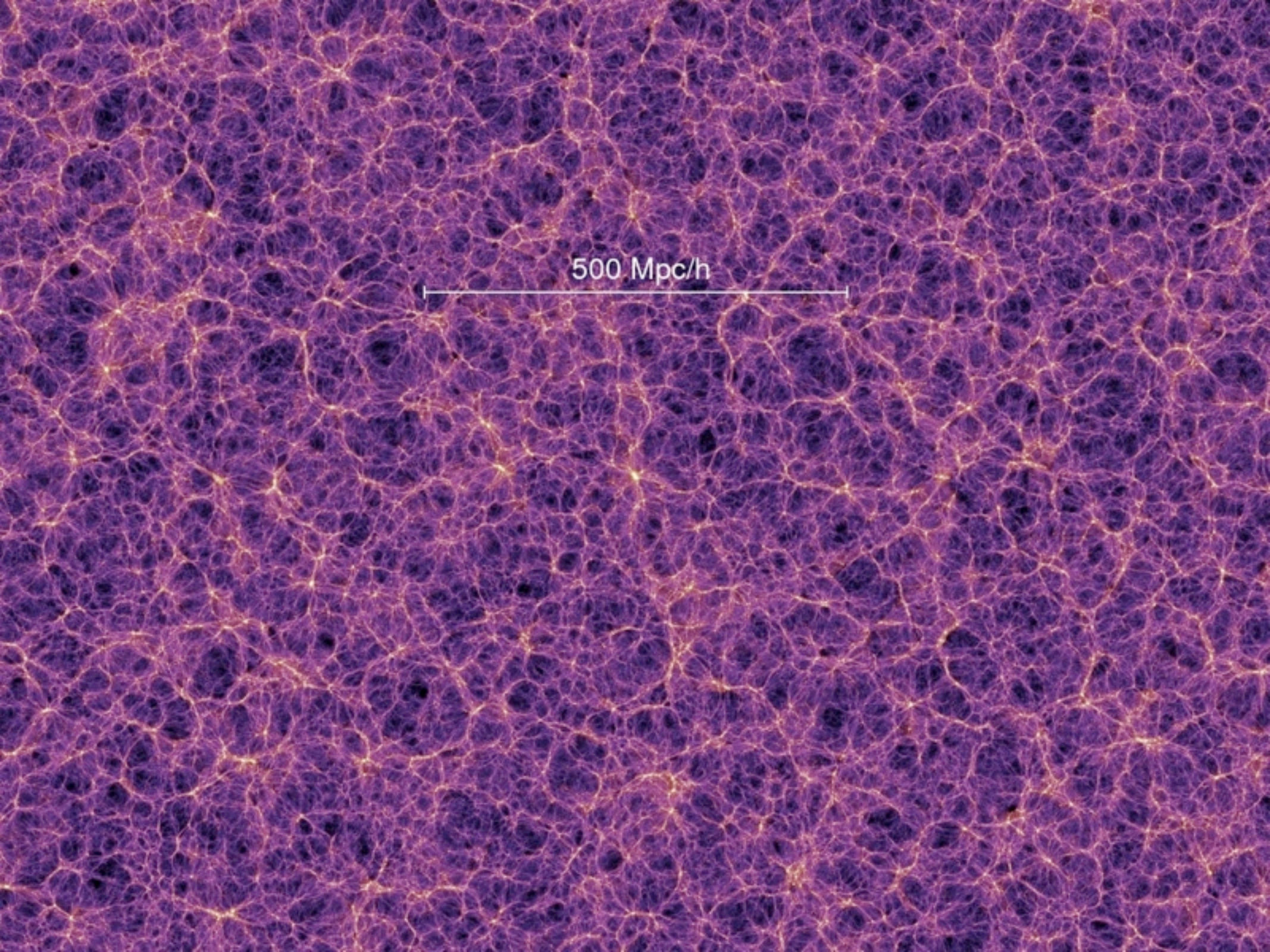
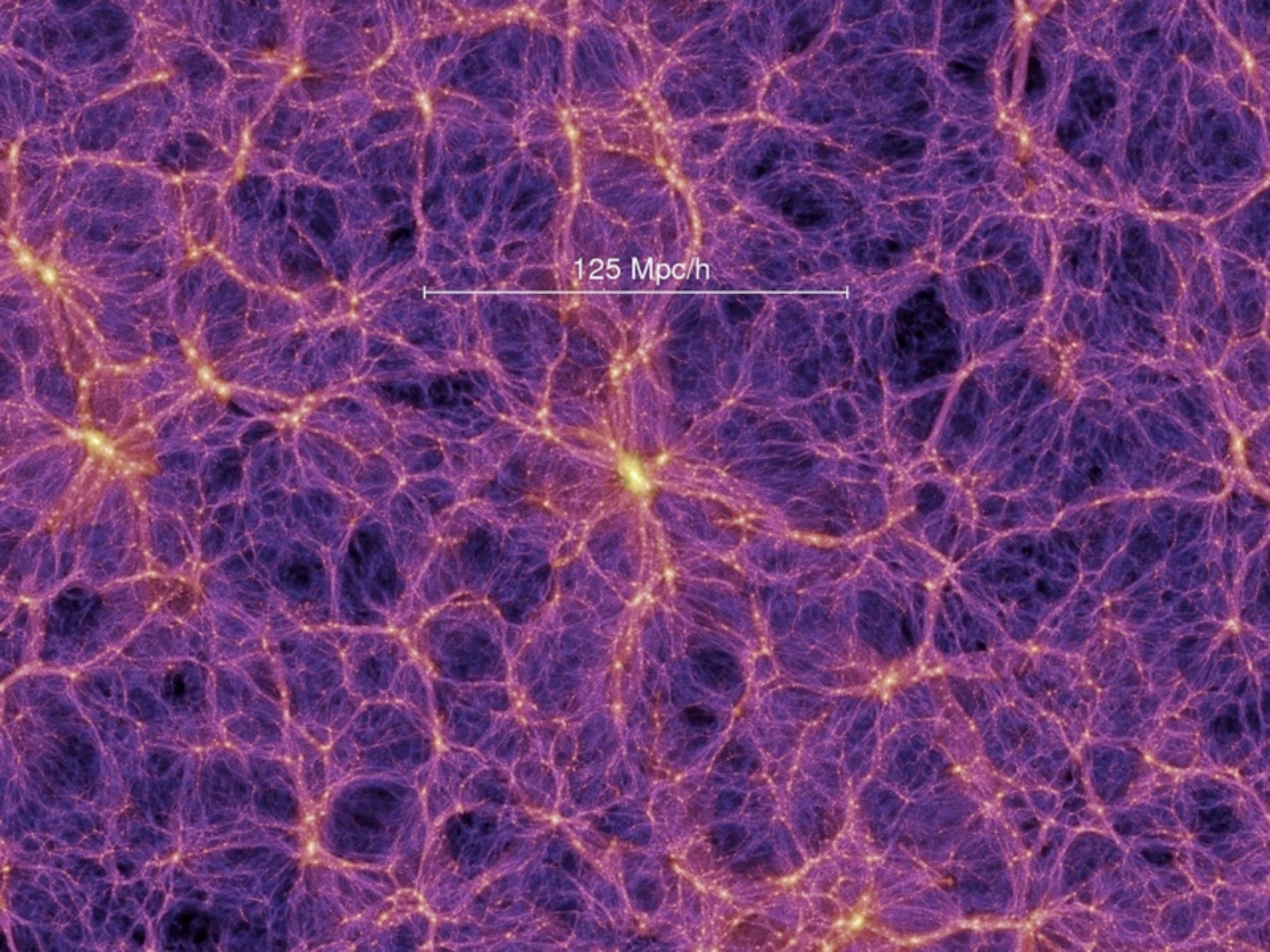


