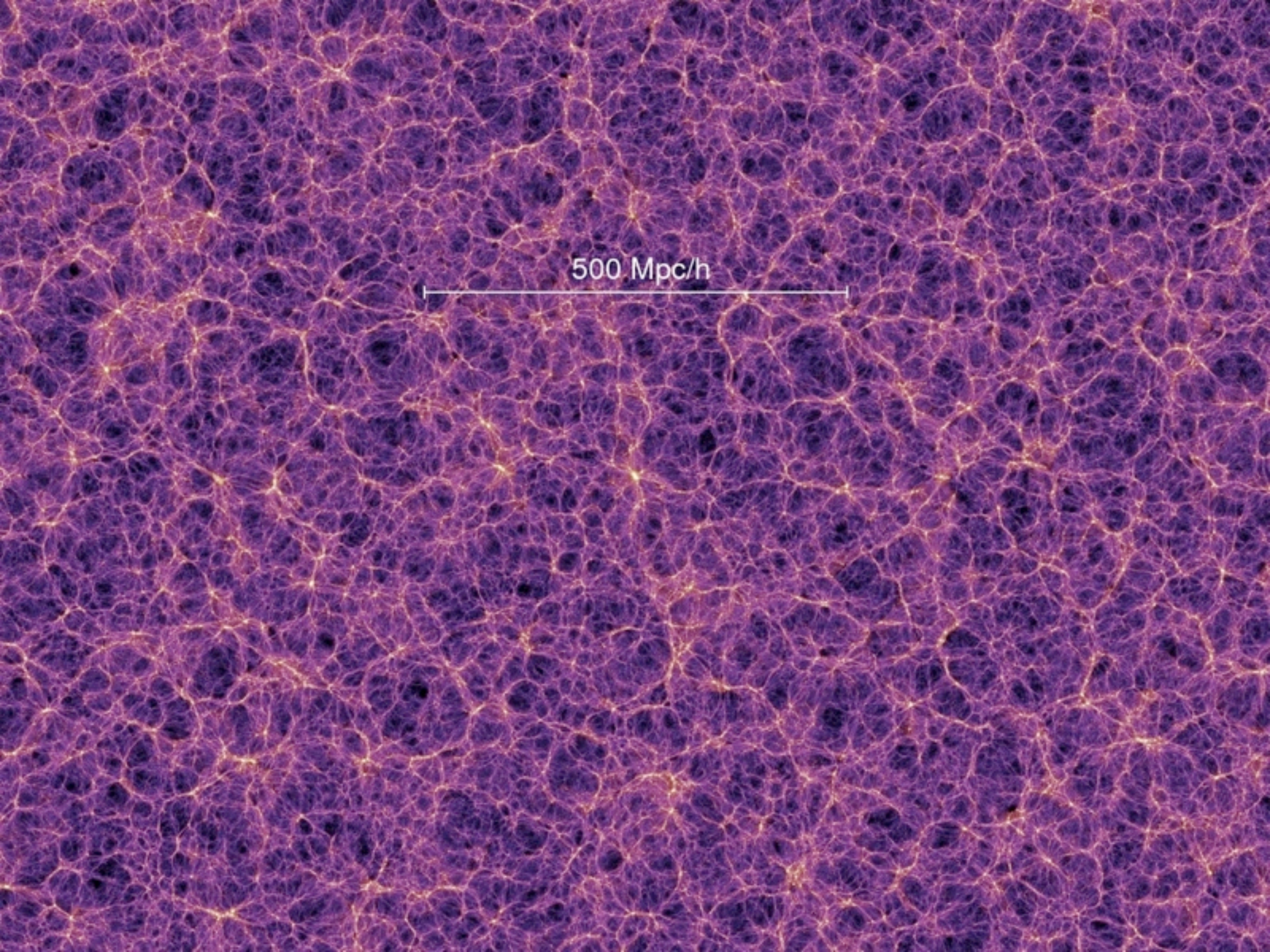
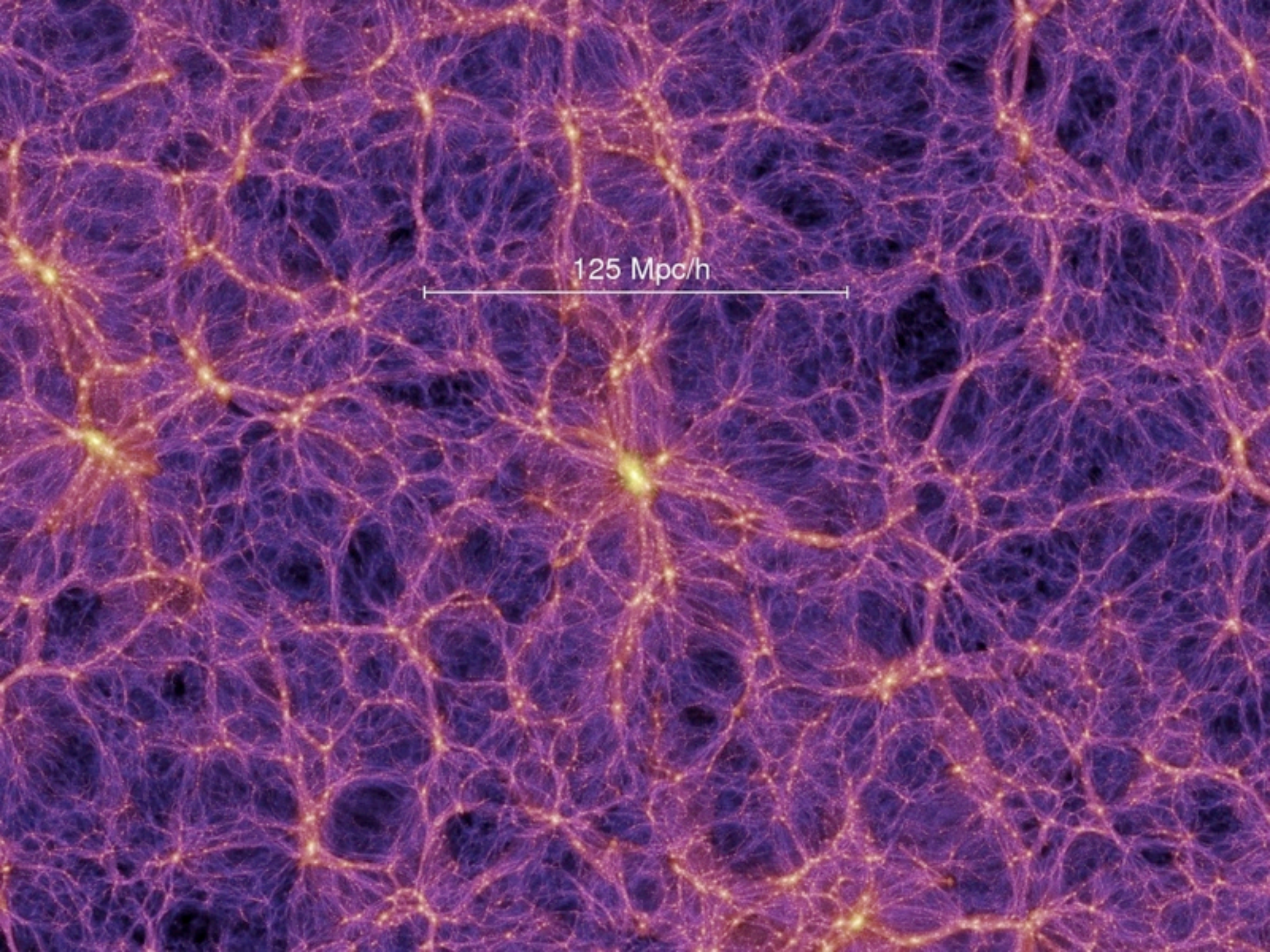
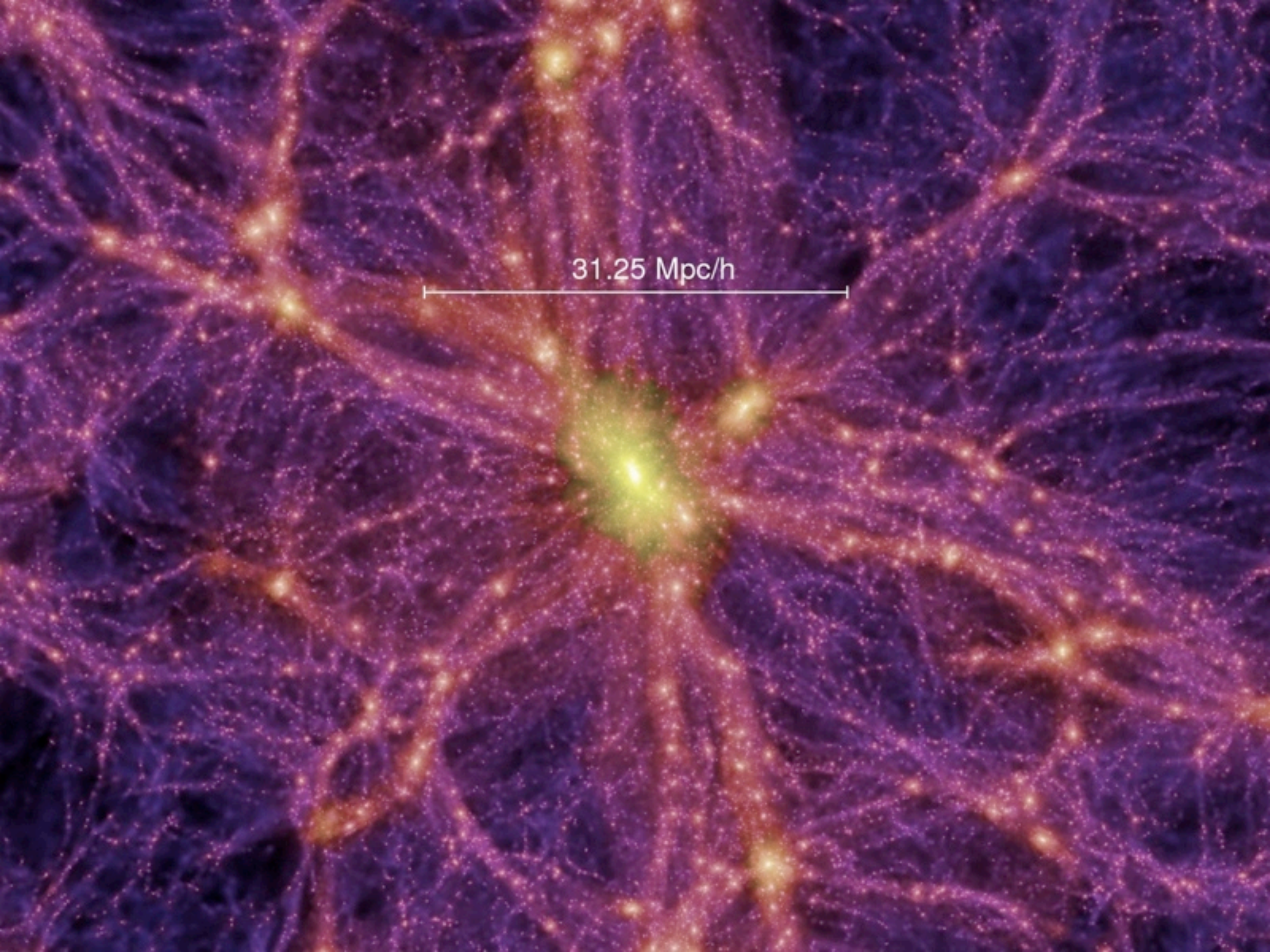
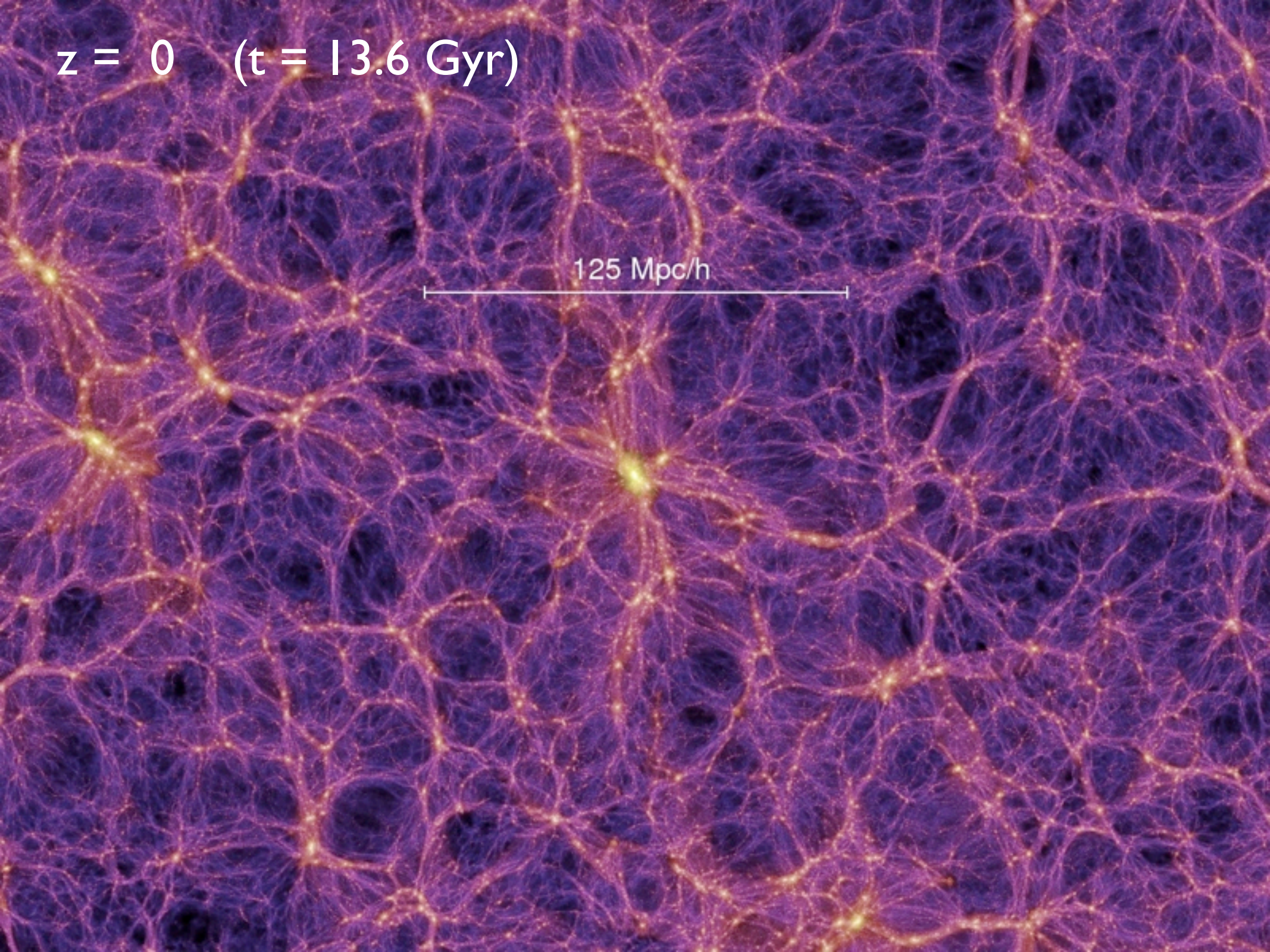
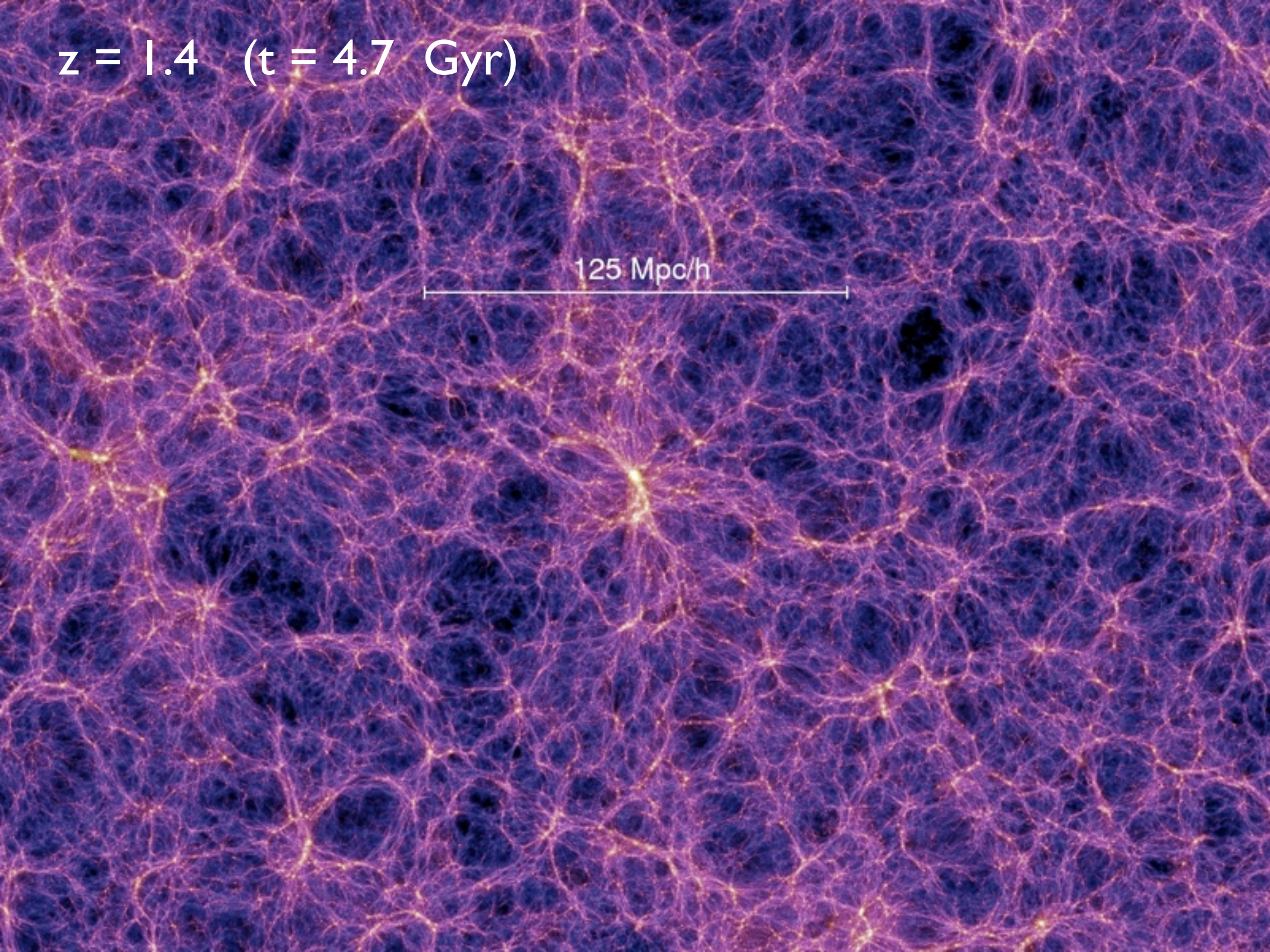
distribution of galaxies in space

