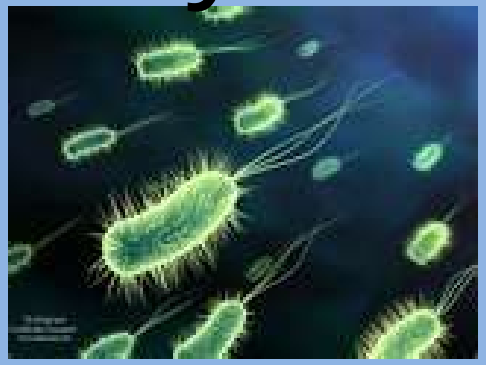
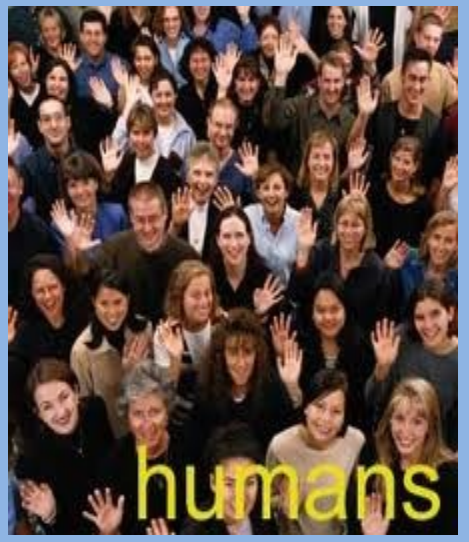
The Universe

Dr. K.Ravikumar

My Relatives in the World

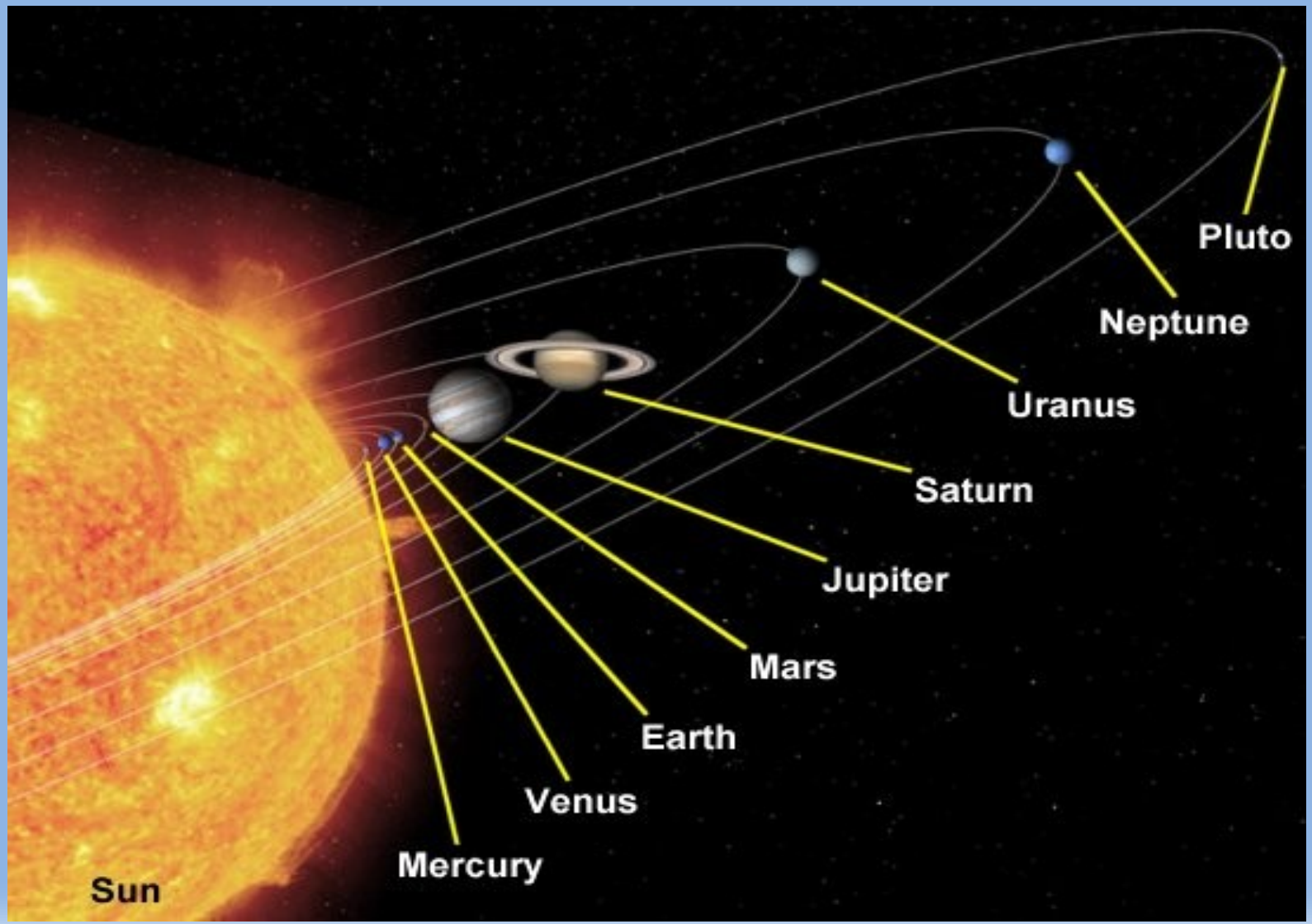




My Relatives in the World

My Home in the Universe

My Home in the Universe



My Home in the Universe

My Home in the Universe

What is galaxy ?

Galaxy - grouping of millions or billions of stars, and dust and gas held together by gravity there are an estimated 100 billion galaxies in the universe.

What is galaxy ?

There are 3 Types of Galaxies classified by shape

Galaxies

There are 3 Types of Galaxies - classified by shape

1.Spiral - disk shaped with spiral arms of dust and gas dust and gas provide a place for new stars to form

2.Elliptical - most common type of galaxy spherical and egg sha

3. Irregular Galaxies

Milky Way galaxy - the galaxy we live in

side view-a huge spiraling disk of stars and interstellar matter 1000 l.y. thick

overhead view A huge bulge in the center 10,000 l.y. thick

Astronomical distance

Astronomical distance measured in light years (ly)- a distance measurement- light year - the distance light travels in one year.

