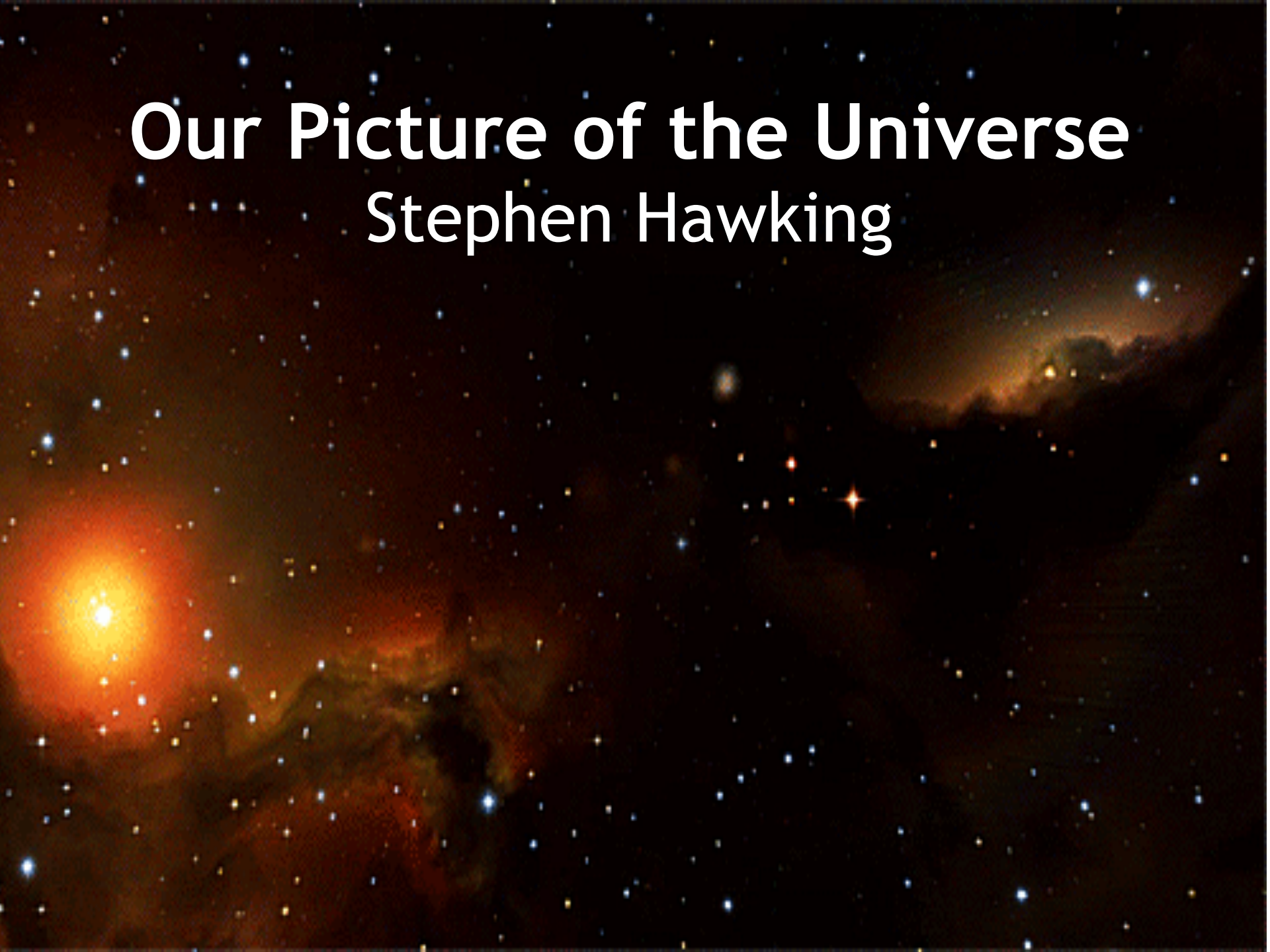
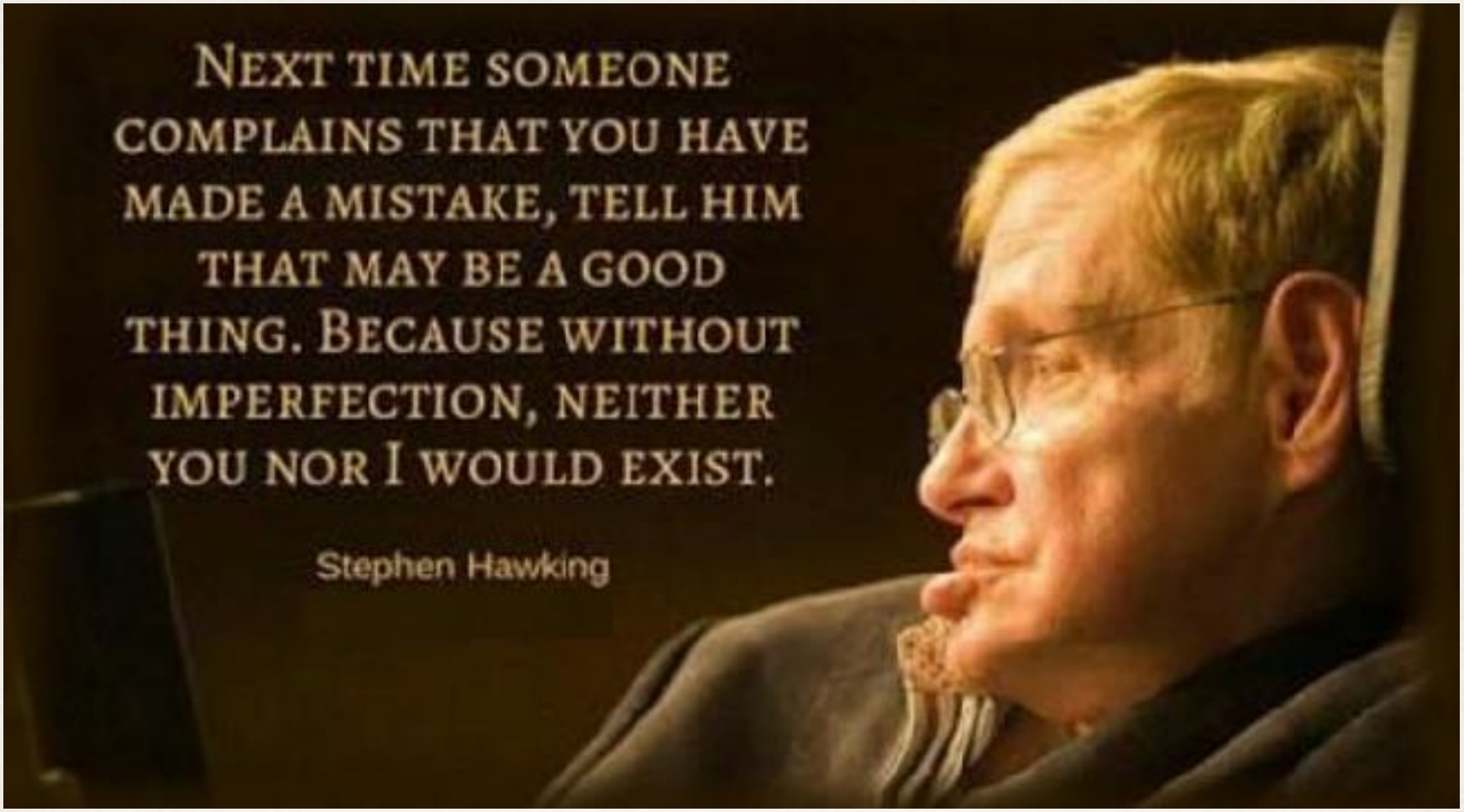