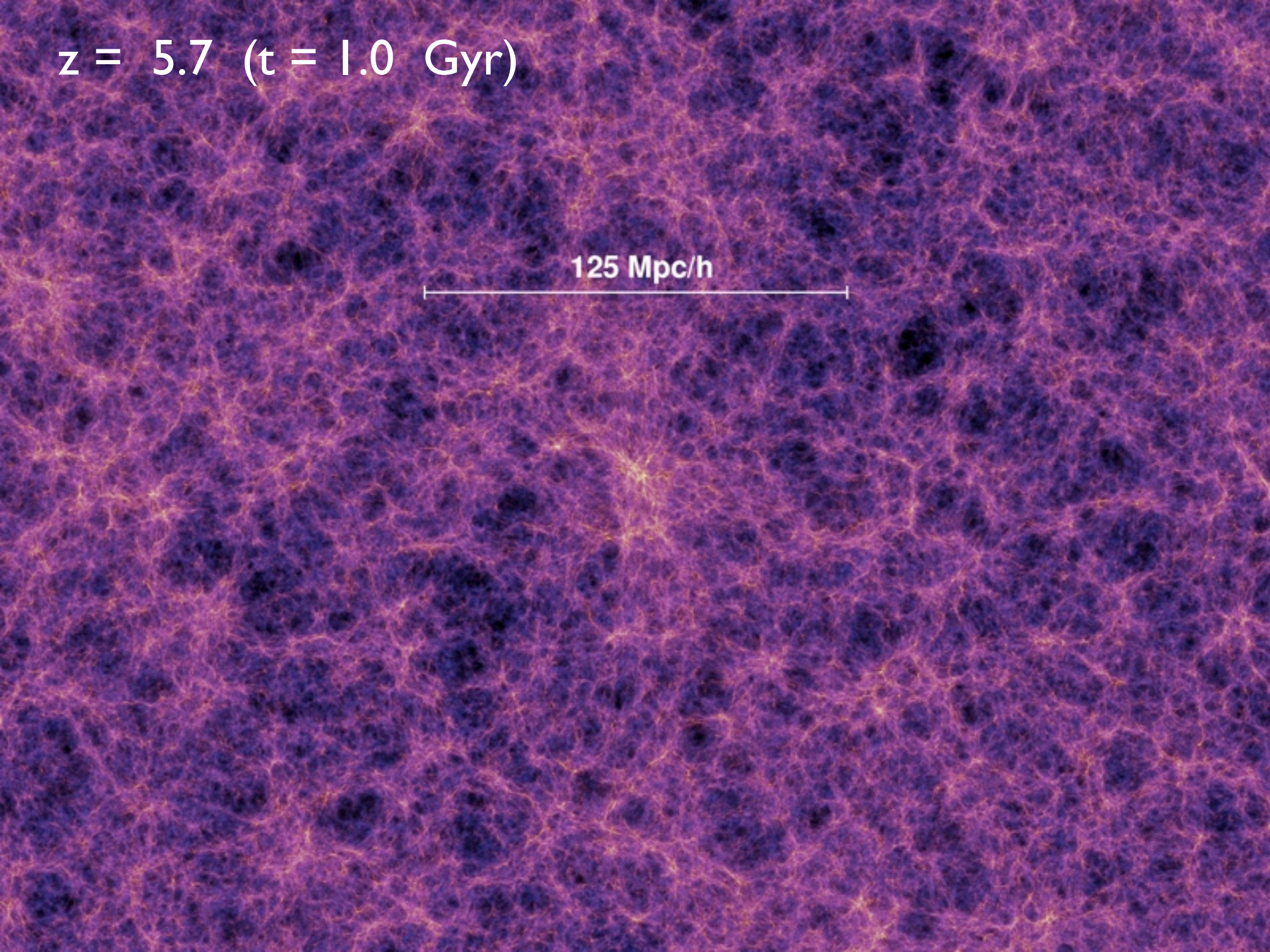

500 Mpc/h

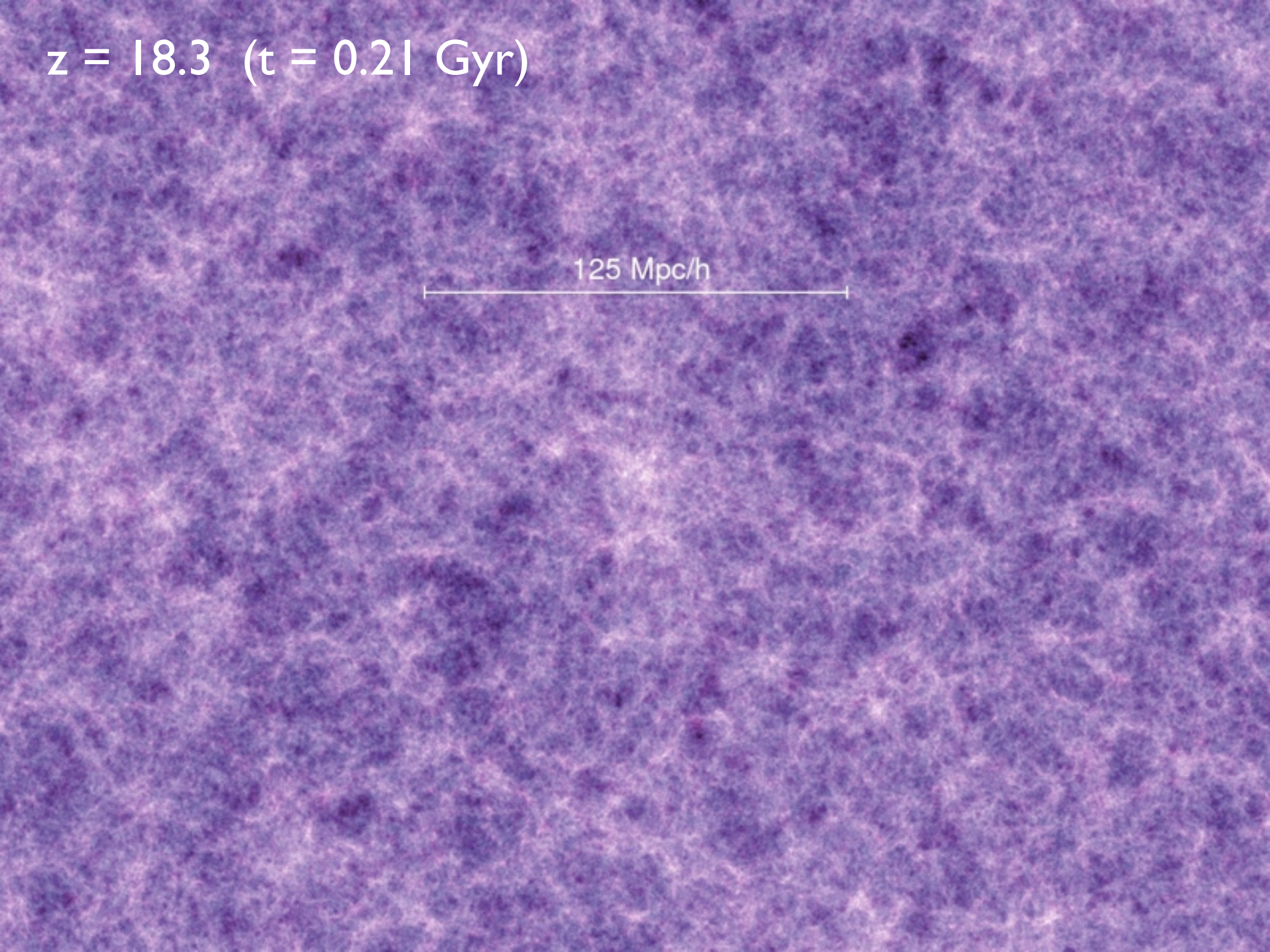

125 Mpc/h


31.25 Mpc/h

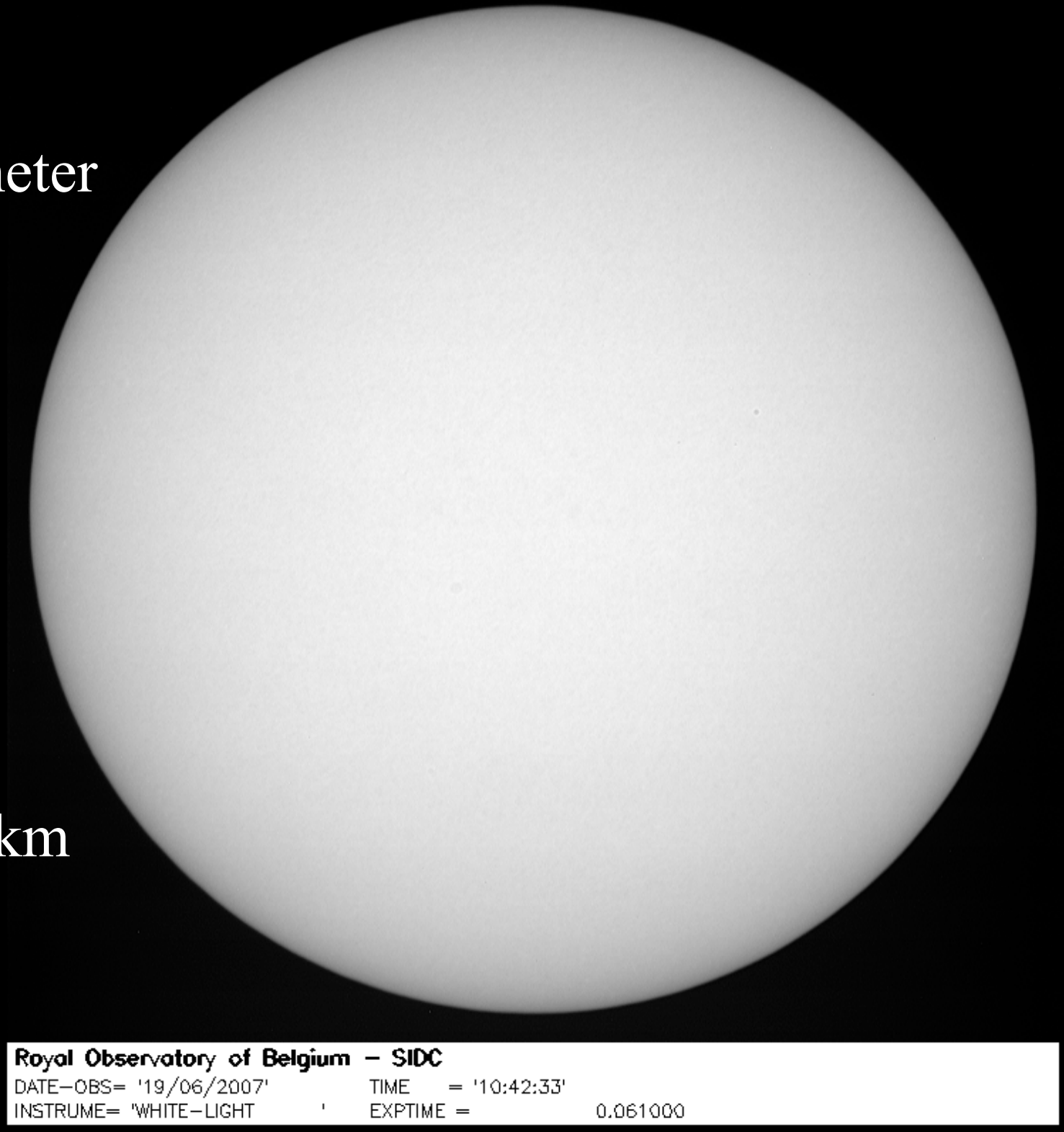

z = 0 (t = 13.6 Gyr)
125 Mpc/h


z = 1.4 (t = 4.7 Gyr)
125 Mpc/h


z = 5.7 (t = 1.0 Gyr)
125 Mpc/h


