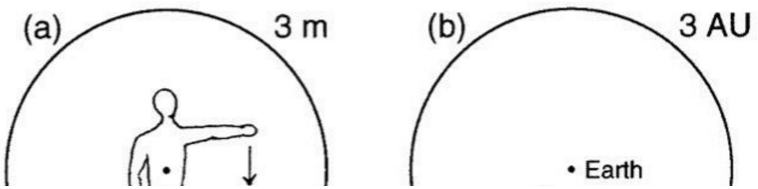
The stars beyond some finite distance, the horizon distance are invisible to

the horizon distance, are invisible to us b/c their light hasn't had time to reach us yet.

∴ The Universe must have had a beginning and is evolving.

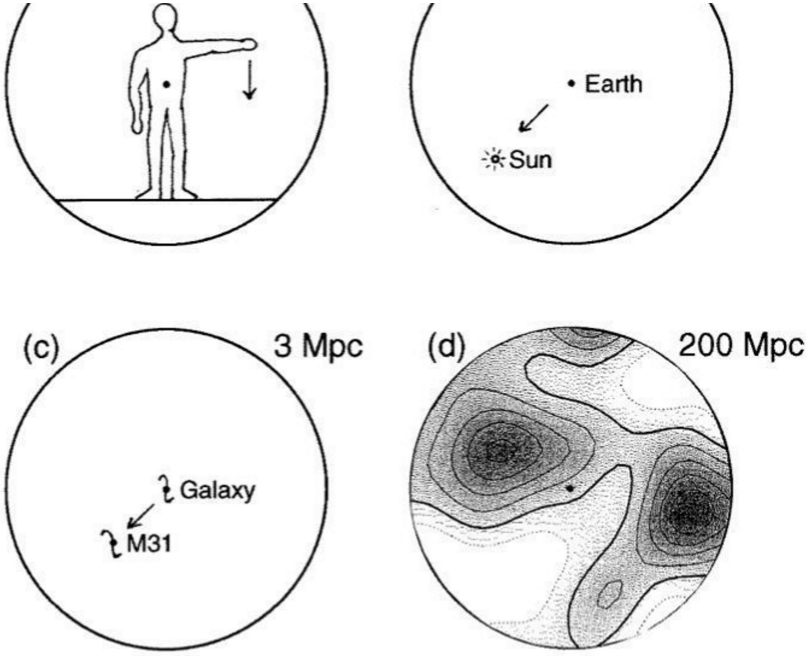
Cosmology is the study of the past, present and future of the Univ.

The Cosmological Principle



The Universe is

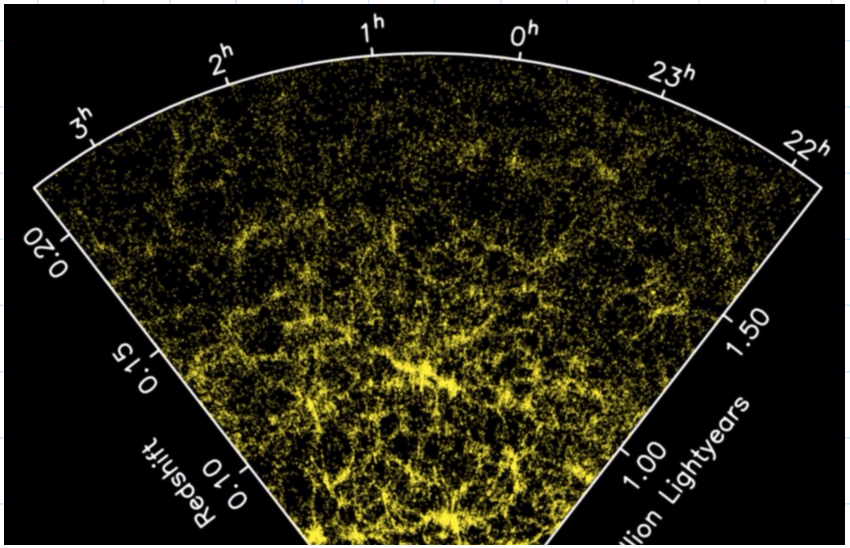
1) Homogeneous



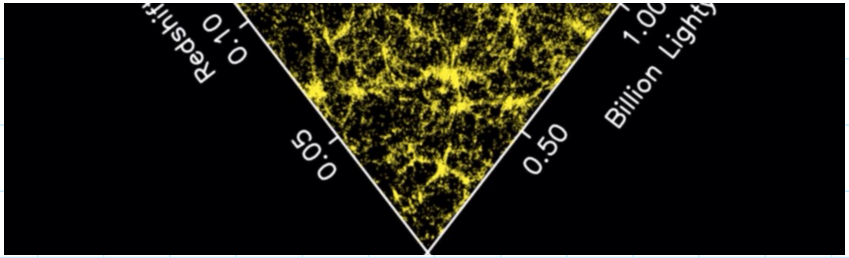
1) Homogeneous
(it looks the same everywhere)

2) Isotropic
(looks the same in all directions)

Only true on V. big scales ($\geq$ 100 Mpc)



The typical distance b/w galaxies is $\sim$1 Mpc.



2df Galaxy Survey