distribution of galaxies in space

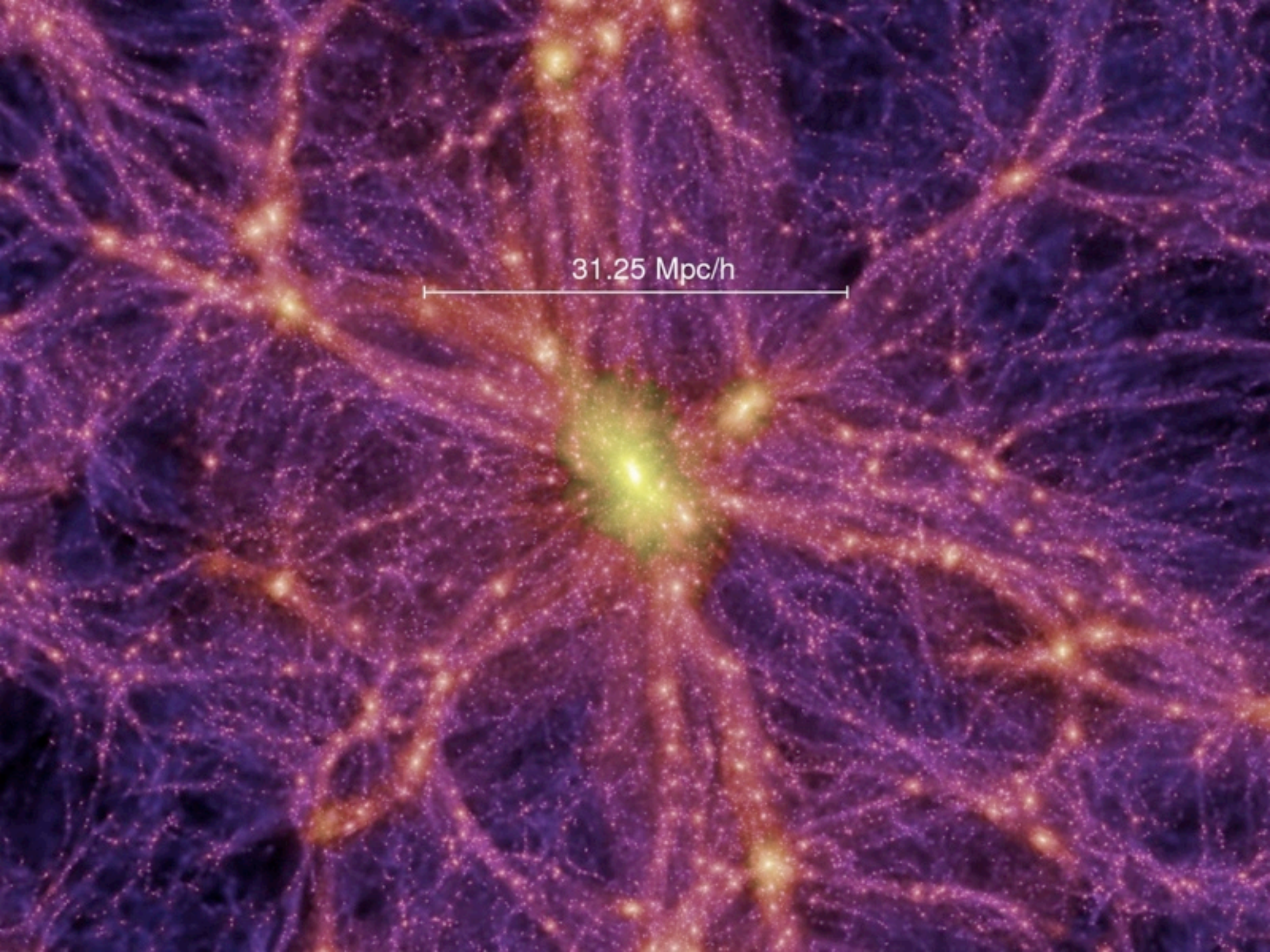
A circular field of view showing a dense distribution of galaxies, with a dark wedge-shaped region on the right side. The galaxies are represented as small, bright, irregular shapes scattered across the circular area. The overall appearance is that of a deep-field astronomical image.



500 Mpc/h

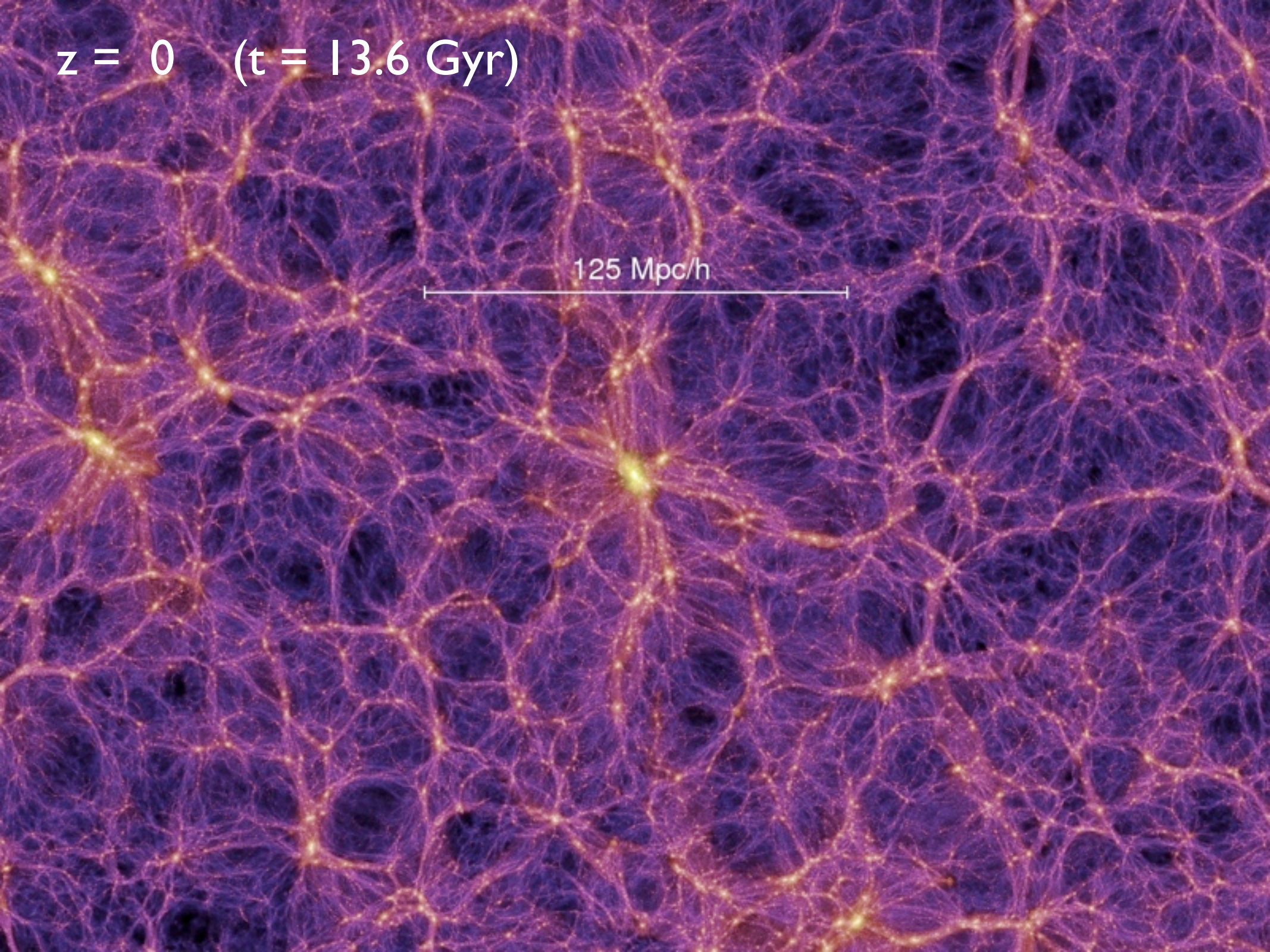


125 Mpc/h



31.25 Mpc/h

$z = 0$ ($t = 13.6$ Gyr)



125 Mpc/h

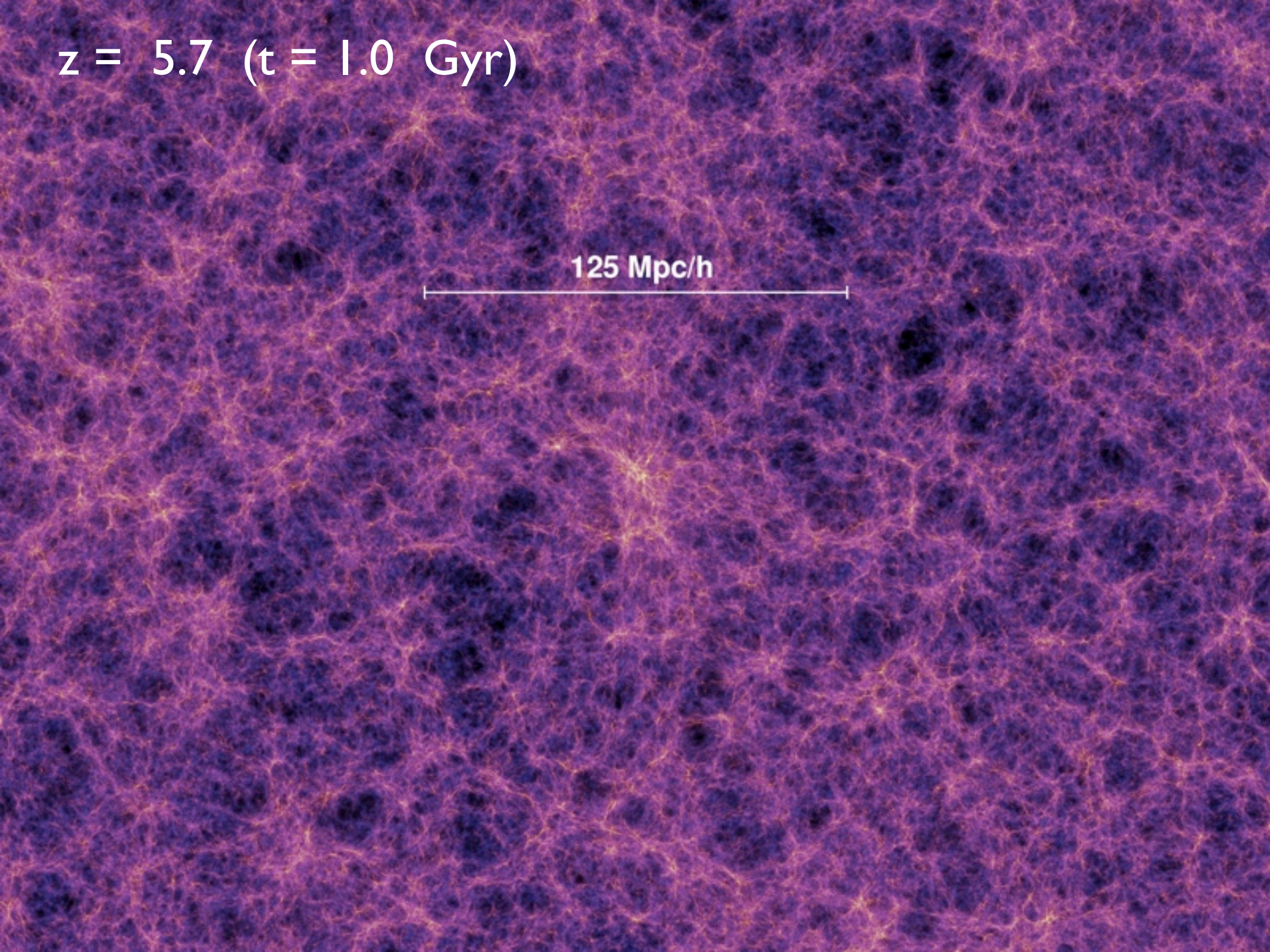
$z = 1.4$ ($t = 4.7$ Gyr)

125 Mpc/h

A visualization of the cosmic web at redshift z=1.4, showing a complex network of filaments and nodes. The filaments are colored in shades of purple and blue, while the nodes are highlighted in yellow and orange. A horizontal scale bar with vertical end-caps is positioned in the upper-middle part of the image, labeled "125 Mpc/h".