z = 18.3 (t = 0.21 Gyr)
125 Mpc/h

Sun:
0.5 degree diameter

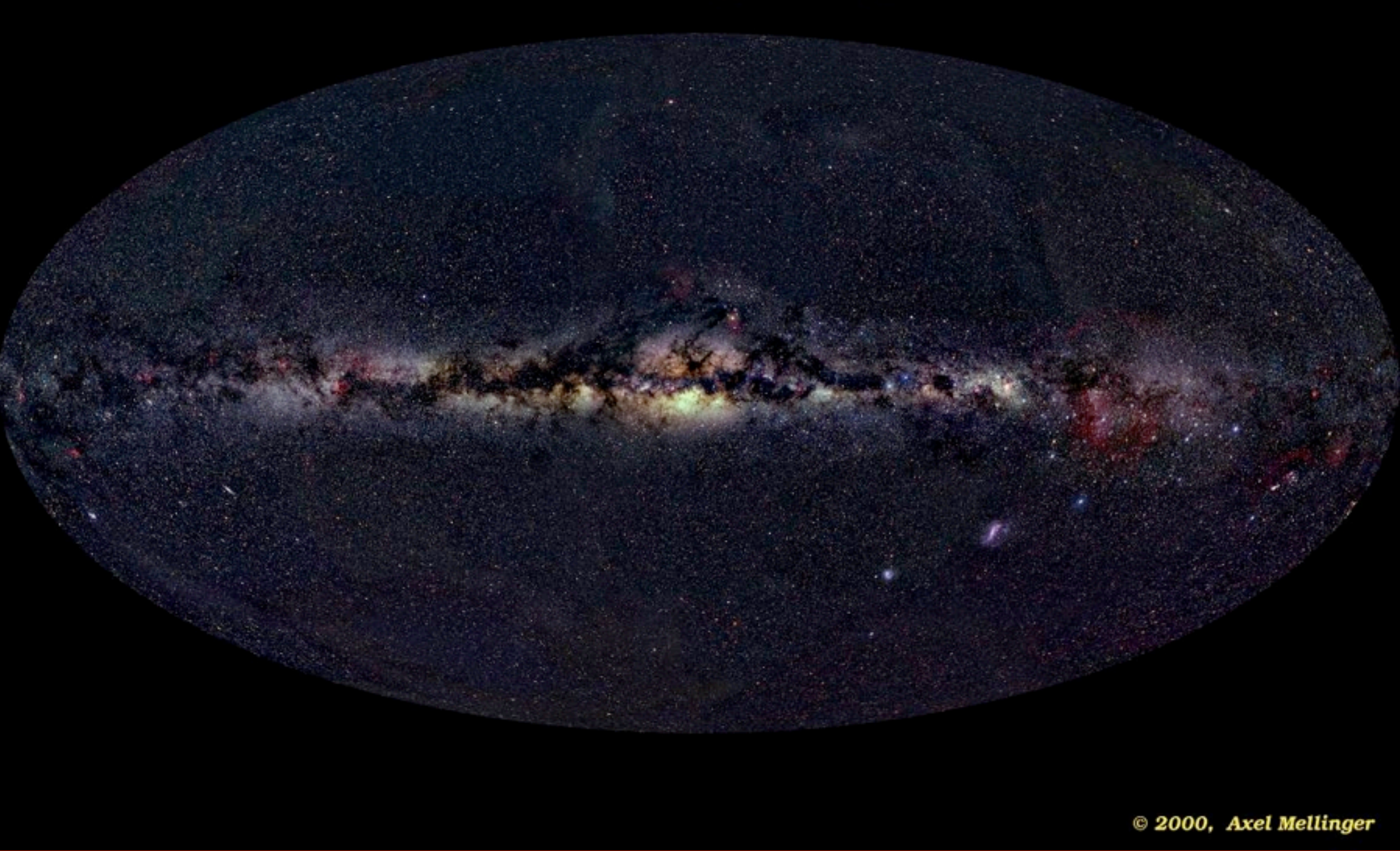



R = 696,000 km
d = 149,000,000 km

Alpha Centauri and the Southern Cross

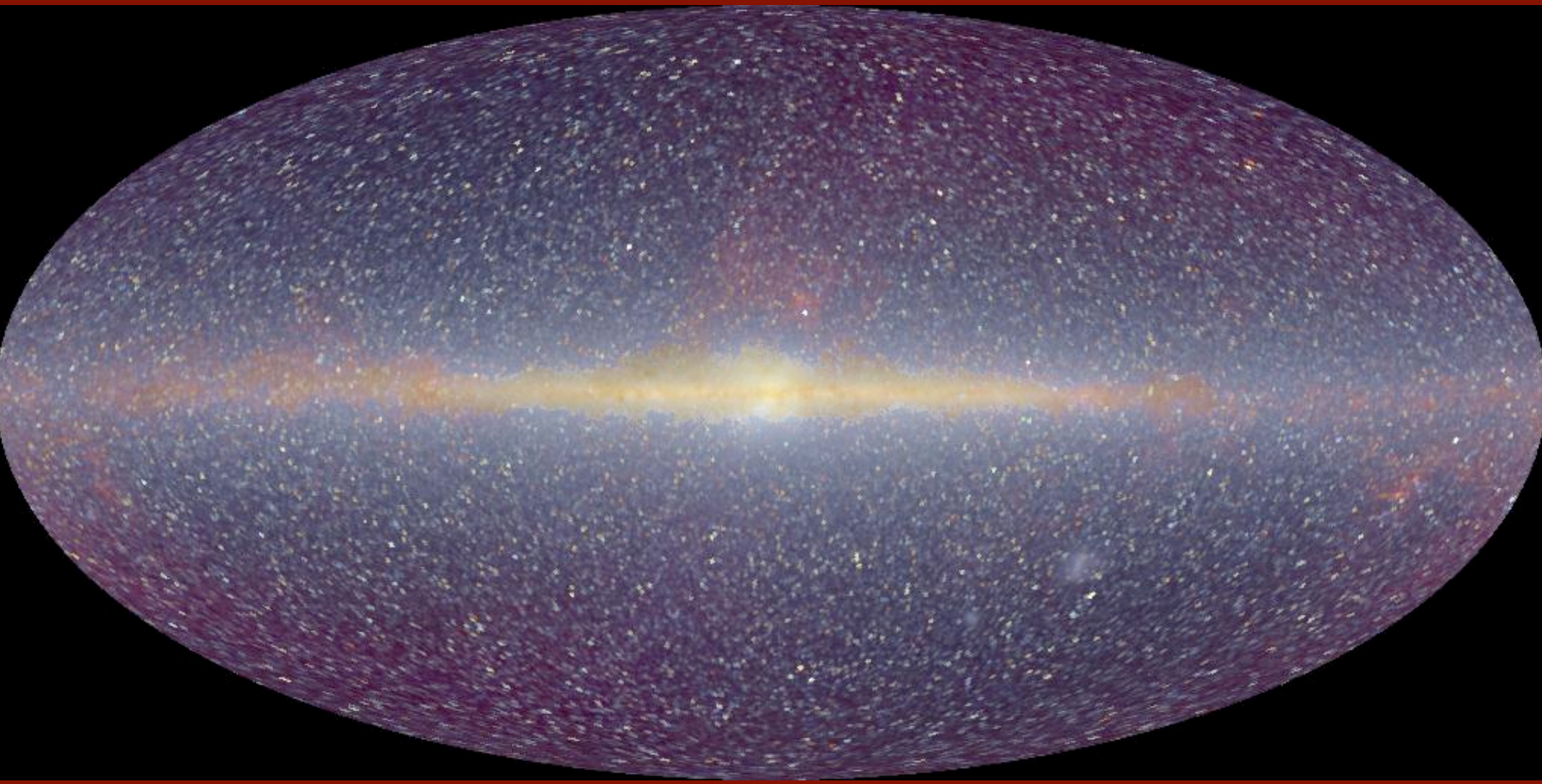
ESO PR Photo 40a/05 (December 21, 2005)

