Universidad Industrial de Santander

GRUPO HALLEY DE ASTRONOMÍA Y CIENCIAS AEROESPACIALES

Astronomía Planetaria

Clase 23 – Galaxias II

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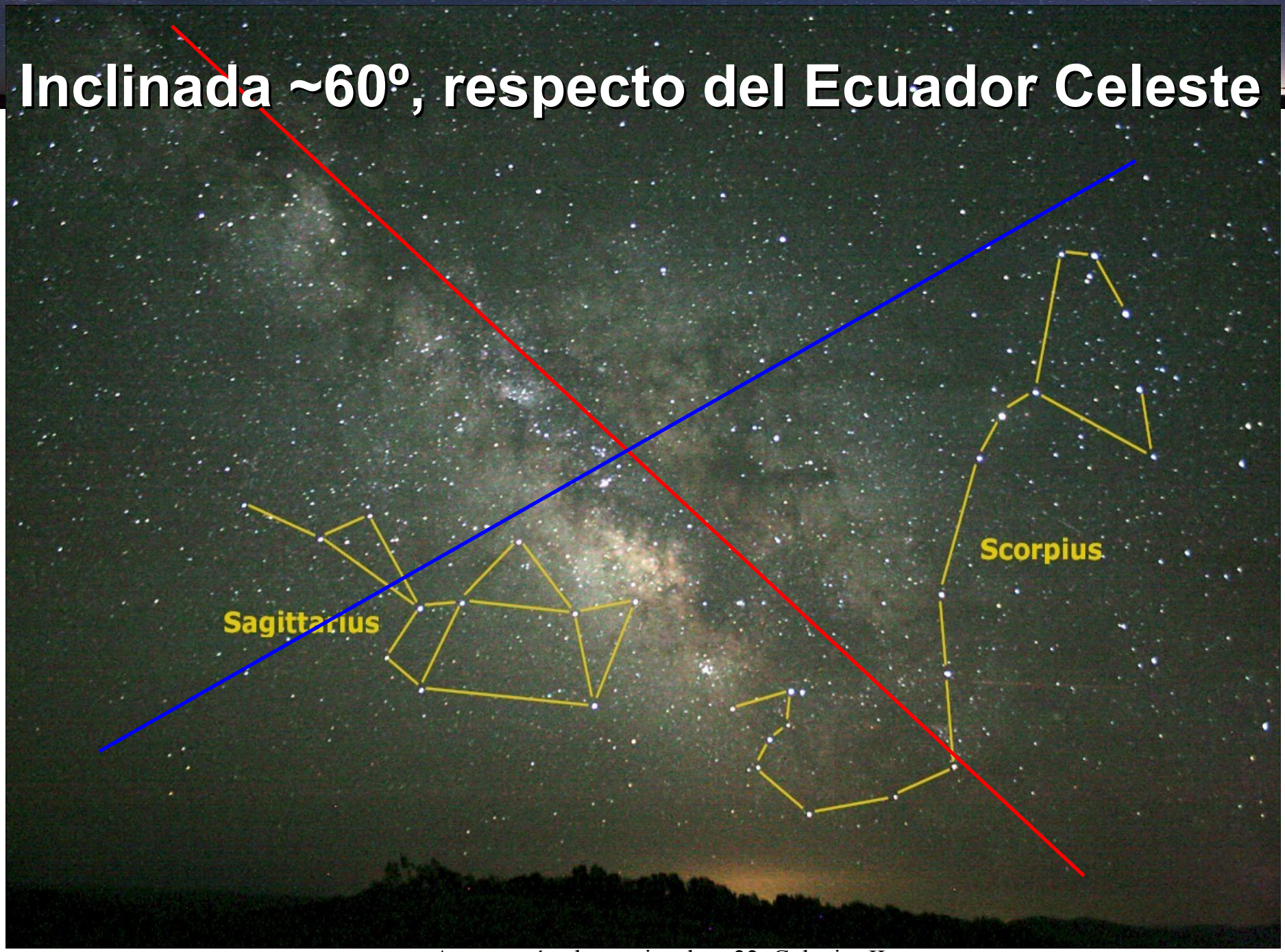
Escuela de Física
Grupo Halley de Astronomía y Ciencias Aeroespaciales
Universidad Industrial de Santander

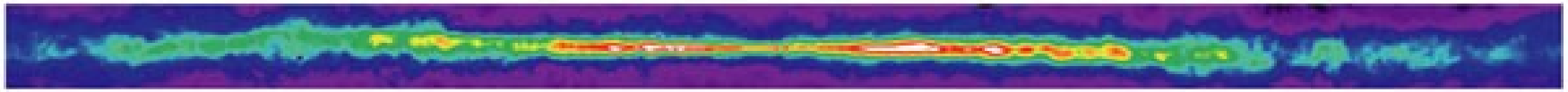
Bucaramanga, II semestre de 2013

En nuestro capítulo anterior

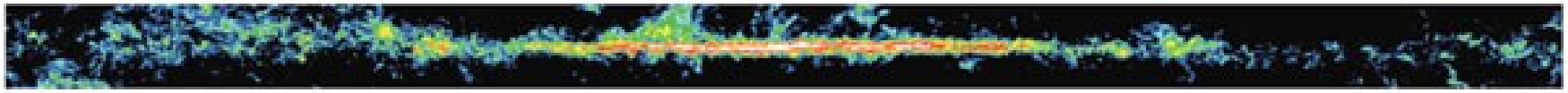

Inclinada ~60º, respecto del Ecuador Celeste
Scorpius
Sagittarius

Inclinada ~60º, respecto del Ecuador Celeste

Scorpius



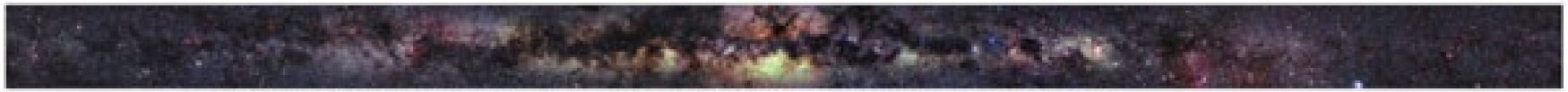
a 21-cm radio emission from atomic hydrogen gas.



b Radio emission from carbon monoxide reveals molecular clouds.

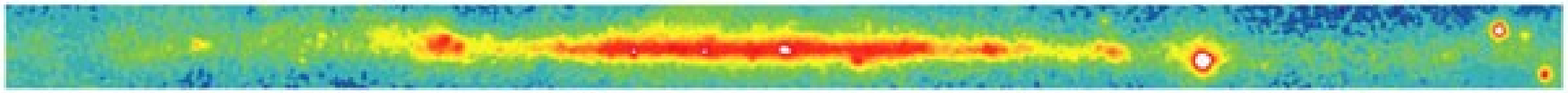
c Infrared (60–100 μm) emission from interstellar dust.

d Infrared (1–4 μm) emission from stars that penetrates most interstellar material.



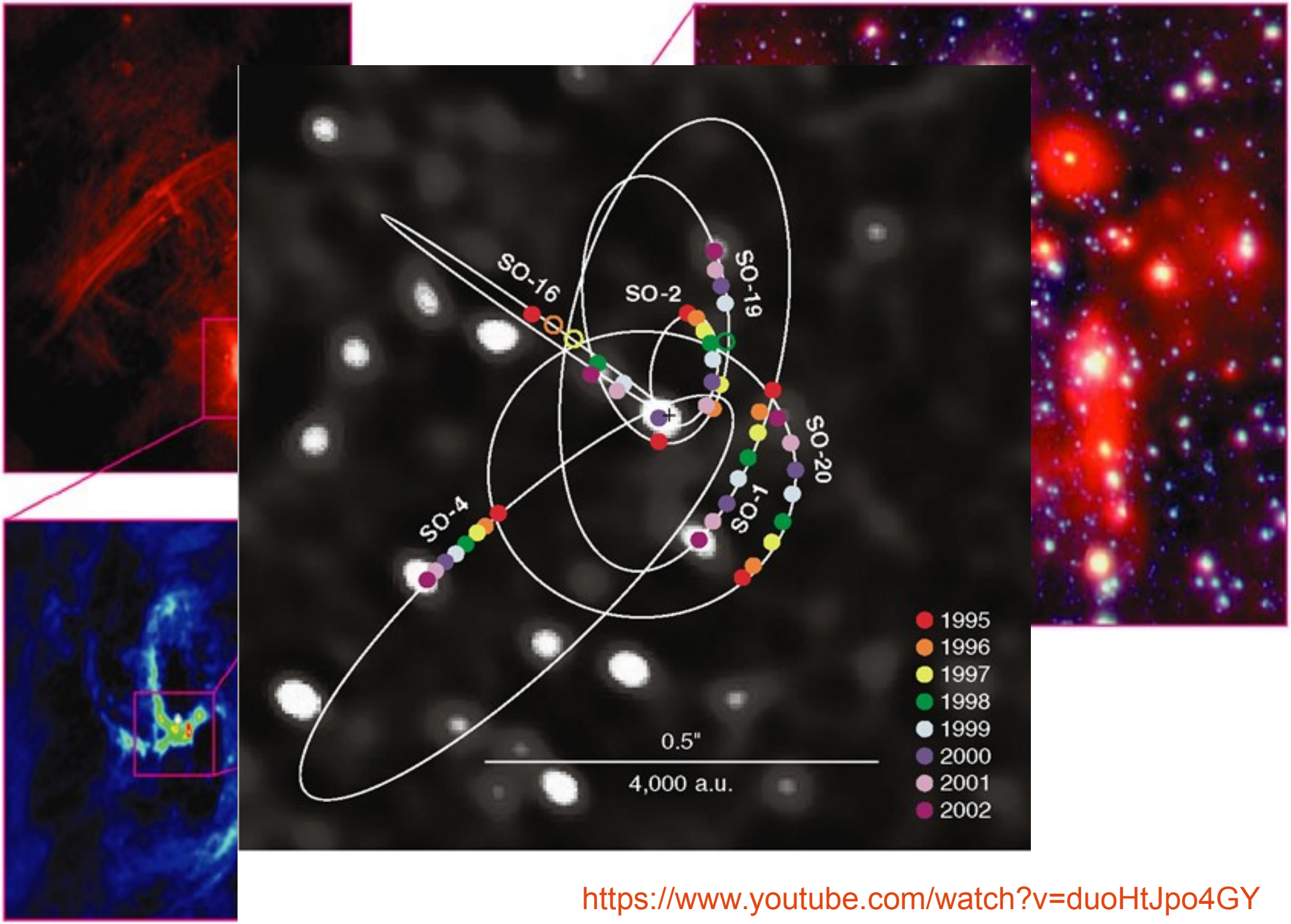
e Visible light emitted by stars is scattered and absorbed by dust.

f X-ray emission from hot gas bubbles (diffuse blobs) and X-ray binaries (pointlike sources).



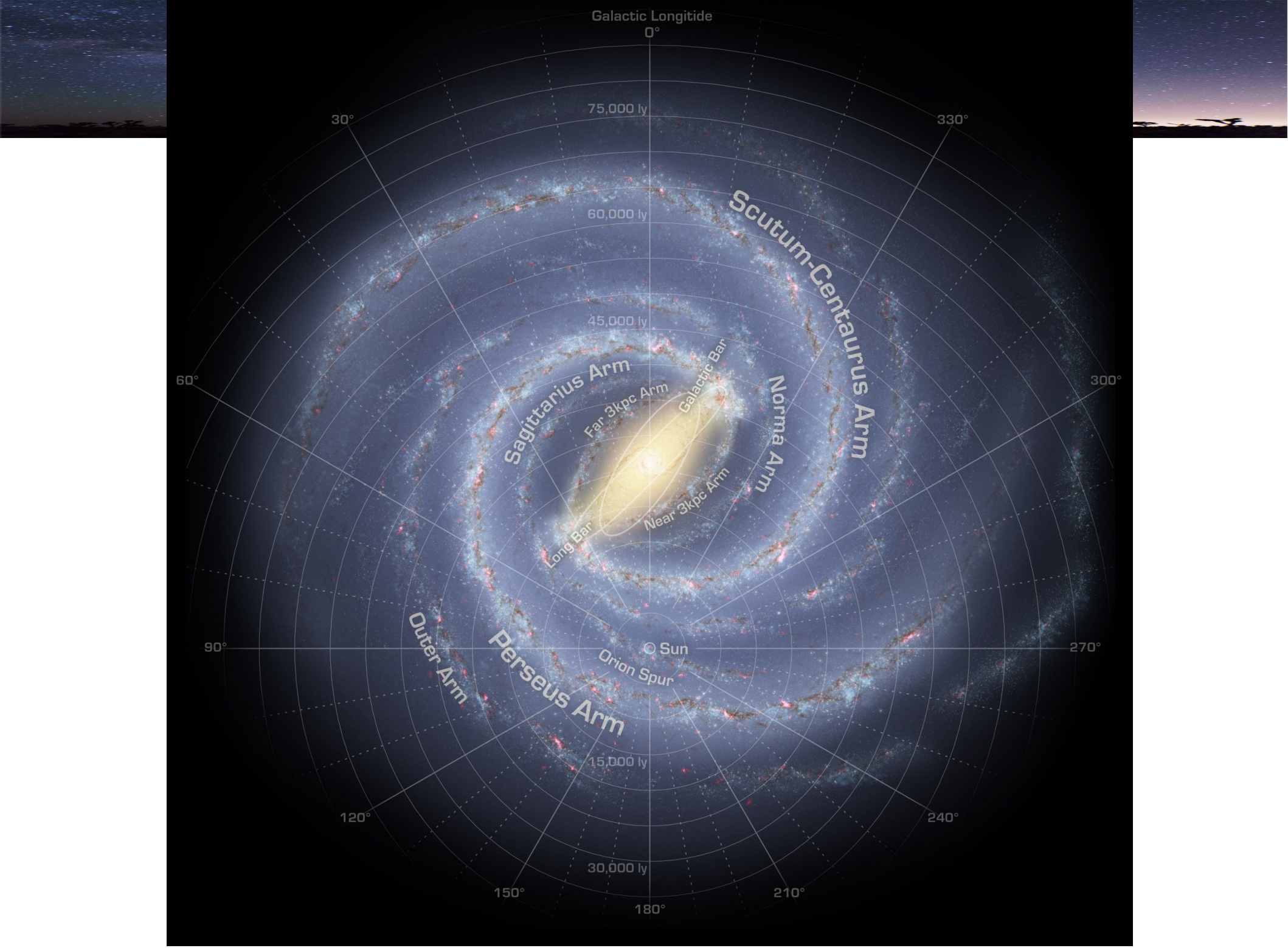
g Gamma-ray emission from collisions of cosmic rays with atomic nuclei in interstellar clouds.