$z = 5.7$ ($t = 1.0$ Gyr)

125 Mpc/h

A cosmological simulation snapshot at redshift $z = 5.7$ ($t = 1.0$ Gyr). The image displays a complex, filamentary network of dark matter and gas, rendered in shades of purple and blue. The filaments are interconnected, forming a web-like structure. A scale bar in the center indicates a length of 125 Mpc/h.

$z = 18.3$ ($t = 0.21$ Gyr)

125 Mpc/h



Sun:
0.5 degree diameter

$R = 696,000 \text{ km}$
 $d = 149,000,000 \text{ km}$



Royal Observatory of Belgium – SIDC

DATE-OBS= '19/06/2007'

TIME = '10:42:33'

INSTRUME= 'WHITE-LIGHT'

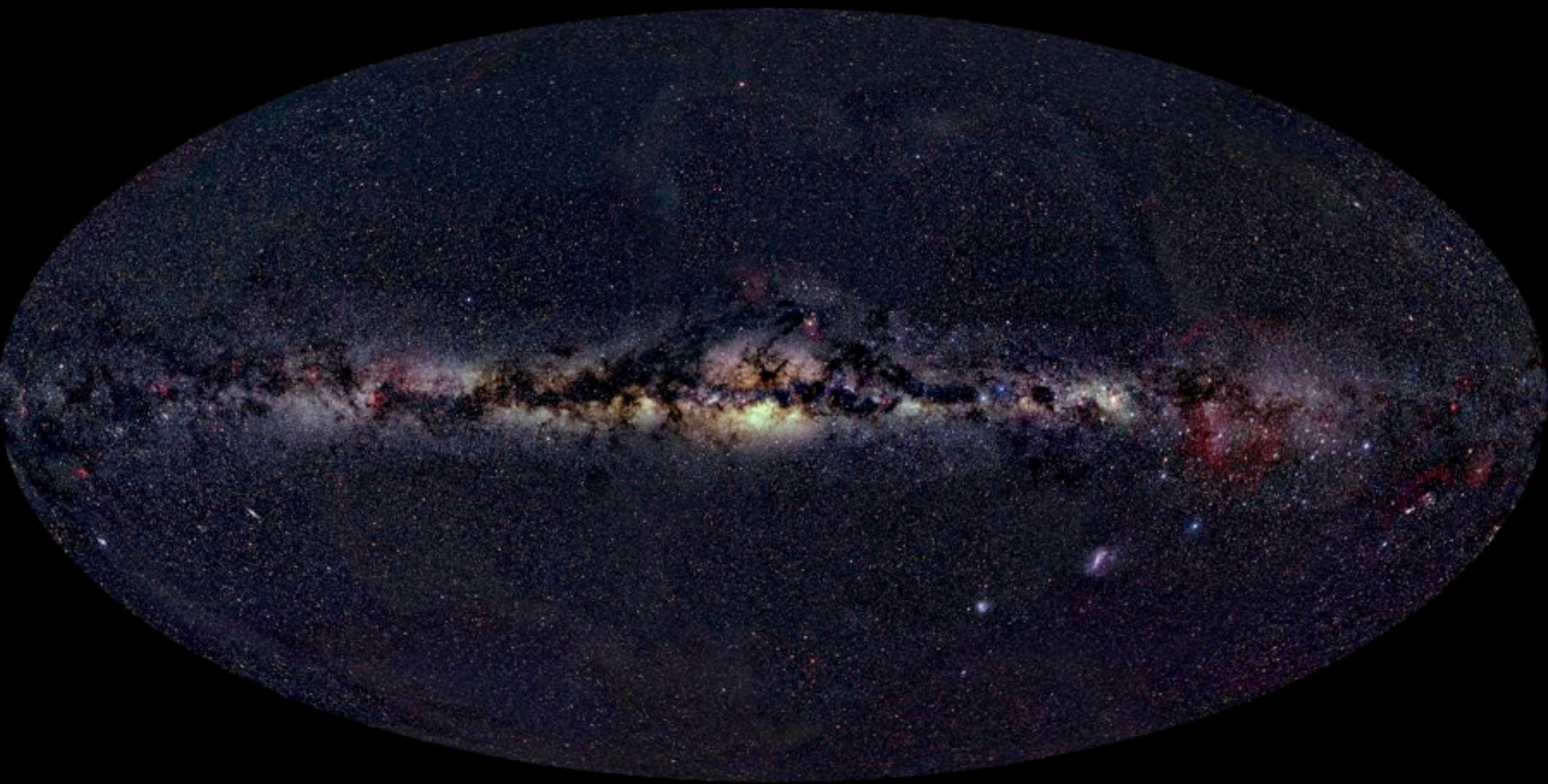
EXPTIME =

0.061000