© ESO




Cygnus Sagittarius Crux Orion

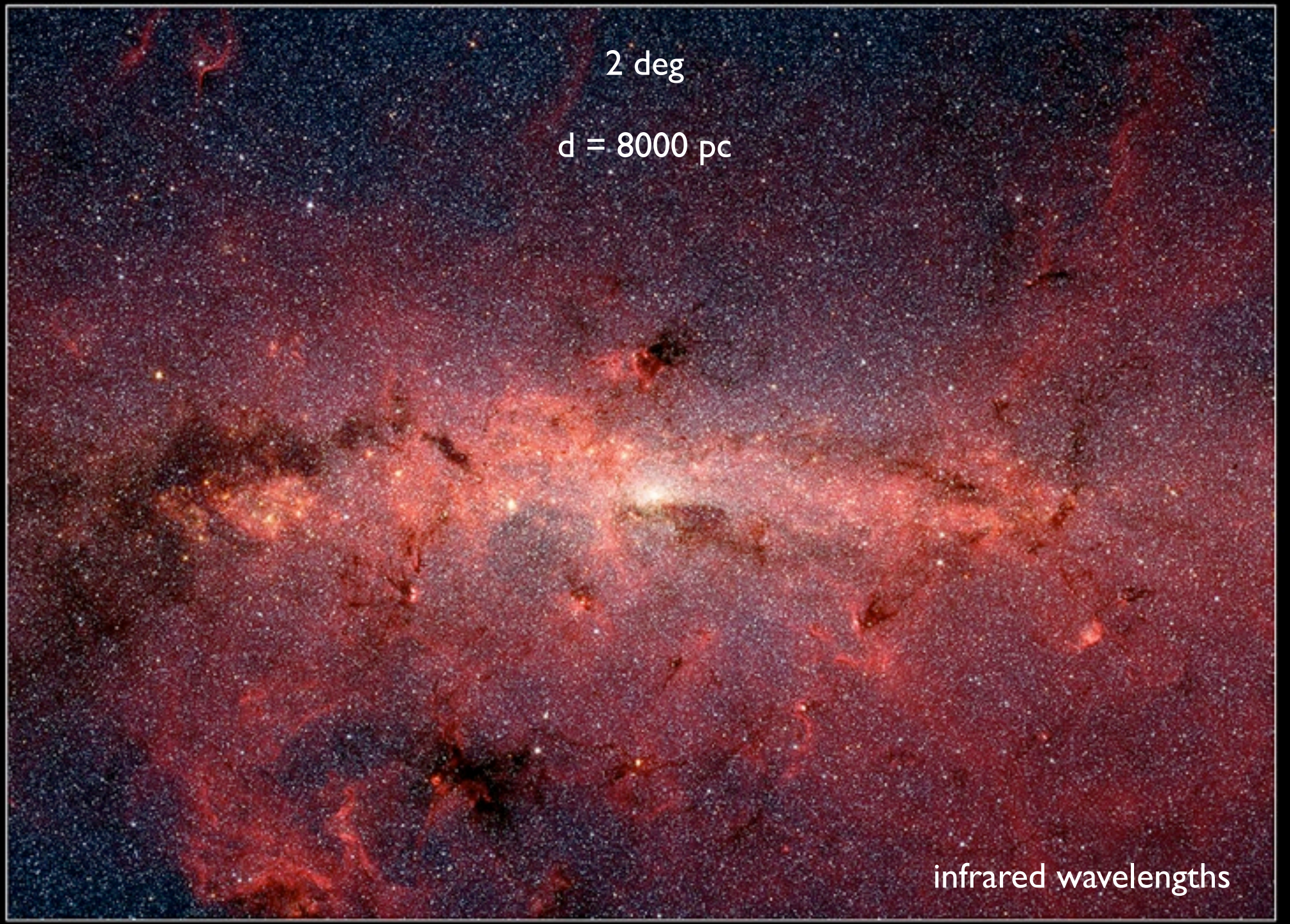
all-sky map: Milky Way disk is aligned along the equator



*Diffuse Infrared Background Explorer*
view of the Milky Way

Interstellar dust can be opaque at visible wavelengths,
but transparent at infrared wavelengths

# Galactic center in Sagittarius: 65 deg



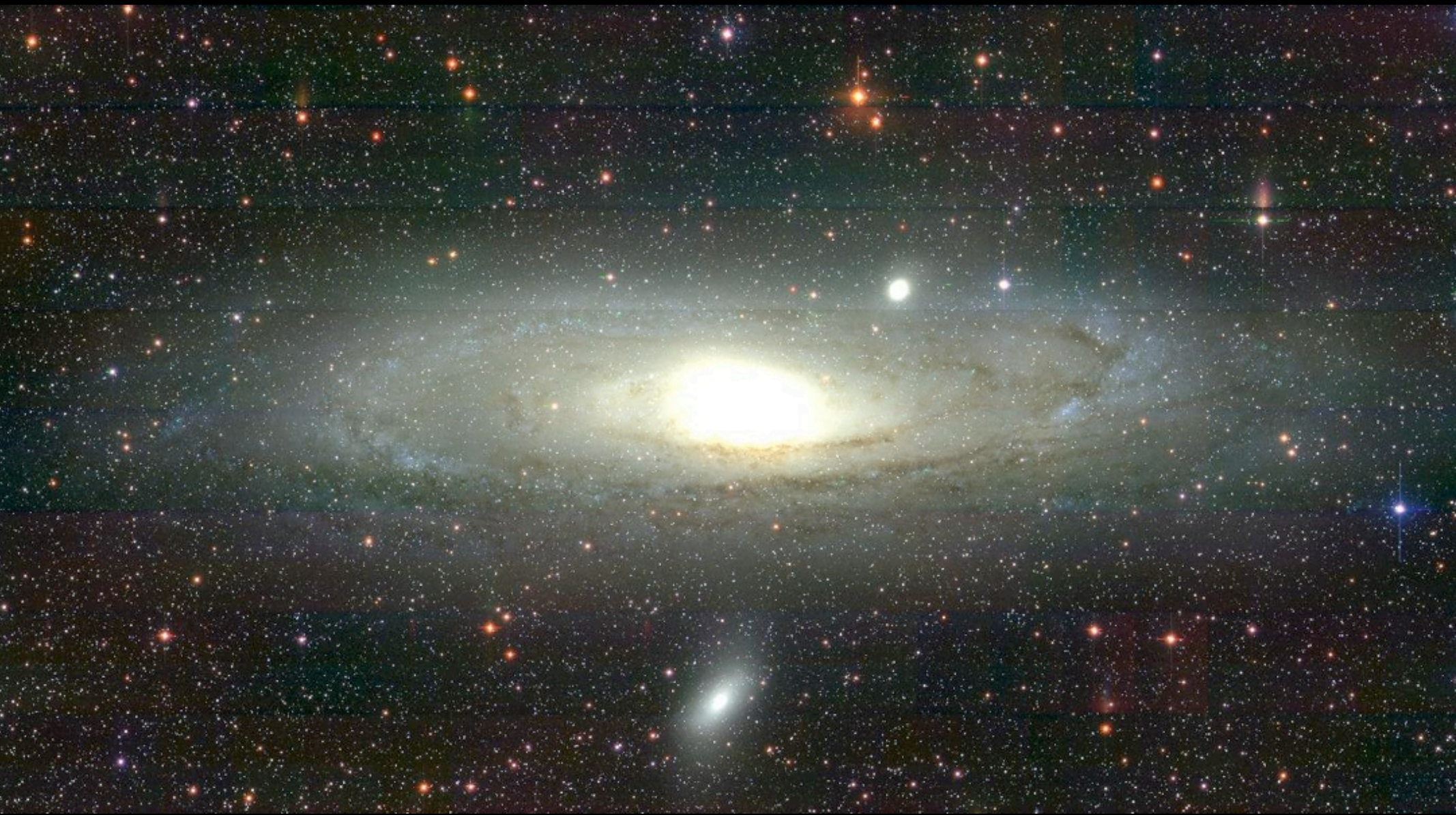

The Center of the Milky Way Galaxy

NASA / JPL-Caltech / S. Stolovy (Spitzer Science Center/Caltech)

