



Looking Out Into Space
Looking Back In Time

TOUR OF THE UNIVERSE

The Speed of Light

- Light takes time to travel through space.
- All observations are consistent with Einstein's Postulate that the speed of light is constant for all observers....
- The speed of light is exactly $299,792,458$ meters/sec or more popularly $186,282$ miles/sec.
- Therefore when we look out into space we are looking back in time.

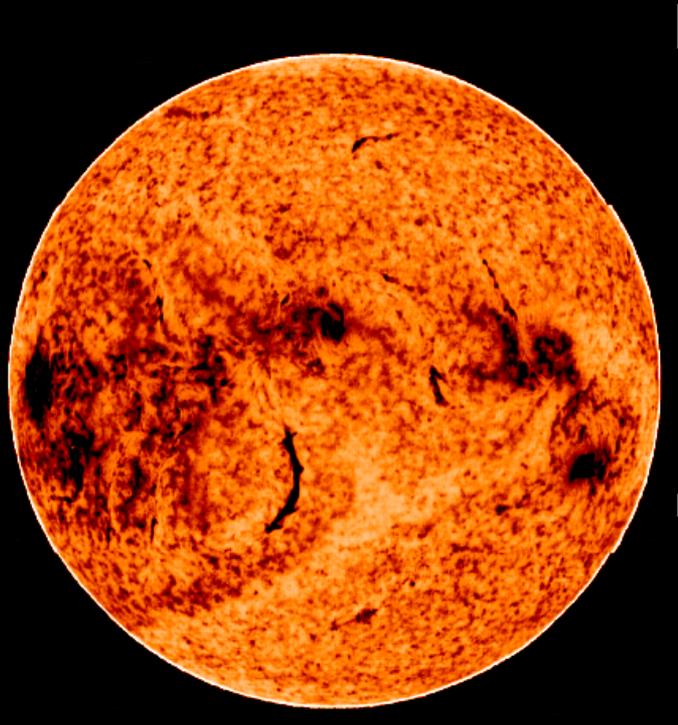
The Moon (1.2 to 1.4 light-seconds)

- The moon is 363,000 to 405,000 km from Earth
- Therefore the light in the image took 1.2 to 1.4 sec to reach us

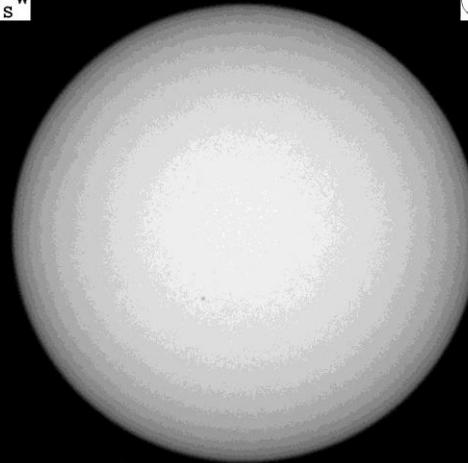


The Sun (8.3 light-minutes)

- The Sun is 149.6 million km from Earth

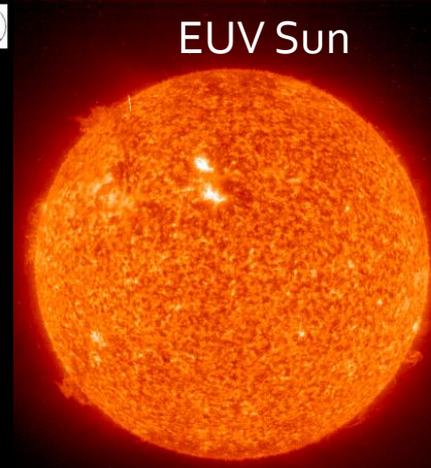


IR Sun



White light

Big Bear Solar Observatory
2006-09-21 20:54:36 UT



EUV Sun



Radio Wave

NoRH 17GHz 2002-11-22 06:20:00

Mars (3 to 23 light-minutes)