α Centauri
28 deg

$d = 1.35$ parsec

Alpha Centauri and the Southern Cross



© 2000, Axel Mellinger

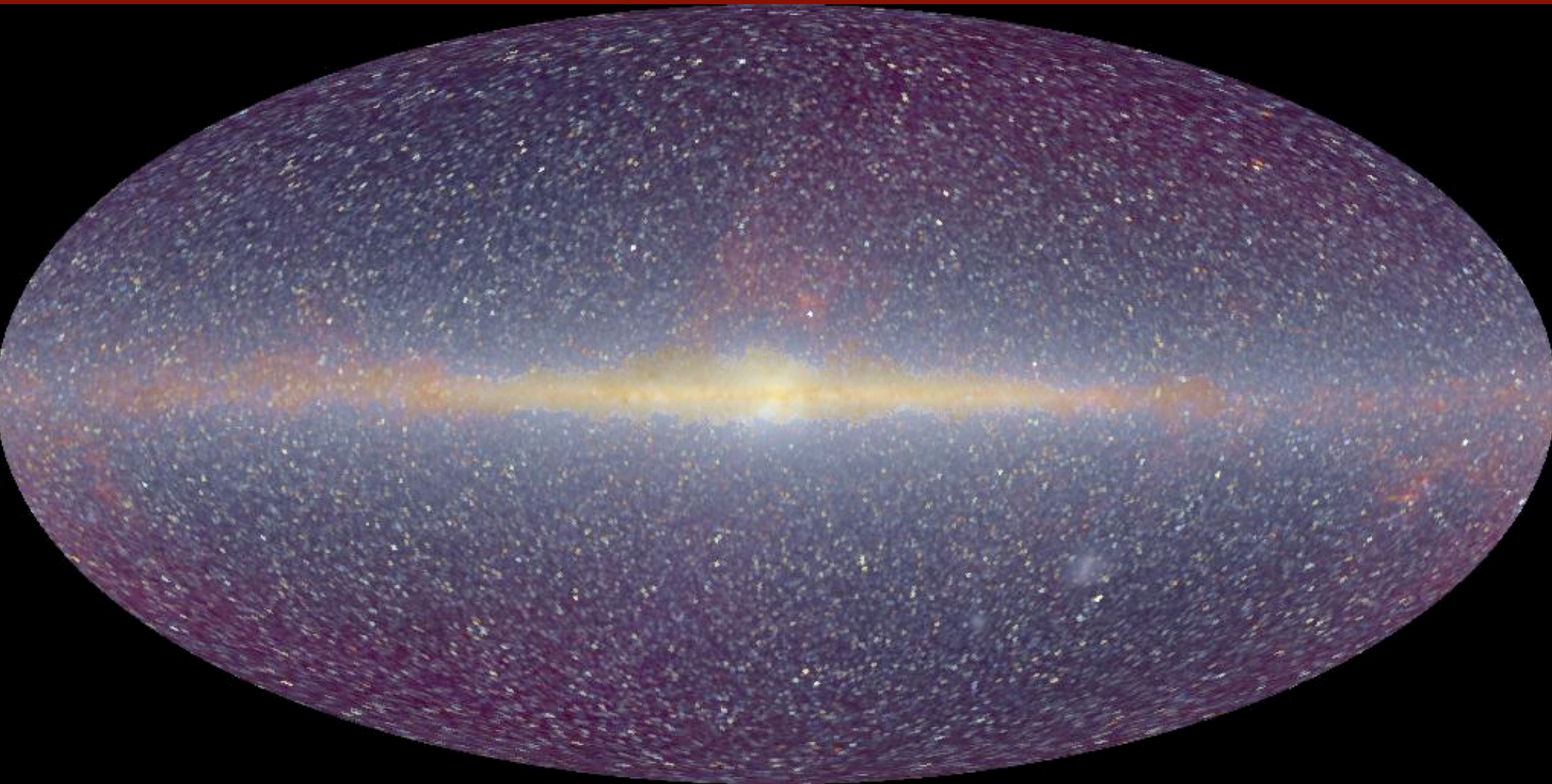
Cygnus

Sagittarius

Crux

Orion

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

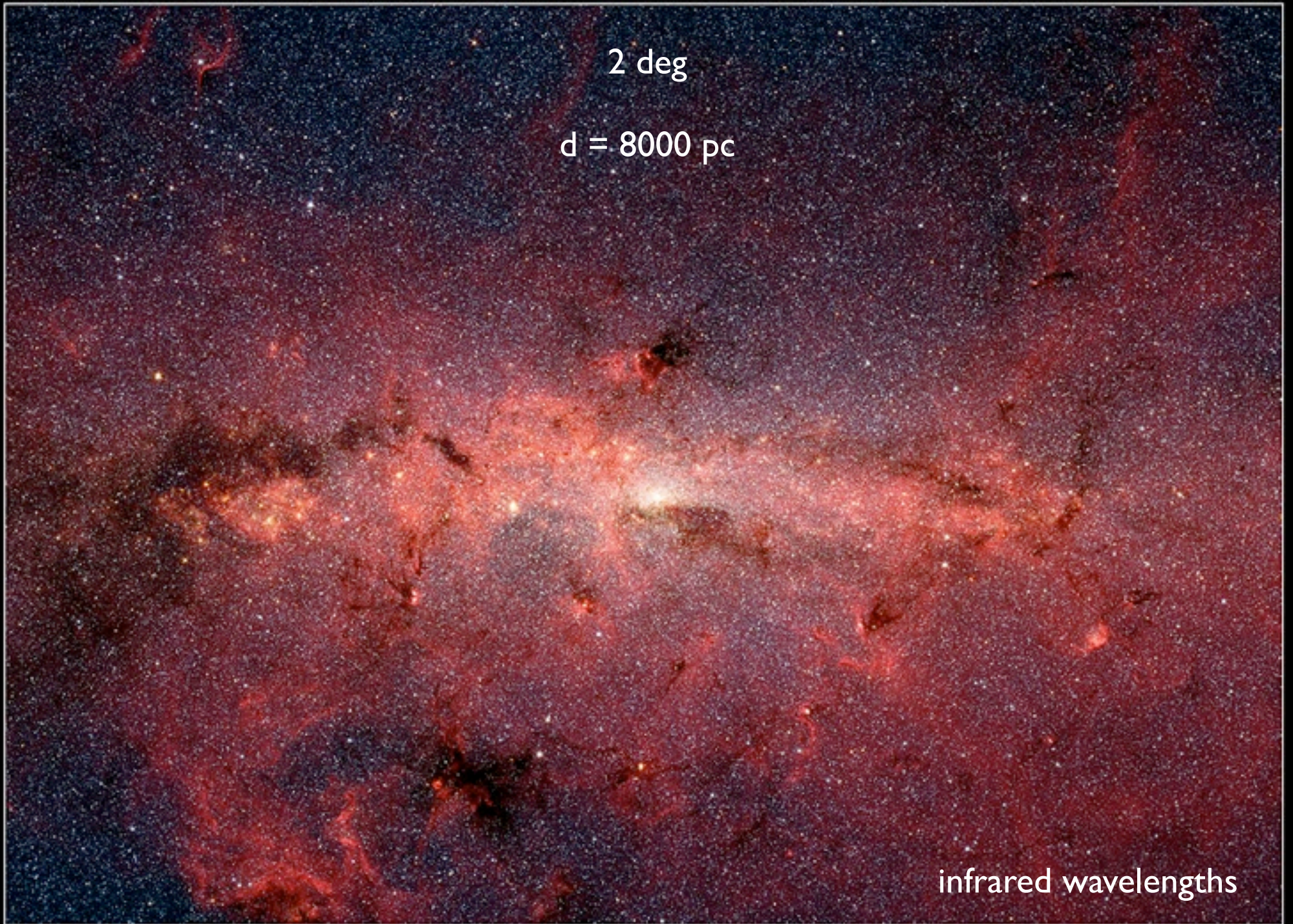


Diffuse Infrared Background Explorer
view of the Milky Way

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

Galactic center in Sagittarius: 65 deg





2 deg

$d = 8000 \text{ pc}$

infrared wavelengths

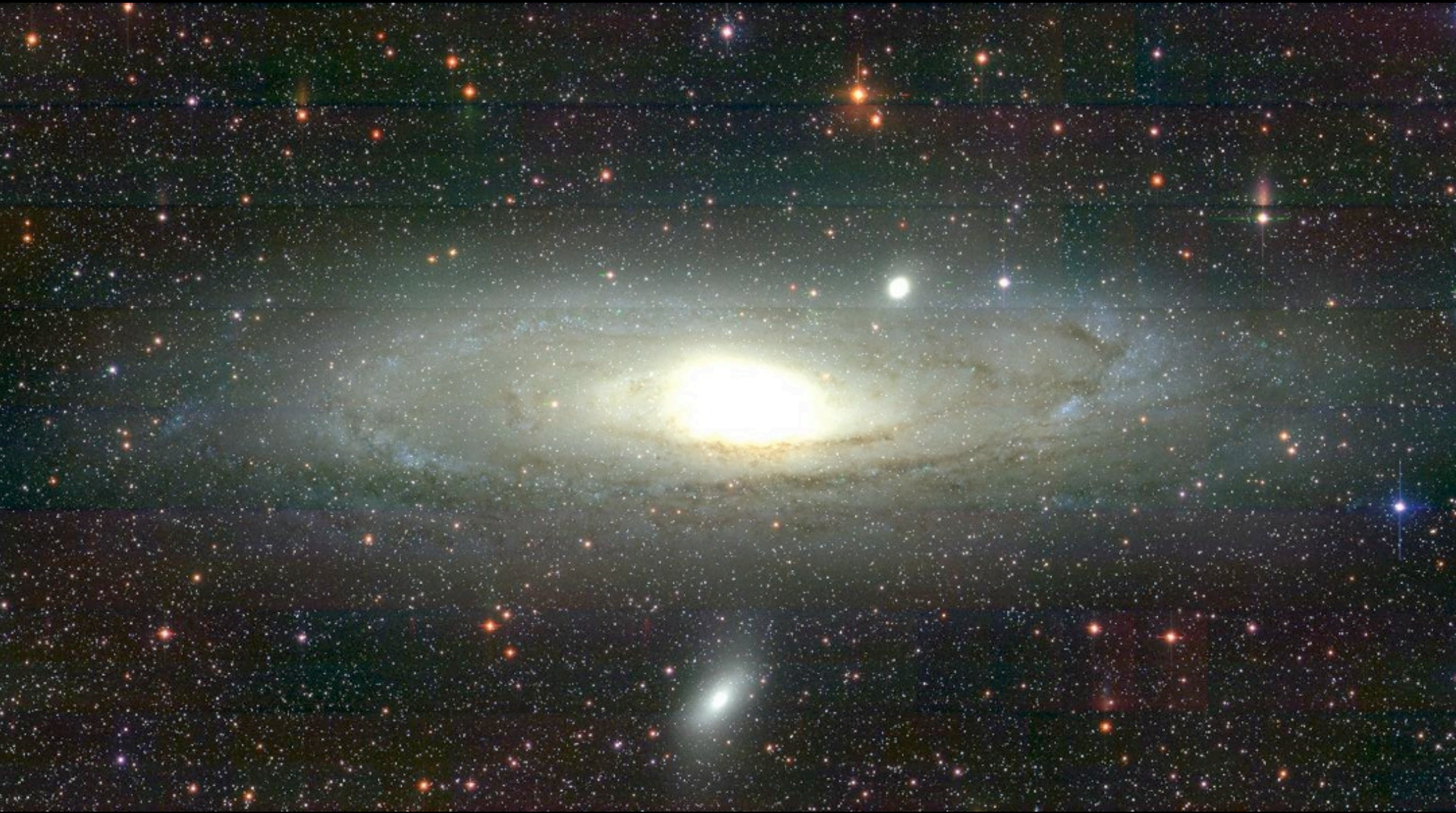
The Center of the Milky Way Galaxy

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)
 $d \sim 10$ Mpc, $N \sim 1000$