1 light year = 9.5x10e15 m

light travels at 3.0x10e8 m/s

What is Universe?

universe - sum of all matter and energy that ever has, does, and ever will exist every thing physical that exists in space and time-

cosmology – the study of how the universe began, what it is made of and how it continues to evolve and change

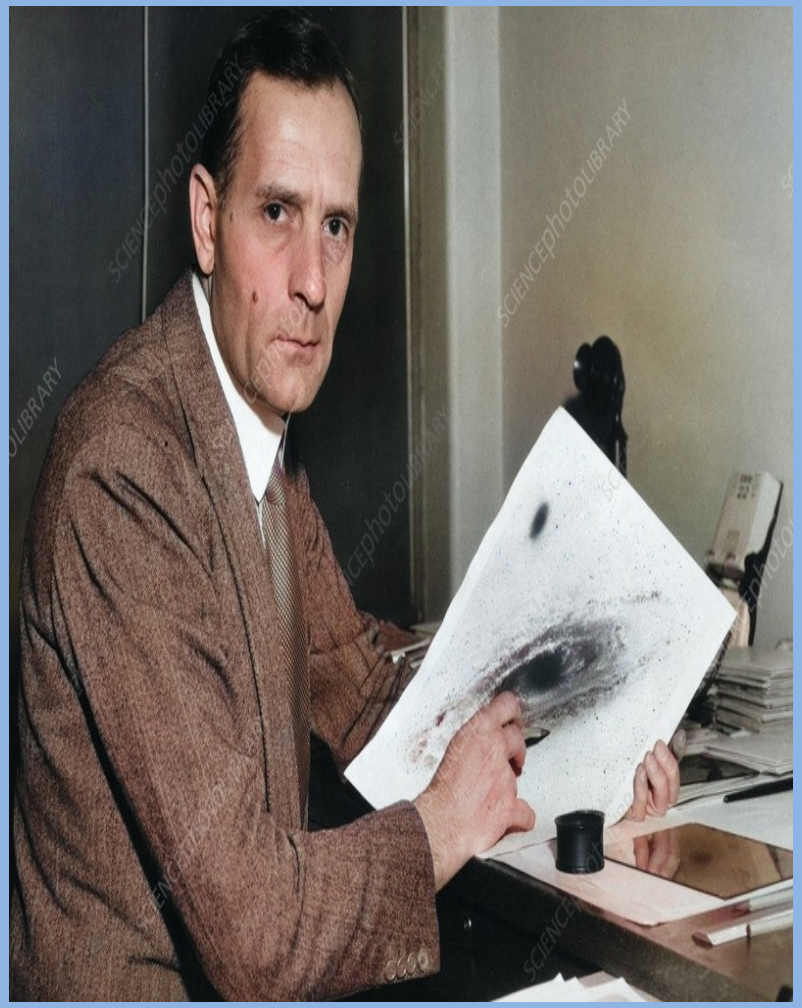
What is Universe?

universe made

Dark matter – theoretical unseen and undetectable mass that adds to the gravity of a galaxy.

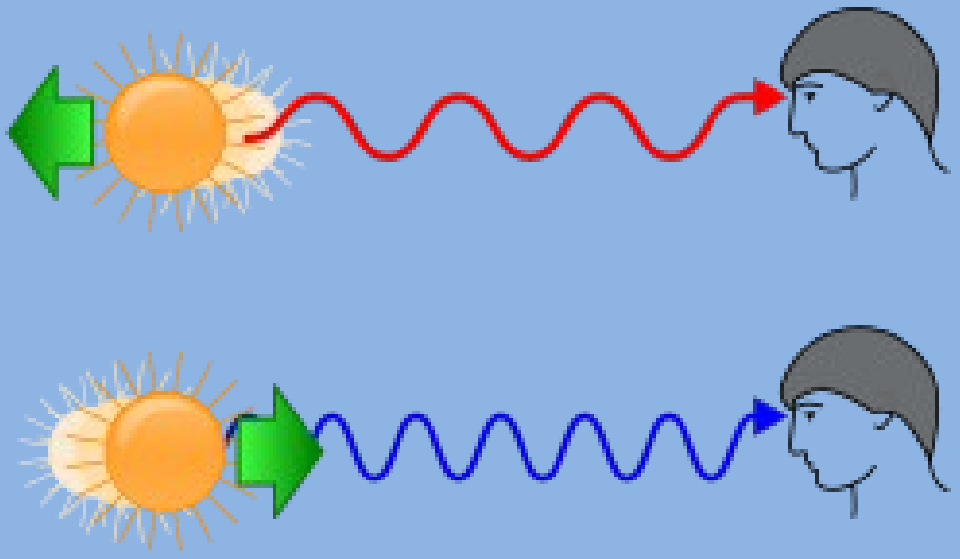
Dark energy – theoretical energy that might be causing accelerated expansion of the universe.

Edwin Hubble



Edwin Hubble's discoveries include the Andromeda galaxy and Hubble's Law

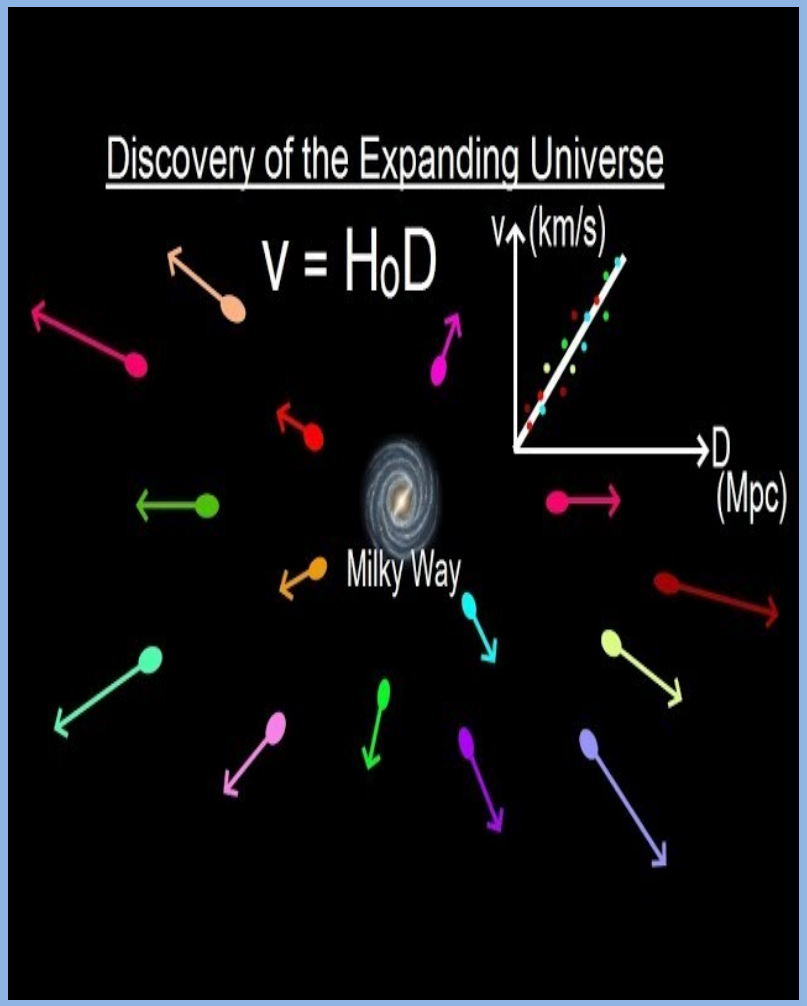
Doppler effect- Measuring speed of stars