Mars - Syrtis Major - March 10, 1997
Hubble Space Telescope - WFPC2



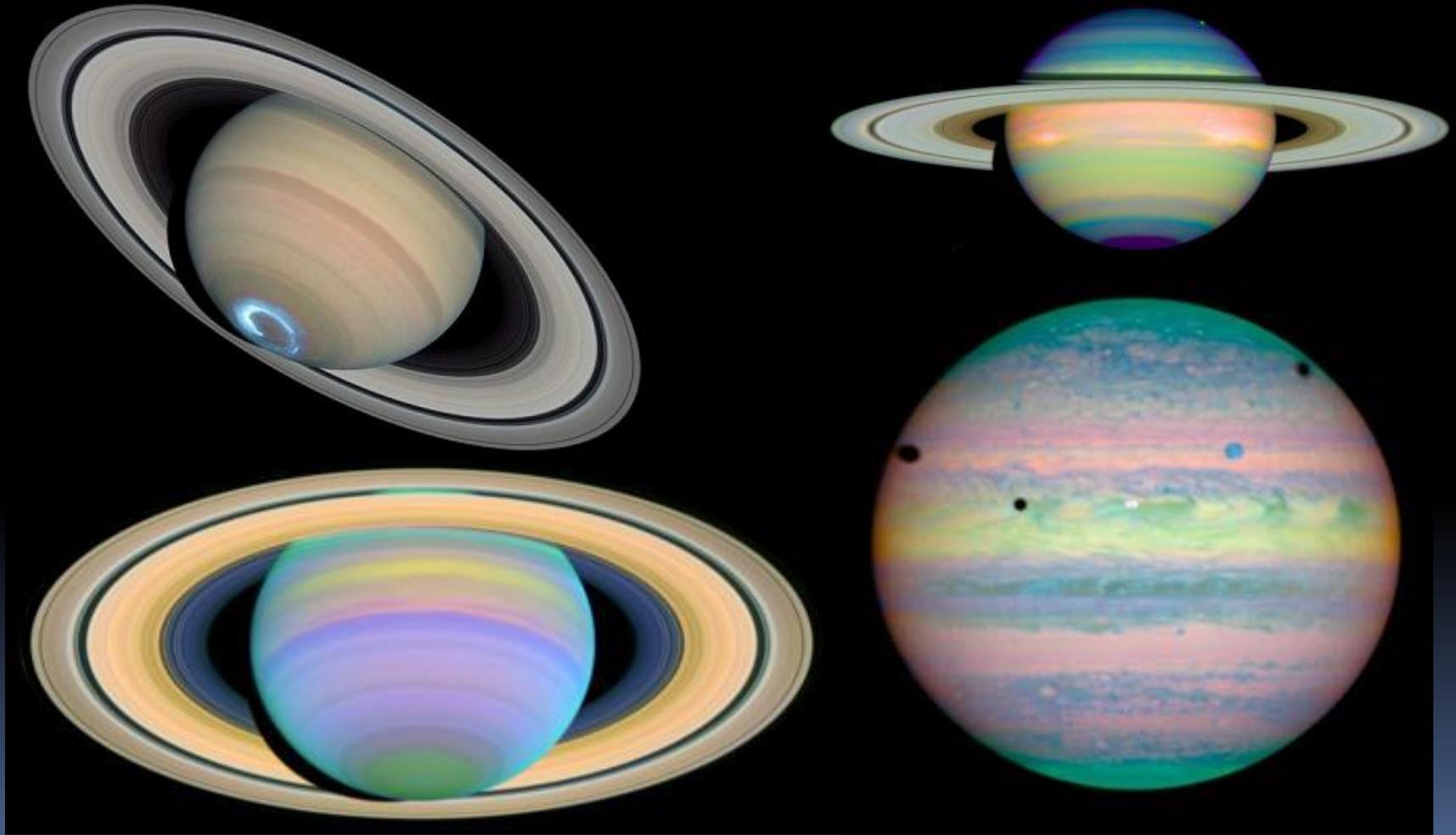
Spirit



[Google Mars](#)