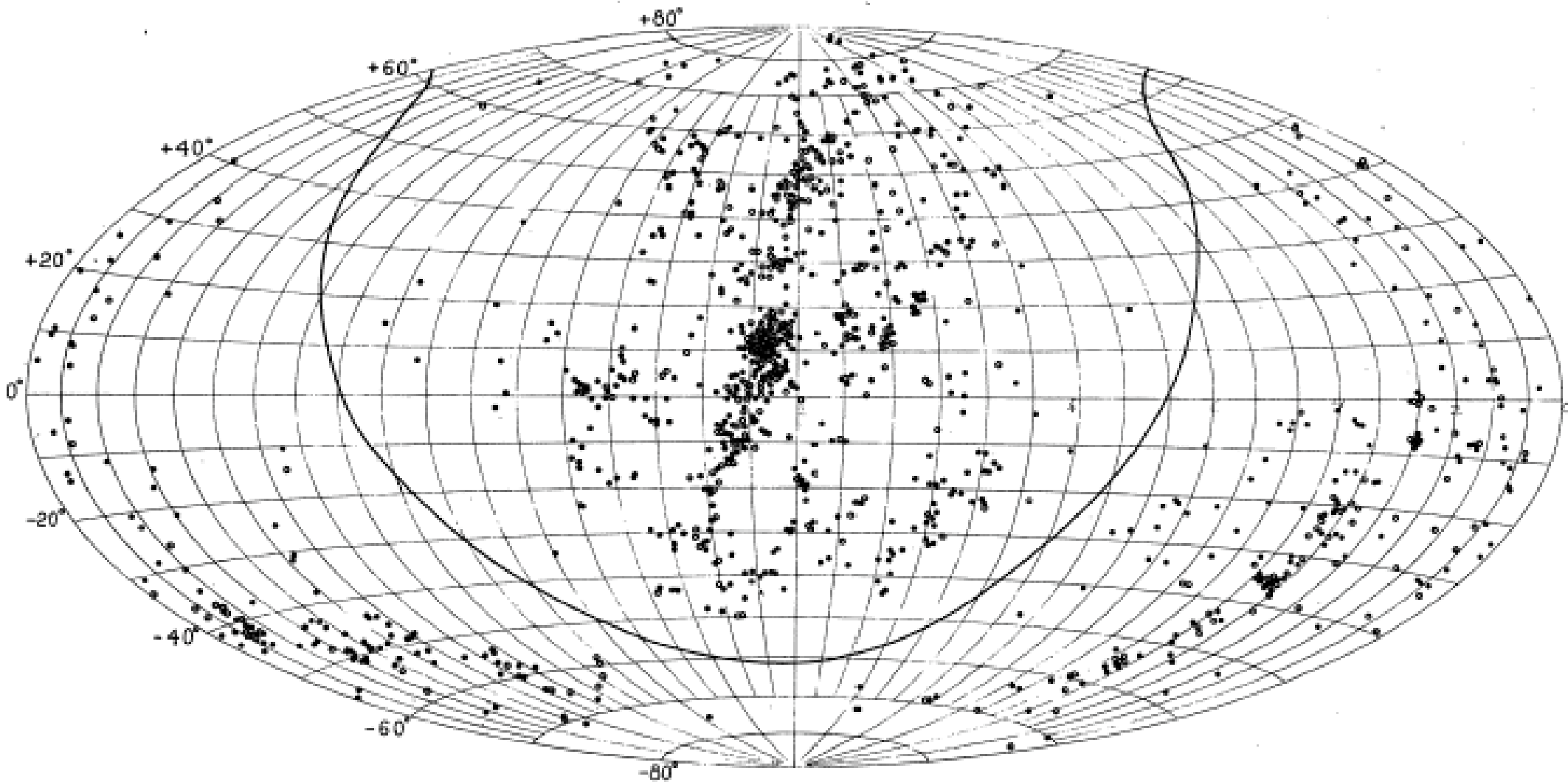
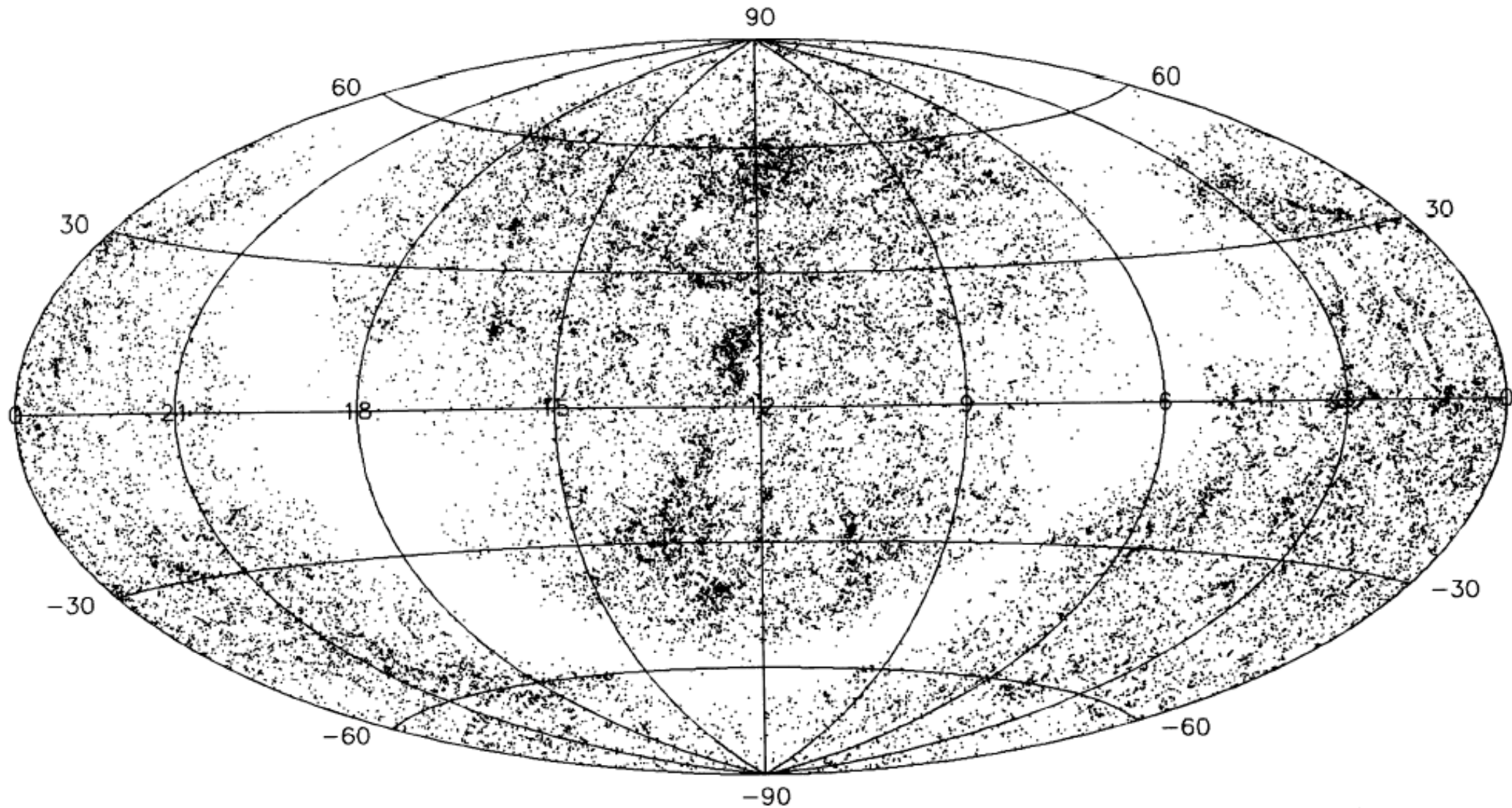


Figure 4

1970's: fainter galaxies
(Zwicky catalog)