Edwin Hubble's discoveries include the Andromeda galaxy and Hubble's Law When an object is receding, its light gets stretched (redshifted). When the object is approaching, its light gets compressed (blueshifted).

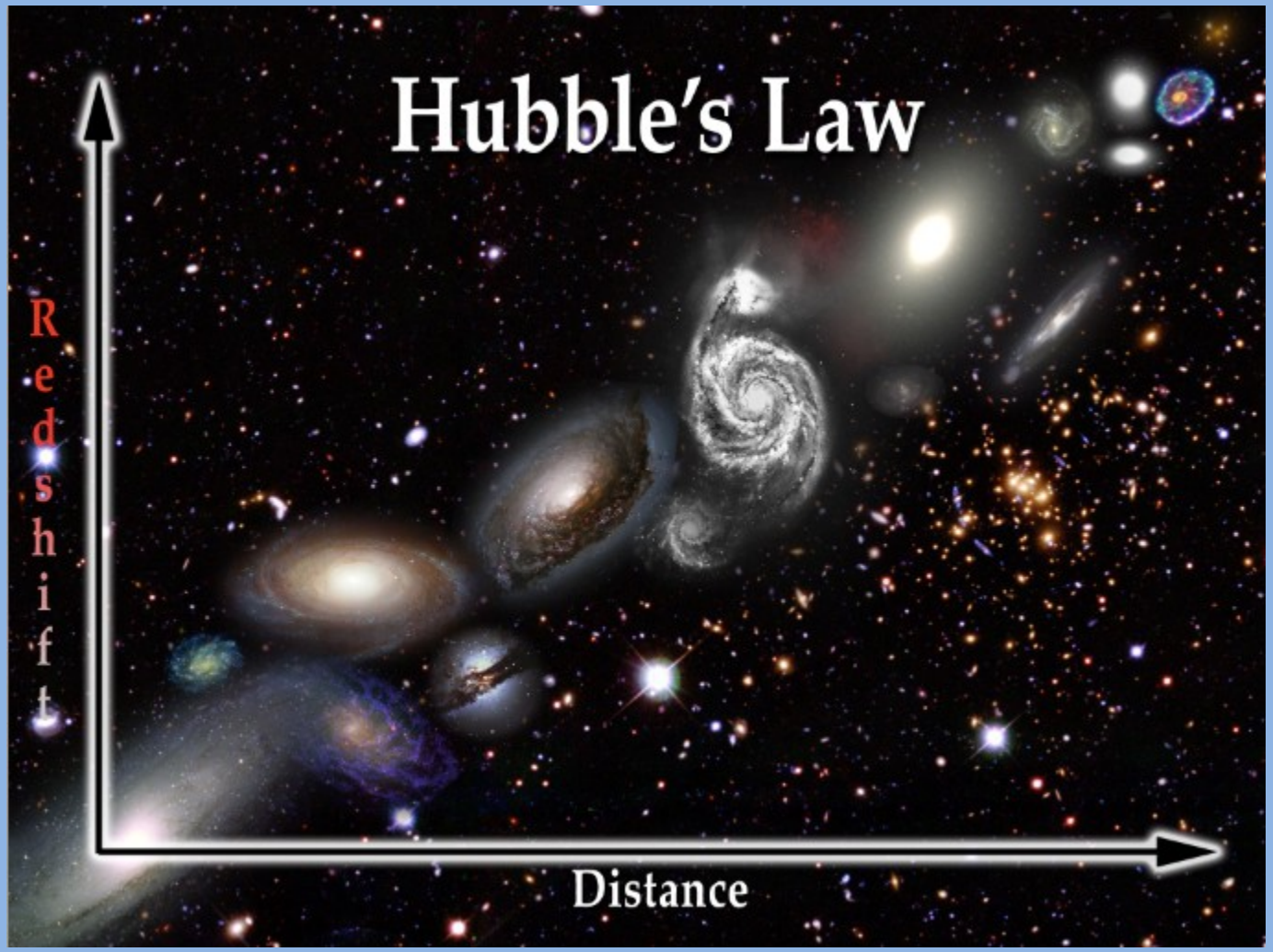
Hubble’s law

Hubble's laws states that the velocity (V) of recession between our galaxy (D) and the other galaxies are directly proportional to the distance between them.