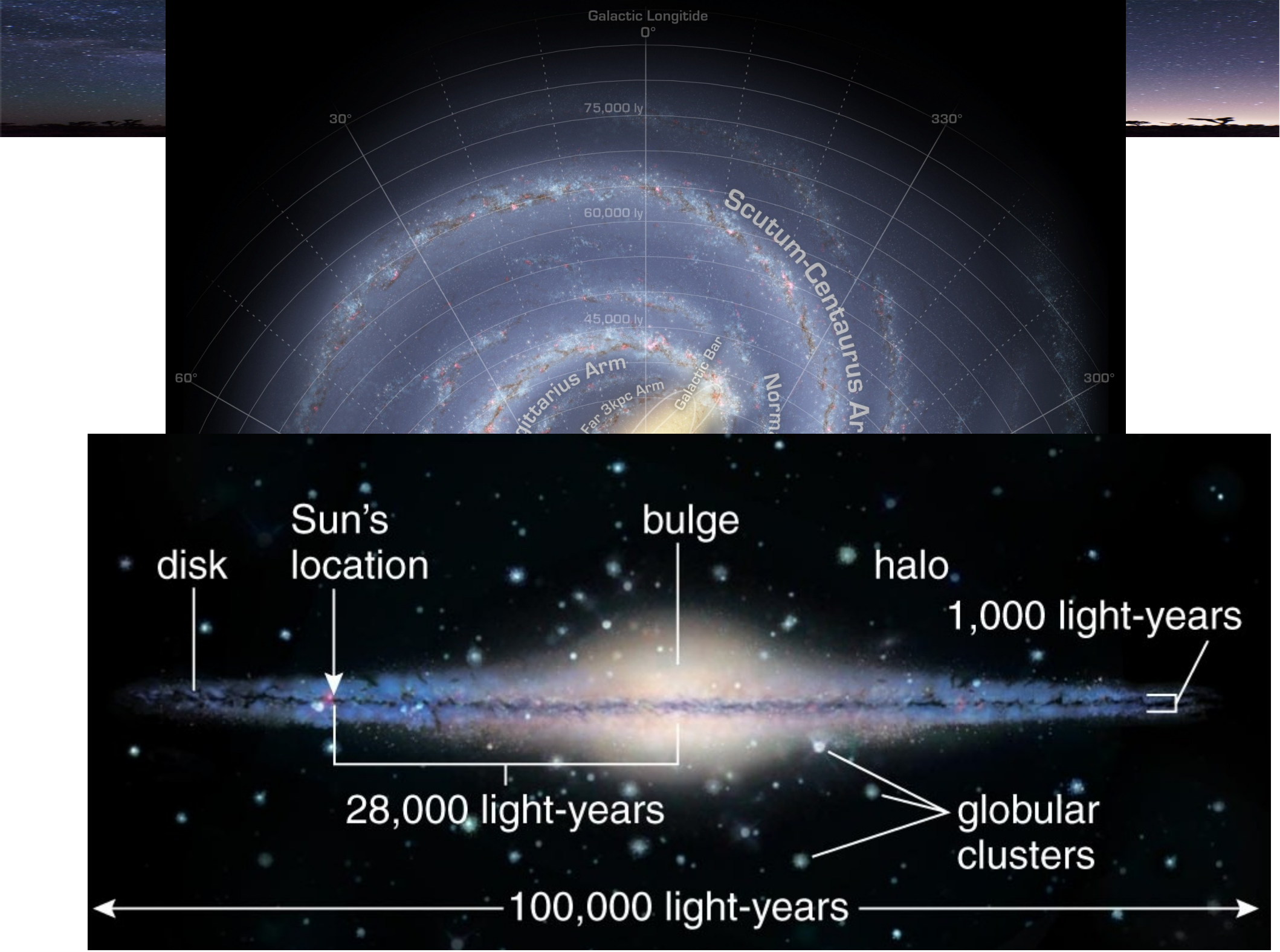
http://en.wikipedia.org/wiki/File:Infrared-visible_light_comparison_of_VISTA's_gigapixel_view_of_the_centre_of_the_Milky_Way.ogv

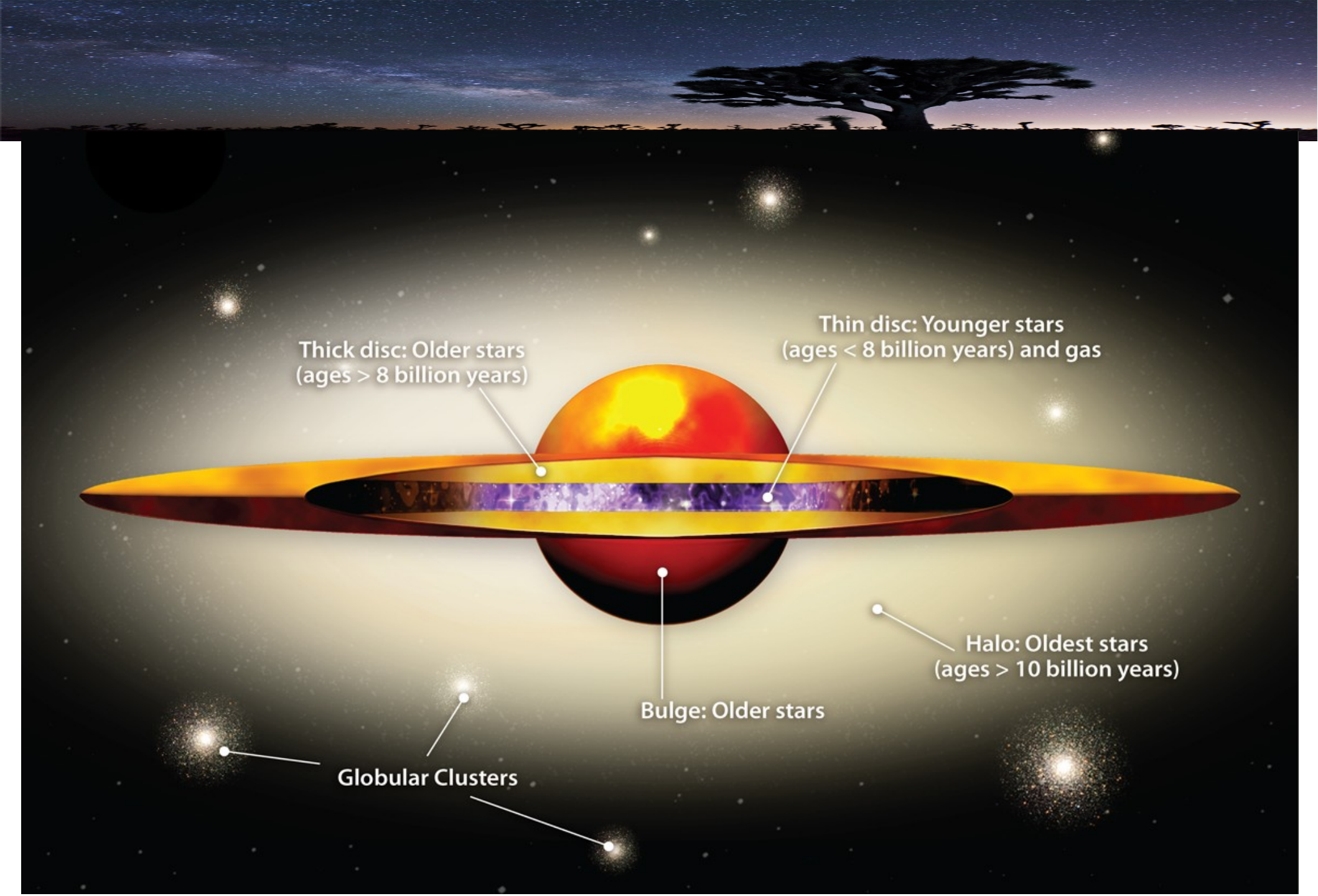


https://www.youtube.com/watch?v=duoHtJpo4GY

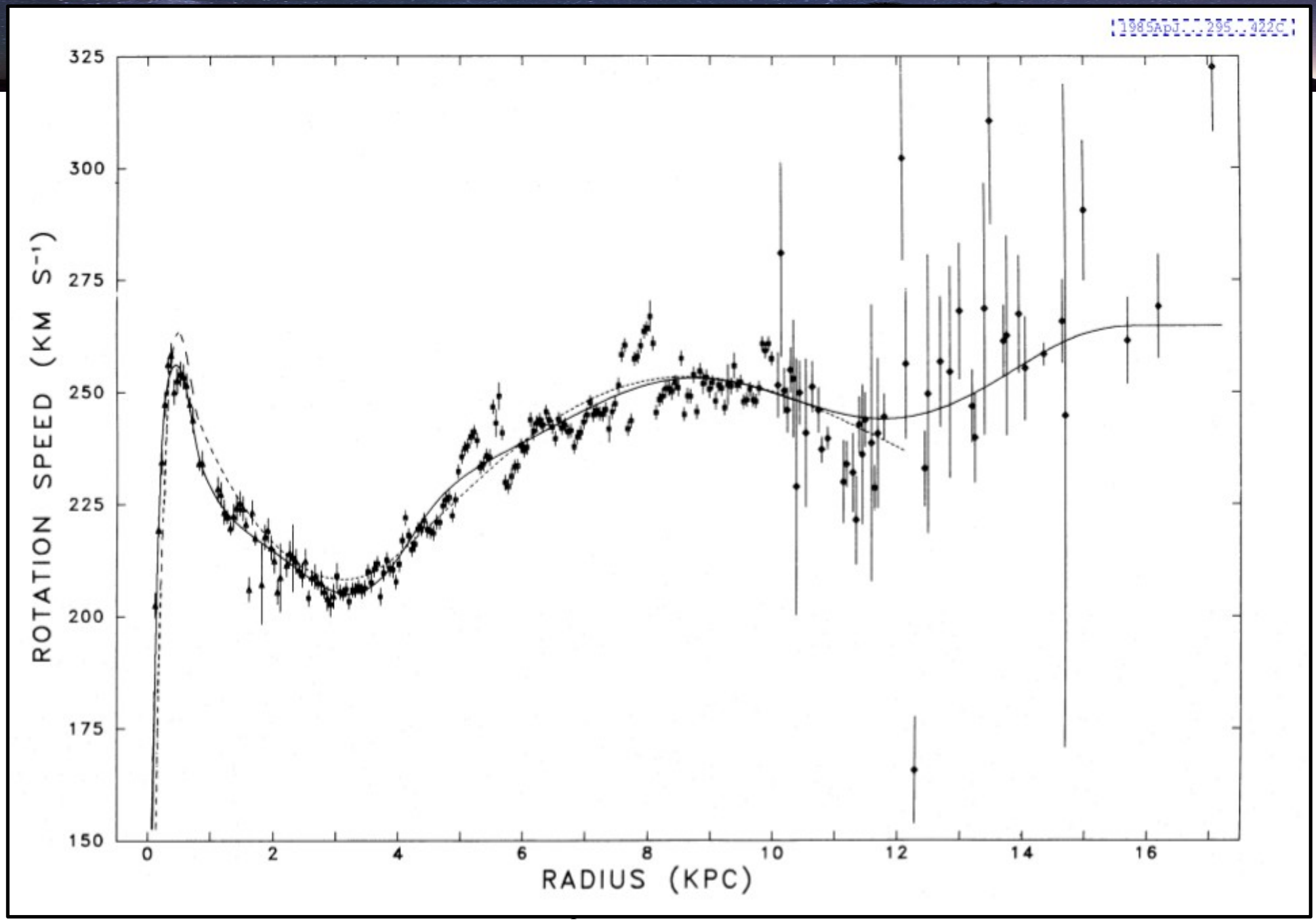
© 2005 Pearson Education, Inc., publishing as Addison Wesley


Galactic Longitide
0°
30°
330°
60°
300°
90°
270°
120°
240°
150°
210°
180°
75,000 ly
60,000 ly
45,000 ly
30,000 ly
15,000 ly
Scutum-Centaurus Arm
Sagittarius Arm
Norma Arm
Perseus Arm
Outer Arm
Far 3kpc Arm
Galactic Bar
Near 3kpc Arm
Long Bar
Sun
Orion Spur

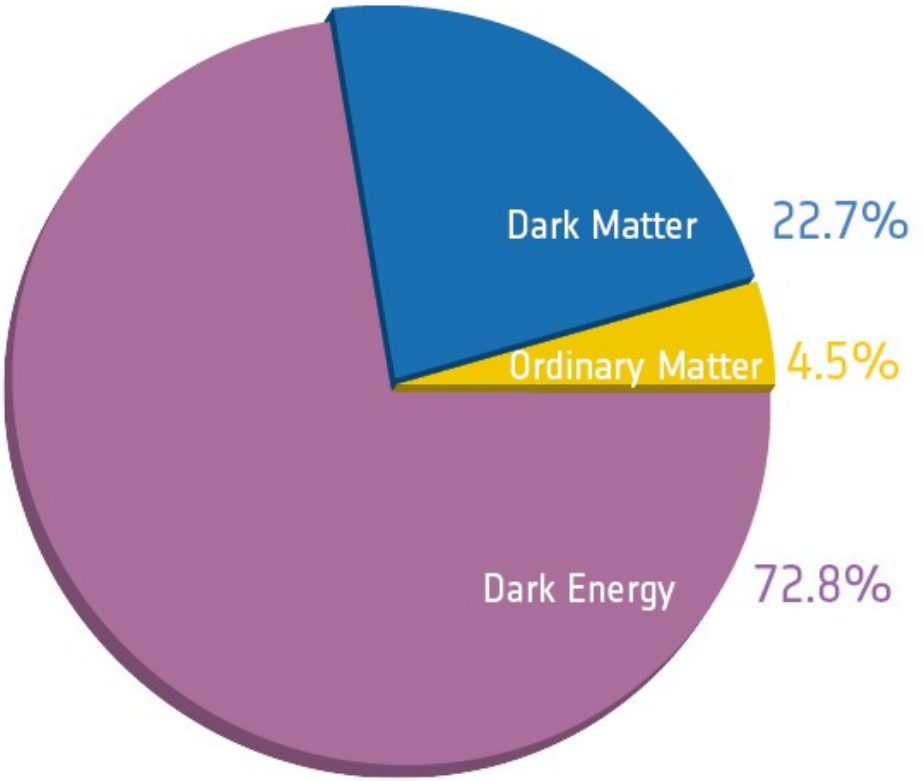

Galactic Longitide
0°
30°
330°
75,000 ly
60,000 ly
45,000 ly
60°
300°
Scutum-Centaurus Ar
Sagittarius Arm
Far 3kpc Arm
Galactic Bar
Norm
disk
Sun's location
bulge
halo
1,000 light-years
28,000 light-years
globular clusters
100,000 light-years


Thick disc: Older stars
(ages > 8 billion years)
Thin disc: Younger stars
(ages < 8 billion years) and gas
Halo: Oldest stars
(ages > 10 billion years)
Bulge: Older stars
Globular Clusters