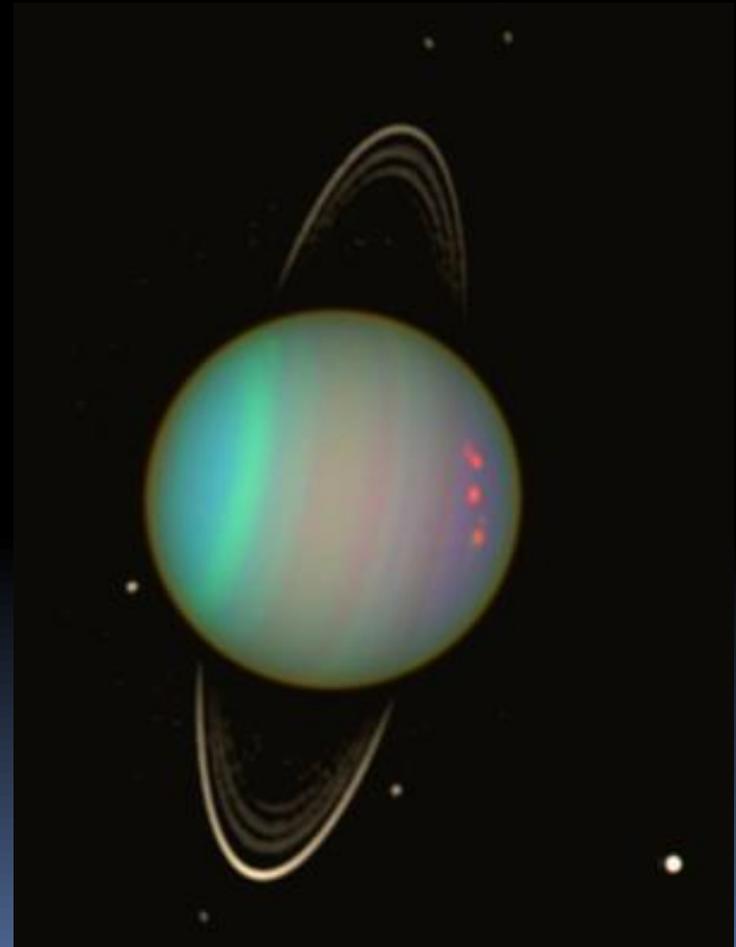
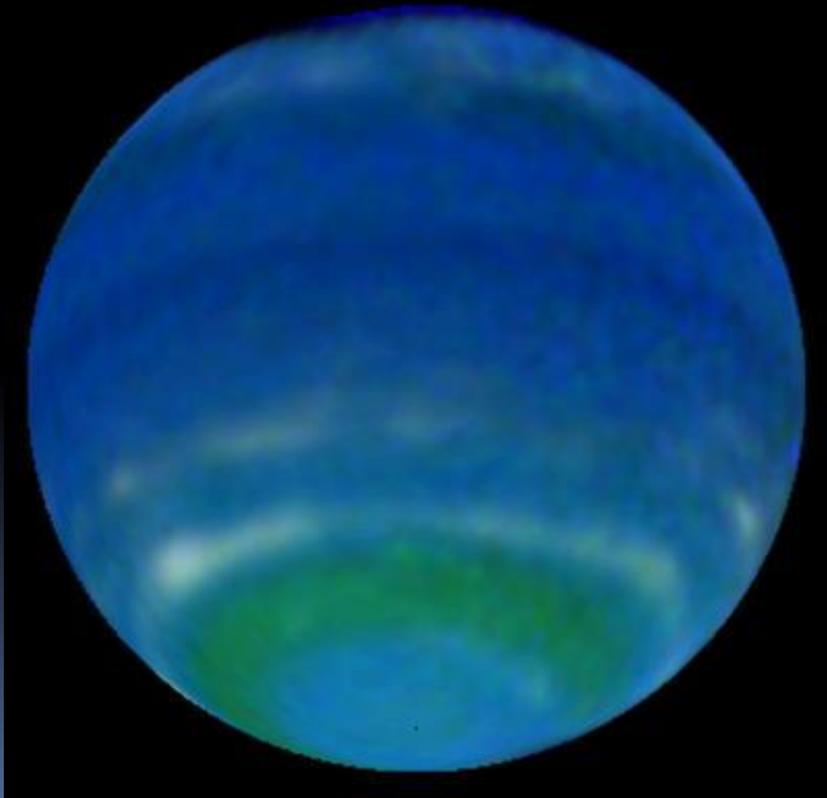
Jupiter and Saturn

(.54 and 1.11 light-hours)