The Hubble (Ho=74 km/s/Mpc) constant is one of the most important numbers in cosmology because it tells us how fast the universe is expanding, which can be used to determine the age of the universe and its

Hubble's law



Hubble's law

$$\text{age of the universe} = \frac{1}{H_0}$$

$$\text{for} \quad H_0 = 72 \frac{\text{km}}{\text{s Mpc}}, \qquad \frac{1}{H_0} = 13.6 \text{ billion years}$$

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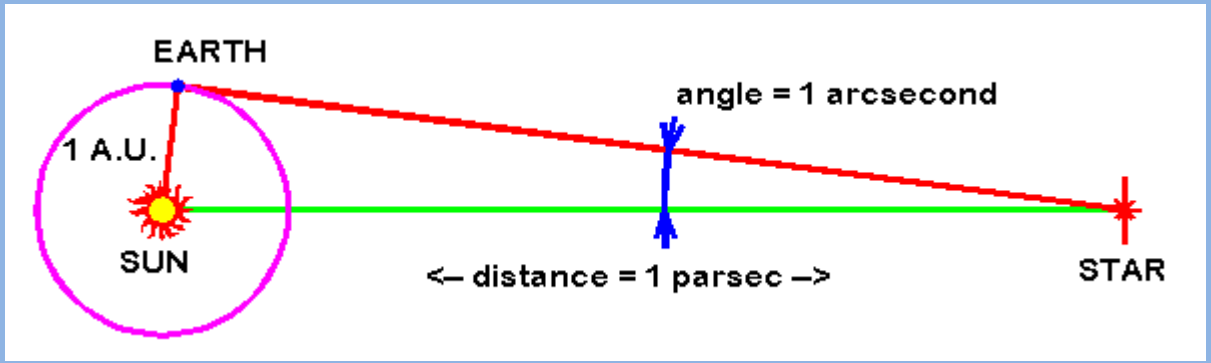
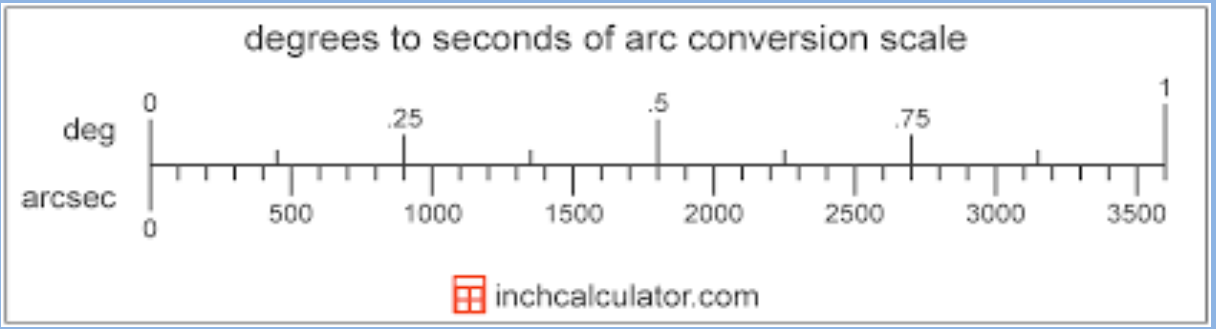
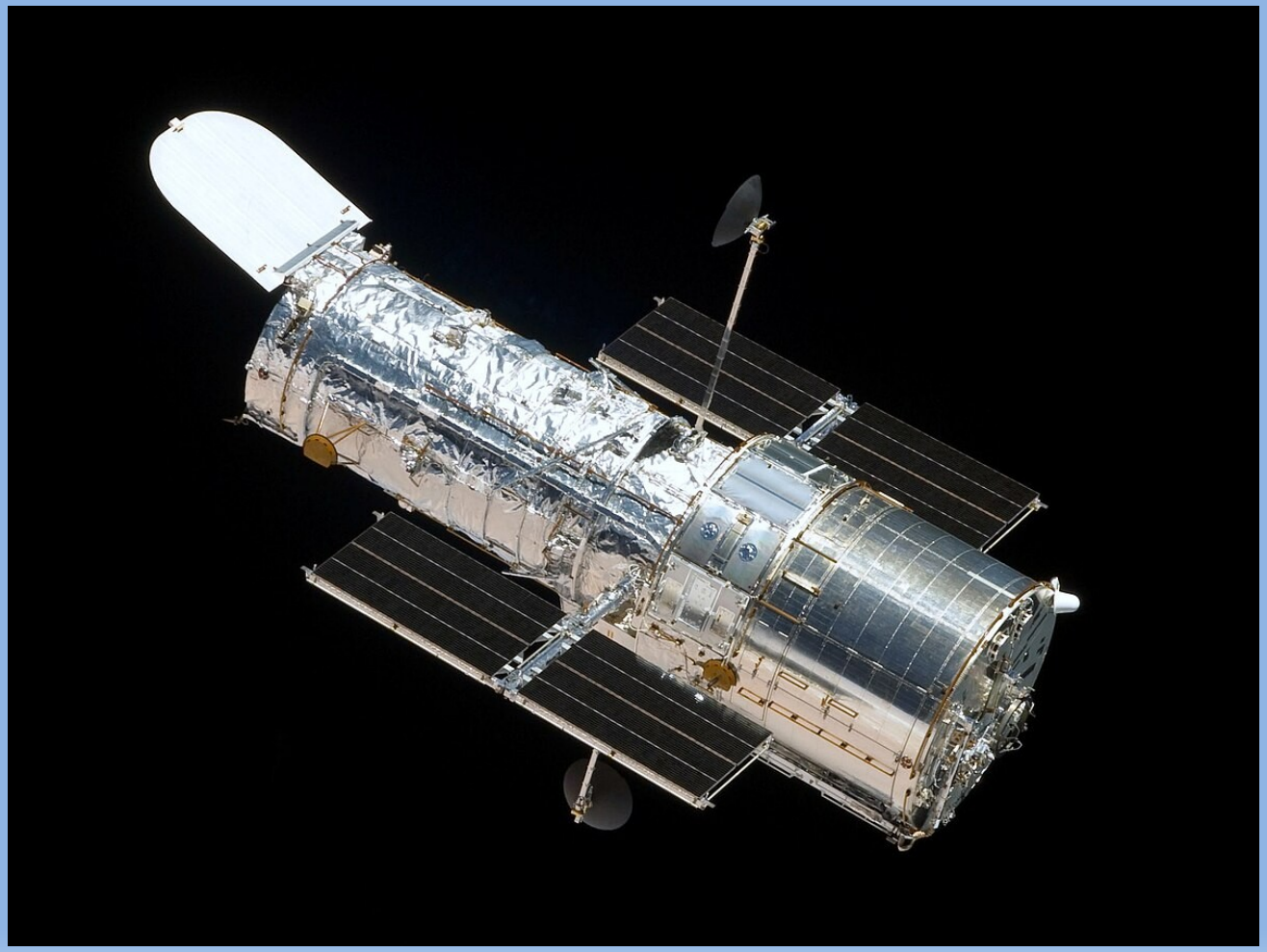
(Ho=74 km/s/Mpc- A megaparsec (Mpc) is a measurement of distance equal to one million parsecs or 3.26 million light years)