Spitzer Space Telescope • IRAC

ssc2006-02a

M31 = Andromeda:  3 deg
d = 780 kpc



# 1932: brightest galaxies (Shapley-Ames catalog)

d ~ 10 Mpc, N ~ 1000

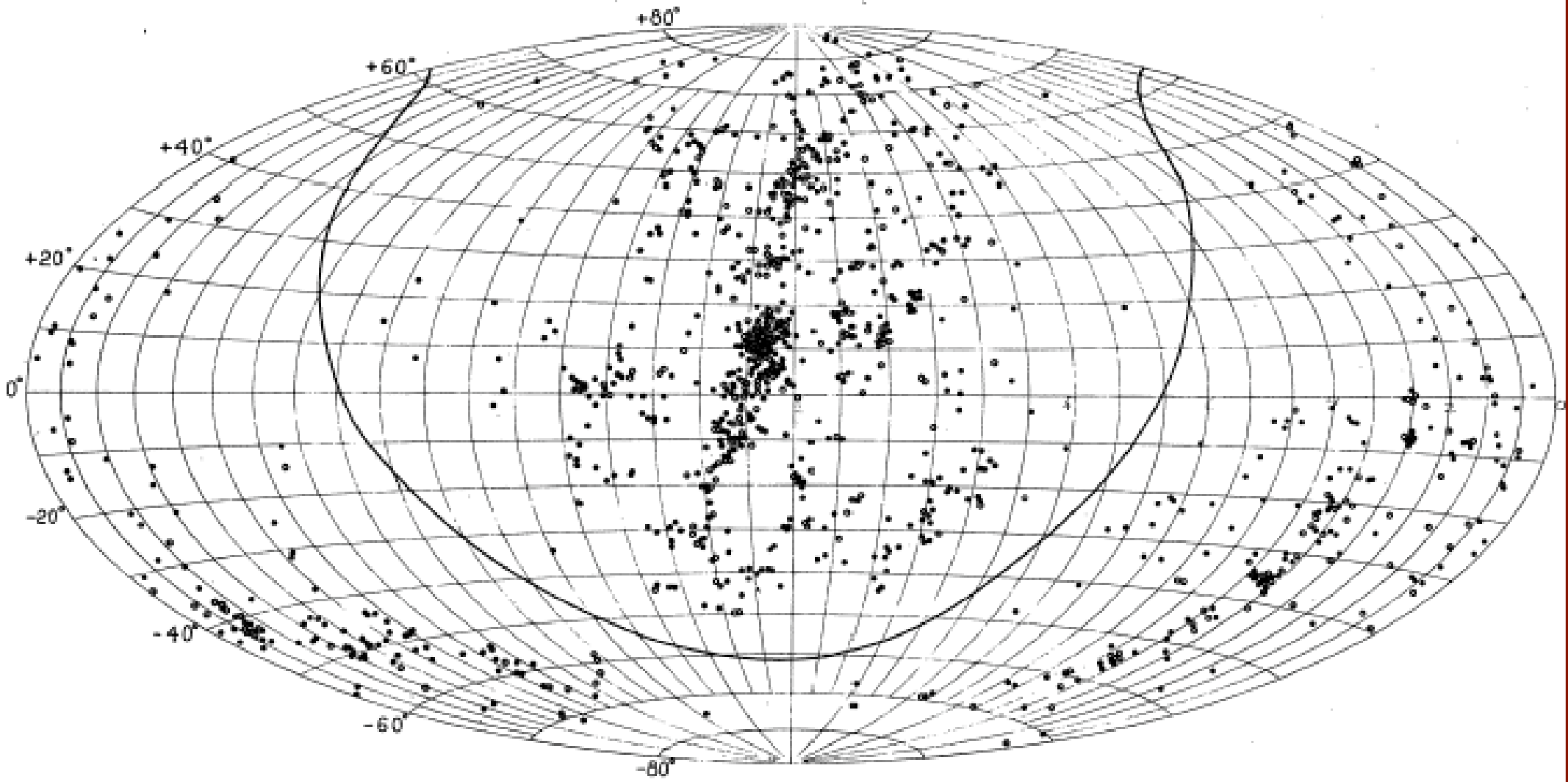
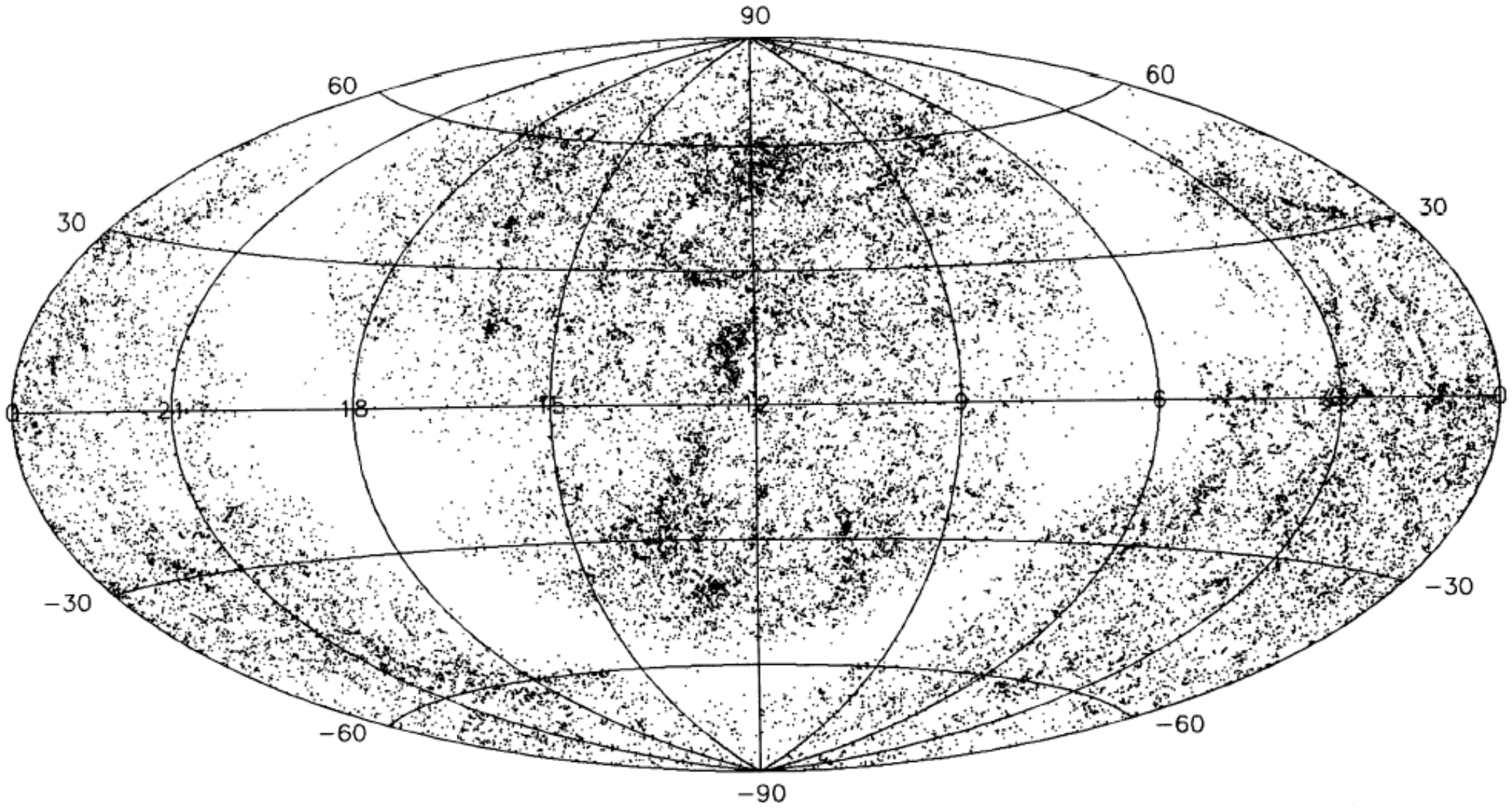