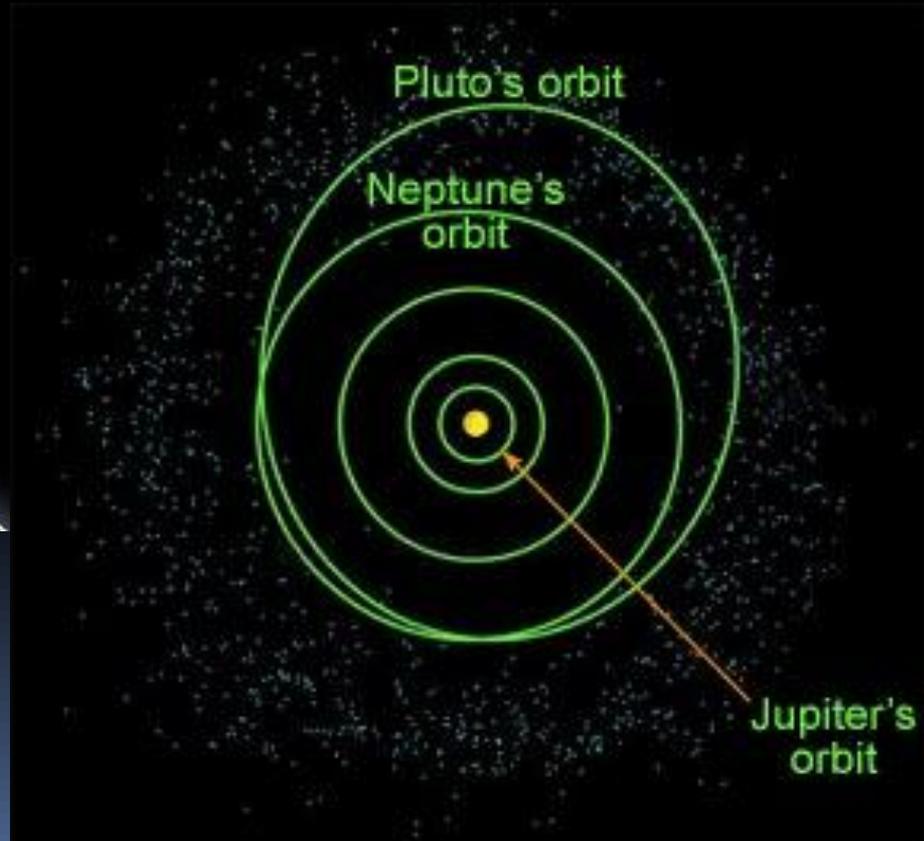


Uranus and Neptune

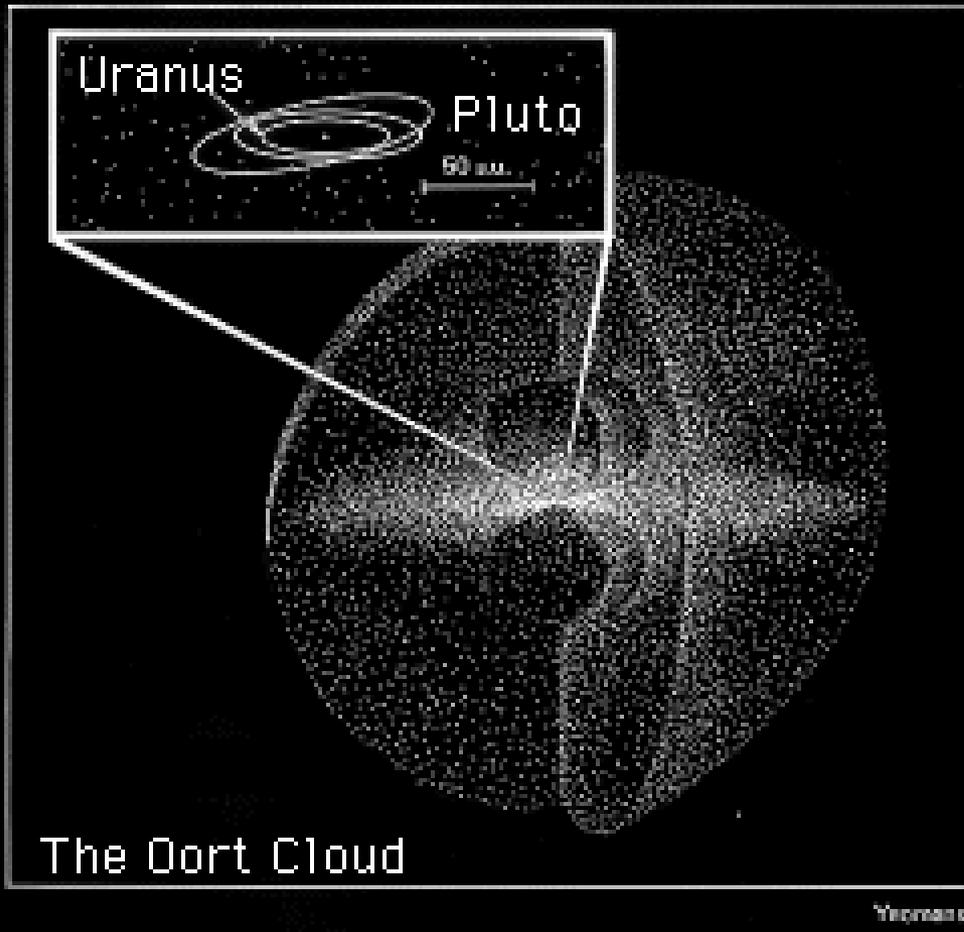
(1.48 and 3.98 light-hours)