Hubble’s law

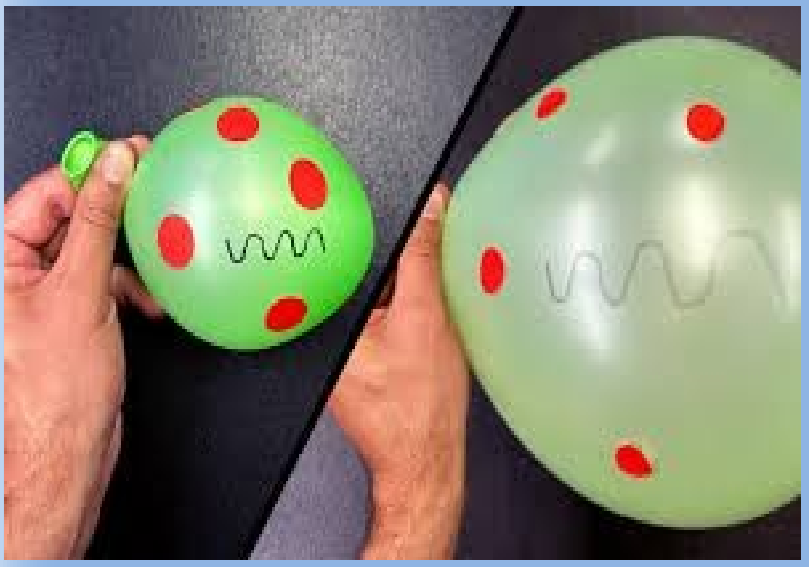

EARTH
angle = 1 arcsecond
1 A.U.
SUN
<– distance = 1 parsec –>
STAR


degrees to seconds of arc conversion scale
deg
arcsec
0
.25
.5
.75
1
0
500
1000
1500
2000
2500
3000
3500
inchcalculator.com

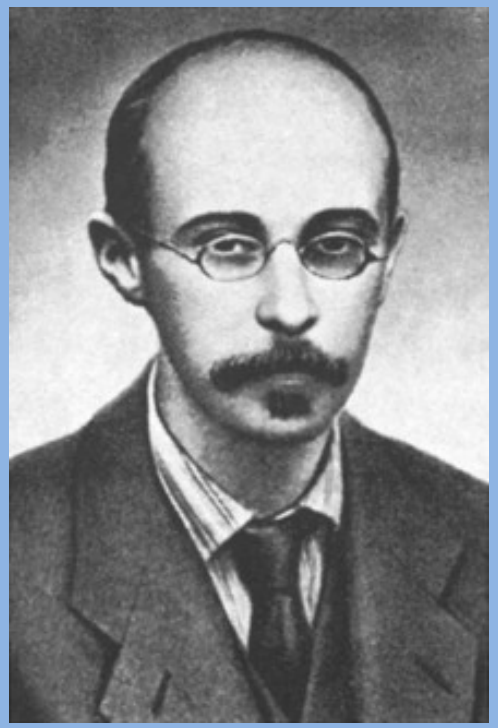
Hubble telescope

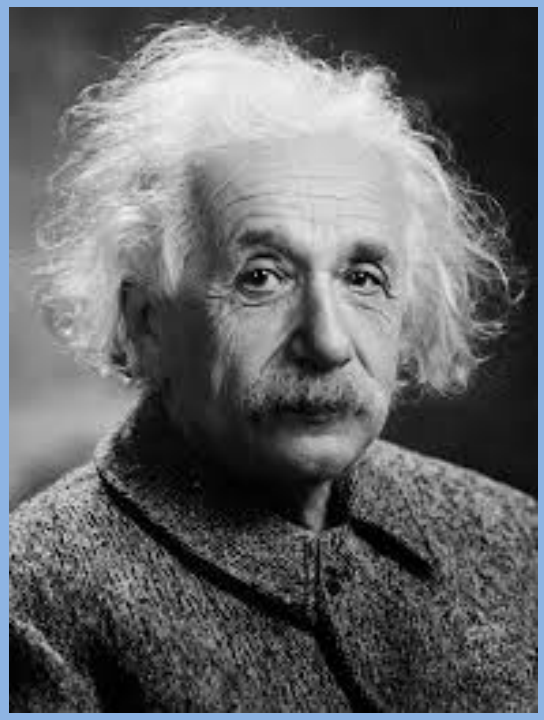


expanding universe and big bang theory



Big bang theory- Alexander Friedmann





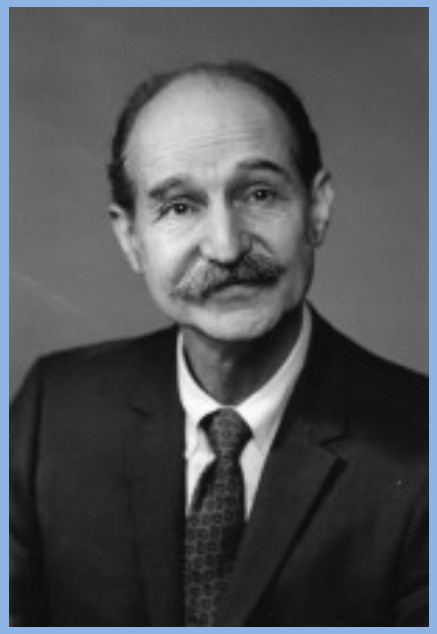
In 1922, Alexander Friedmann (1) and in 1927 Georges Lemaître (2) used the Einstein (3) field equations to provide theoretical evidence that the universe

Big bang theory- Alexander Friedmann

Astronomer Walter Baade recalculated the size of the known universe in the 1940s, doubling the previous calculation made by Hubble in 1929.