$d \sim 30$ Mpc, $N \sim 27000$



28.8 deg

Coma Berenices and Virgo

Coma Berenices

28.8 deg



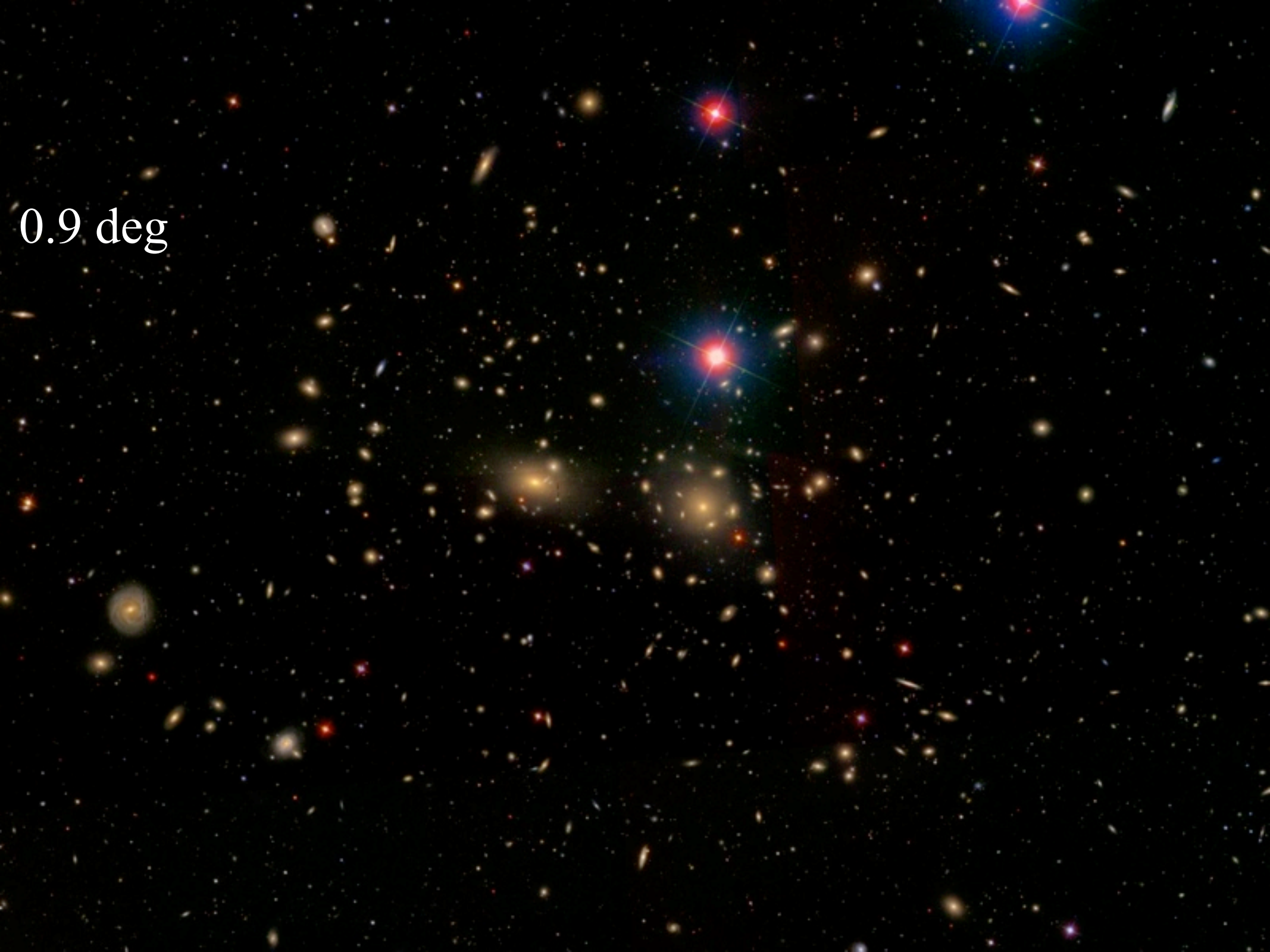
14.4 deg



3.6 deg

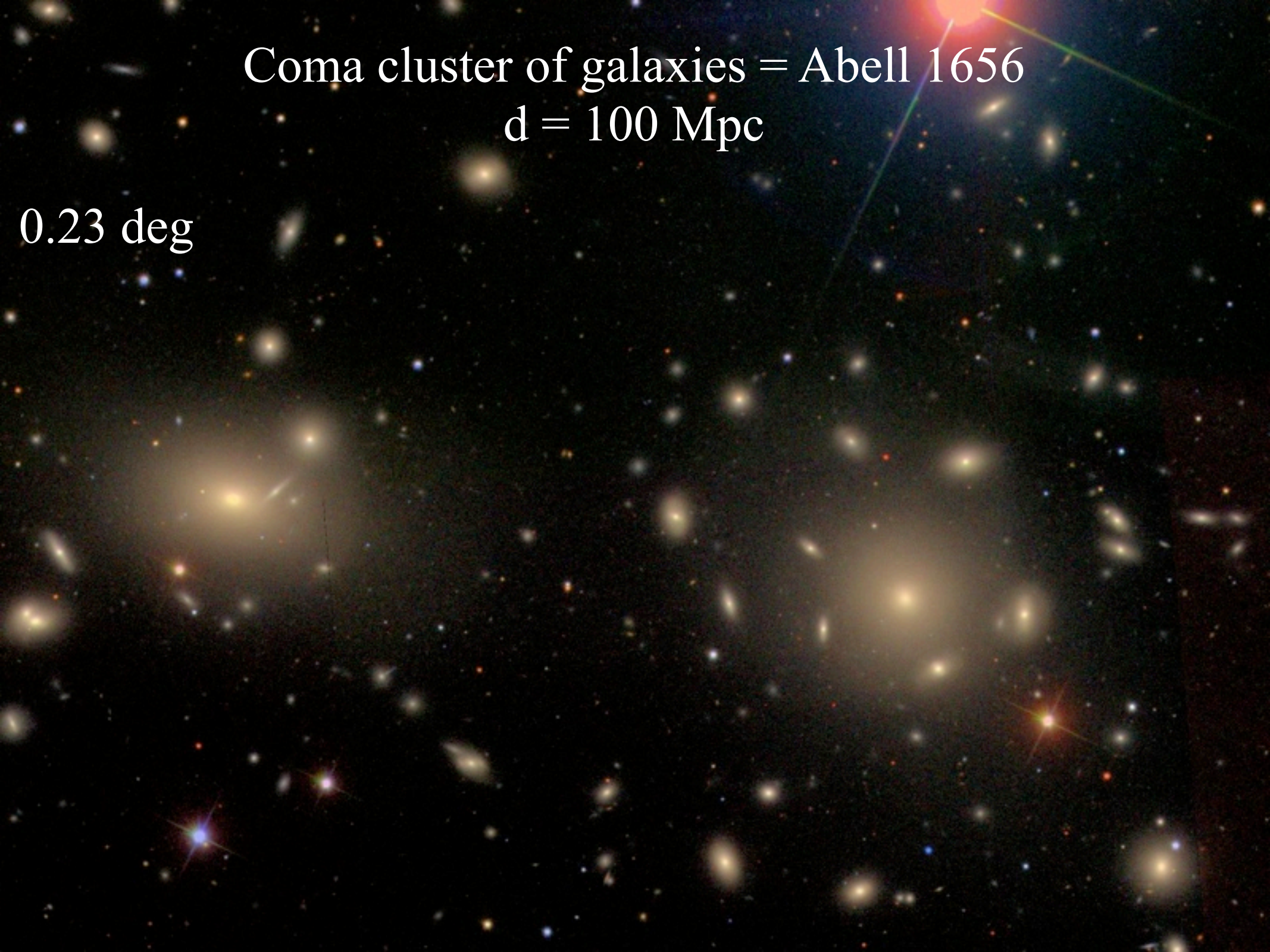


0.9 deg

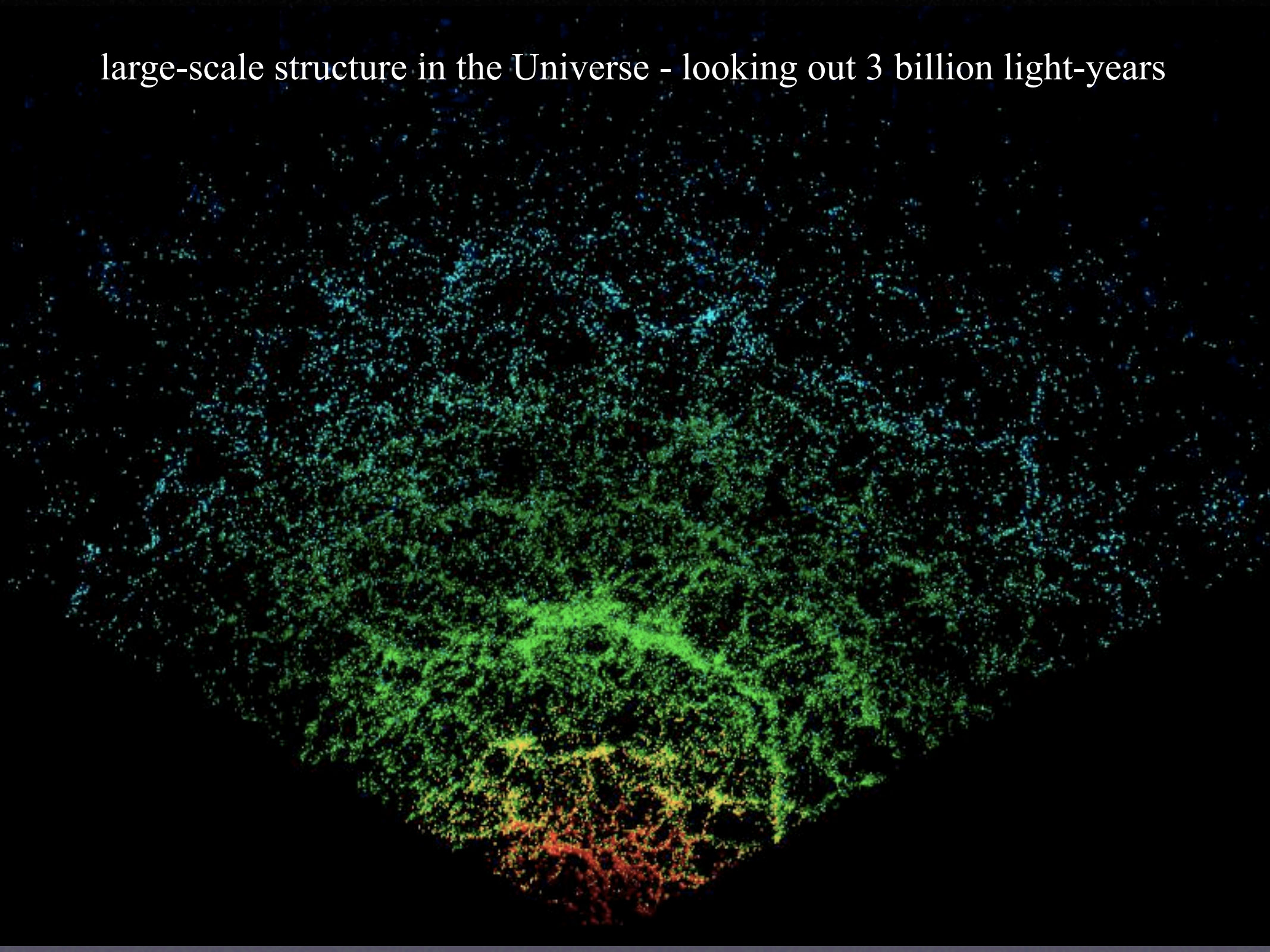


Coma cluster of galaxies = Abell 1656
 $d = 100 \text{ Mpc}$

0.23 deg



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



Sun:
0.5 degree diameter

$R = 696,000 \text{ km}$
 $d = 149,000,000 \text{ km}$



Royal Observatory of Belgium – SIDC

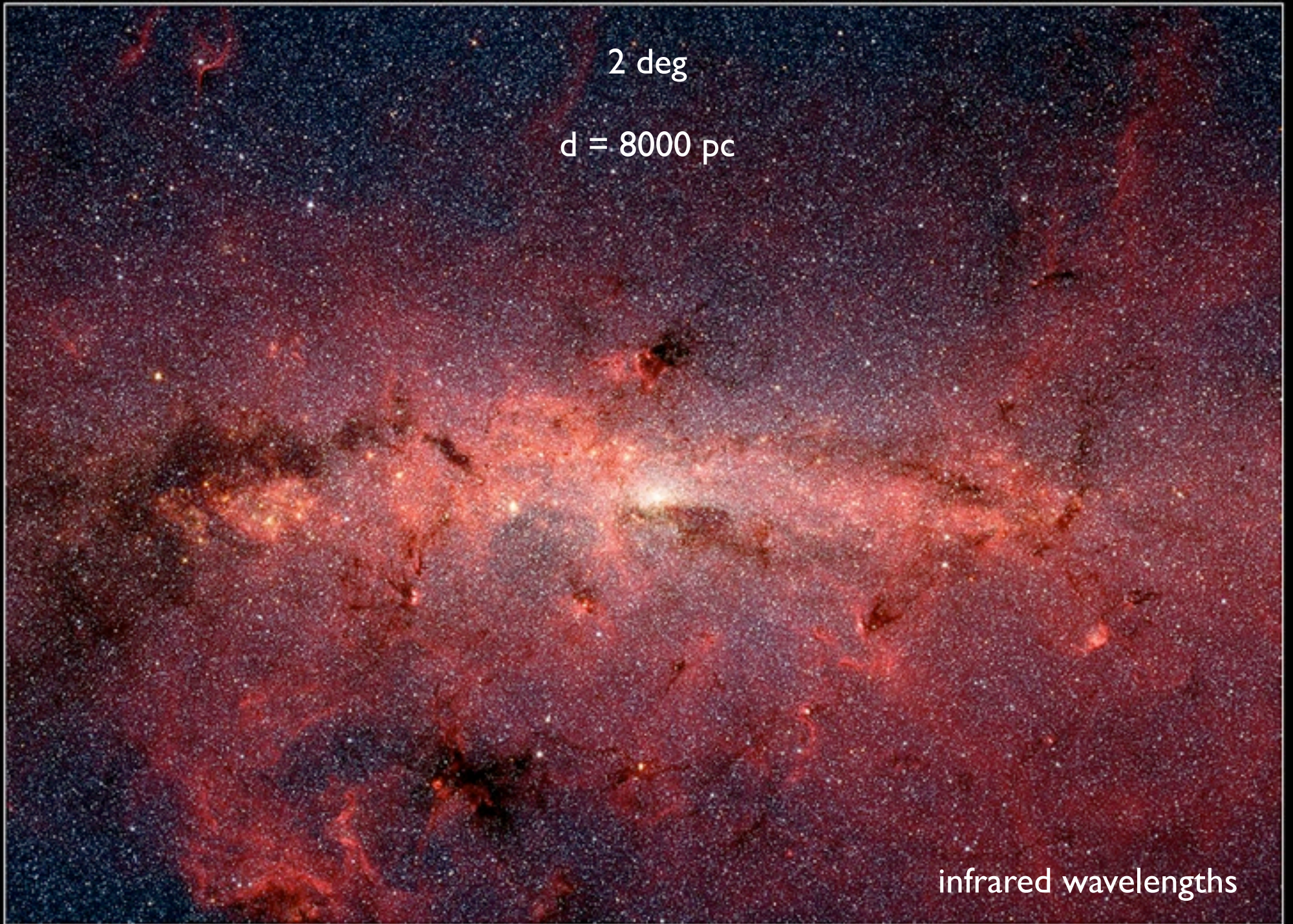
DATE-OBS= '19/06/2007'

TIME = '10:42:33'

INSTRUME= 'WHITE-LIGHT'