Our Picture of the Universe
Stephen Hawking

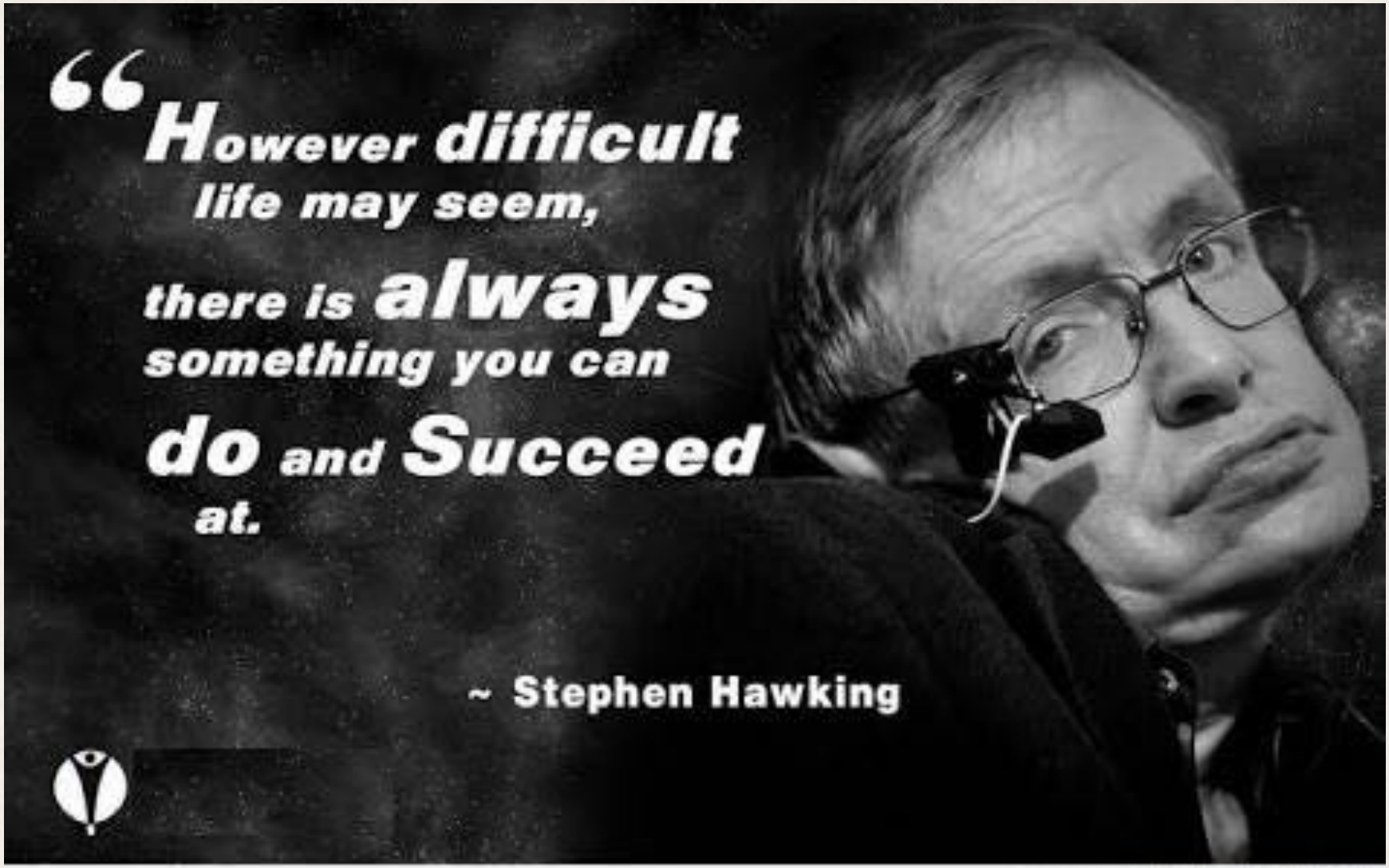

Professor
Stephen Hawking
1942-2018

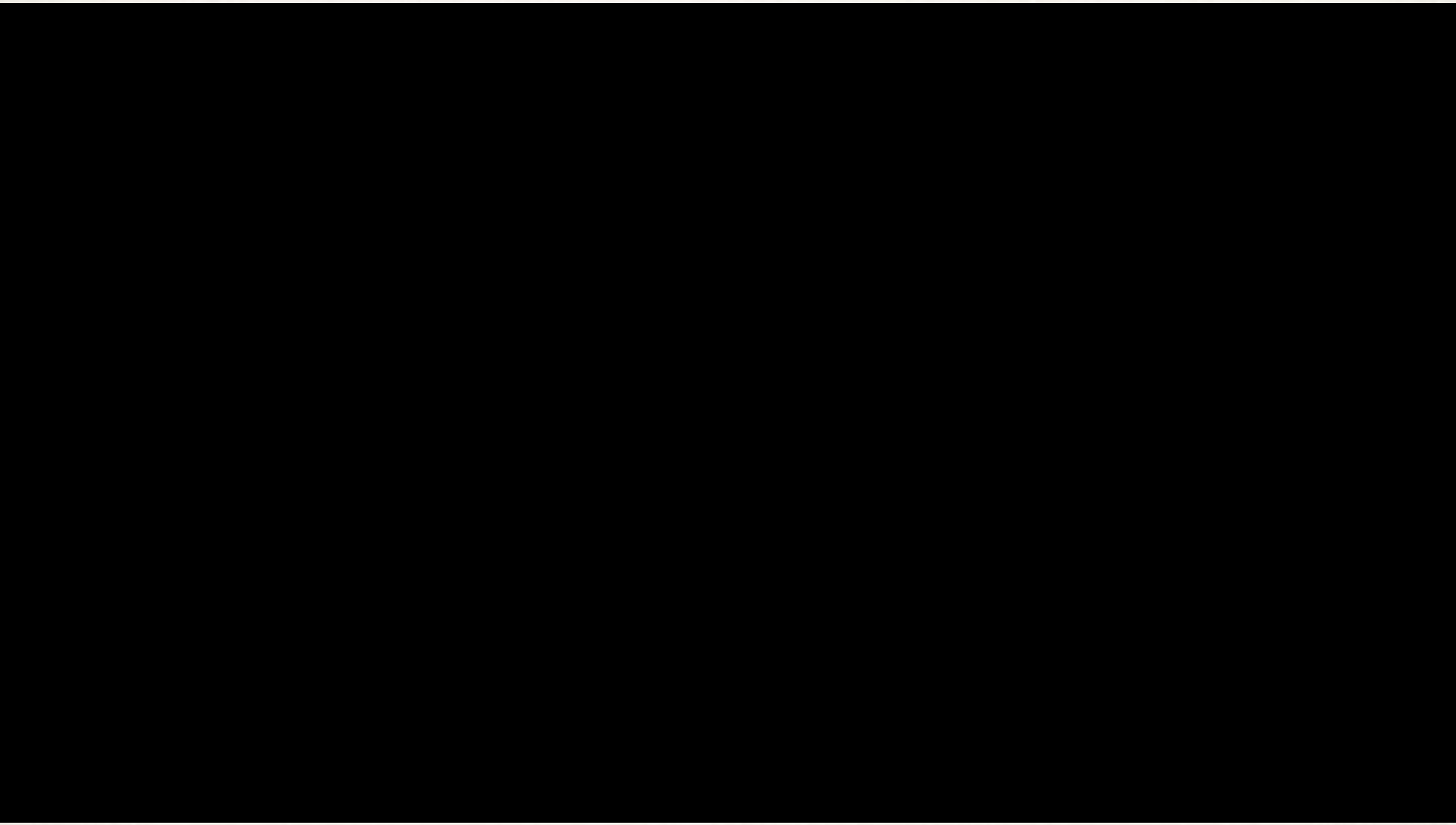

NEXT TIME SOMEONE COMPLAINS THAT YOU HAVE MADE A MISTAKE, TELL HIM THAT MAY BE A GOOD THING. BECAUSE WITHOUT IMPERFECTION, NEITHER YOU NOR I WOULD EXIST.
Stephen Hawking


INTELLIGENCE
IS THE ABILITY
TO ADAPT
TO CHANGE

He married Jane Wilde, a language student in 1965. He said this was a real turning point for him at a time when he was fatalistic because of his illness. They later divorced but had three children


"REMEMBER
TO LOOK UP
AT
THE STARS
AND NOT DOWN
AT
YOUR FEET."
teachstarter


"However difficult life may seem, there is always something you can do and Succeed at.
~ Stephen Hawking
www.MyLovelyQuotes.com



Stephen Hawking's pearls of wisdom

- On the reason why the universe exists: 'If we find the answer to that, it would be the ultimate triumph of human reason - for then we would know the mind of God' - A Brief History Of Time, published 1988.

- On being diagnosed with motor neurone disease: 'My expectations were reduced to zero when I was 21. Everything since then has been a bonus' - Interview in The New York Times, December 2004.

-

Stephen Hawking's pearls of wisdom

- On black holes: 'Einstein was wrong when he said, 'God does not play dice'. Consideration of black holes suggests, not only that God does play dice, but that he sometimes confuses us by throwing them where they can't be seen' - The Nature Of Space And Time, published 1996.

On God: 'It is not necessary to invoke God to light the blue touch paper and set the universe going' - The Grand Design, published 2010.

-

Stephen Hawking's pearls of wisdom

- On commercial success: 'I want my books sold on airport bookstalls' - Interview in The New York Times, December 2004.

- On fame: 'The downside of my celebrity is that I cannot go anywhere in the world without being recognised. It is not enough for me to wear dark sunglasses and a wig. The wheelchair gives me away' - Interview on Israeli TV, December 2006.

- On an imperfect world: 'Without imperfection, you or I would not exist' - In Into The Universe With Stephen Hawking, The Discovery Channel, 2010.

Stephen Hawking's pearls of wisdom

- On the importance of having a sense of humour: 'Life would be tragic if it weren't funny' - Interview in The New York Times, December 2004.