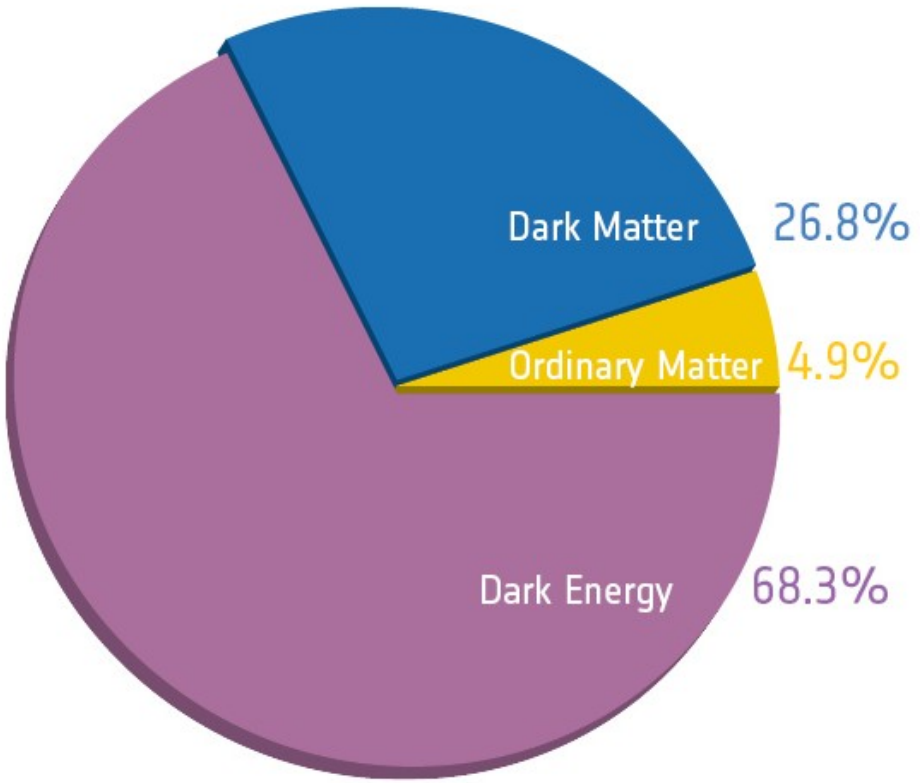
1985ApJ...295..422C



Misión Planck



Before Planck

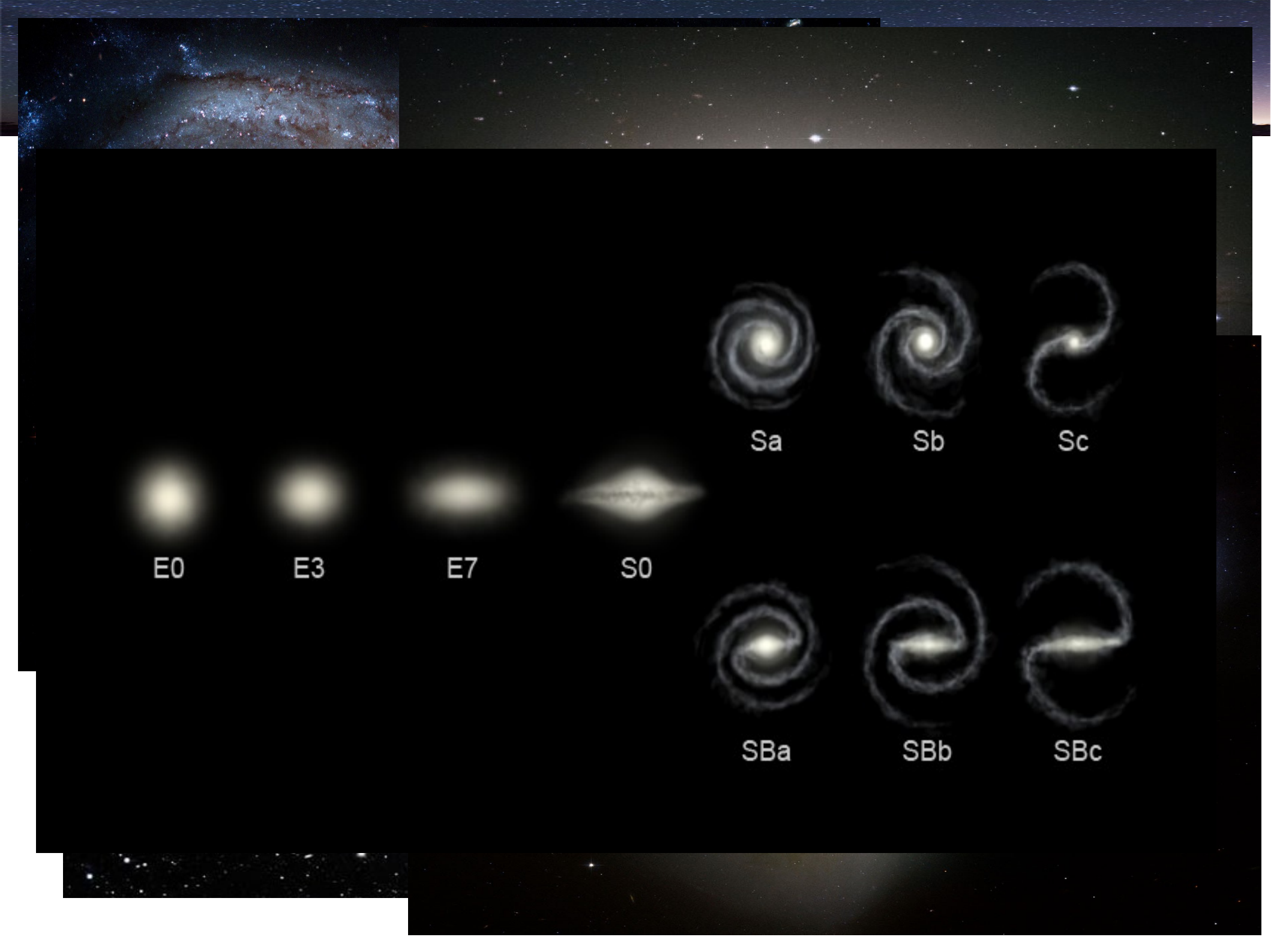


After Planck

Clasificación Galáctica

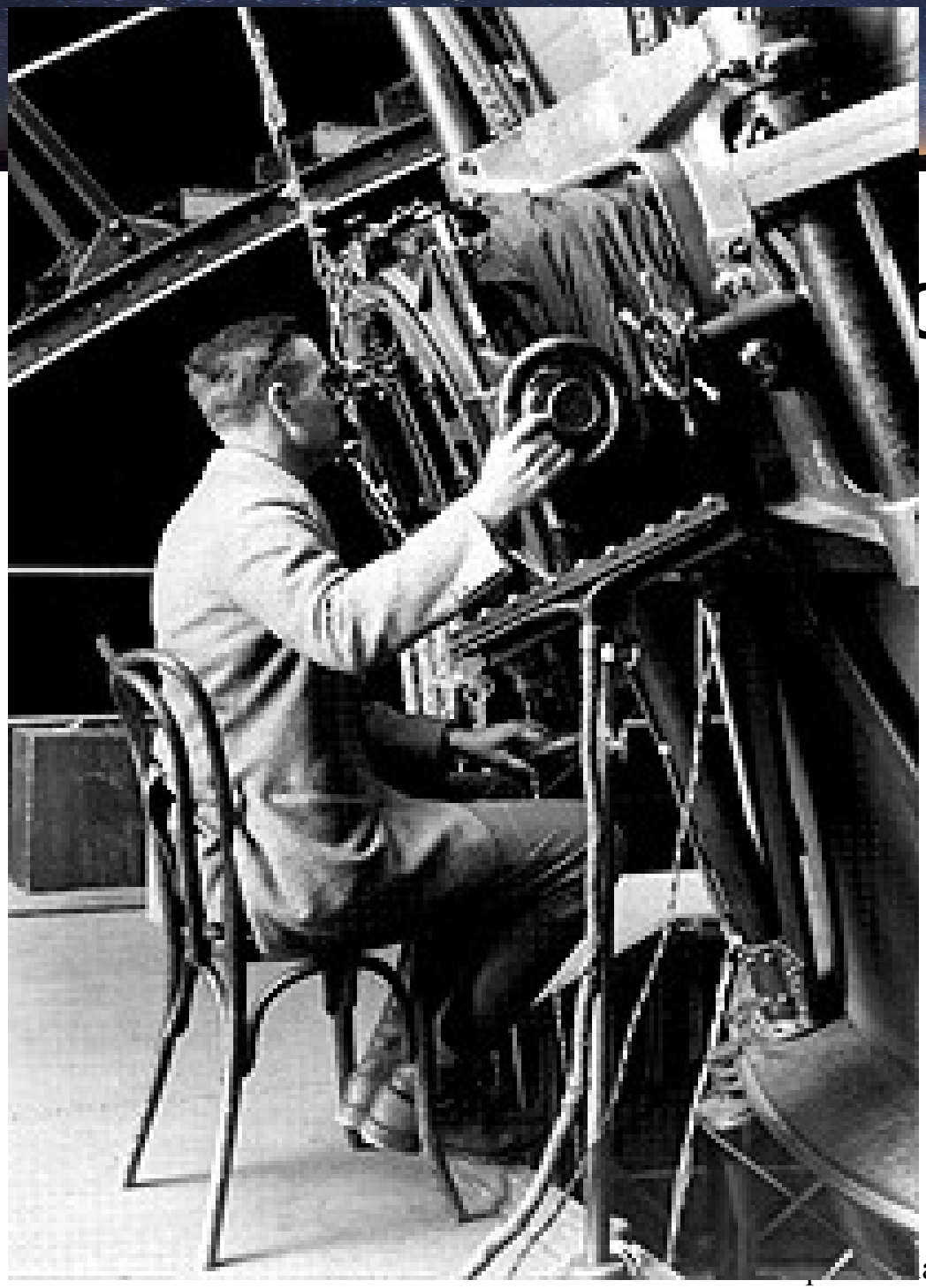
tica

The Sombrero Galaxy — M104
HUBBLESITE.org


E0
E3
E7
S0
Sa
Sb
Sc
SBa
SBb
SBc

Expansión del Universo

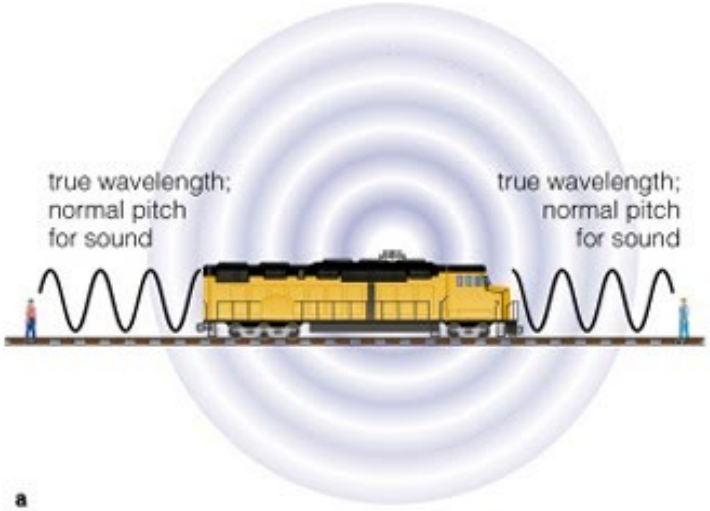
Expansión del Universo



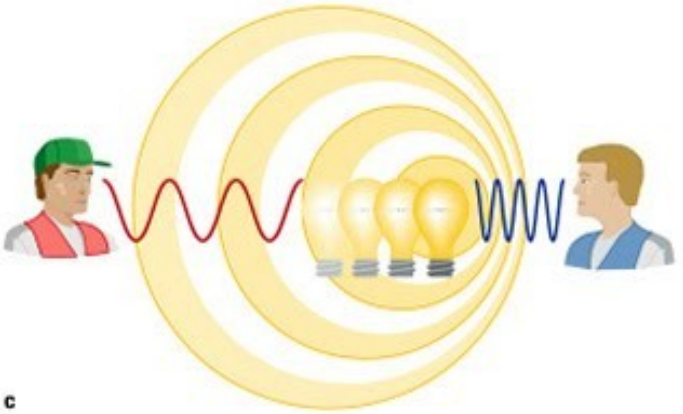
del Universo

Efecto Doppler

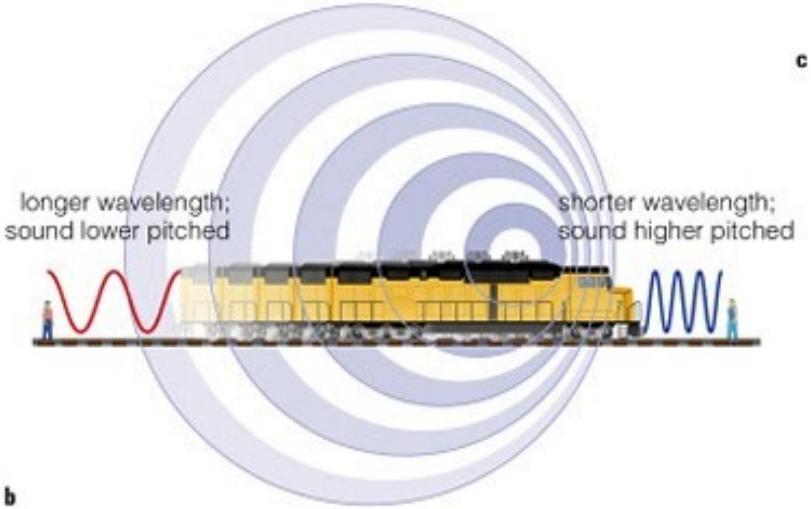
Efecto Doppler



a