EXPTIME =

0.061000



2 deg

$d = 8000 \text{ pc}$

infrared wavelengths

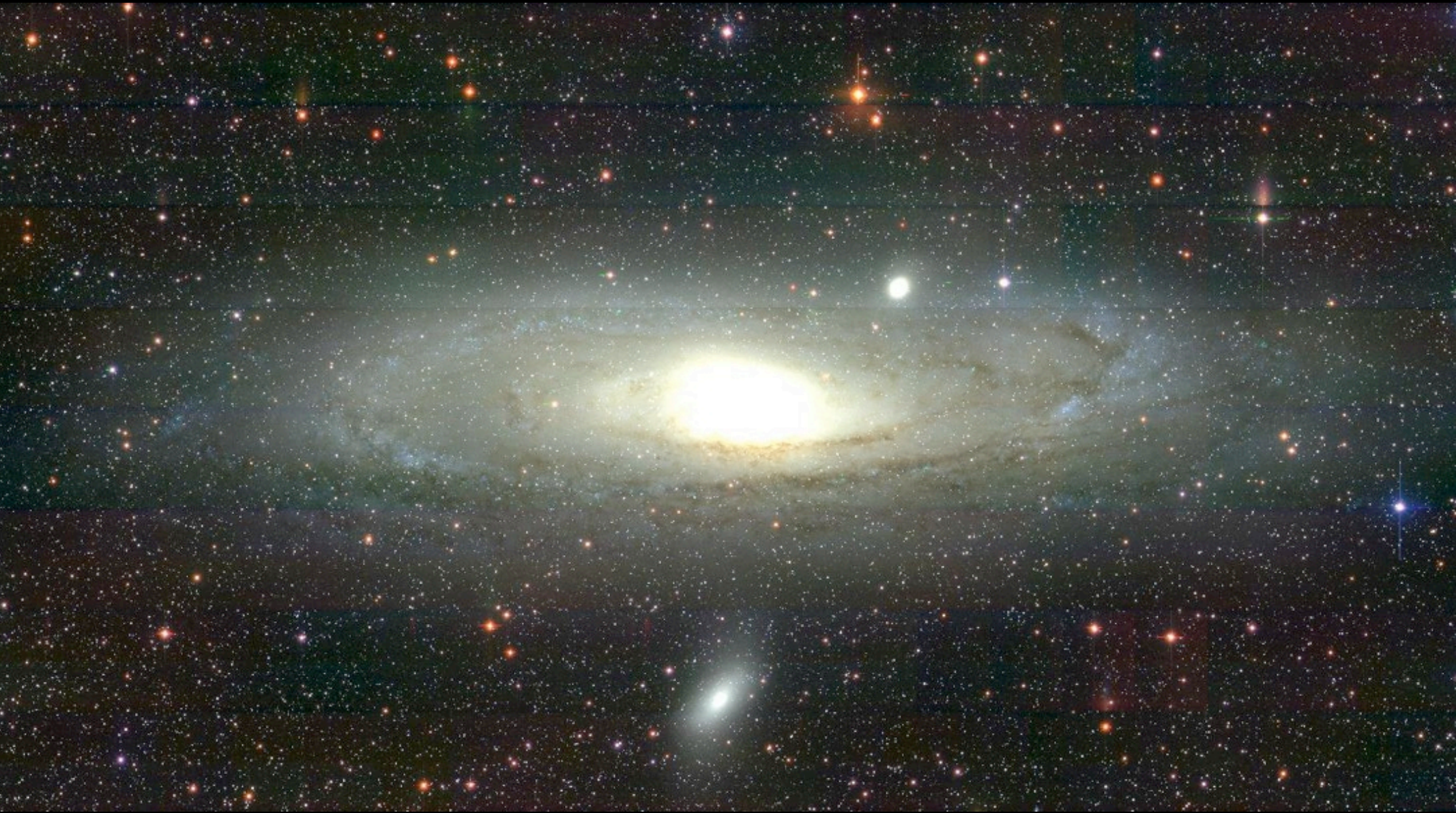
The Center of the Milky Way Galaxy

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

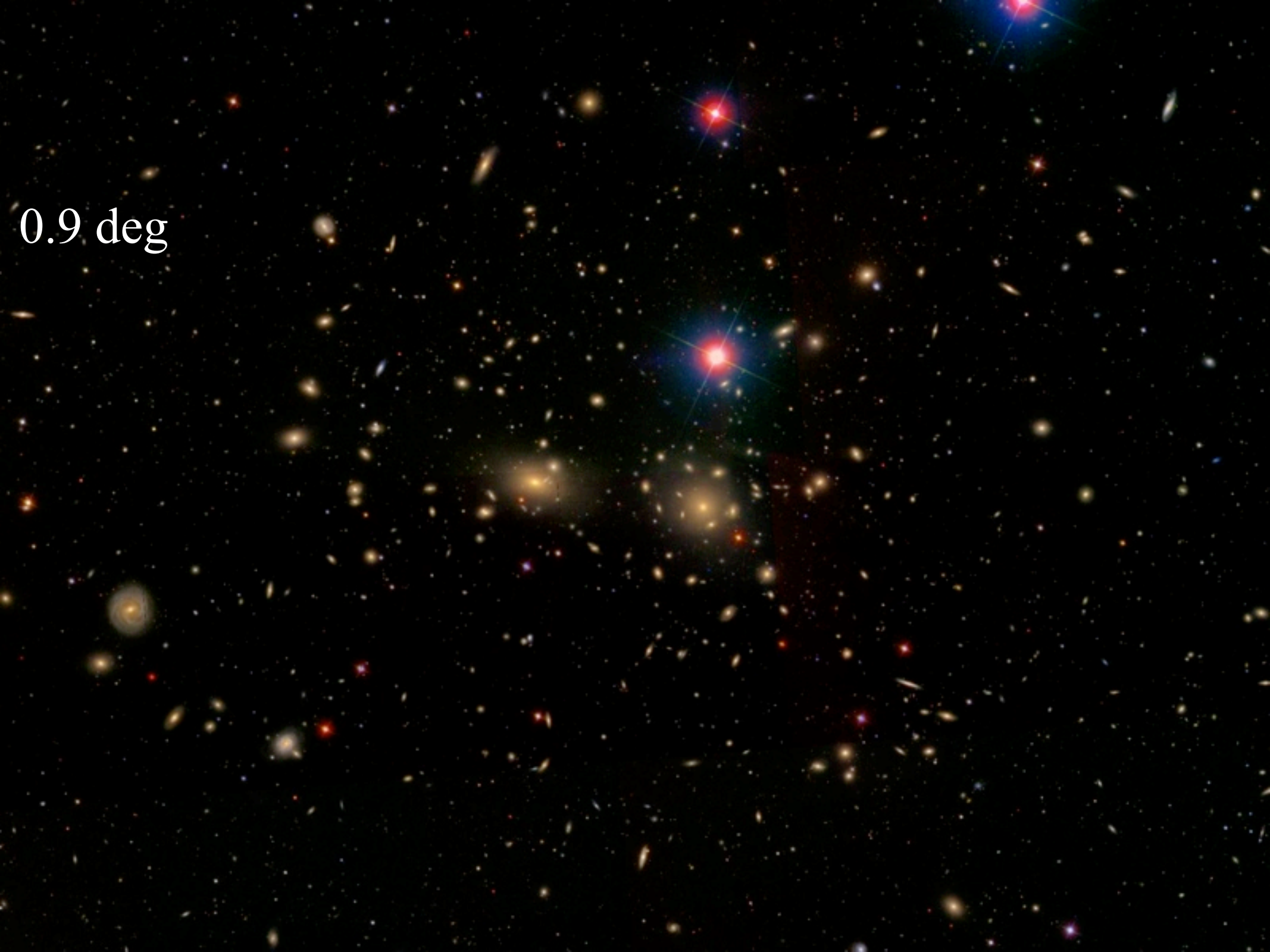
Spitzer Space Telescope • IRAC

ssc2006-02a

M31 = Andromeda: 3 deg
d = 780 kpc



0.9 deg

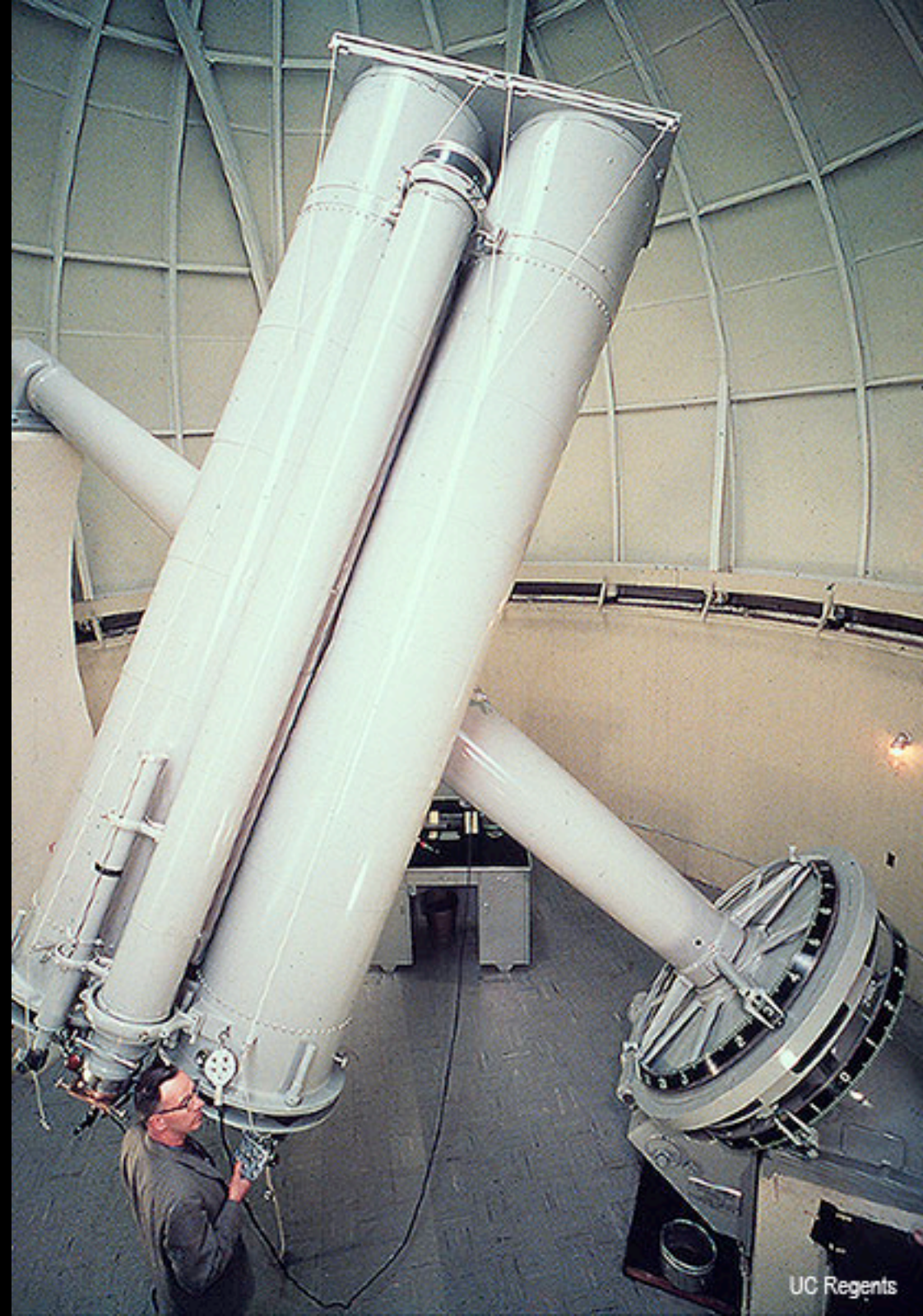


distances as light-travel times:

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.