Kupier Belt (4.0 to 13 light hours)



Ort Cloud (out to 577 light-days)



Source of comets

Alpha and Proxima Centauri (4.37 and 4.24 light-years)



Australian
Astronomical
Observatory

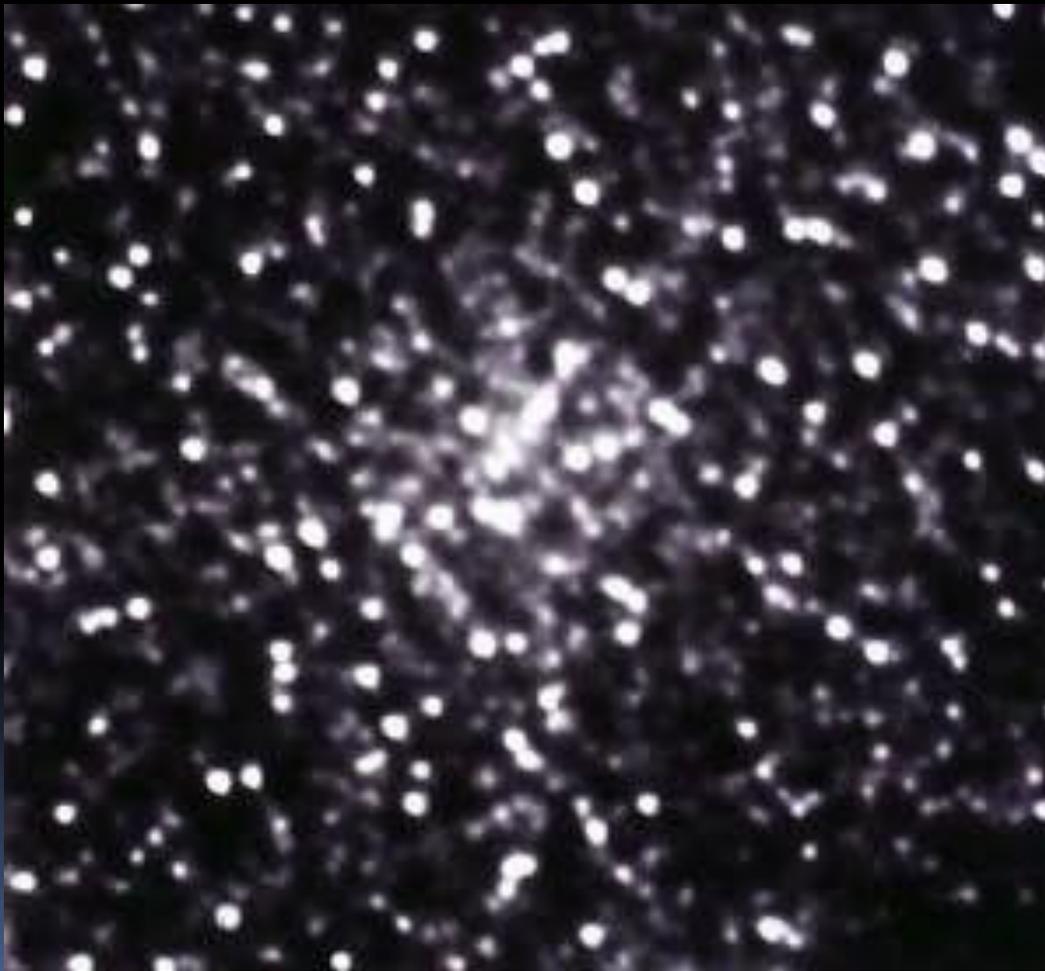
Monocerits (20,000 light-years



Outer edge of Milky Way
Galaxy
Outburst of light in Jan 2002
illuminated dust cloud
Novae 600,000 as bright as
Sun