- On death: 'I have lived with the prospect of an early death for the last 49 years. I'm not afraid of death, but I'm in no hurry to die. I have so much I want to do first' - Interview in The Guardian, May 2011.'

Stephen Hawking

- 1942-2018
- Theoretical physicist and cosmologist
- Suffers from Motor neuron disease and completely paralysed
- Expert in Cosmology, black hole Mechanics , Quantum Gravity have ensured him a place among the leading scientists.


Seeking Answers for the perennial(perpetual or eternal) questions

- Explains the complex cosmic problems in the language of the common man

- This essay taken from the first chapter of his widely acclaimed book **"A Brief History of Time" (1988)**

- Seeks to analyse **man's eternal quest to understand the universe**

-

- The question discussed in this essay is **"whether it is possible to find a unified theory for the origin of the universe?"**

- Though science aims at providing a unified theory as an answer, it is often difficult to formulate one.

-

- Scientists break up the problem and **invent partial theories,** but **man's thirst for knowledge continues to inspire him in his search** for a complete comprehension of underlying order in the world.

Summary of the Essay

1. The question on the origin of universe
2. Big Bang theory and Expanding Universe
3. What is a Scientific theory?
4. Any physical theory is provisional because at any time some one may prove it otherwise
5. New theories are extensions of previous theories
6. Eventual goal of science is to provide a single theory that can describe the whole universe
7. Partial theory approach is completely wrong
8. Two basic partial theories -a) the general theory of relativity b)Quantum Mechanics
9. The paradox in searching for a unified theory
10. "The principle of natural selection"- will be applicable to scientific theories too
11. Let us continue our quest for a complete description of the universe

1. The question on the origin of the universe

- When **most people believed in as essentially static and unchanging universe**, the question of Whether or not the universe had a beginning or not was really one of metaphysics or theology

- Metaphysics - philosophy dealing with the nature of existence, truth and knowledge

- Theology- study of religion

1. The question on the origin of the universe

- Two theories for origin of the universe

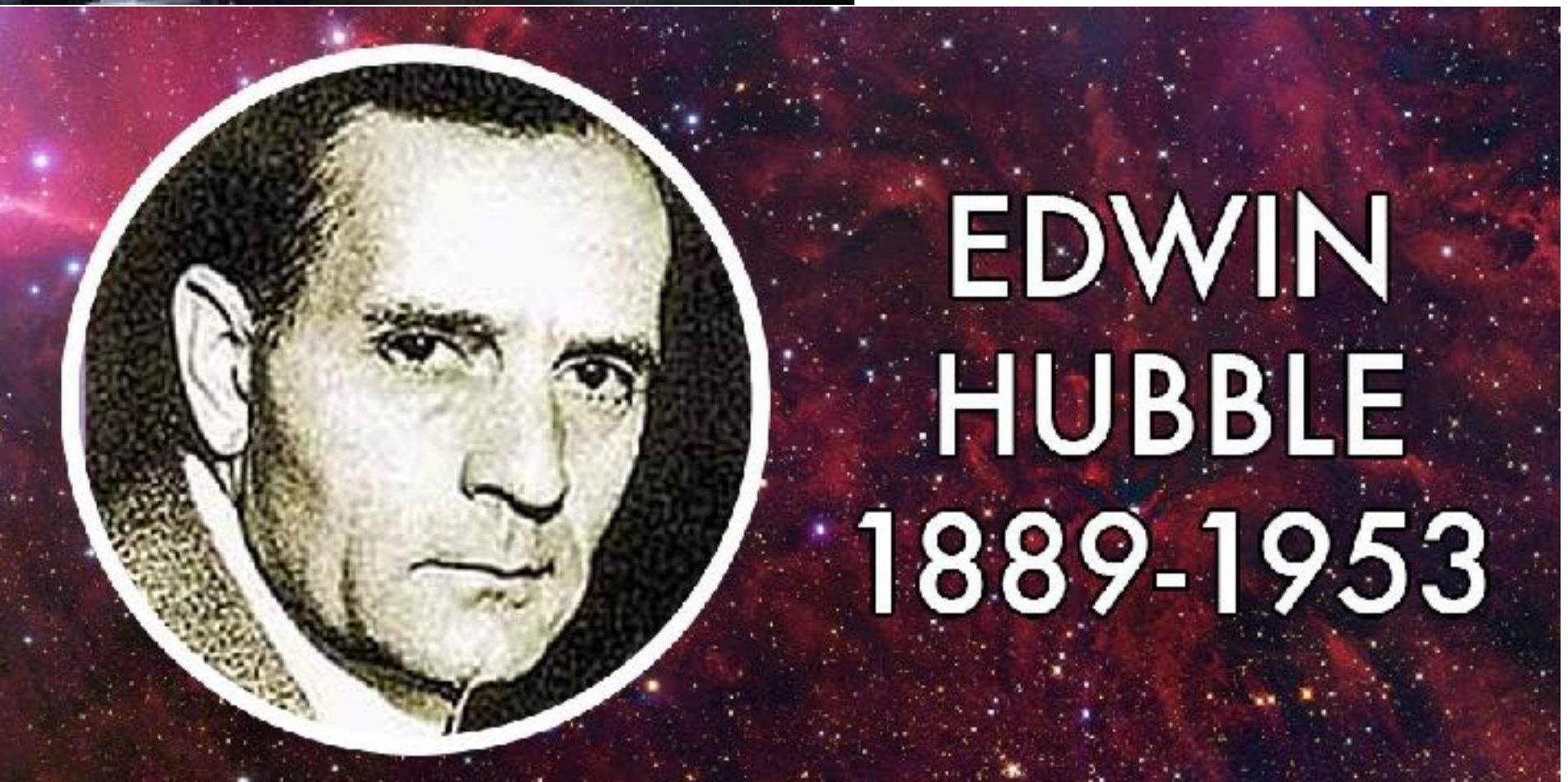
  a) It had existed forever

  b) It was set in motion at some finite time

-

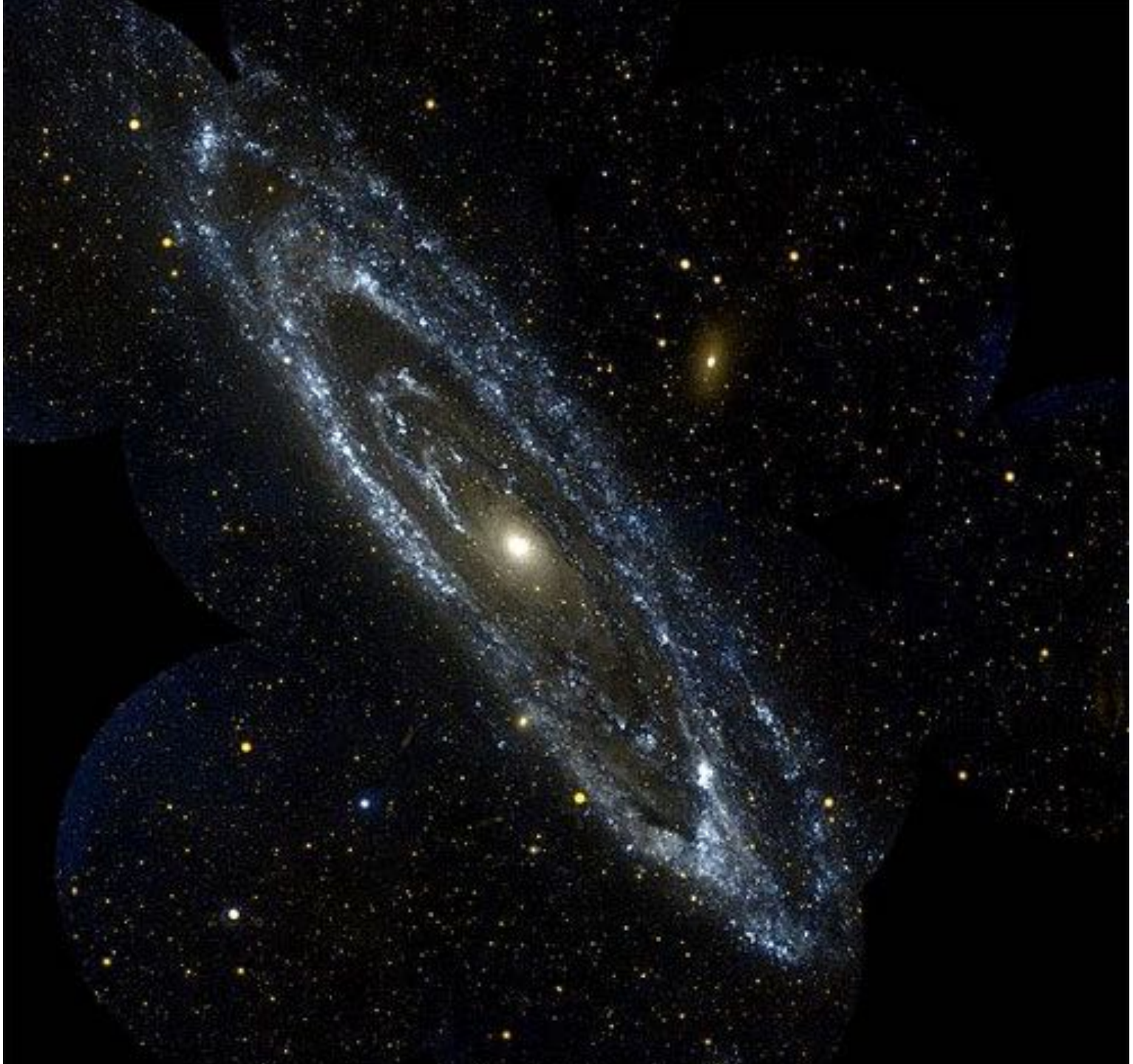
1. The question on the origin of the universe