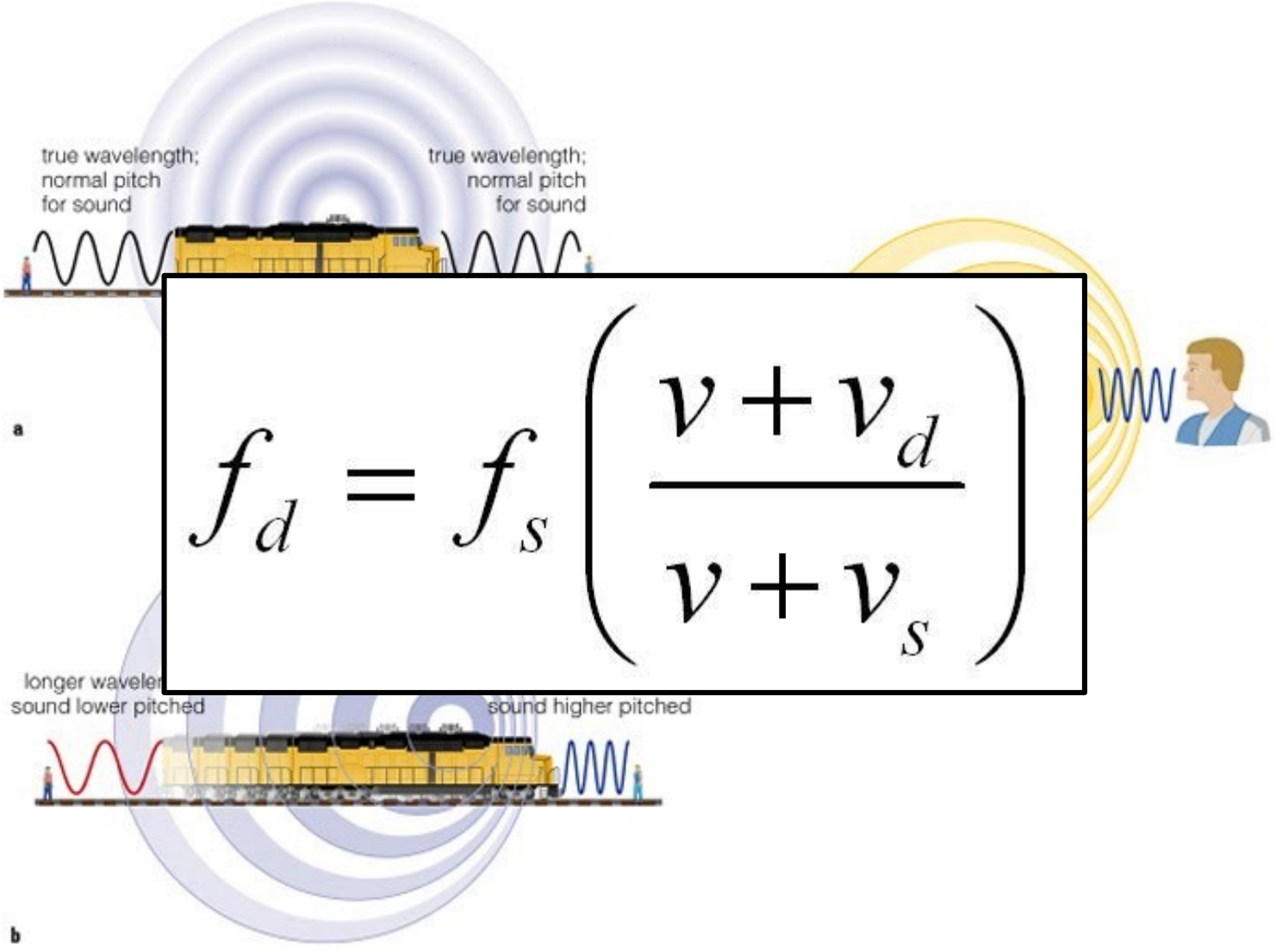


c



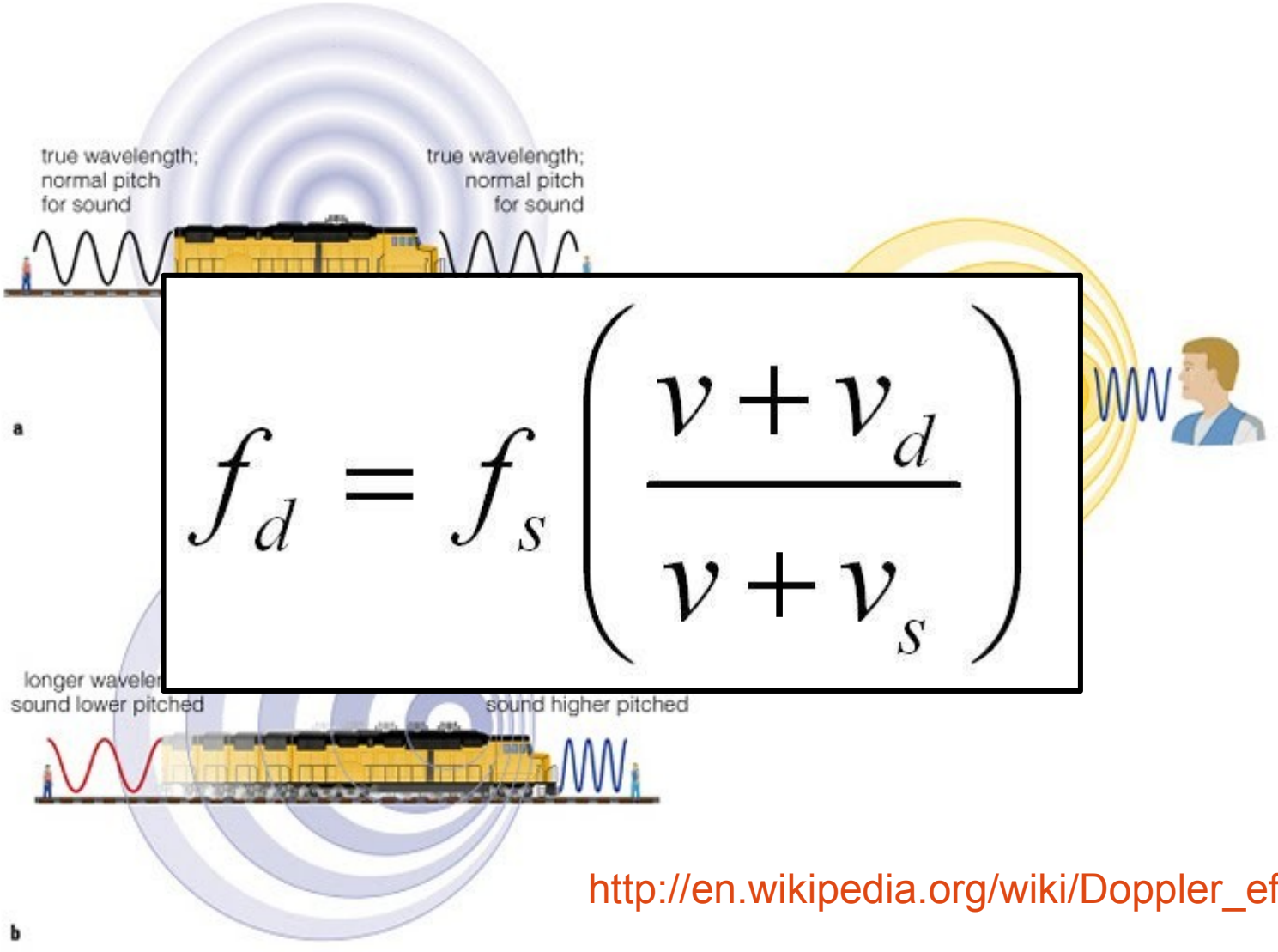
b

Efecto Doppler



$$f_d = f_s \left(\frac{v + v_d}{v + v_s} \right)$$

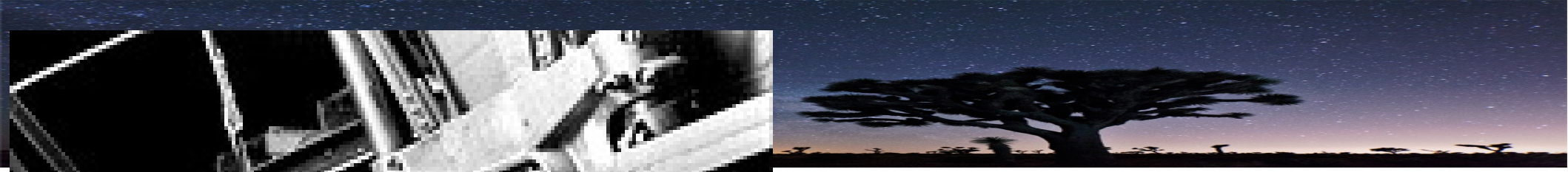
Efecto Doppler



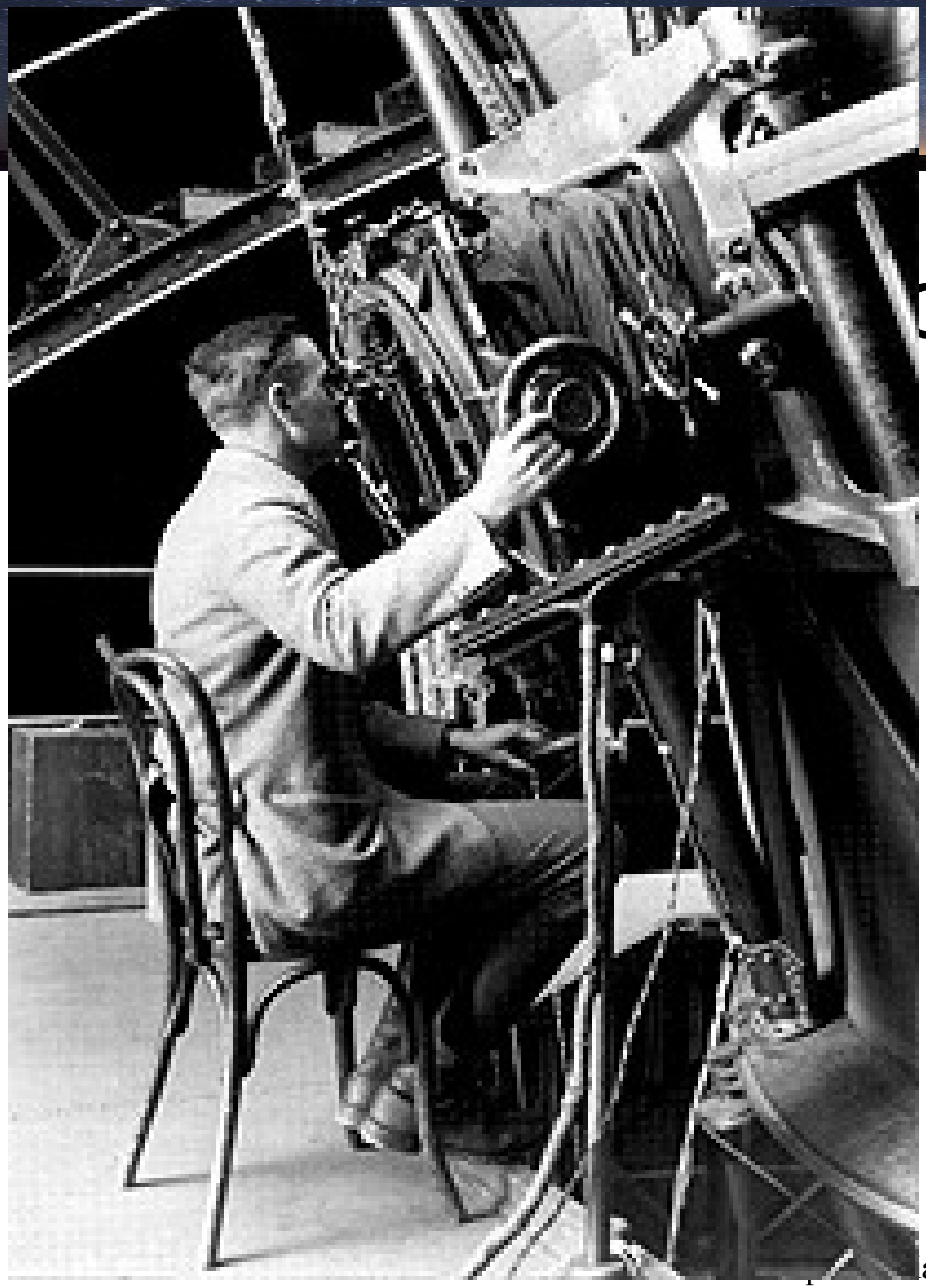
$$f_d = f_s \left(\frac{v + v_d}{v + v_s} \right)$$

http://en.wikipedia.org/wiki/Doppler_effect

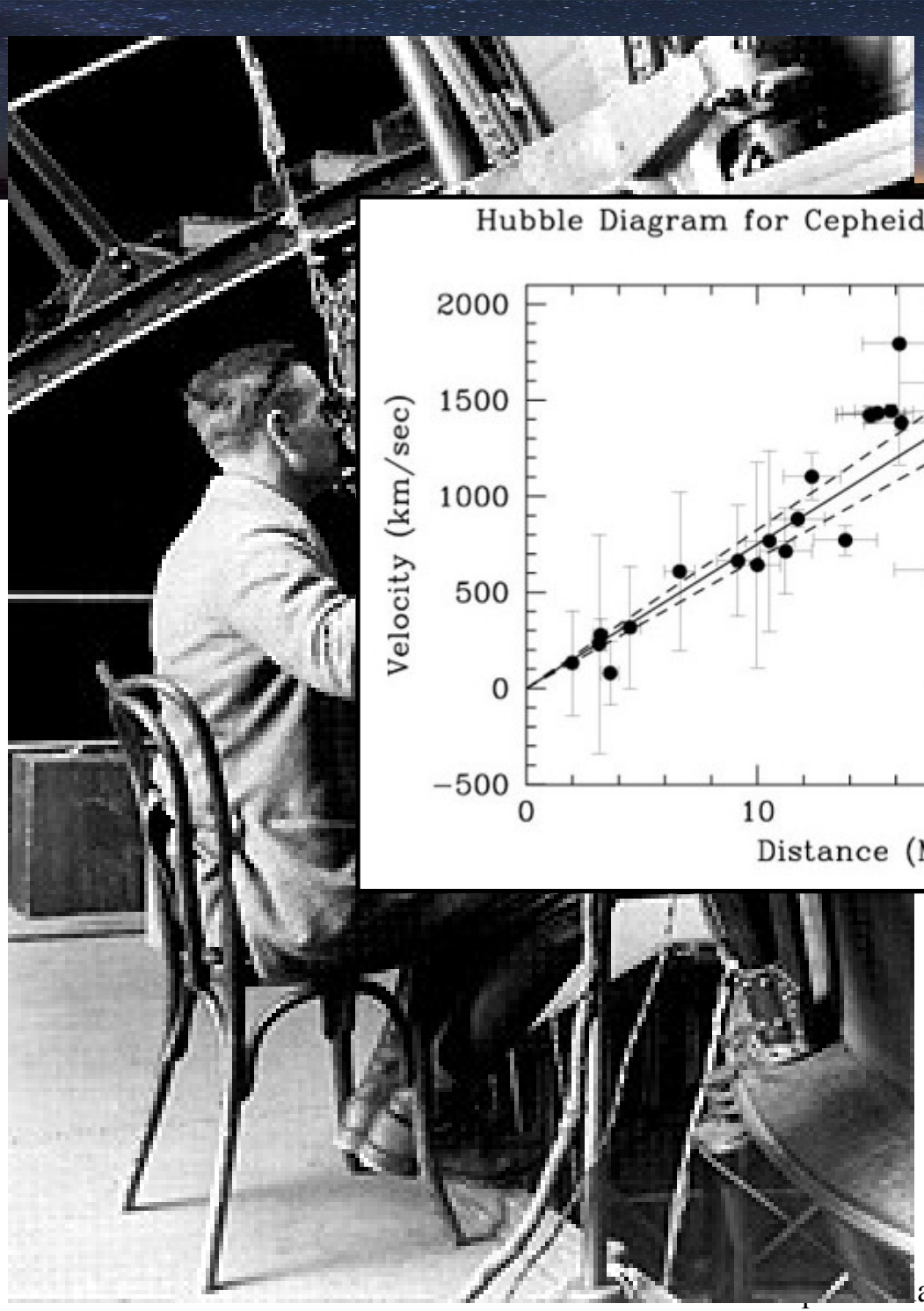
Efecto Doppler

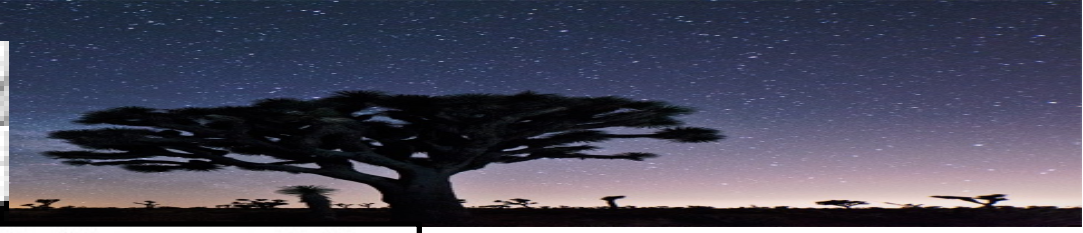


del Universo



http://astro.sfasu.edu/courses/ast105/lectures105/chapter15/discover_hubble_law.htm