A circular map of the universe showing the distribution of galaxies. The map is filled with numerous small white dots representing galaxies, which are not randomly scattered but are clustered together in a complex, web-like pattern. A white horizontal line is drawn across the top right of the map, indicating a scale of 1 billion light-years.

1 billion light-years

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



1 billion light-years

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

1932: brightest galaxies
(Shapley-Ames catalog)
 $d \sim 10$ Mpc, $N \sim 1000$

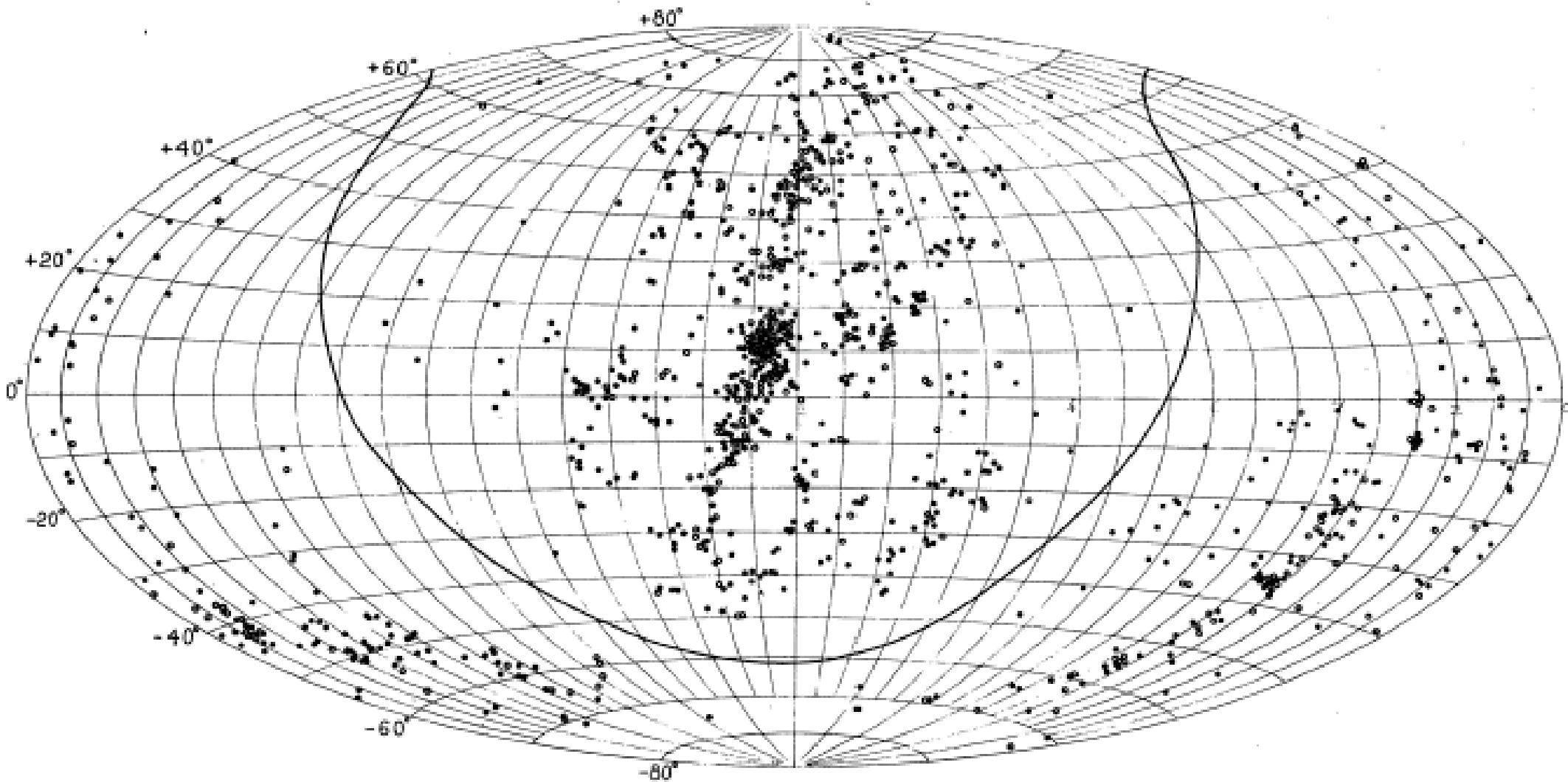


Figure 4