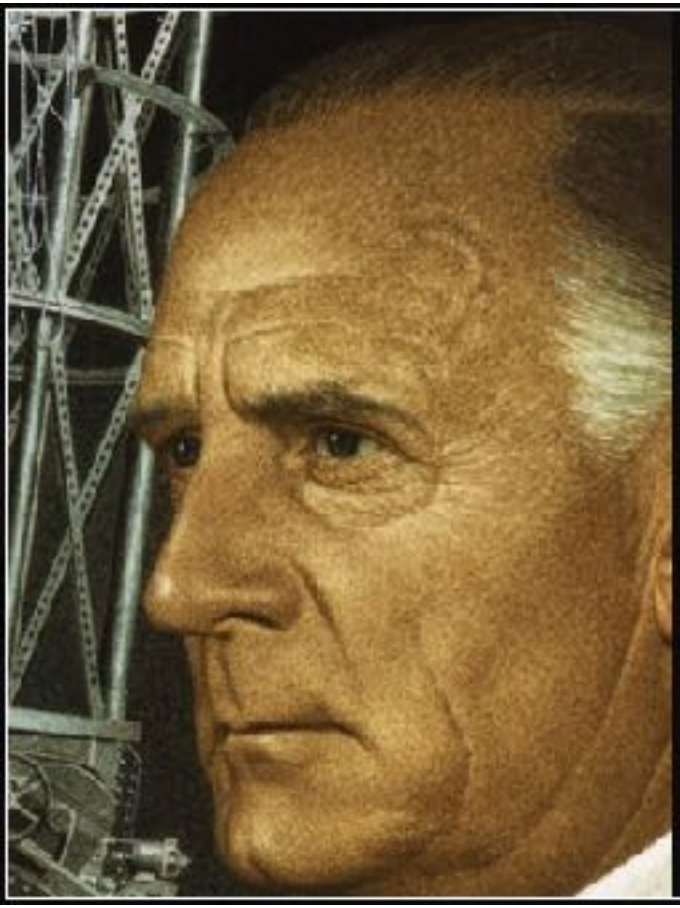
- But, in 1929, **Edwin Hubble** made a land mark observation- "universe is expanding"-galaxies are rapidly moving away from us
-


EDWIN
HUBBLE
1889-1953

Edwin Hubble
(1889-1953)

- Measured distances to nearby galaxies using Cepheid variables
- Galaxies are islands of stars
- Developed a classification scheme for galaxies.
- Discovered the Expansion of the Universe
- Space telescope named after him!





Equipped with his five senses, man explores the universe around him and calls the adventure Science.

— Edwin Powell Hubble —

AZ QUOTES

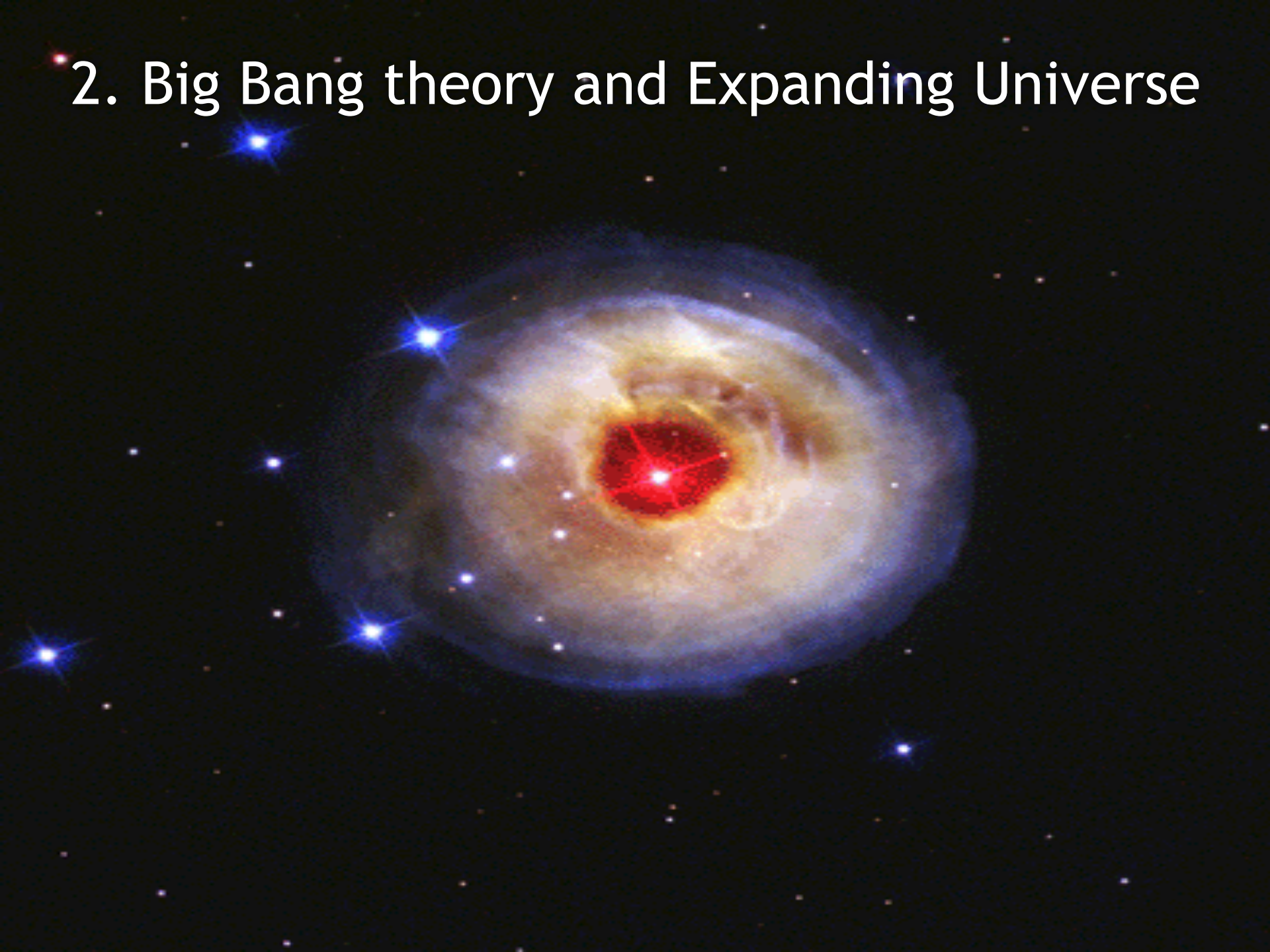
1. The question on the origin of the universe

- If then, there was a time when **objects were closer together**

- Then, there was a time, when they were all exactly the same place and when, therefore, the density of the universe was infinite

- This theory brought the question of the beginning of universe into the realm of science