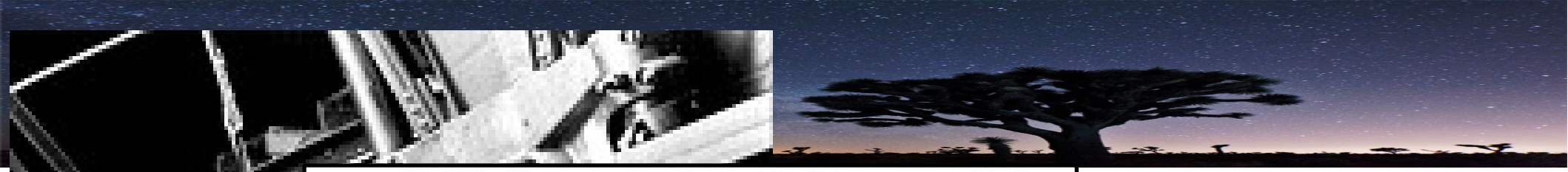


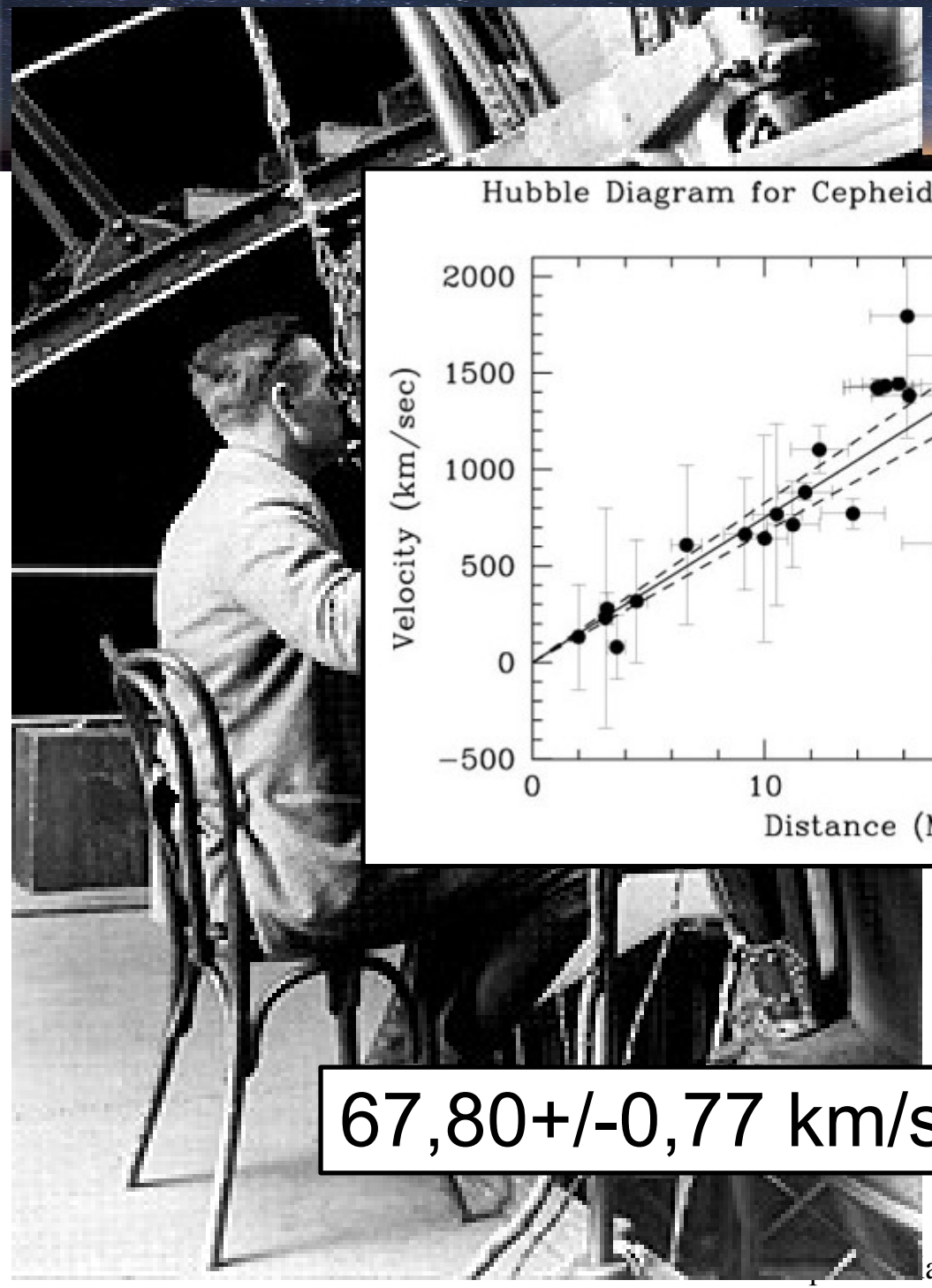


erso

$$v = H_o d$$

http://astro.sfasu.edu/courses/ast105/lectures105/chapter15/discover_hubble_law.htm



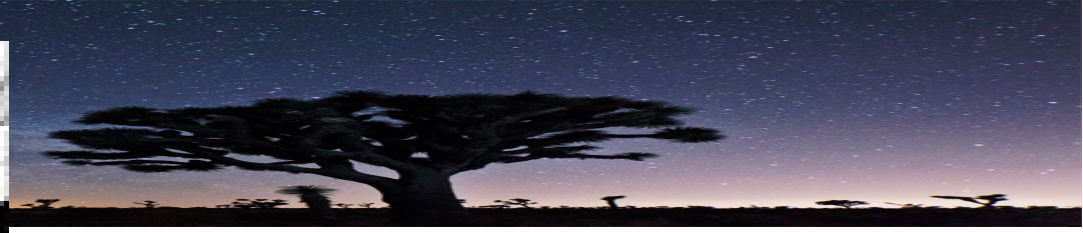


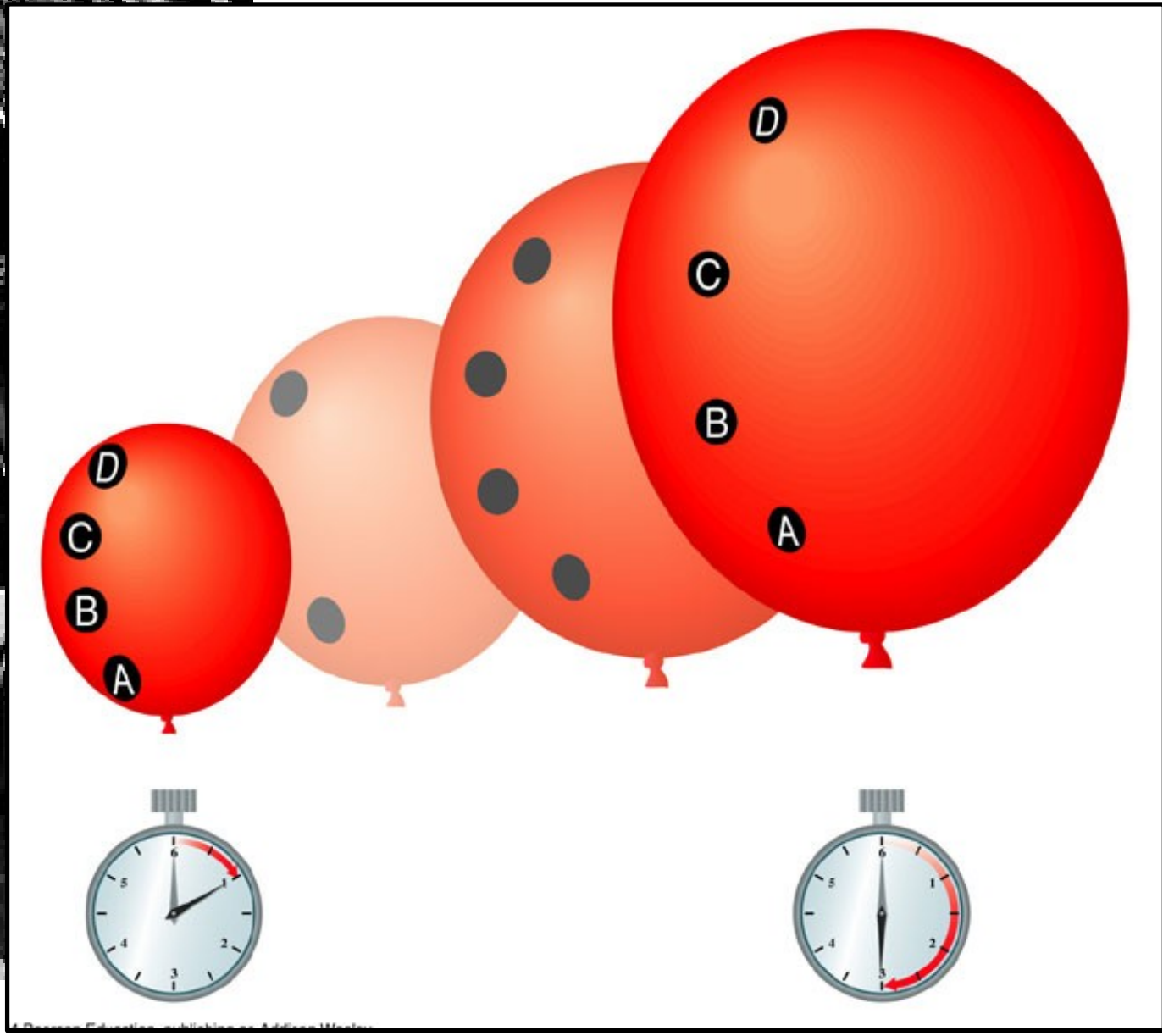
erso

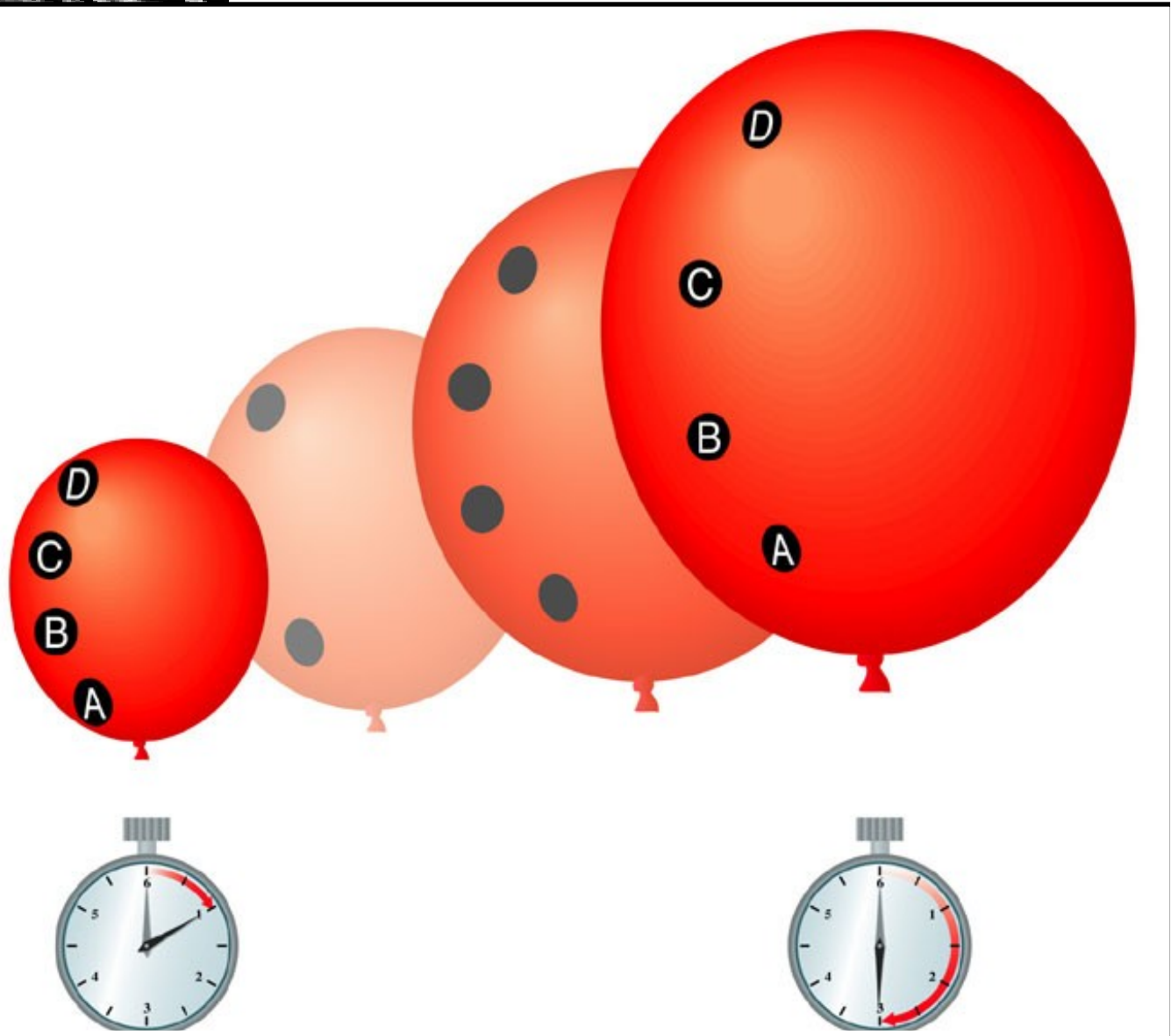
$$v = H_o d$$

67,80+/-0,77 km/s/Mpc

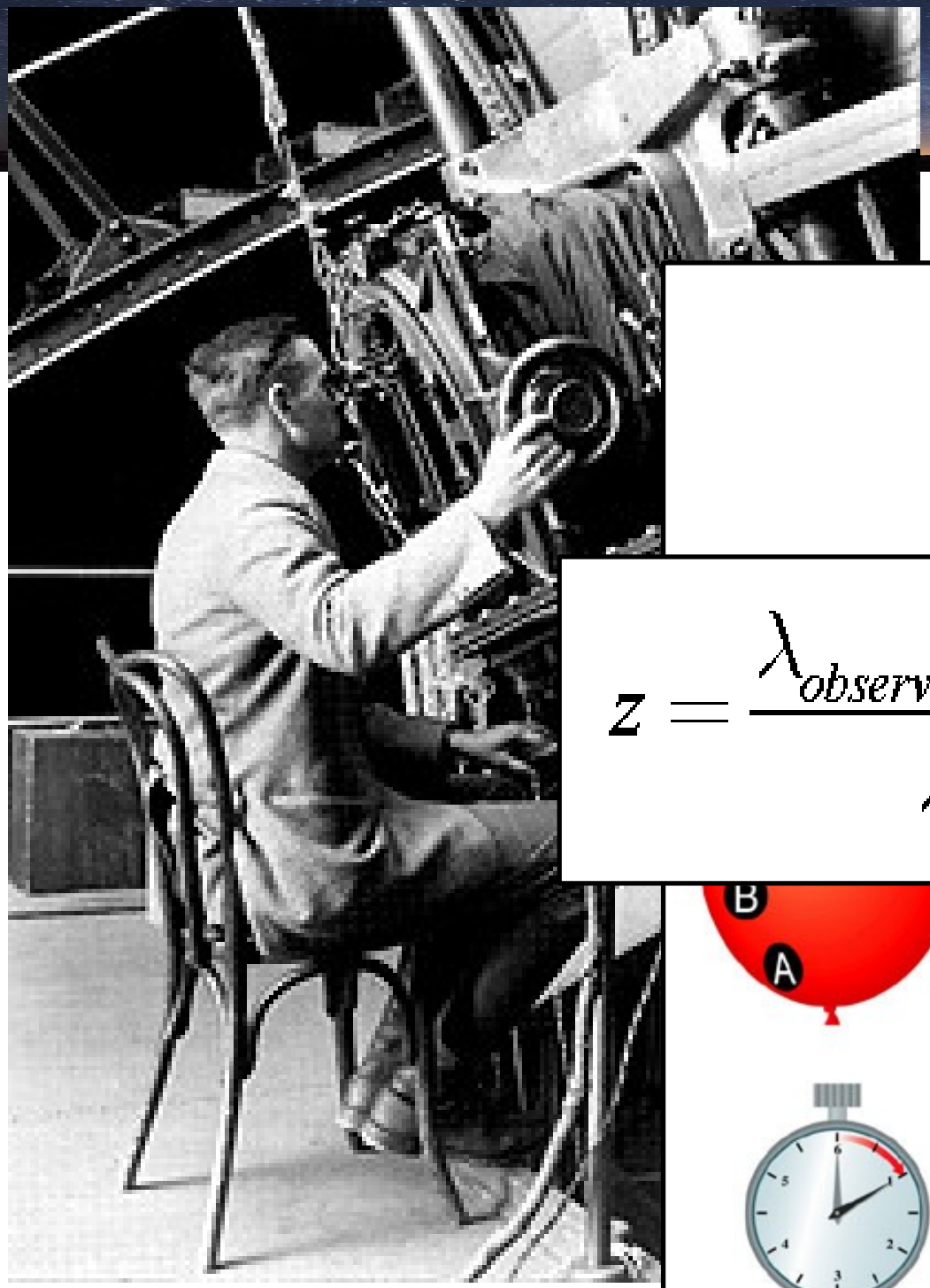
http://astro.sfasu.edu/courses/ast105/lectures105/chapter15/discover_hubble_law.htm