Dense Star Cluster

(42,000 light-years)



Near Center of our galaxy
Collapsing cluster of stars
7000 stars within .8 light years
Or $1/5$ distance to Alpha Centauri

A Map of the Milky Way Galaxy (100,000 light-years across)



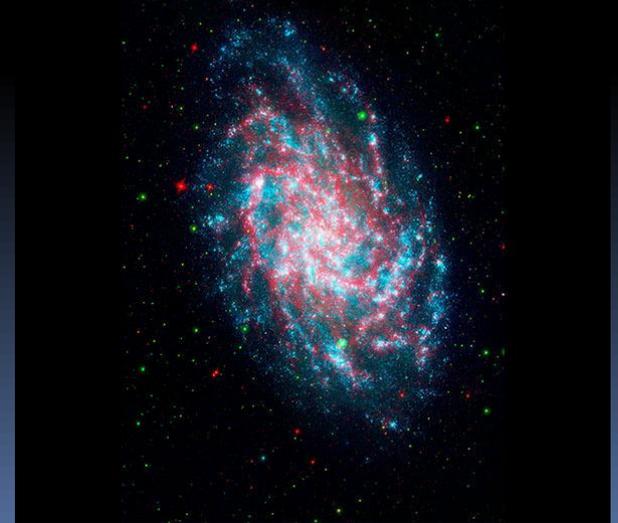
200 to 400
billion stars

Our Local Group of Galaxies (2.3 to 2.5 million light-years)



M₃₁ Andromeda
1 trillion stars

M₃₃ Triangulum



NGC 1301 Pin Wheel Galaxy

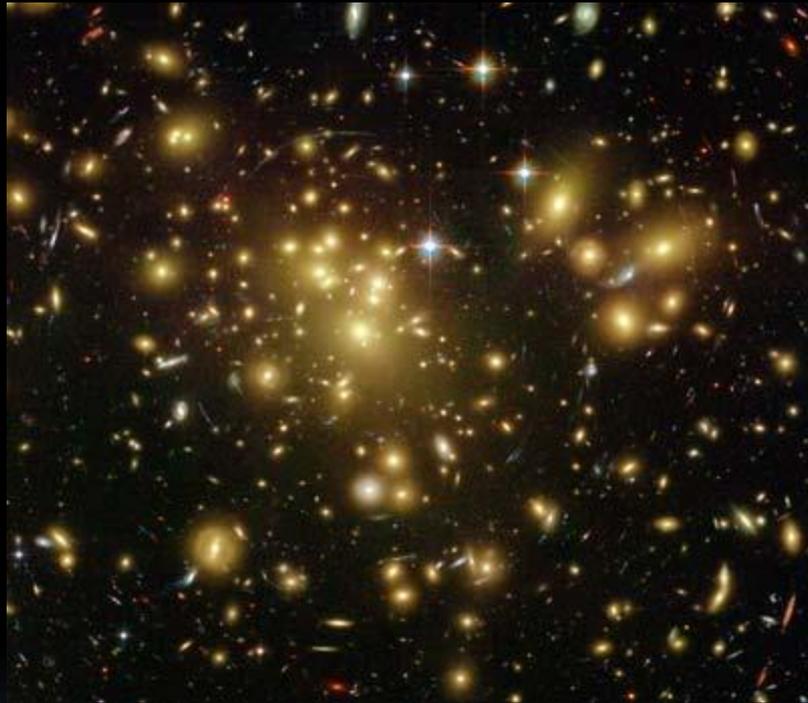


Top down look at Pin Wheel Galaxy
100 million light years from Sun
89,000 light years across