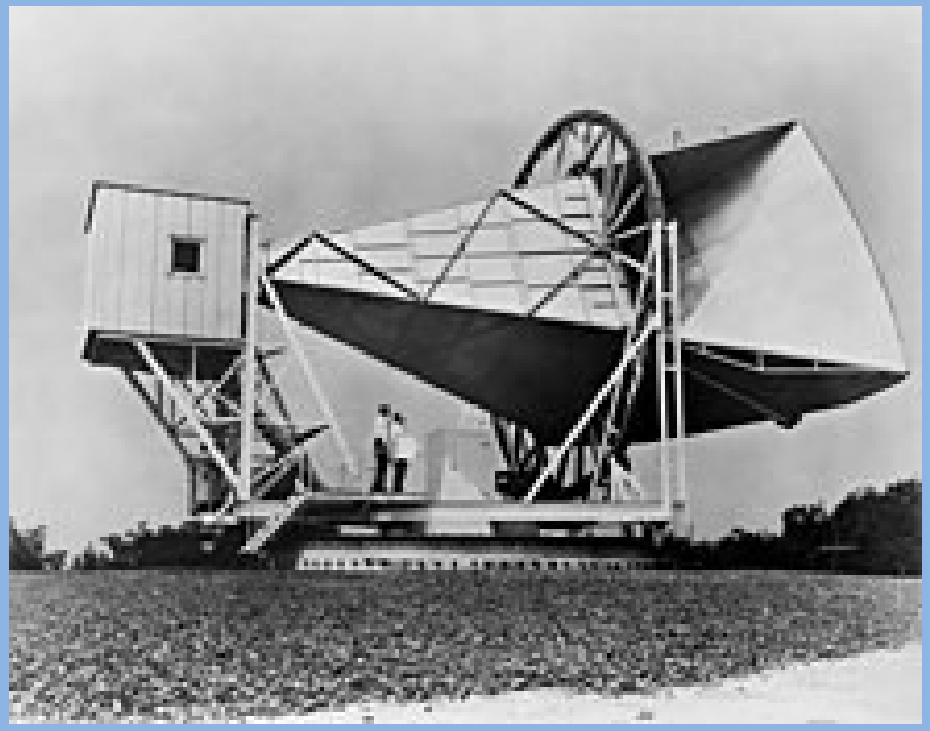
Cosmic microwave background (CMB)





The cosmic microwave background was first predicted in 1948 by George Gamow, Ralph Alpher and Robert Herman. They estimate the temperature of the cosmic microwave background to be 5 K. doubling the previous calculation made by Hubble in 1929.

Cosmic microwave background

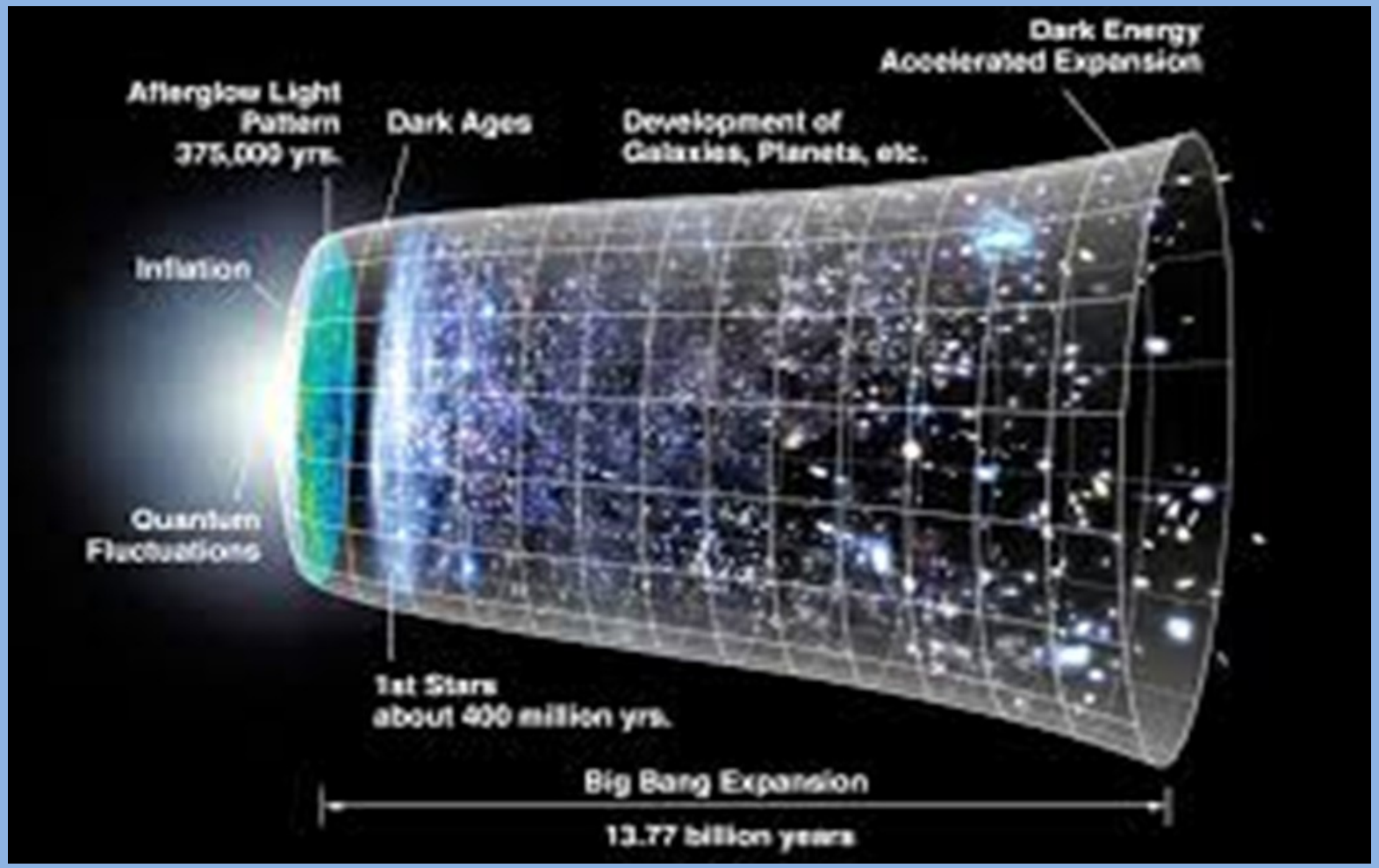


The Holmdel Horn Antenna on which Penzias and Wilson discovered the cosmic microwave background.