Figure 4

# 1970's: fainter galaxies (Zwicky catalog)

d ~ 30 Mpc, N ~ 27000

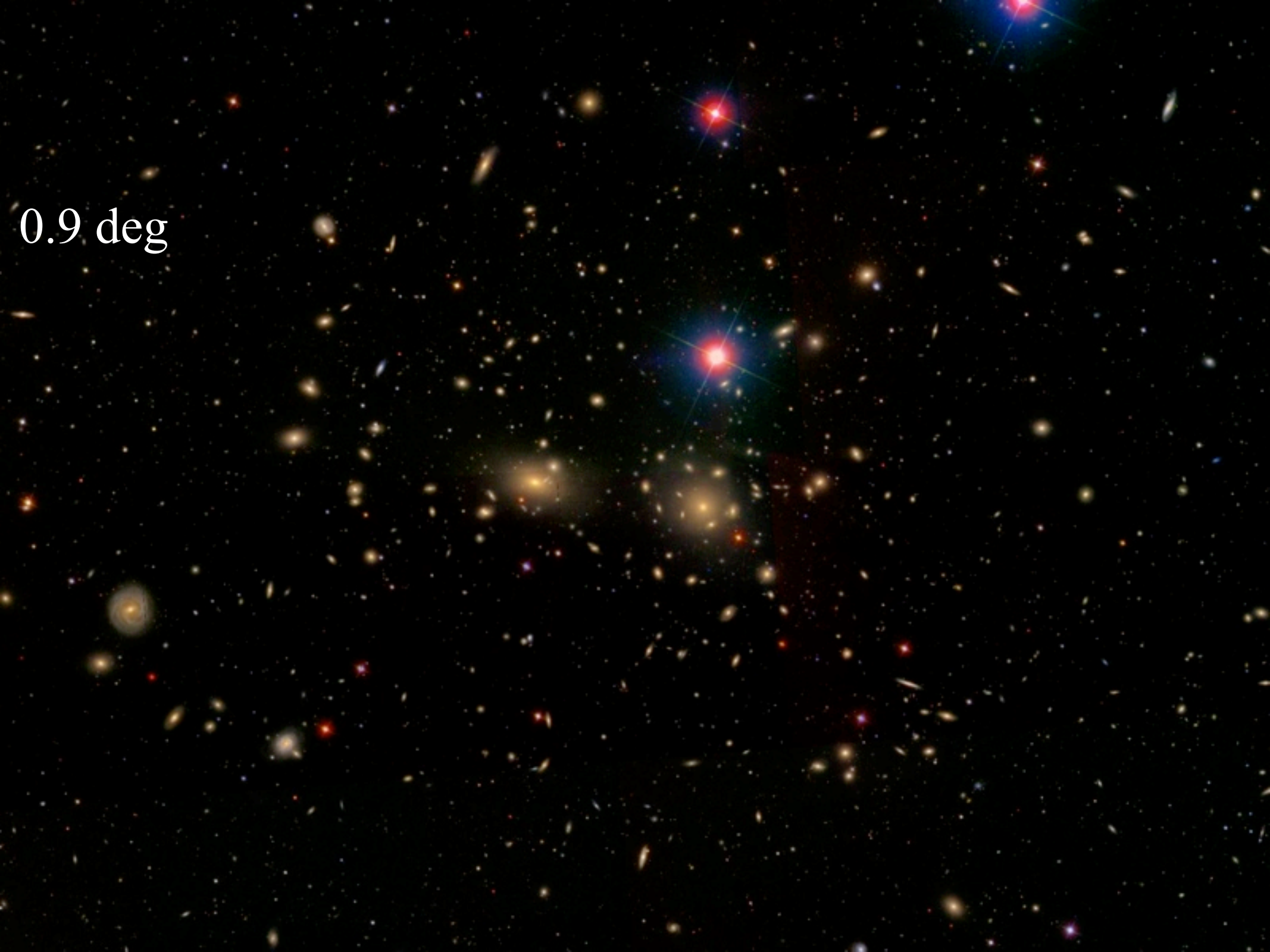


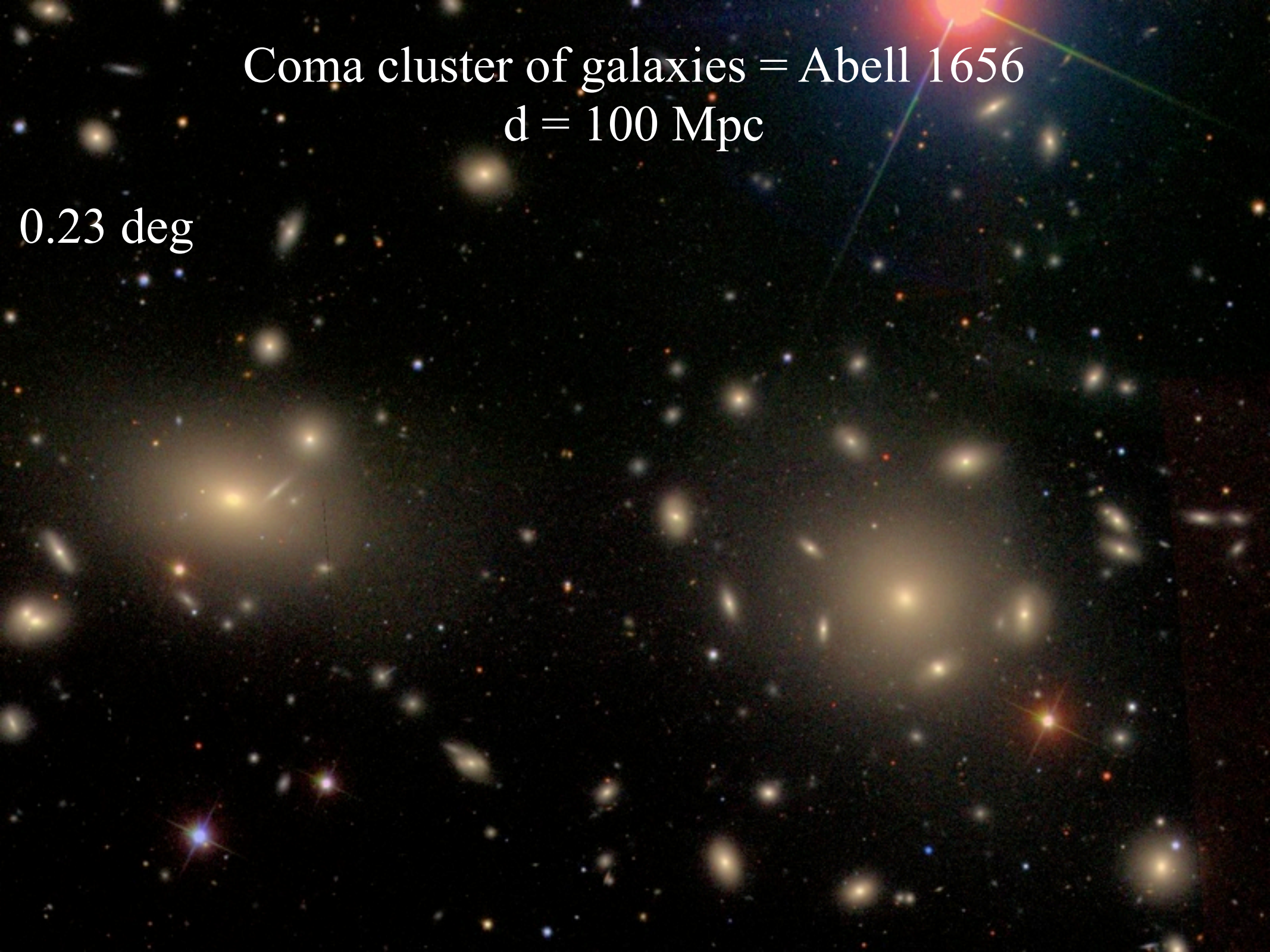
28.8 deg
Coma Berenices and Virgo

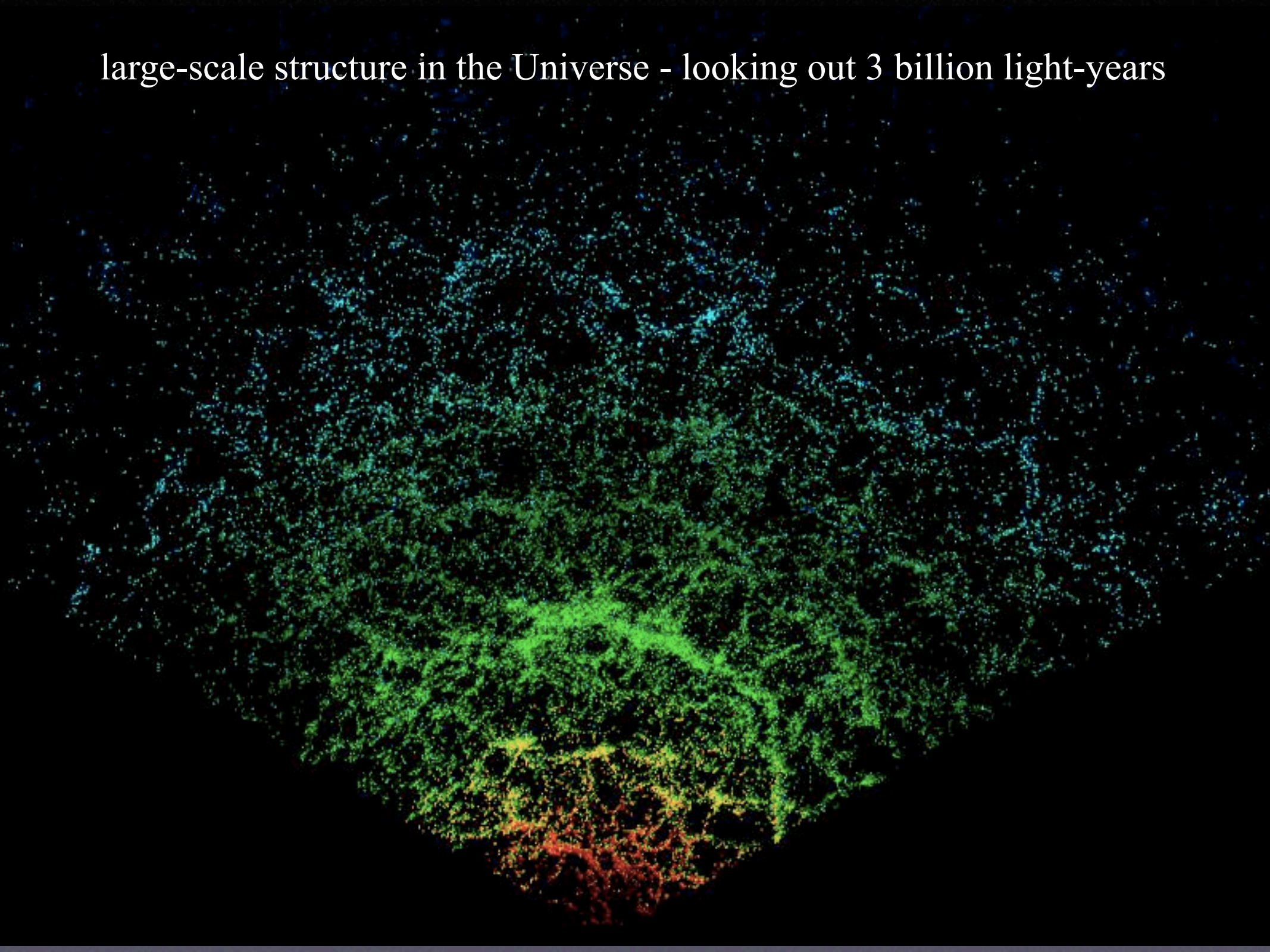
Coma Berenices
28.8 deg

14.4 deg

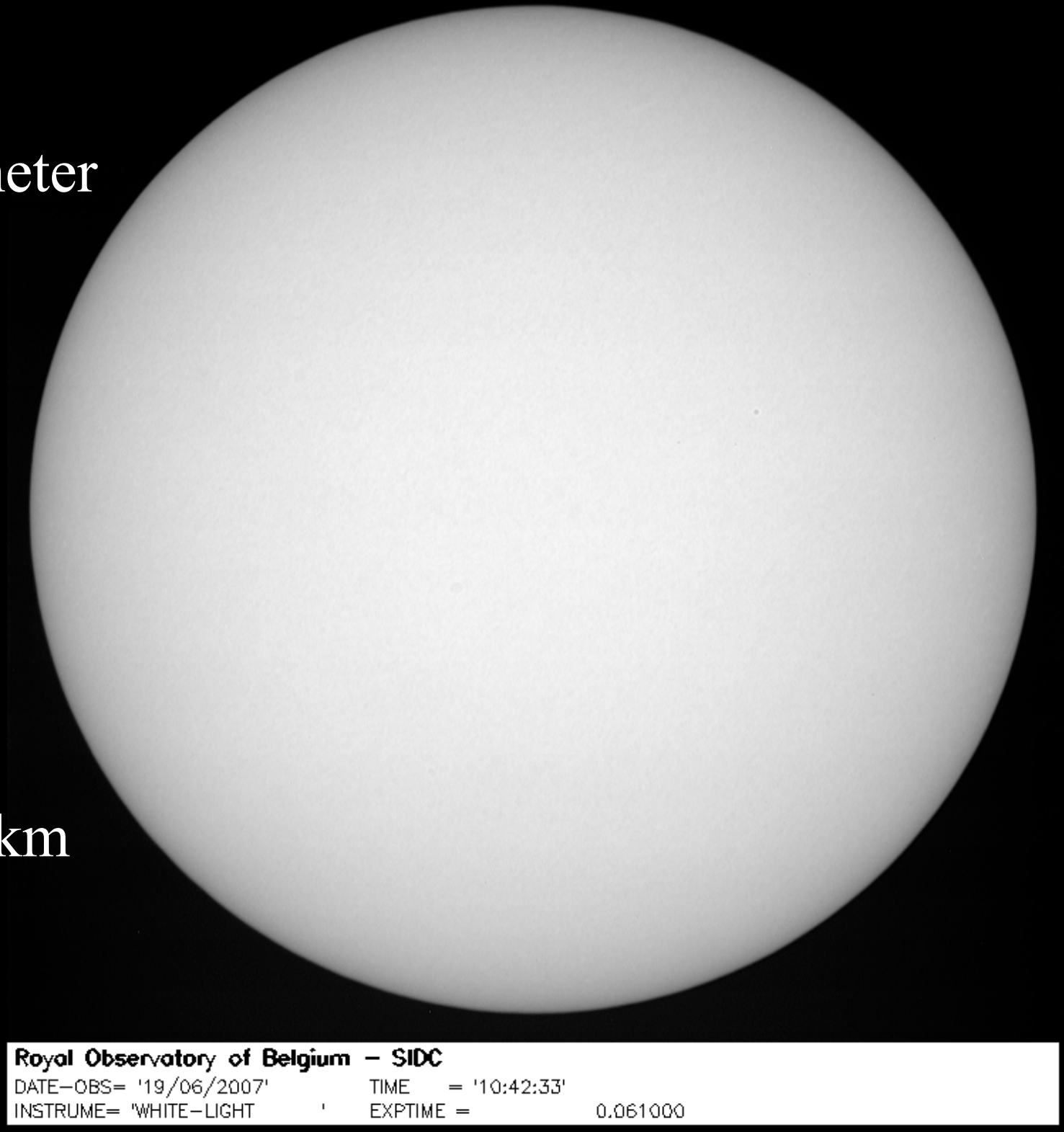
3.6 deg


0.9 deg

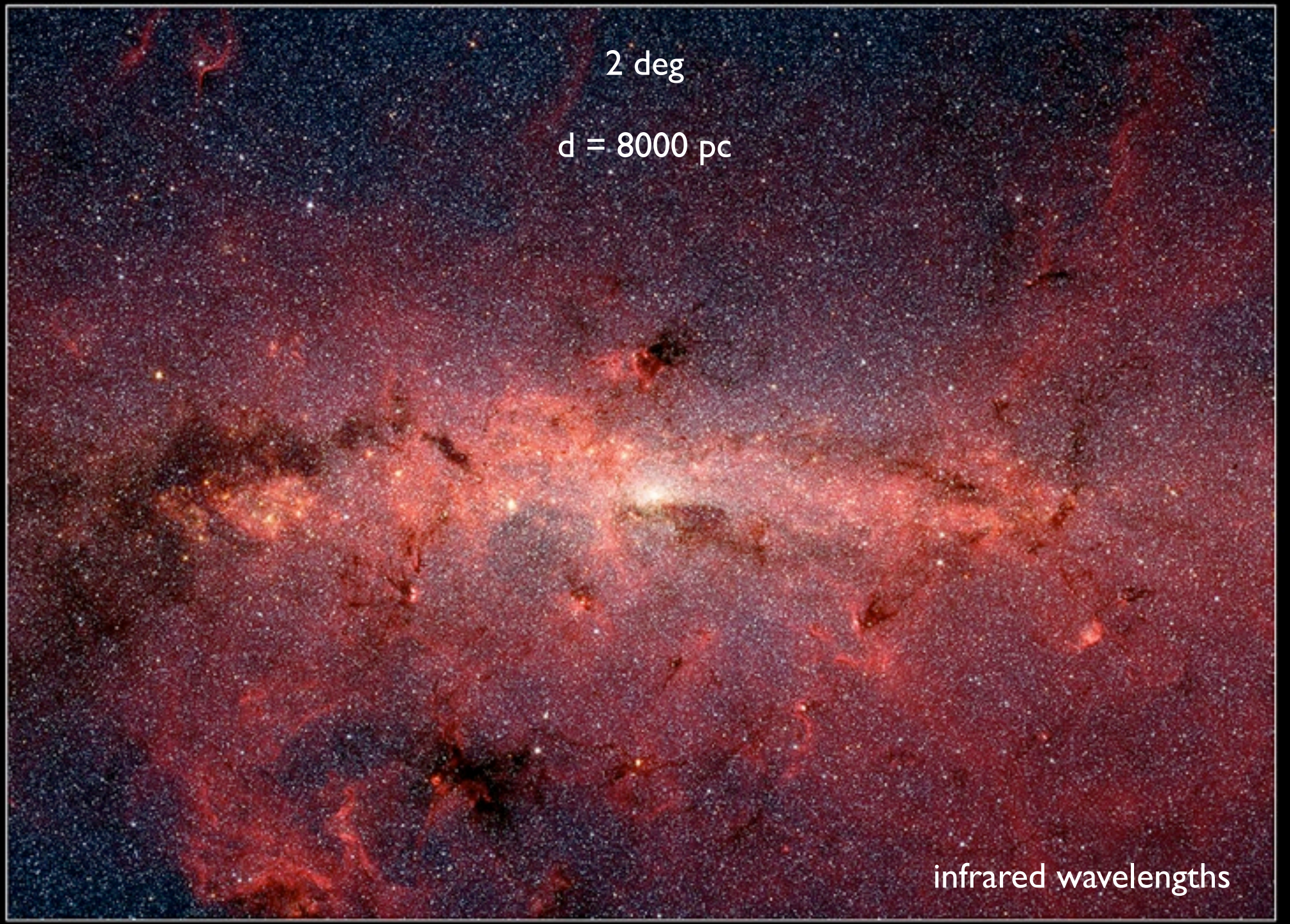