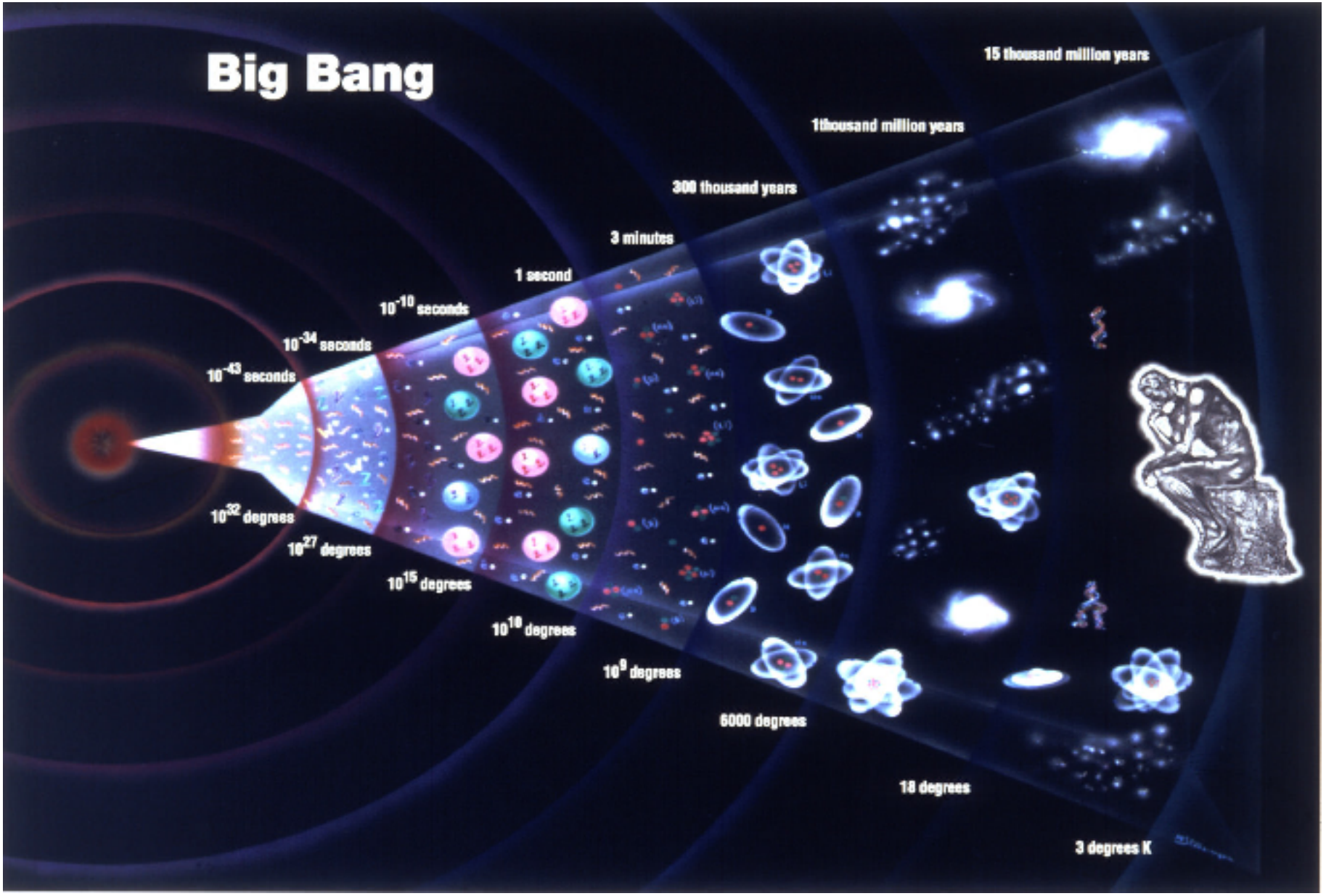
2. Big Bang theory and Expanding Universe

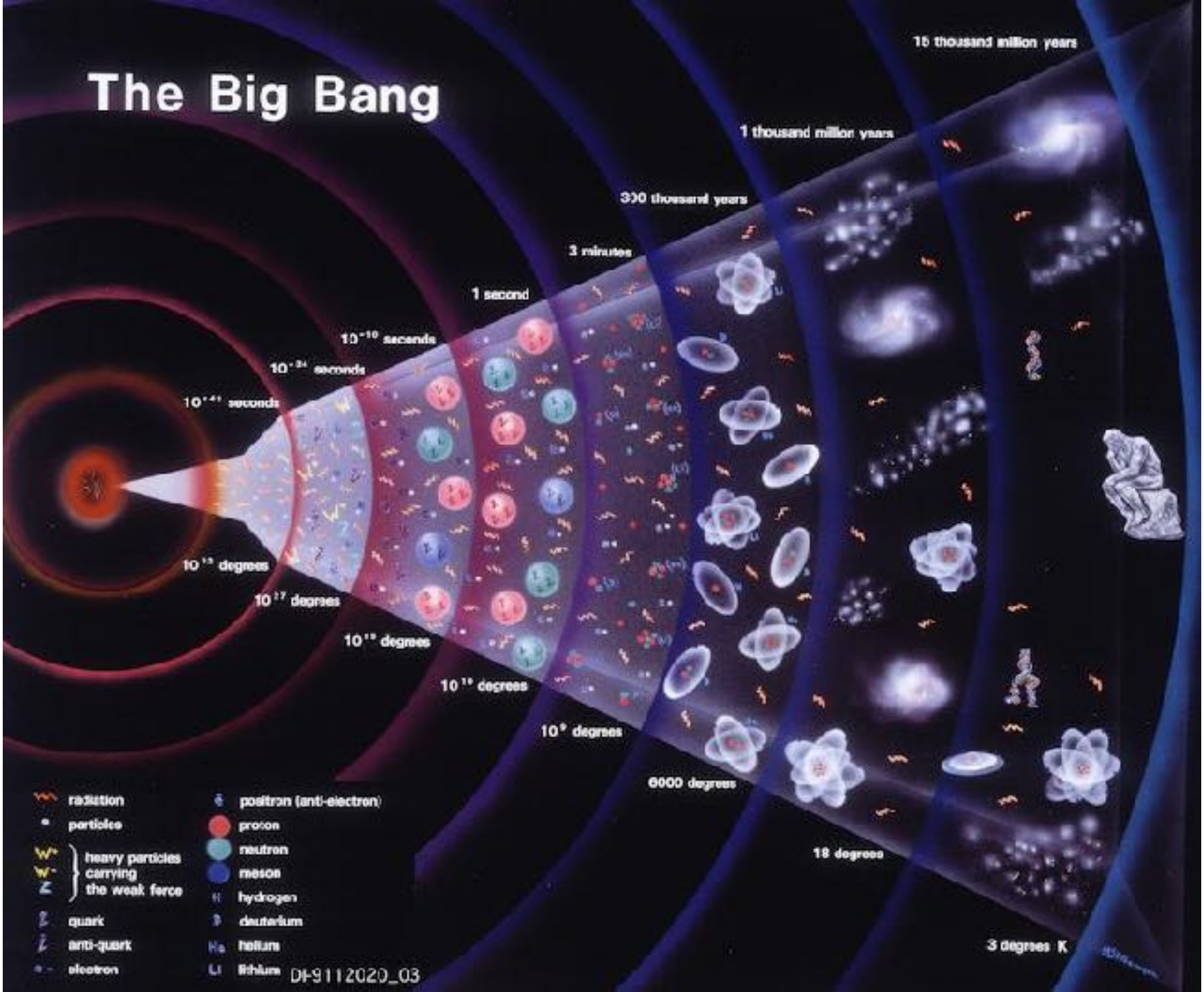


Distant Galaxies are moving rapidly away from us

The Big Bang Theory

The most popular theory of our universe's origin centers on a cosmic cataclysm unmatched in all of history—the **big bang**. This theory was born of the observation that other galaxies are moving away from our own at great speed, in all directions, as if they had all been propelled by an ancient explosive force.


Big Bang
15 thousand million years
1thousand million years
300 thousand years
3 minutes
1 second
10^{-10} seconds
10^{-34} seconds
10^{-43} seconds
10^{32} degrees
10^{27} degrees
10^{15} degrees
10^{10} degrees
10^{9} degrees
6000 degrees
18 degrees
3 degrees K