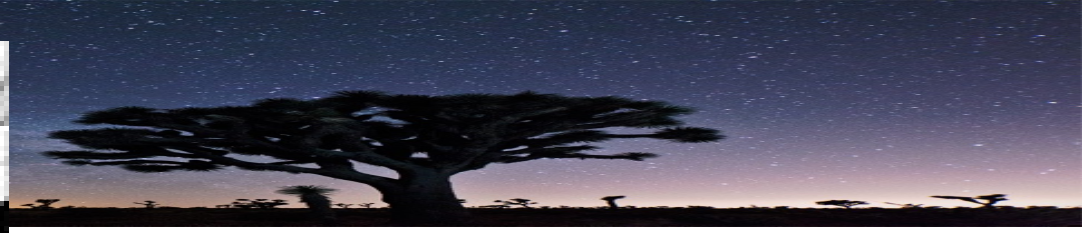



D
C
B
A
D
C
B
A

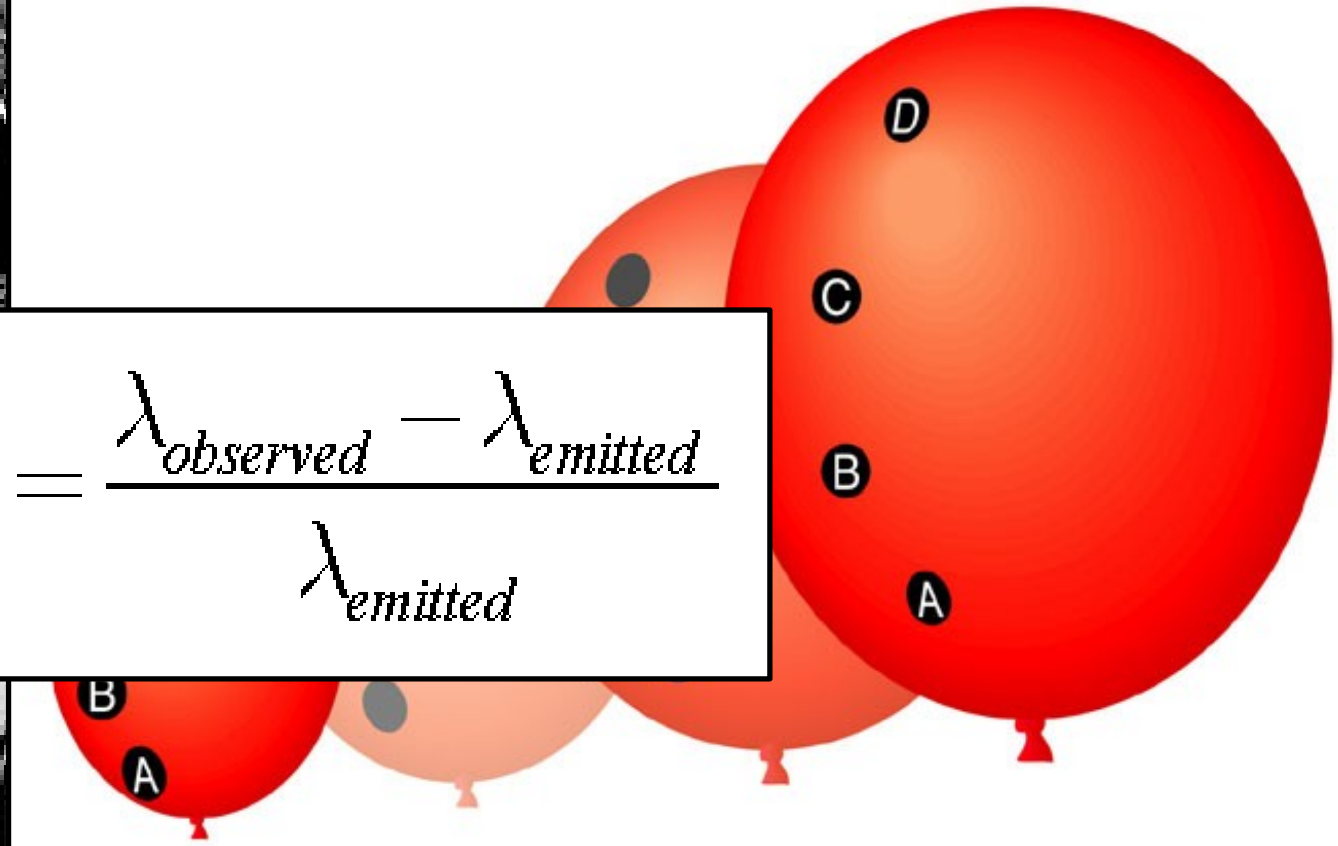


http://astro.sfasu.edu/courses/ast105/lectures105/chapter15/cosmological_redshift.htm



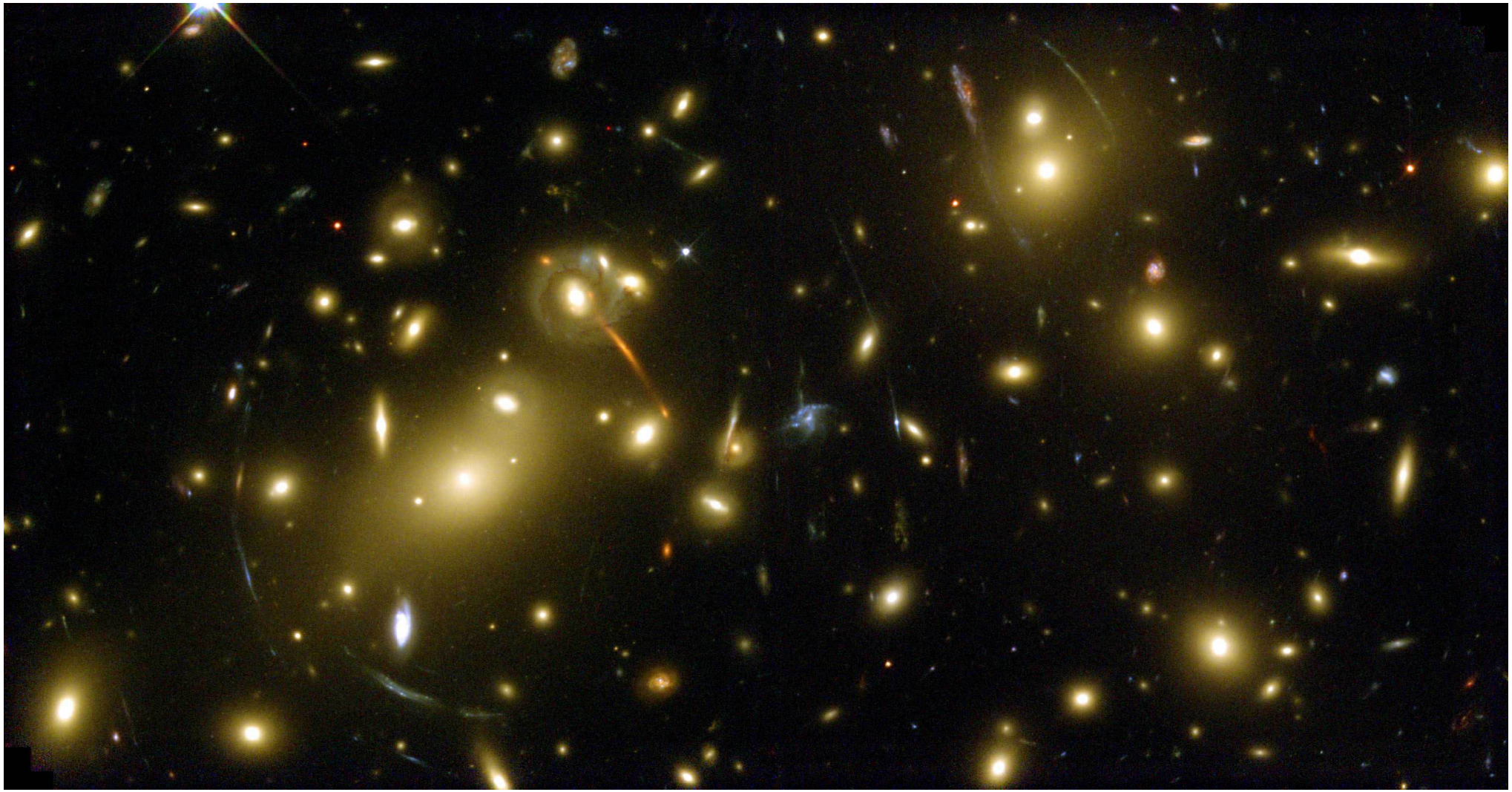


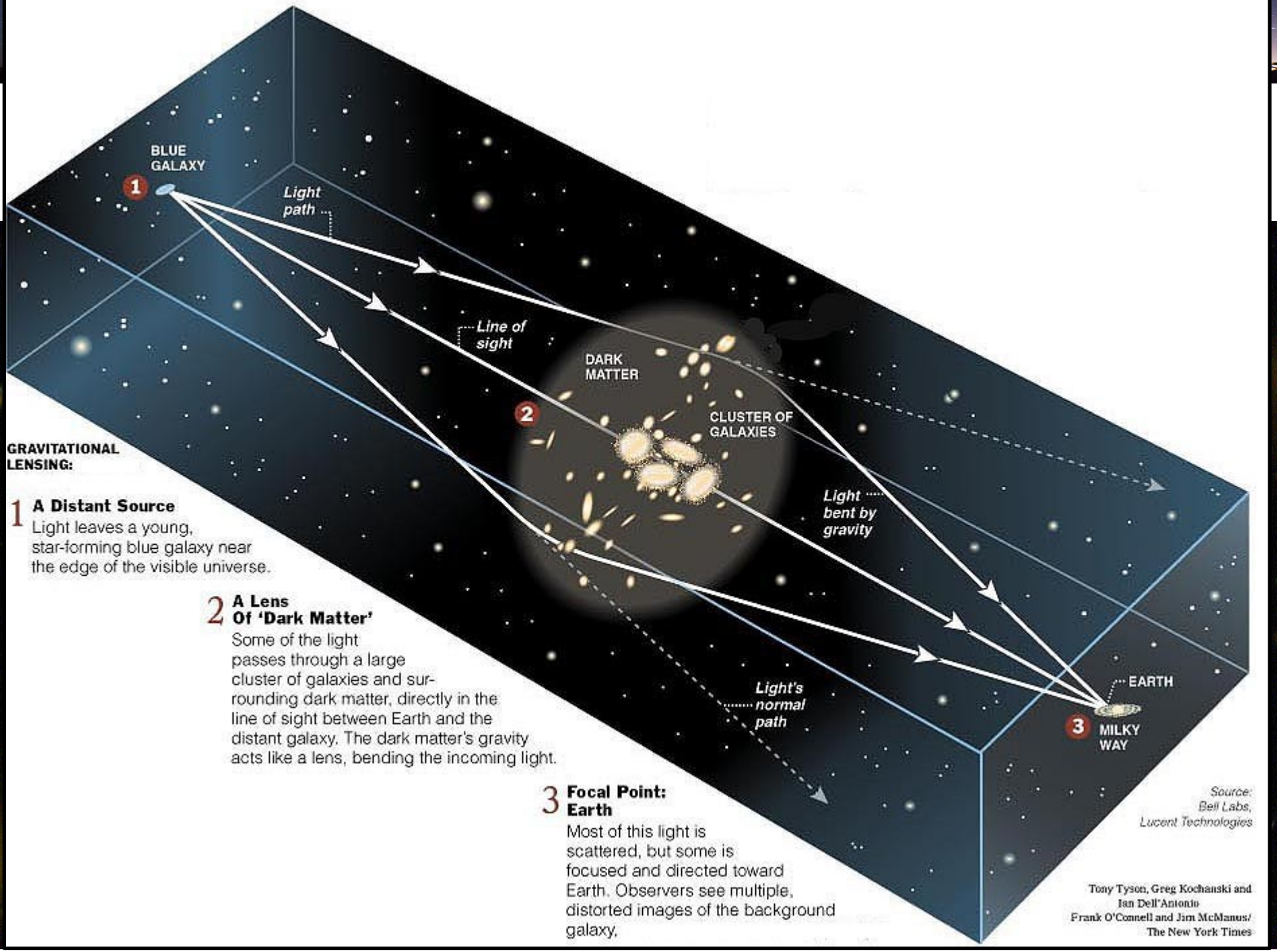
$$z = \frac{\lambda_{observed} - \lambda_{emitted}}{\lambda_{emitted}}$$



Efectos Gravitacionales

Efectos Gravitacionales





GRAVITATIONAL LENSING:

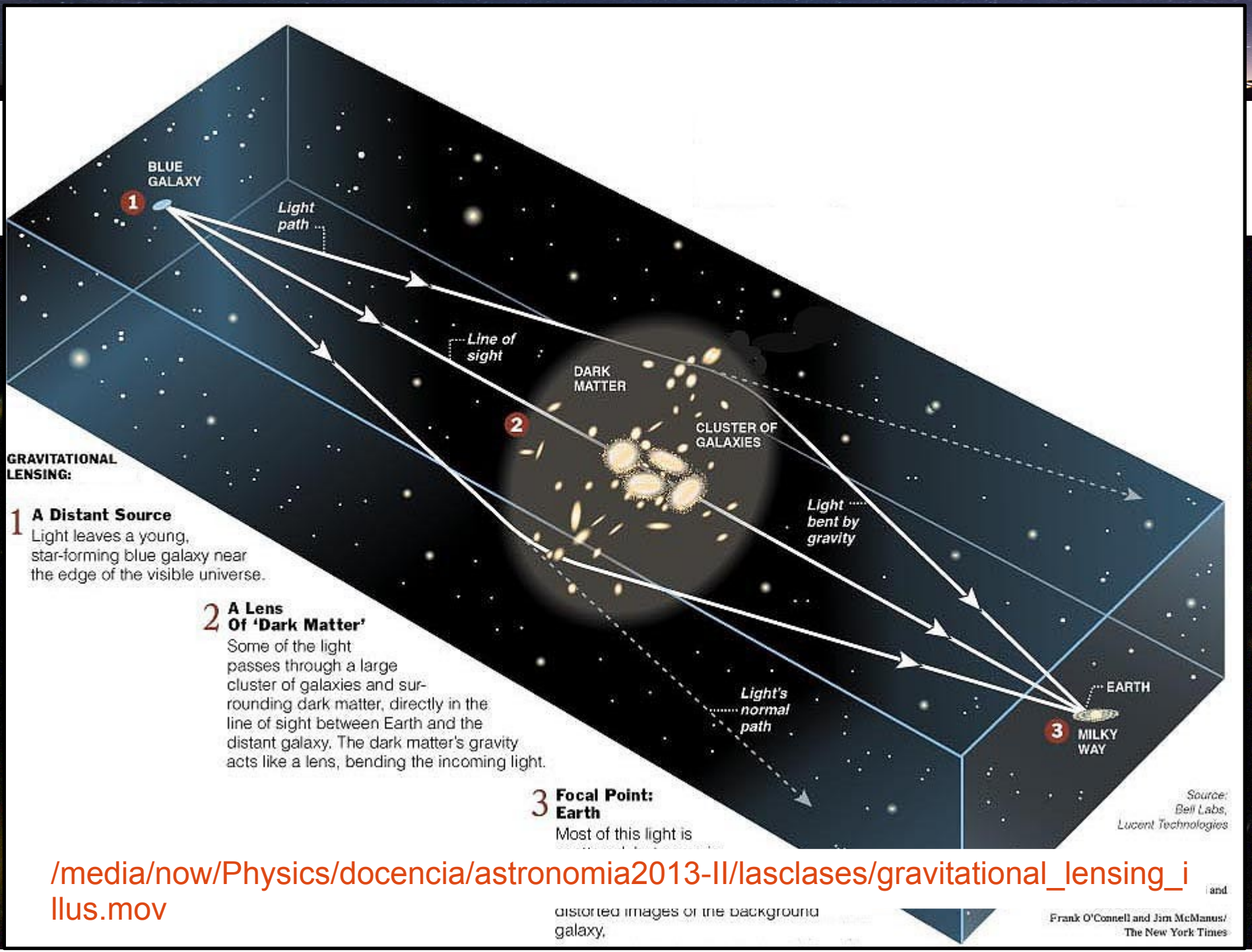
1 A Distant Source
Light leaves a young, star-forming blue galaxy near the edge of the visible universe.