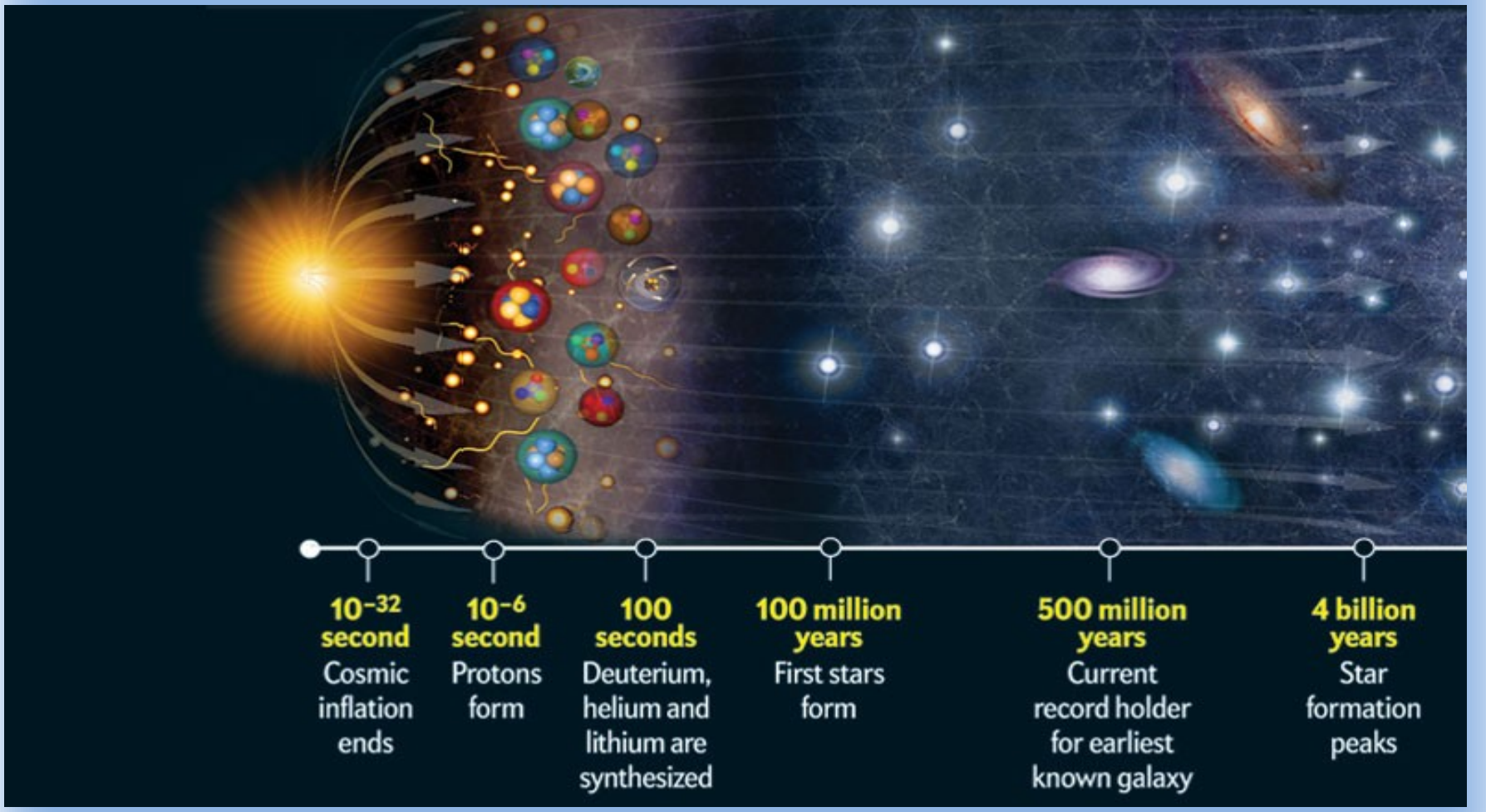
Cosmic microwave background

1964, US physicist Arno Allan Penzias and radio-astronomer Robert Woodrow Wilson discovered the cosmic microwave background (CMB), estimating its temperature as 3.5 K. In 1978, Penzias and Wilson were awarded the Nobel Prize

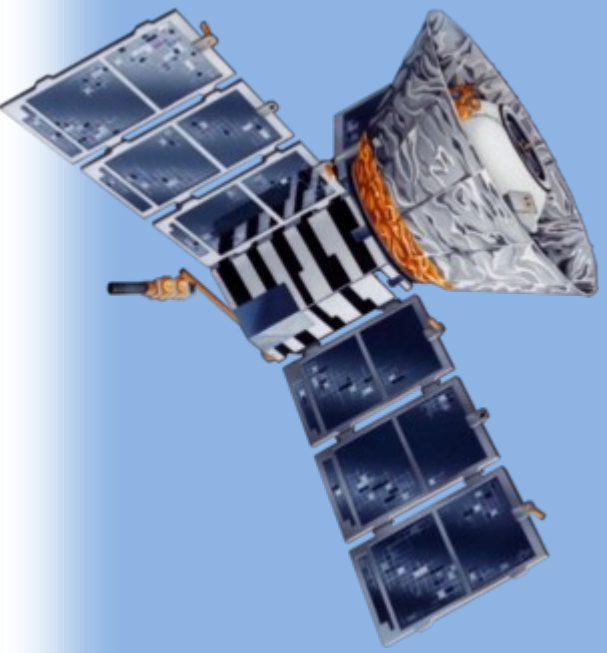
universe


Dark Energy
Accelerated Expansion
Afterglow Light
Pattern
375,000 yrs.
Dark Ages
Development of
Galaxies, Planets, etc.
Inflation
Quantum
Fluctuations
1st Stars
about 400 million yrs.
Big Bang Expansion
13.77 billion years