The Big Bang
15 thousand million years
1 thousand million years
300 thousand years
3 minutes
1 second
10⁻¹⁰ seconds
10⁻³⁴ seconds
10⁻⁴³ seconds
10¹⁵ degrees
10²⁷ degrees
10¹³ degrees
10¹⁰ degrees
10⁹ degrees
6000 degrees
18 degrees
3 degrees K
radiation
particles
heavy particles carrying the weak force
quark
anti-quark
electron
positron (anti-electron)
proton
neutron
meson
hydrogen
deuterium
helium
lithium
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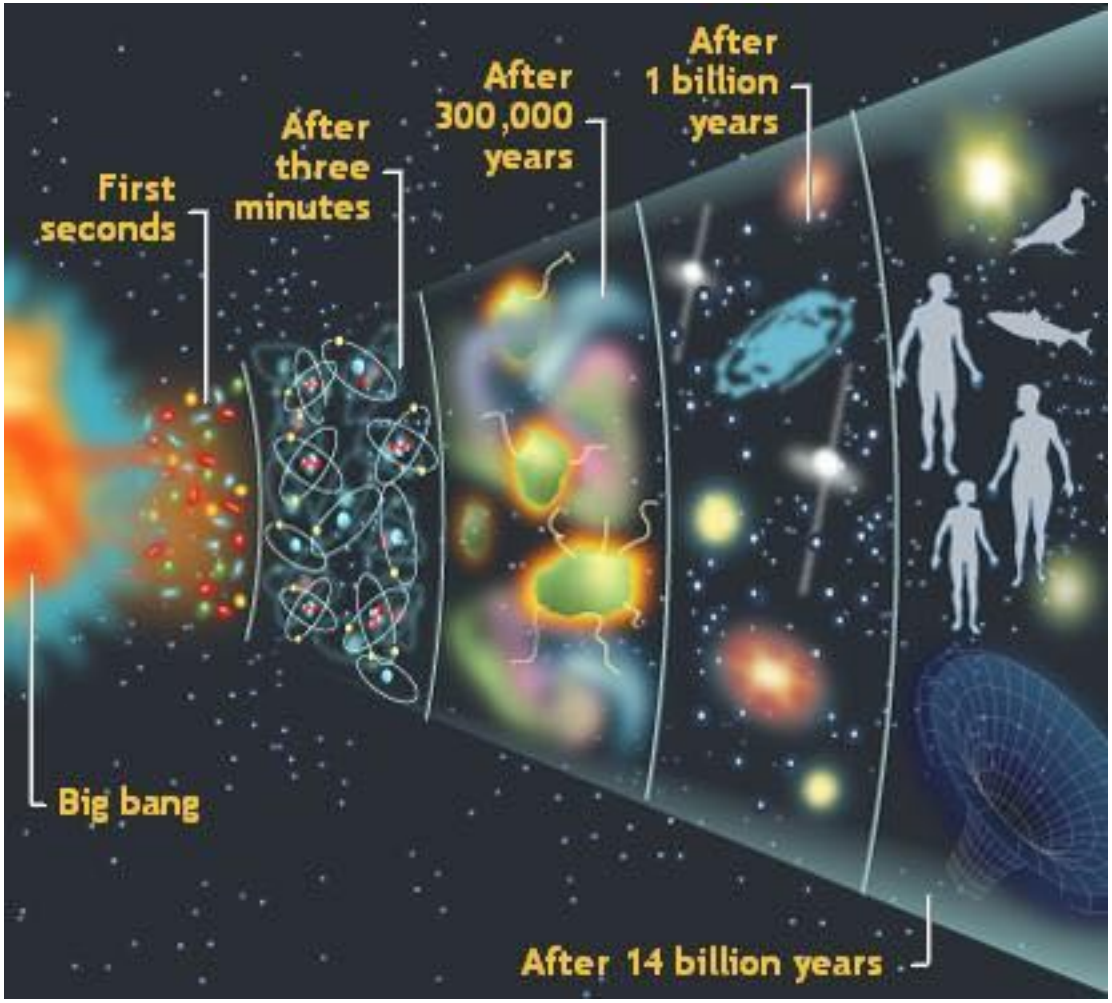
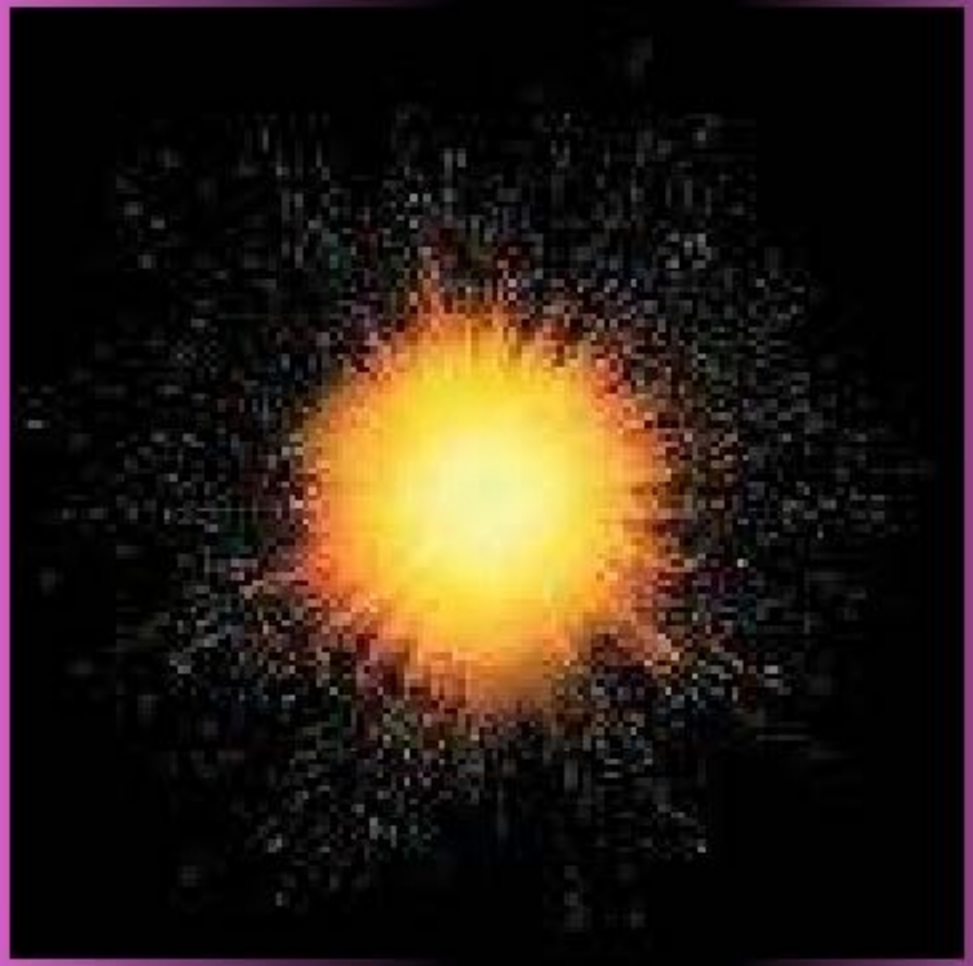

Big bang
First seconds
After three minutes
After 300,000 years
After 1 billion years
After 14 billion years


Origin of the Universe

The Big Bang Theory



The Big Bang theory is the most accepted scientific theory out of the three..

Many Scientists have solid proof that The Big Bang theory could be real, but there are also things that can prove that it was not how the universe was created. So what should we really believe?

Big Bang Theory

- Hubble's observations suggested that there was a time, called the Big Bang, when the
- Universe was infinitesimally (externally small) small and infinitely(without limit) dense

- No laws of science are applicable - Under such conditions all the laws of science, and therefore all ability to predict the future, would break down.
-

Big Bang Theory

- If there were events earlier than this time, then they could not affect what happened at the present time.
- Their existence can be ignored because it would have no observational consequences.

- One may say that Even **Time** had a beginning at the Big Bang, in the sense that earlier times simply would not be defined.
- It should be emphasised that this beginning in time is different from those that had been considered previously.
-

Big Bang Theory

- In an unchanging universe a beginning in time is something that has to be imposed by some being outside the inverse; there is no physical necessity for a beginning.
- One can imagine that God created the universe at literally any time in the past.
- It will be like- God created the universe at a particular time in the past and then everything had its beginning.

Does Big Bang Theory negate God?

- **If universe is expanding**, there should necessarily be a physical reason why there has to be a beginning

- The theory of Expanding universe **does not negate God**, because one can still imagine that Big Bang was the moment of creation

Does Big Bang Theory negate God?

- Creation cannot happen before big bang
- If then, big bang theory place limits on the creator on when he might have carried out his job of creation.

- ie, we can by scientific calculation reach at the moment of creation

3. What is a Scientific theory?

- To talk about the nature of the universe we have to be clear about what a scientific theory is

- **A theory is a set of rules resulted by the observations we made on the universe**

- A theory is a good theory if it satisfy two requirements:

a) It must accurately describe a large class of observation on the basis of a model. This model should have only few arbitrary elements