2 A Lens Of 'Dark Matter'
Some of the light passes through a large cluster of galaxies and surrounding dark matter, directly in the line of sight between Earth and the distant galaxy. The dark matter's gravity acts like a lens, bending the incoming light.

3 Focal Point: Earth
Most of this light is scattered, but some is focused and directed toward Earth. Observers see multiple, distorted images of the background galaxy.

Source: Bell Labs, Lucent Technologies

Tony Tyson, Greg Kochanski and Ian Dell'Antonio
Frank O'Connell and Jim McManus/
The New York Times



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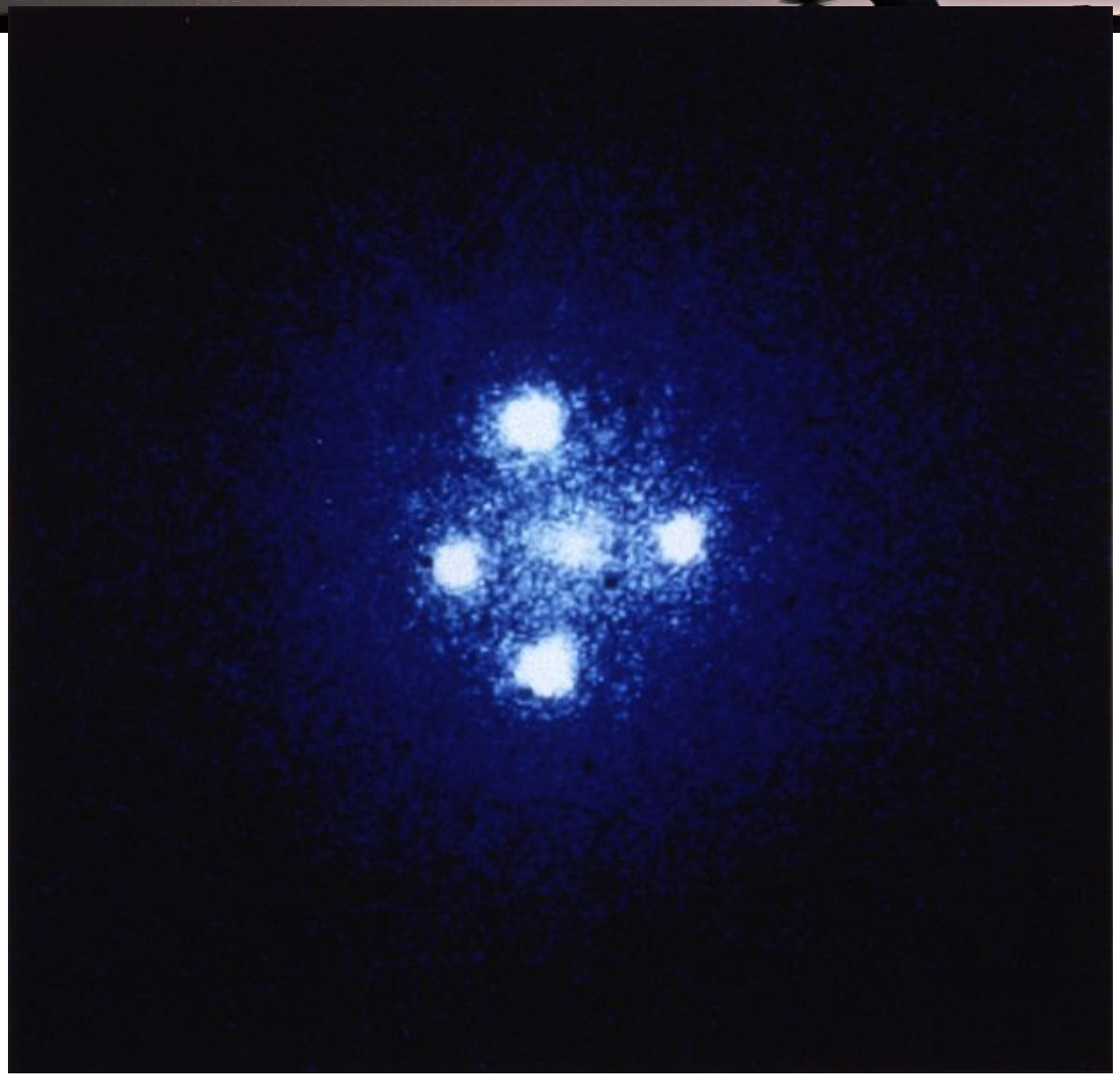
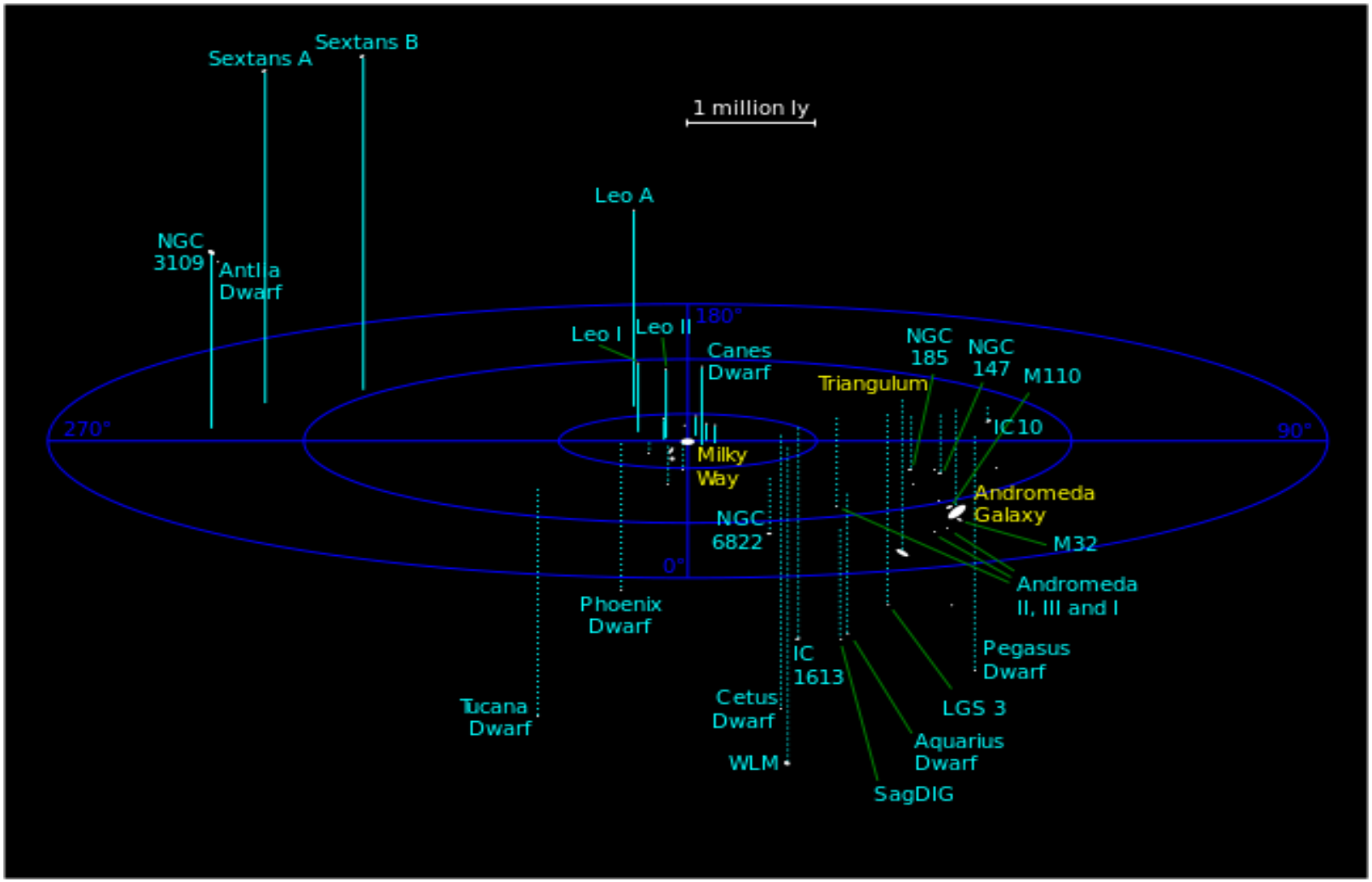