Coma cluster of galaxies = Abell 1656
d = 100 Mpc
0.23 deg


large-scale structure in the Universe - looking out 3 billion light-years

Sun:
0.5 degree diameter




R = 696,000 km
d = 149,000,000 km



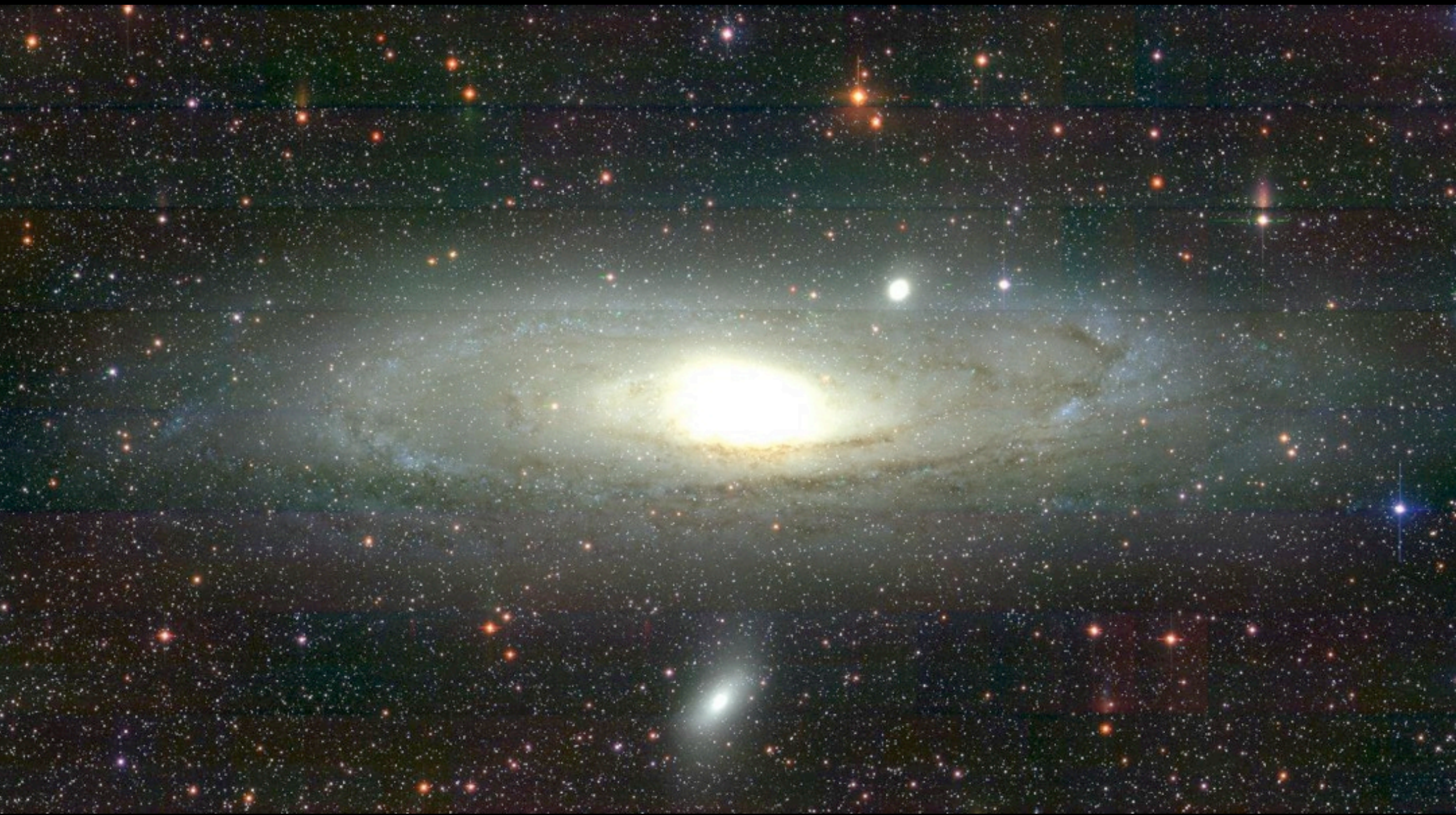

The Center of the Milky Way Galaxy

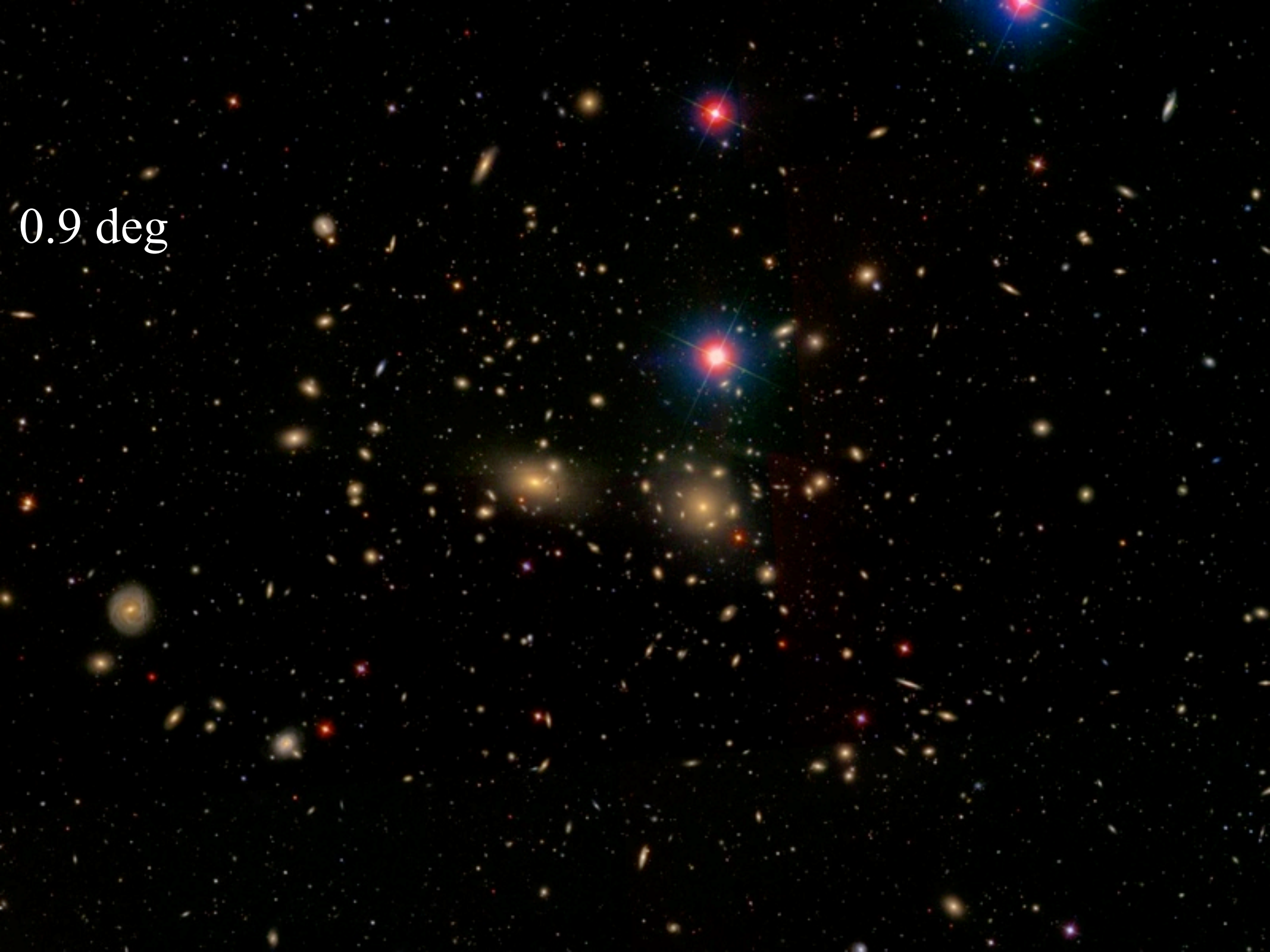
NASA / JPL-Caltech / S. Stolovy (Spitzer Science Center/Caltech)