b) It must make definite predictions about the results of future observations

-

3. What is a Scientific theory?

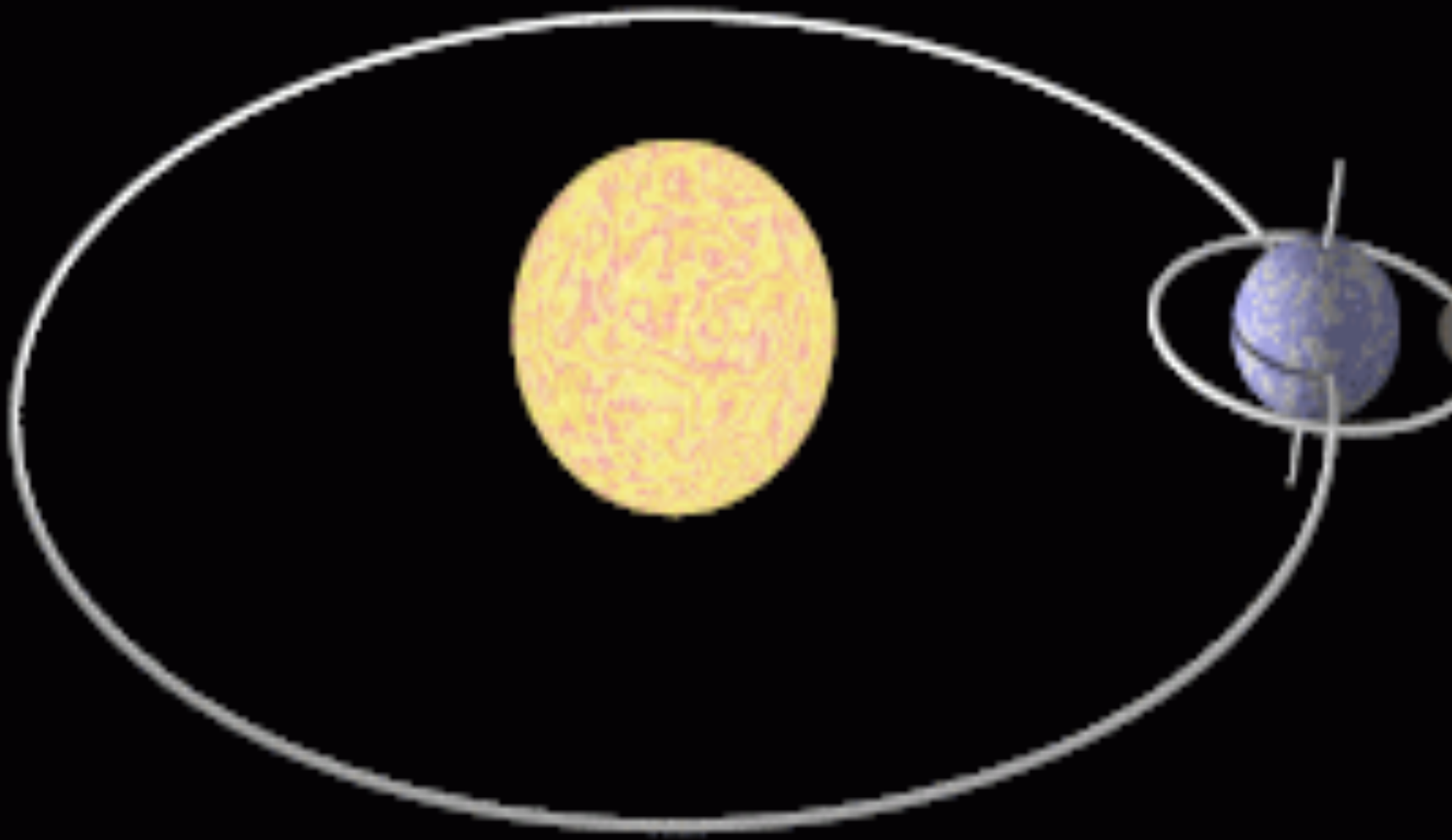
- Eg. **Aristotle's theory of four elements-** not useful to make any future predictions

- The ancient Greeks believed that there were **four elements** that everything was made up of: earth, water, air, and fire. This **theory** was suggested around 450 BC, and it was later supported and added to by **Aristotle**.

3. What is a Scientific theory?

- Eg. **Aristotle's theory of four elements-** not useful to make any future predictions

- But, Newton's theory of Gravity can do that- it can foretell about the motions of sun, the moon, and the planets accurately



4. Any physical theory is provisional- at any time some one may prove it wrong

- Any physical theory can be considered only as a **hypothesis-** it may change later
- We cannot be sure about whether the result may contradict the existing theory
- Even with a single observation contradicting the theory you can disapprove a theory
-

4. Any physical theory is provisional- at any time some one may prove it wrong

- "a good theory is a theory that always leaves a chance to be disproved or falsified by further observations"

-Karl Popper

- If a new observation disagrees with the theory abandon it- but you can still question the competence of the person who carried out the observation

5. New theories are extensions of previous theories

- Eg. Einstein's general theory of relativity was an extension of Newton's theory of gravity

  - Einstein found a slight difference between the motion of the planet Mercury and the prediction of Newton's theory of gravity

-

5. New theories are extensions of previous theories

- Thus, it was proved that Newton's theory of gravity cannot be used for future predictions in all cases.
  - there can be exemptions
- Even then we use Newton's theory of gravity for practical purposes

6. Eventual goal of science is to provide a single theory that can describe the whole universe

- Most scientists separate the problem into two parts:

  a) Laws that tell us about the evolution of the universe

  b) Laws that tell us about the initial state of the universe

-

6. Eventual goal of science is to provide a single theory that can describe the whole universe

- Some people believe that science should deal only with the first part, second part is a topic for metaphysics and religion
- They say that God who is omnipotent created the universe off any way He wanted- therefore no need to discuss about the laws that govern the initial state of the universe
- But, God wouldn't simply allow the universe to develop in an arbitrary way, definitely He might set some laws in the evolution of the universe
- If then, it is reasonable to suppose that there are also laws that govern the initial state

7. Partial theory approach is completely wrong

- It is difficult to find out a theory with which we can explain the whole universe
- Therefore, there is a tendency to break the problem into bits and invent a number of partial theories
-

7. Partial theory approach is completely wrong

- But, this approach is wrong
- If everything in the universe depends of everything else, how can we find a full solution to the mysteries of the universe by investigating parts of it in isolation?

8. Two basic partial theories

- Today scientists describe the universe in terms of two partial theories

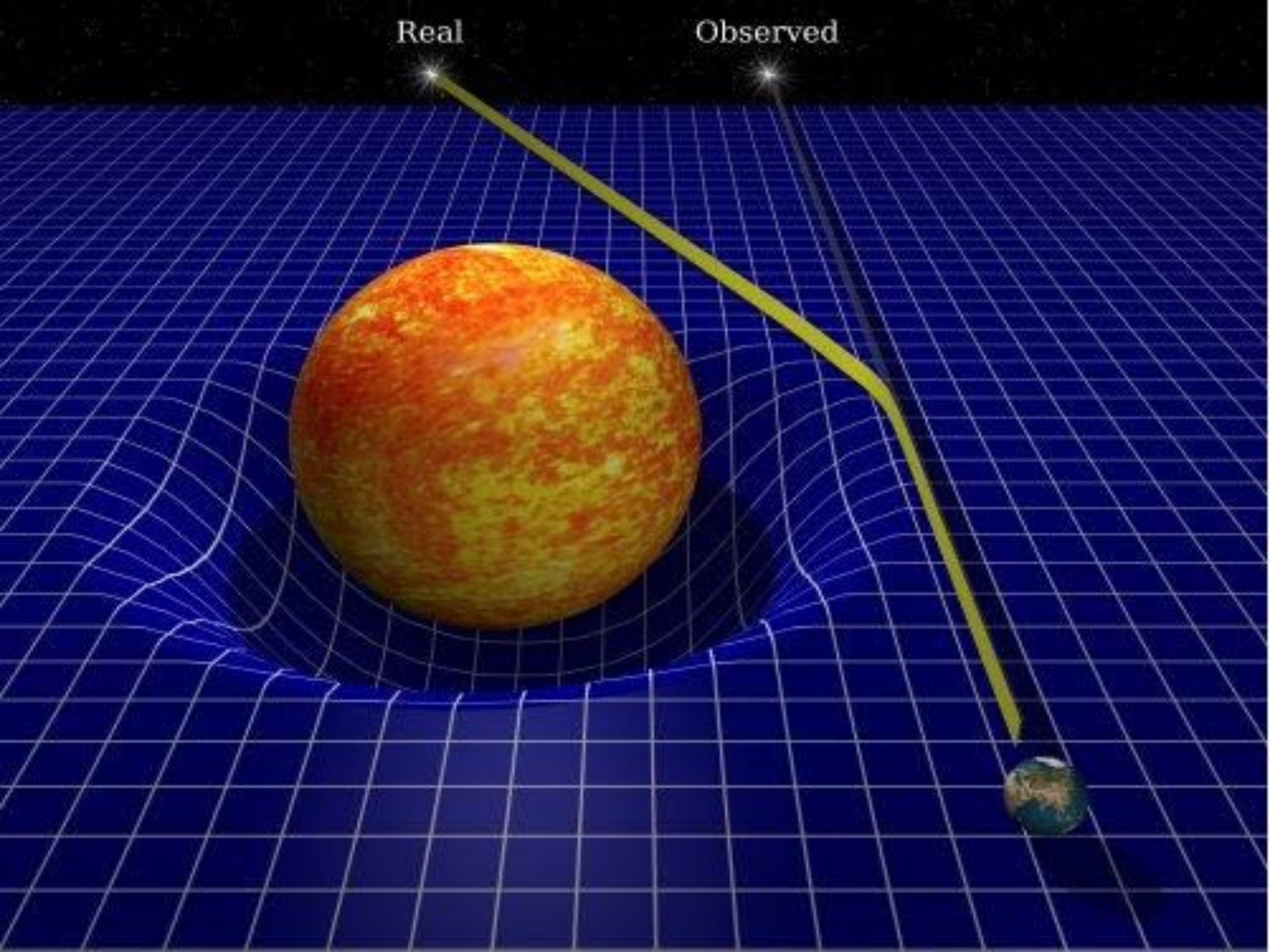
- A) General theory of Relativity- Describes the force of gravity and the large scale structure of the universe