Astronomía planetaria, clase 22. Galaxias II

Cúmulos Galácticos

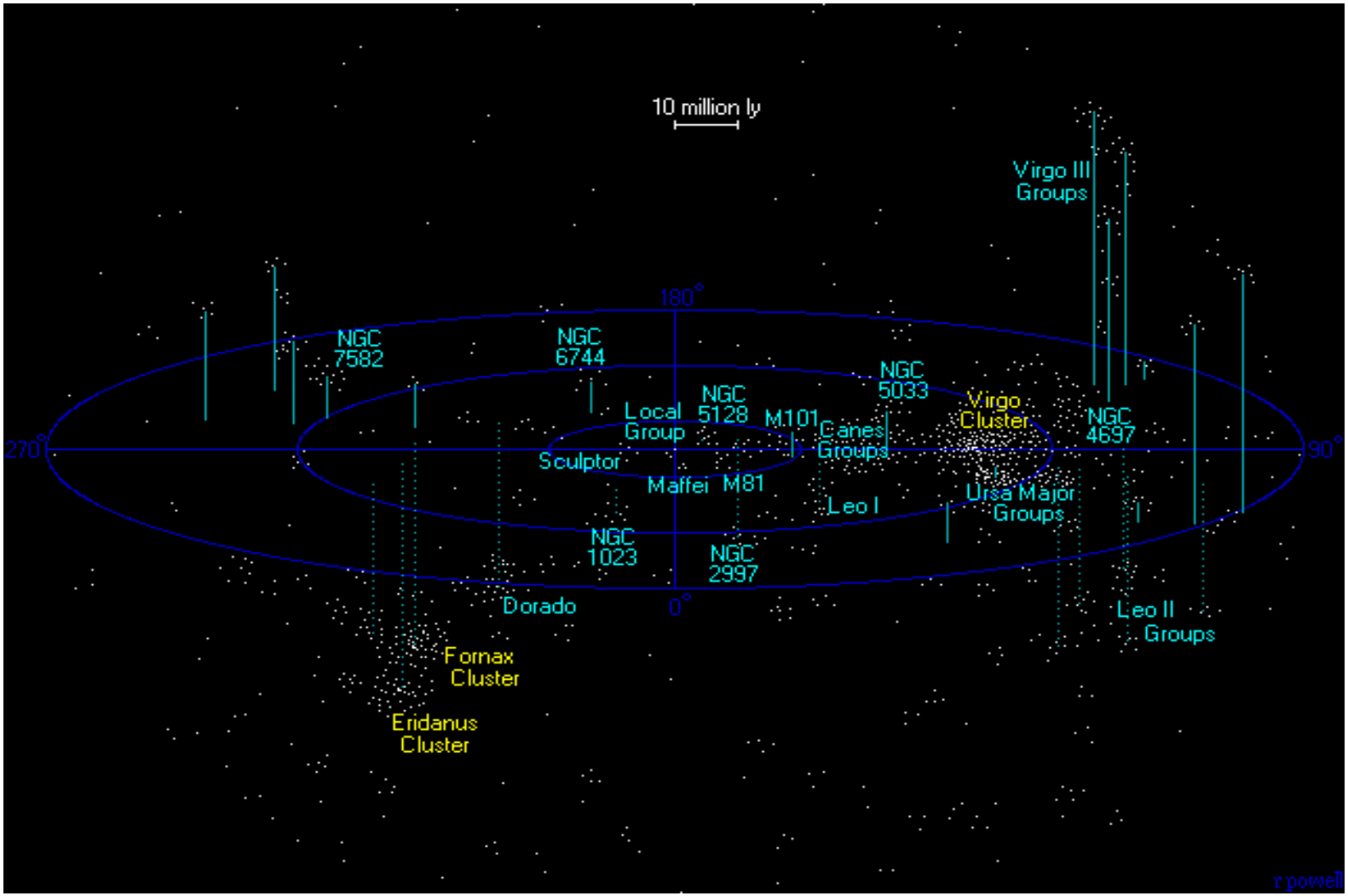
Cúmulos Galácticos



Cúmulos Galácticos

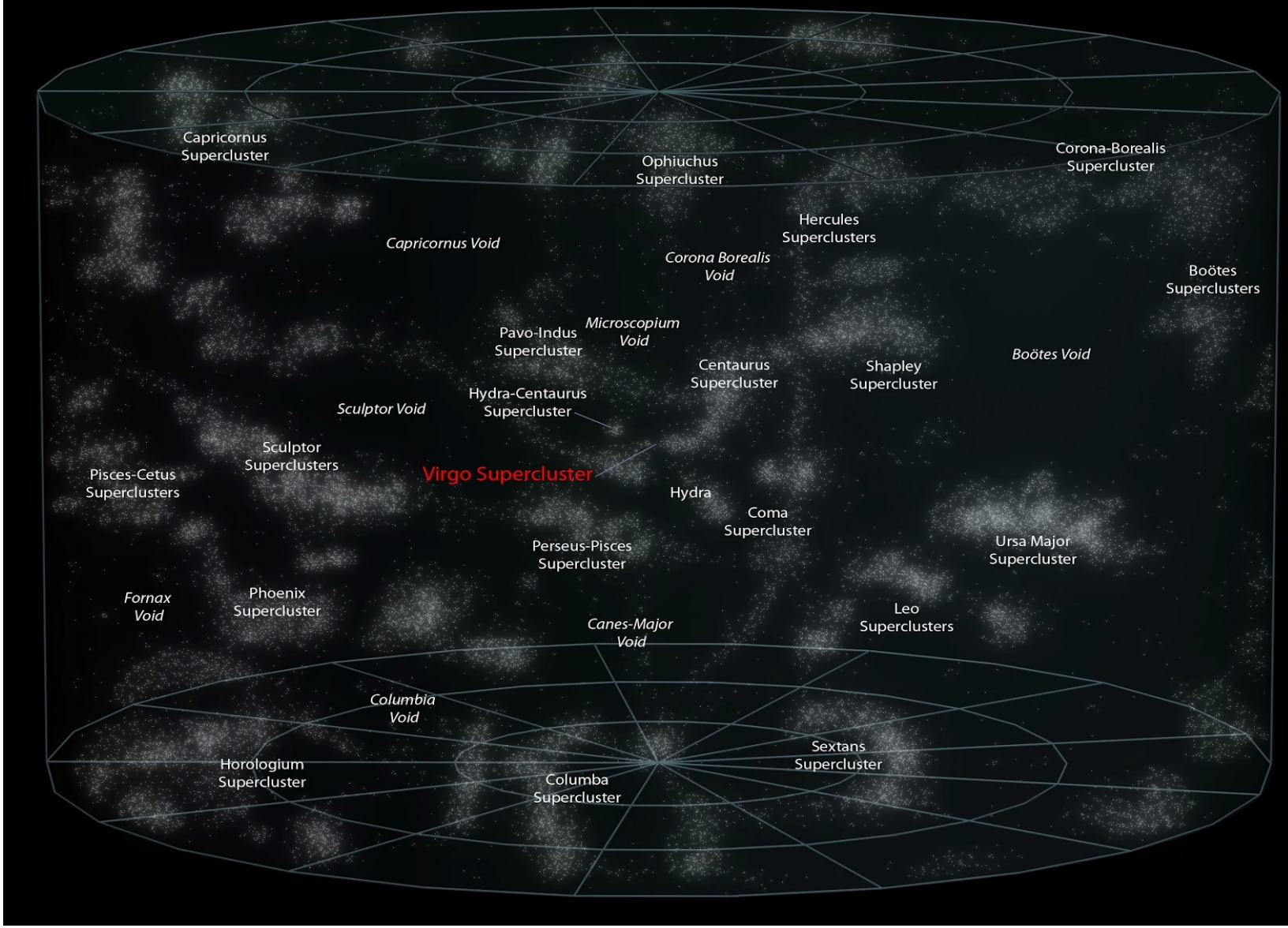
Super Cúmulo de Virgo

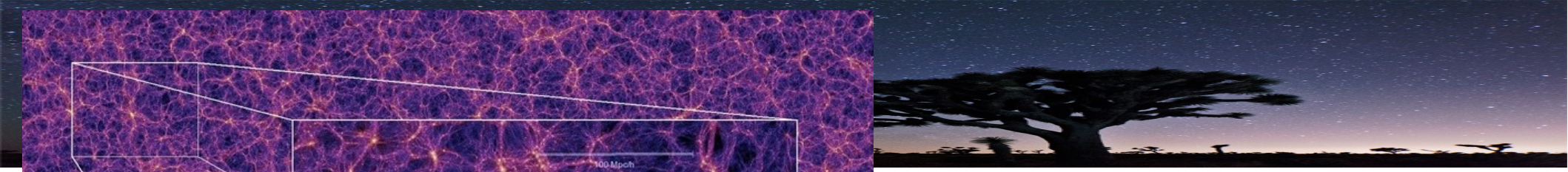
Super Cúmulo de Virgo



Super Cúmulo de Virgo

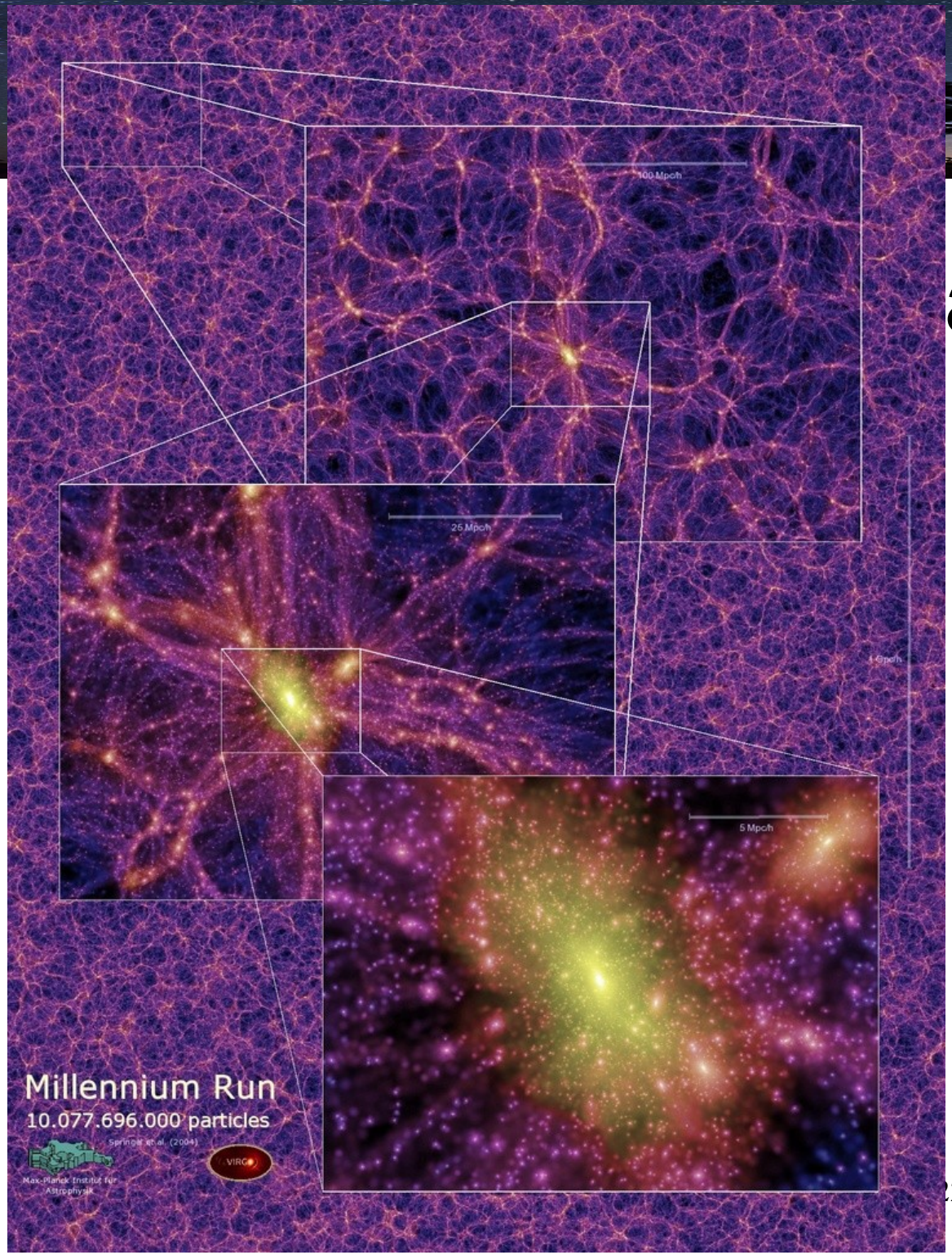
Local Superclusters





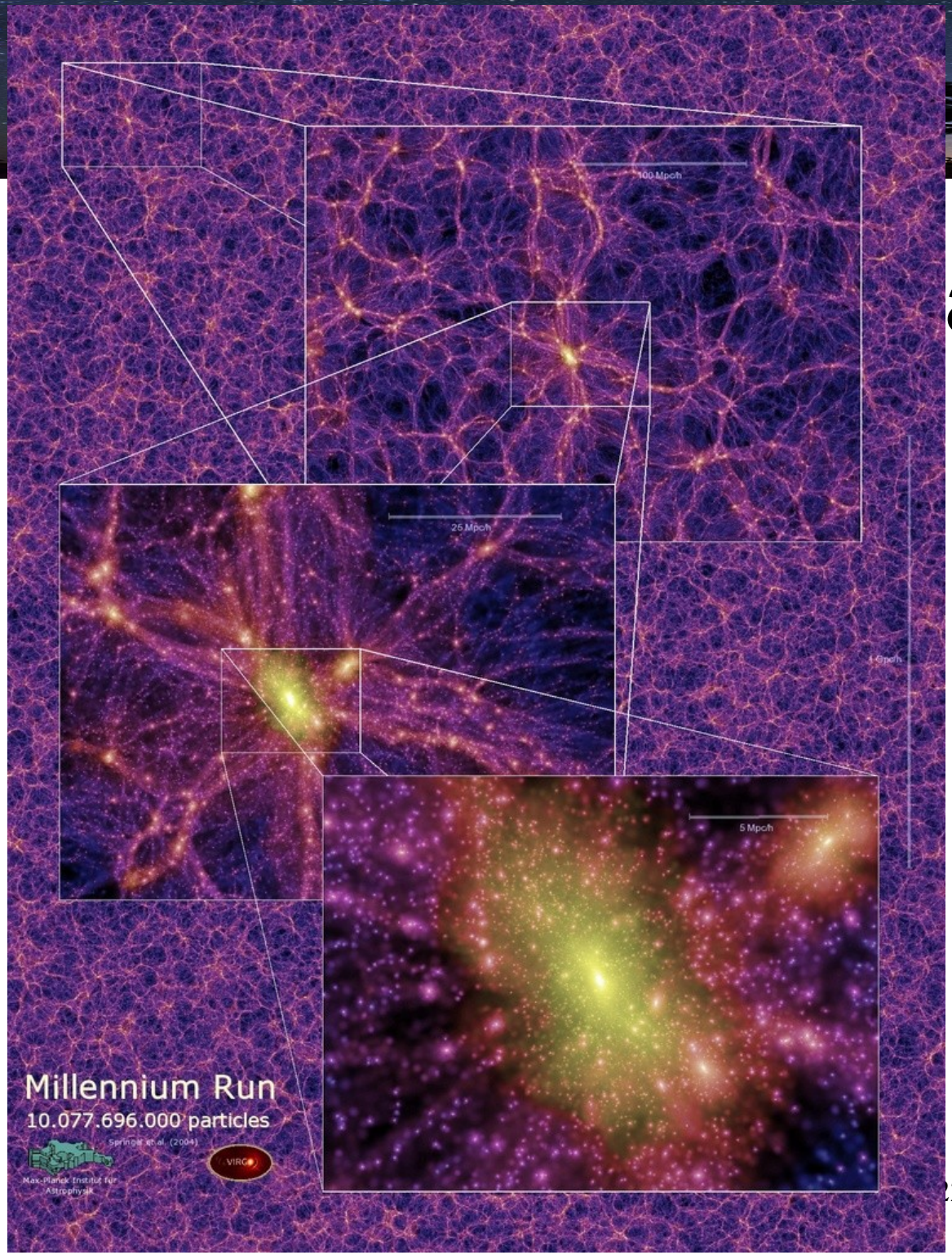
acionales

100 Mpc/h
25 Mpc/h
5 Mpc/h
Millennium Run
10.077.696.000 particles
Springel et al. (2004)
Max-Planck-Institut für Astrophysik
VIRGO



acionales

- 100 billones de partículas
- 2 billones de años luz de lado



acionales

- 100 billones de partículas
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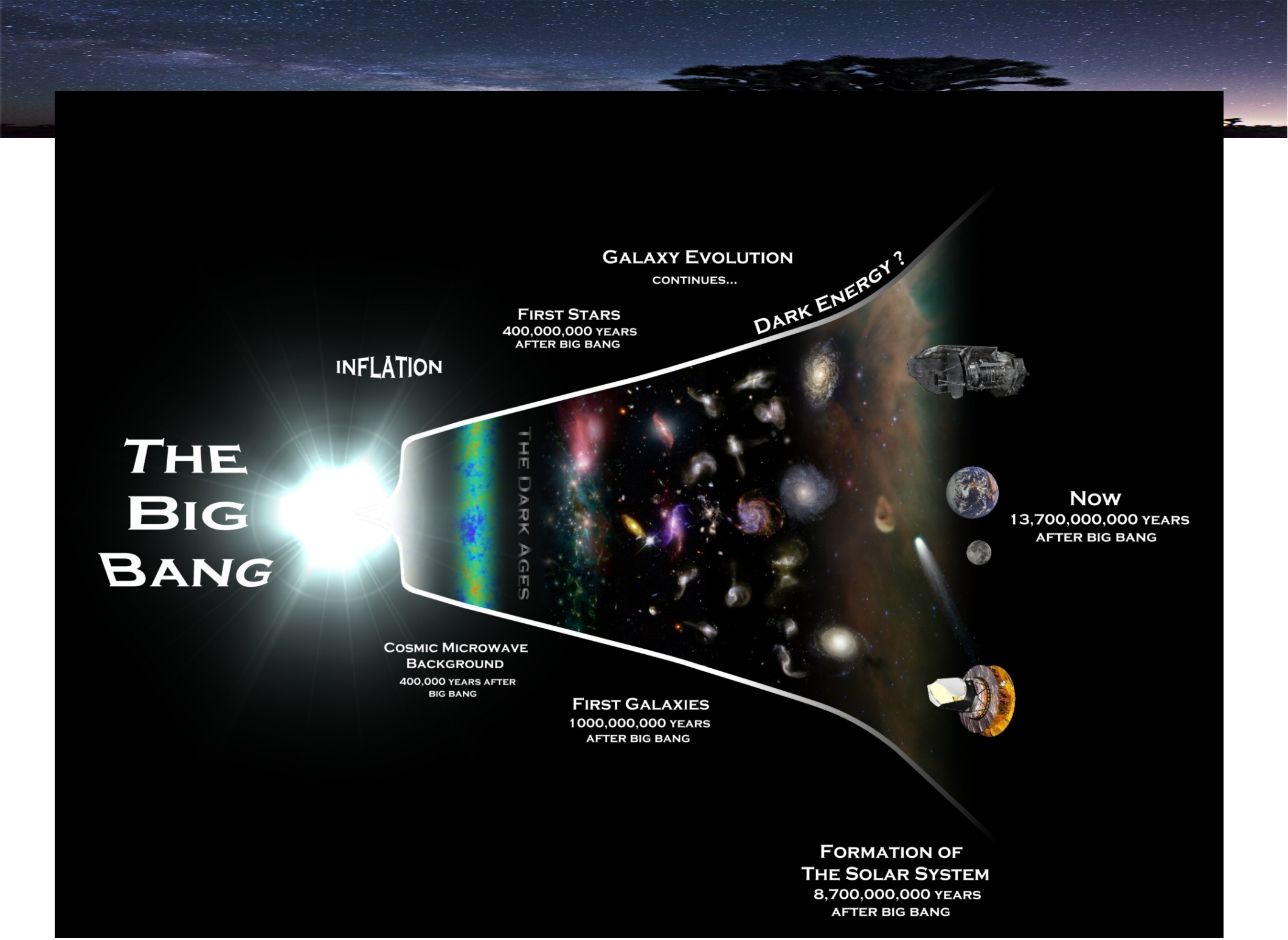
http://www.youtube.com/watch?v=jzFbLHLJhnM


THE BIG BANG
INFLATION
FIRST STARS
400,000,000 YEARS
AFTER BIG BANG
GALAXY EVOLUTION
CONTINUES...
DARK ENERGY ?
THE DARK AGES
COSMIC MICROWAVE
BACKGROUND
400,000 YEARS AFTER
BIG BANG
FIRST GALAXIES
1000,000,000 YEARS
AFTER BIG BANG
NOW
13,700,000,000 YEARS
AFTER BIG BANG
FORMATION OF
THE SOLAR SYSTEM
8,700,000,000 YEARS
AFTER BIG BANG