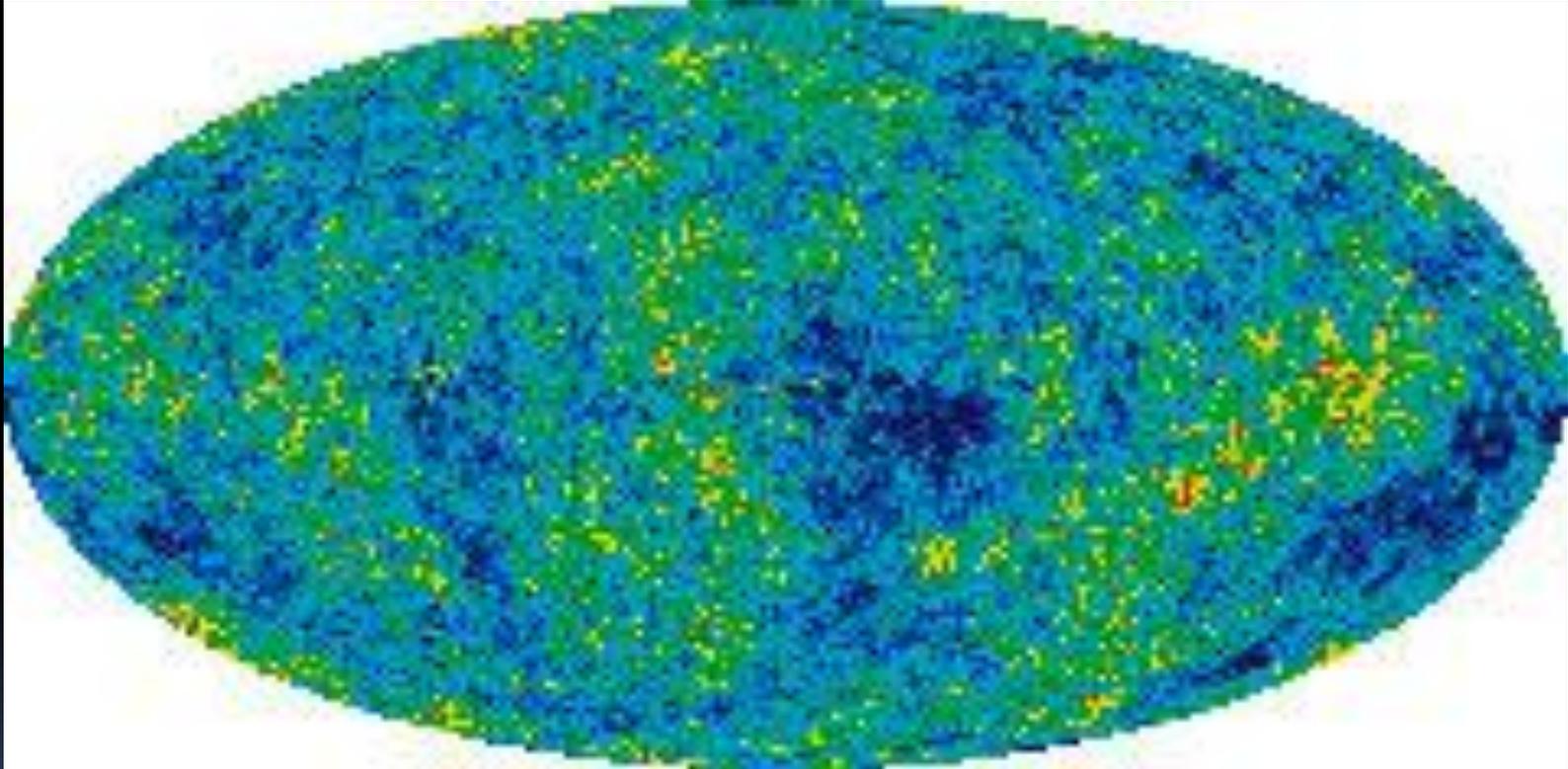
NGC 4710

Galaxy Cluster Abell 1689



2.2 Billion light-years to cluster in front and 12.8 billion light-years to galaxy cluster behind who's light appears as rings.

Comic Microwave Background 13.8 Billion Light-Years



WMAP Map of the surface of last scattering
Entire sky out to the horizon of the universe



Sloan Digital Sky Survey

Mapping the distribution of Galaxies in the entire Universe. [Video](#)