universe

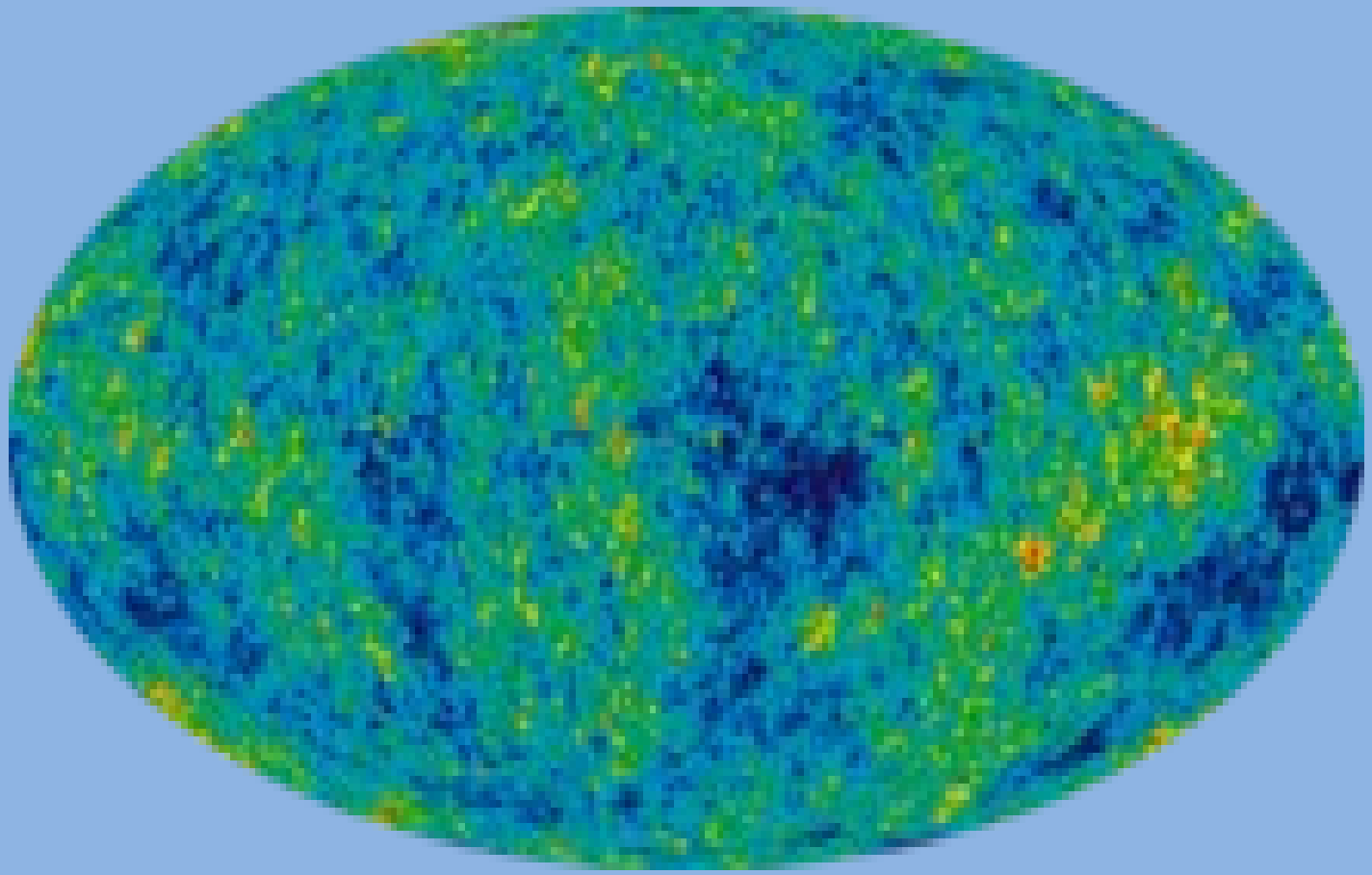

10⁻³² second
Cosmic inflation ends
10⁻⁶ second
Protons form
100 seconds
Deuterium, helium and lithium are synthesized
100 million years
First stars form
500 million years
Current record holder for earliest known galaxy
4 billion years
Star formation peaks

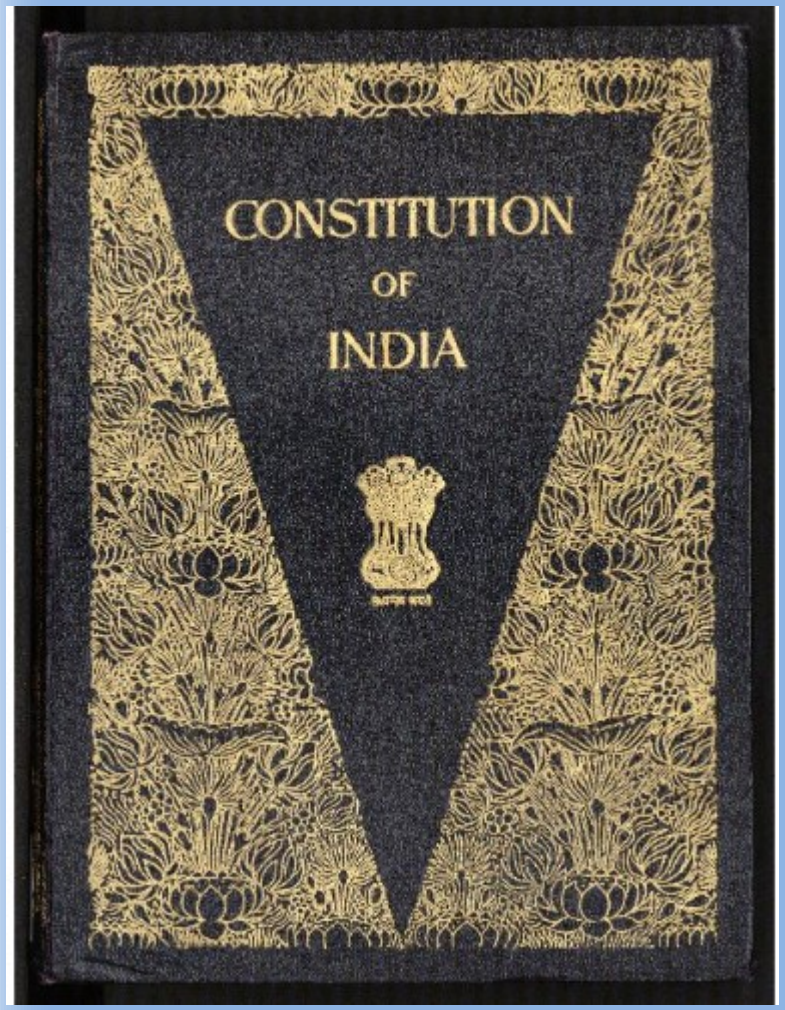
universe-cosmic microwave background explorer (COBE)



The **COBE** (**Explorer 66**) was a NASA satellite dedicated to cosmology, operated from 1989 to 1993. to investigate the cosmic microwave background radiation (CMB or CMBR) of the universe and provide measurements that would help shape the understanding of the cosmos.

universe-cosmic microwave background explorer (COBE)





Article 51AH which states that it is the duty of every citizen to develop scientific temper and the spirit of enquiry and humanism.

FUNDAMENTAL DUTY OF AN INDIAN CITICEN