Spitzer Space Telescope • IRAC

ssc2006-02a

M31 = Andromeda:  3 deg
d = 780 kpc



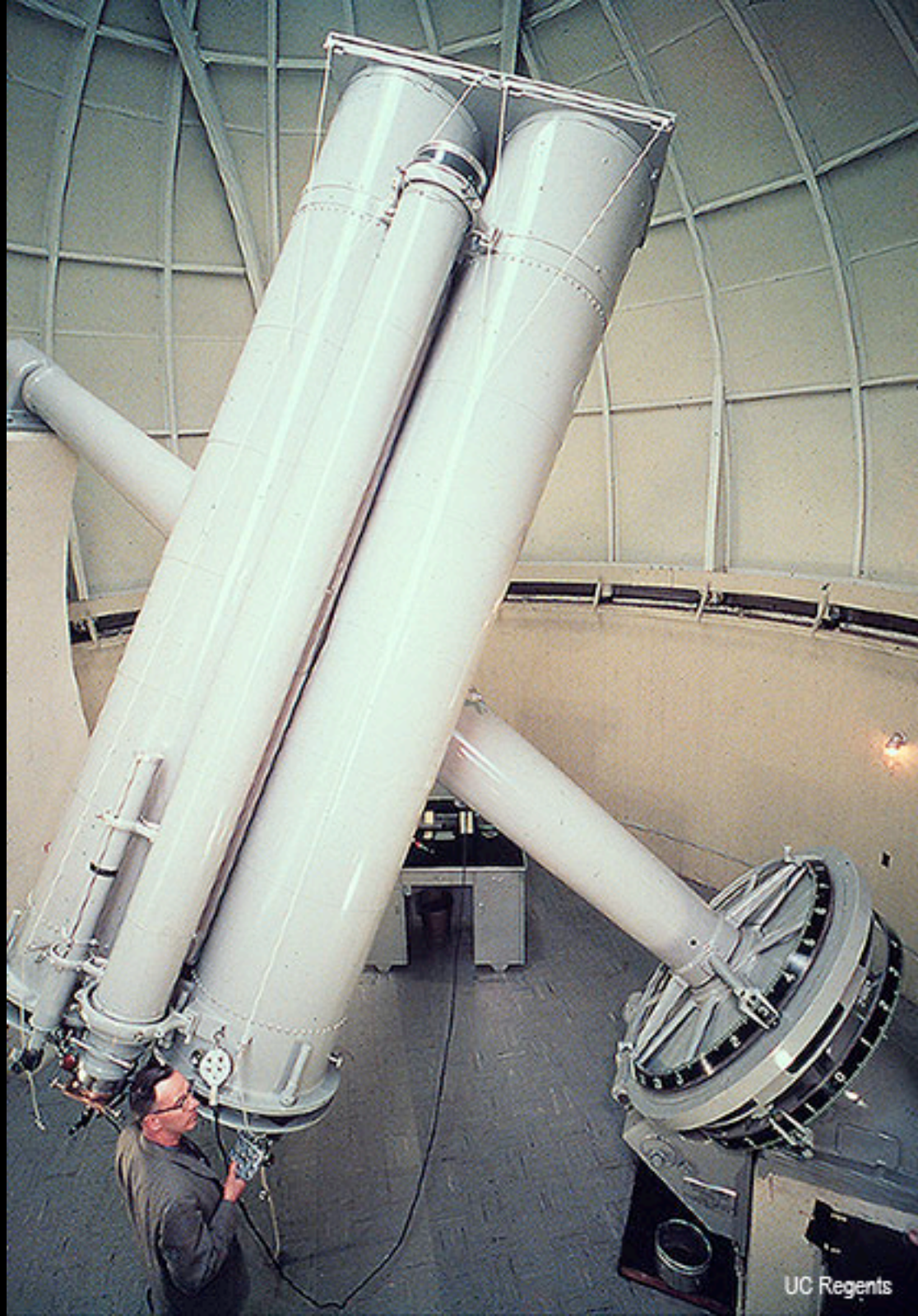

0.9 deg

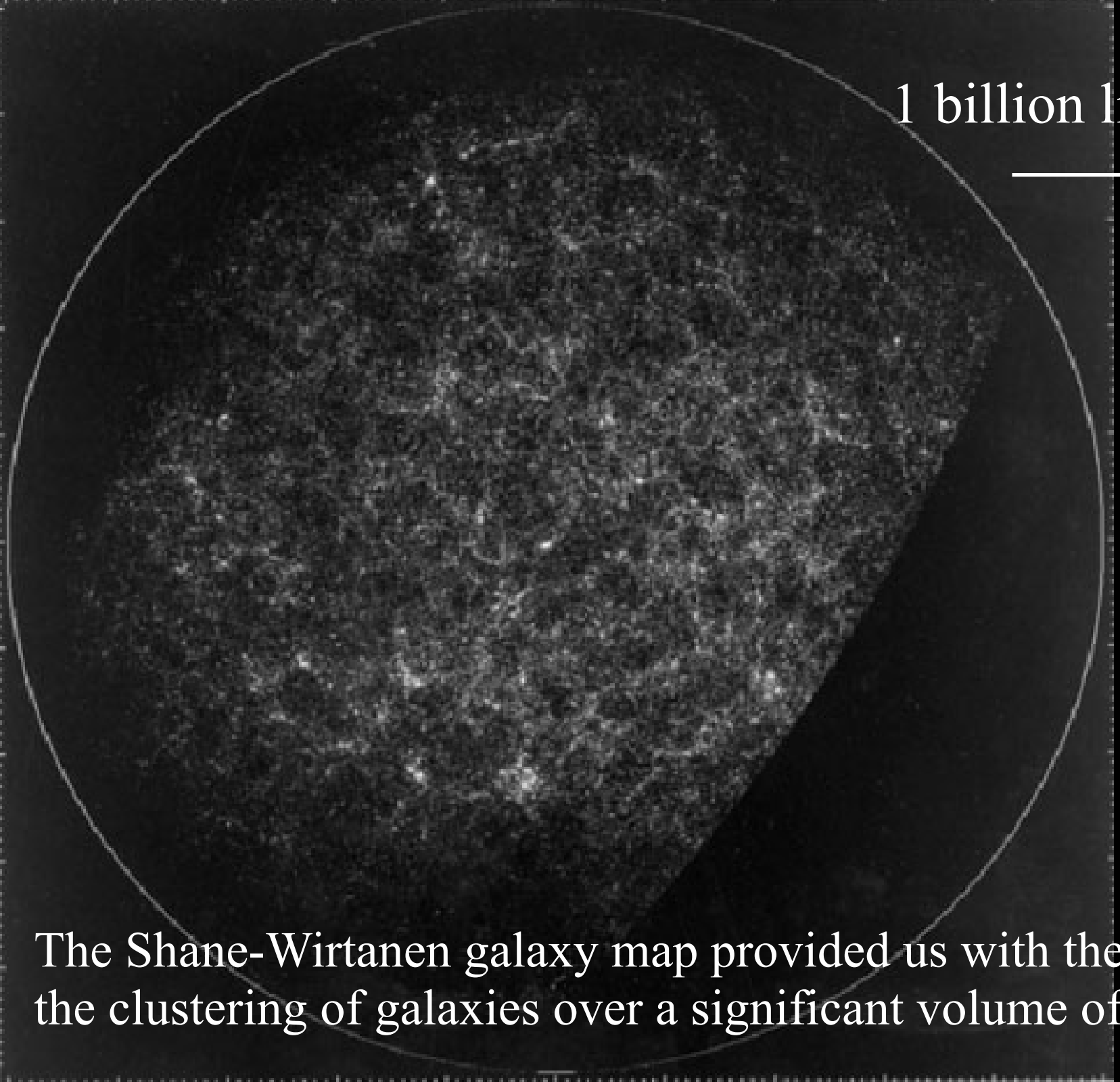
# distances as light-travel times:

| | |
|---|---|
| circumference of Earth | 0.133 sec |
| distance to Moon | 1.28 sec |
| circumference of Sun | 15 sec |
| Sun | 500 sec |
| Neptune | 4 hours |
| diameter of Oort Cloud | 10 months |
| α Centauri | 4.3 years |
| center of Milky Way | 27,000 years |
| Andromeda galaxy | 2 million years |
| Virgo cluster | 50 million years |
| Coma cluster | 0.3 billion years |
| quasars | many billion years |
| cosmic horizon | 13.7 billion years |

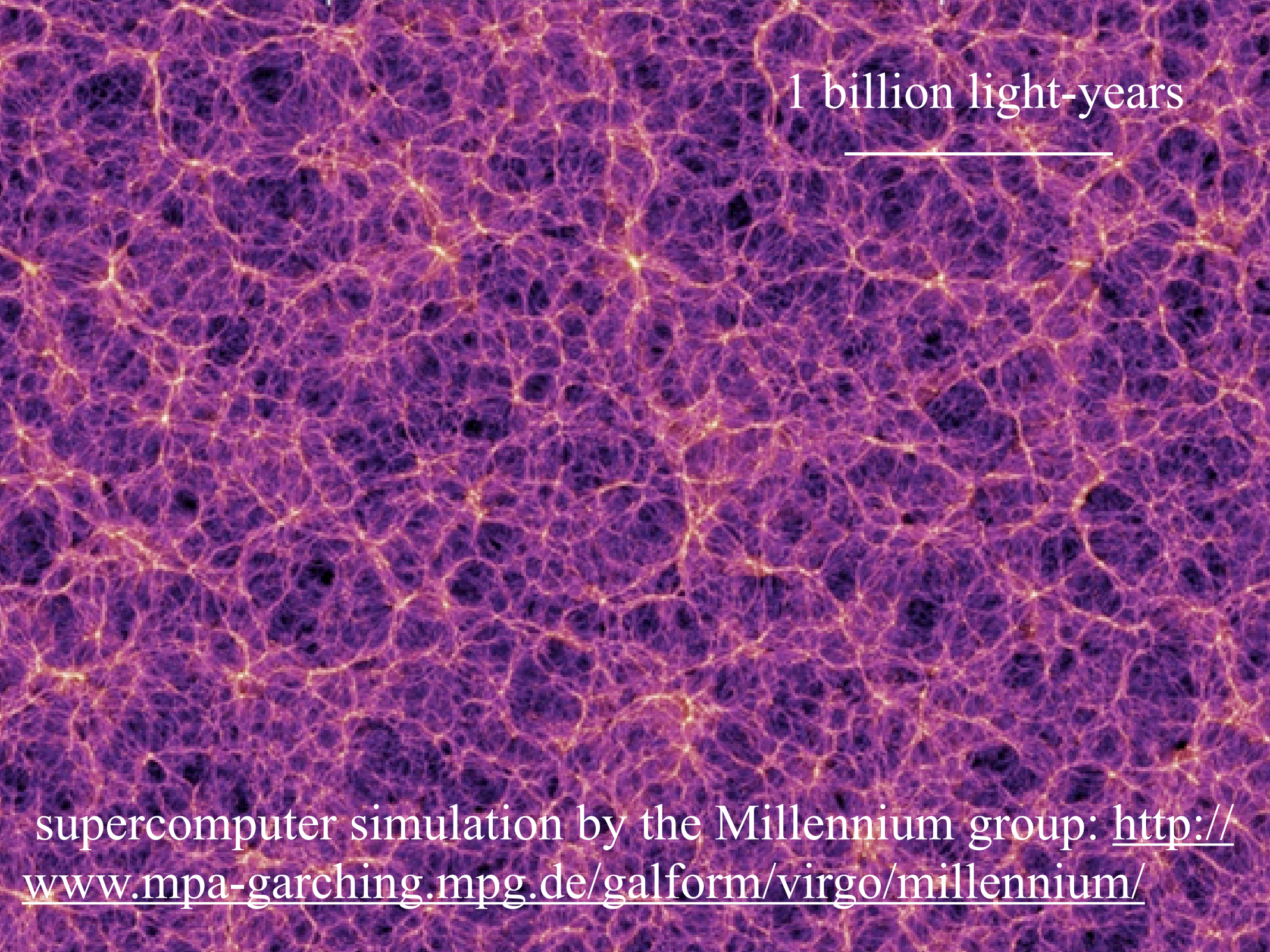
This telescope at Lick Observatory made an atlas of the sky in the 1960's.

Carl Wirtanen and Donald Shane counted galaxies on the glass plates - one million galaxies in total.






The Shane-Wirtanen galaxy map provided us with the first view of the clustering of galaxies over a significant volume of the Universe.




supercomputer simulation by the Millennium group: http://www.mpa-garching.mpg.de/galform/virgo/millennium/

# 1932: brightest galaxies (Shapley-Ames catalog)

d ~ 10 Mpc, N ~ 1000

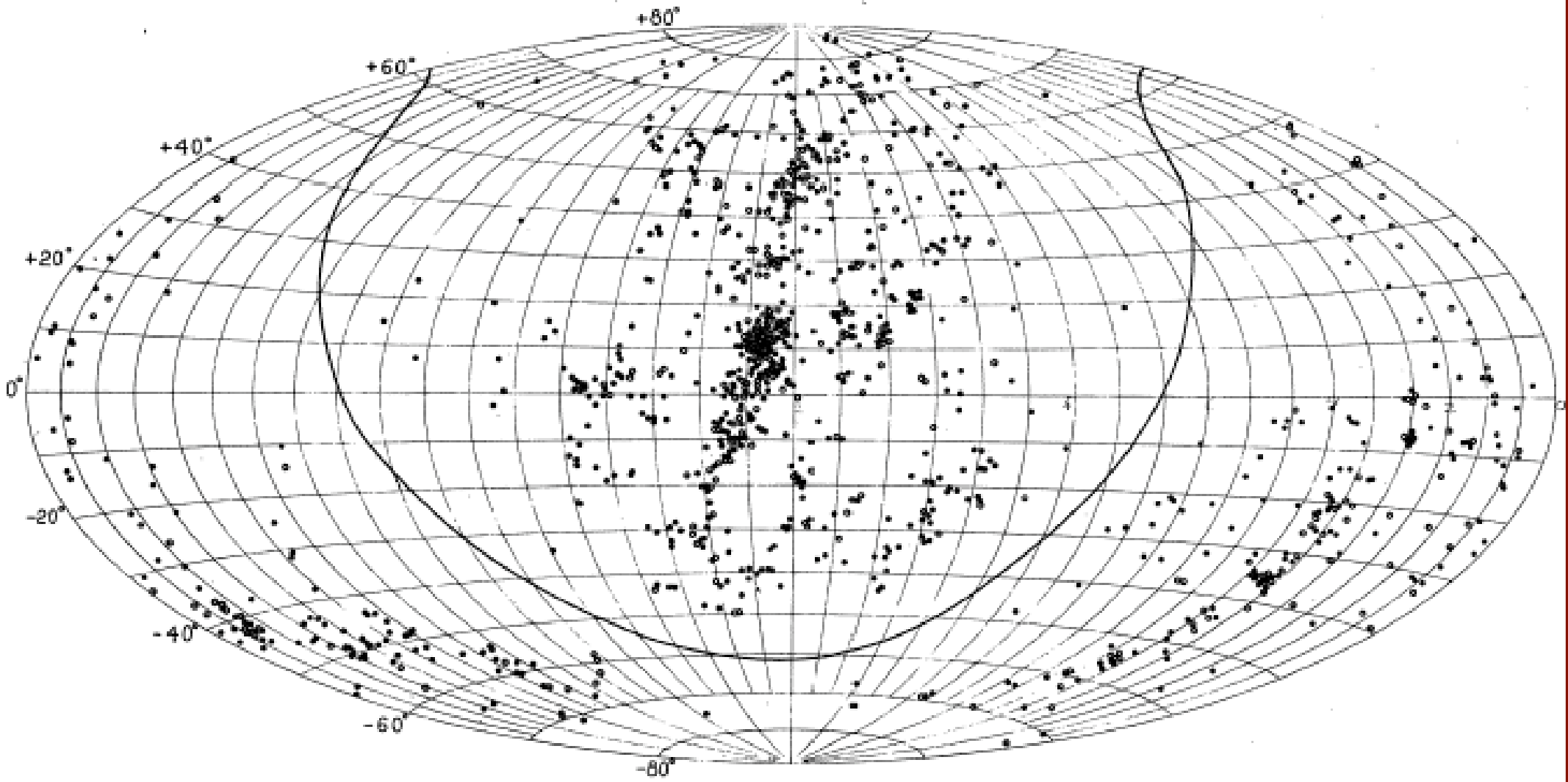



Figure 4