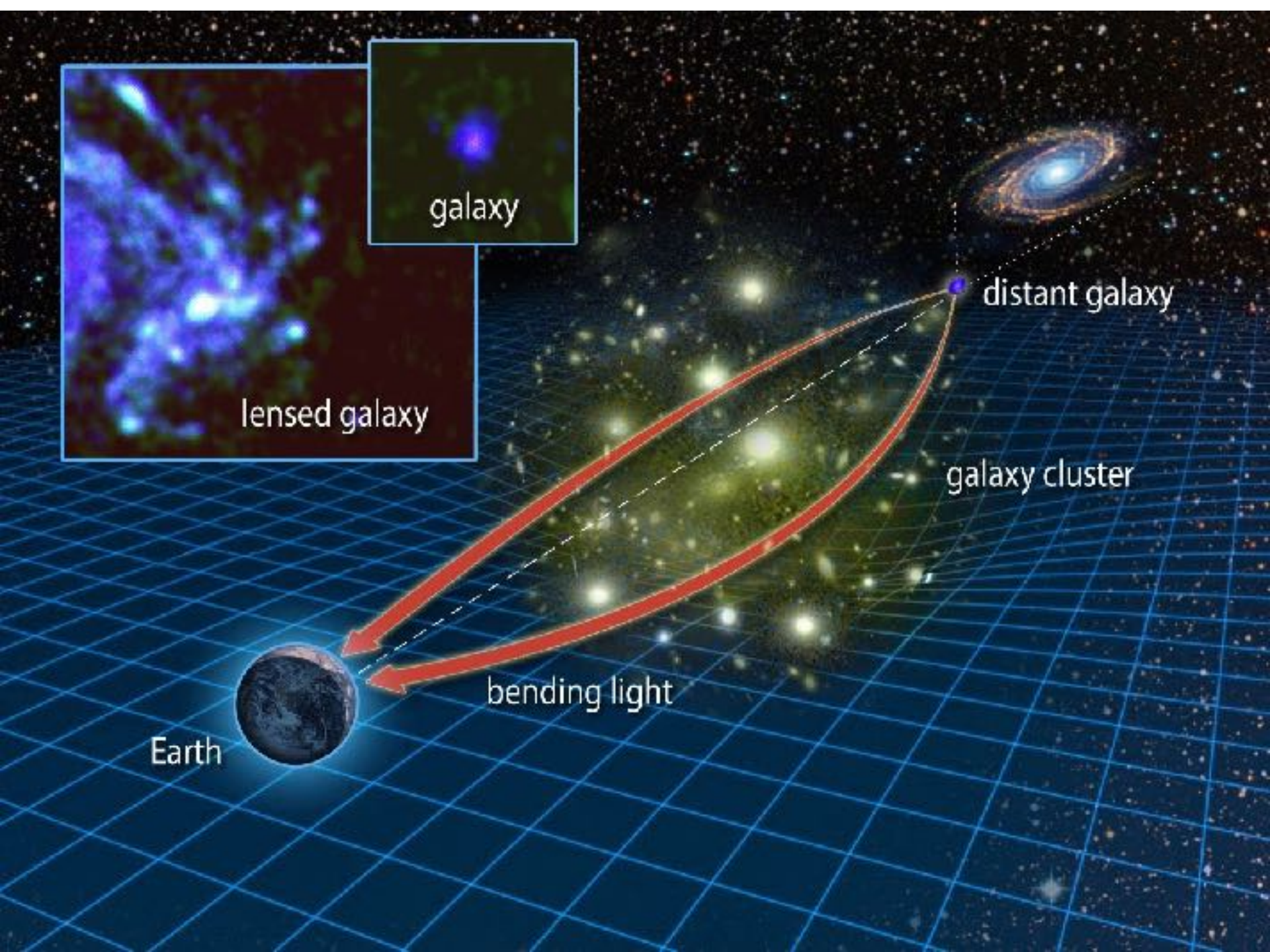
Special &General Theories of Relativity

- In 1905, Albert Einstein determined that the laws of physics are the same for all non-accelerating observers, and that the speed of light in a vacuum was independent of the motion of all observers. This was the theory of special relativity.
-

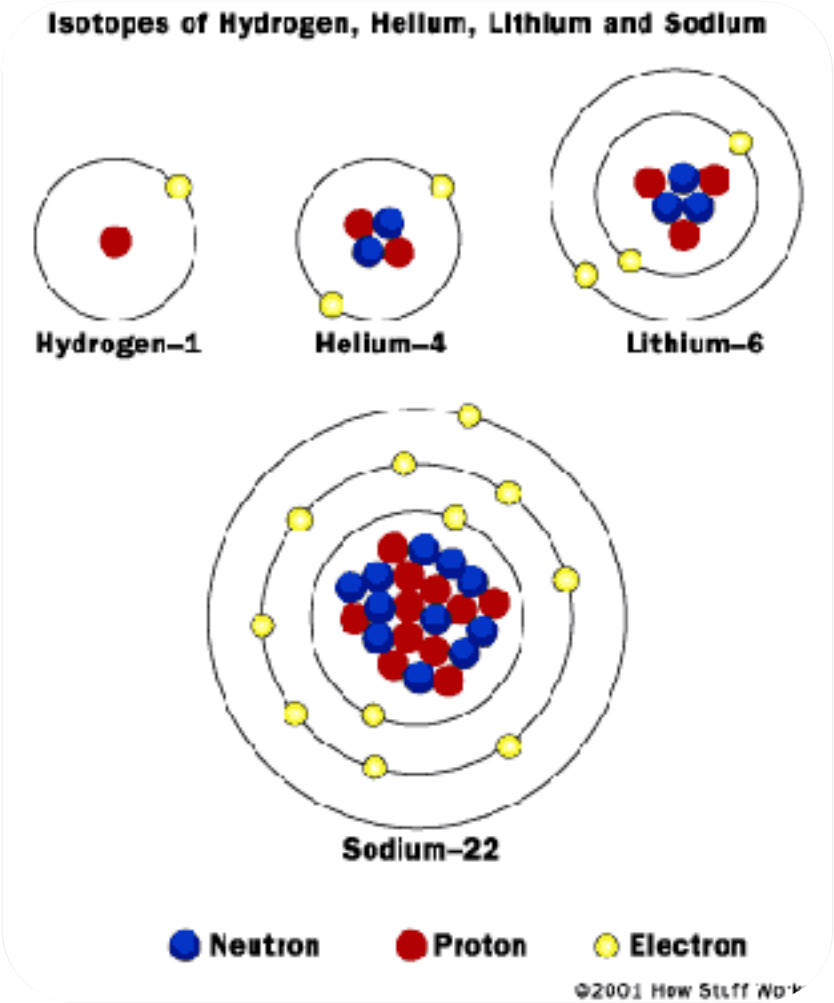
Special &General Theories of Relativity

- Einstein then spent 10 years trying to include acceleration in the theory and published his theory of general relativity in 1915. In it, he determined that massive objects cause a distortion in space-time, which is felt as gravity.

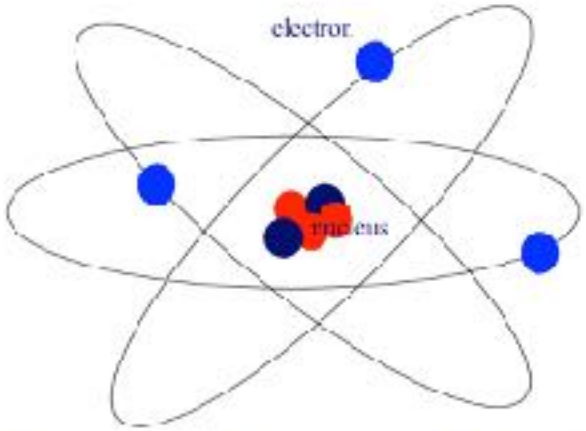

Real
Observed


galaxy
lensed galaxy
distant galaxy
galaxy cluster
bending light
Earth

- B) Quantum mechanics- Deals with universe in its extremely small scales.



- Unfortunately, these two theories are known to be inconsistent with each other
- If then, they cannot both be correct
- Therefore, we should find out a new theory incorporating both the theories, such as a “Quantum theory of Gravity”.
- We still have a long way to go to find out such a theory



Atomic Planetary Model

9. The paradox in searching for a unified theory

- If we believe that the universe is not arbitrary, but governed by definite laws, then we ultimately will have to combine the partial theories and form a unified theory.
-

9. The paradox in searching for a unified theory

- But, there is a fundamental paradox in searching for such a complete unified theory
- Scientific theory assume that we as rational beings are free to observe the universe and make logical conclusions based on our observations.

- If then, we might at any time find out new theories modifying the old theories in our search to find out answers to the mysteries of universe
-

- Suppose, there is a completely unified theory, then, **it would influence our actions too.**
- If then, it would also **influence our search**
- If then, **it would determine the outcome of our search**

10. “The principle of natural selection”- will be applicable to scientific theories too

- The only answer to this problem can be given in the light of ‘Darwin’s principle of natural selection’

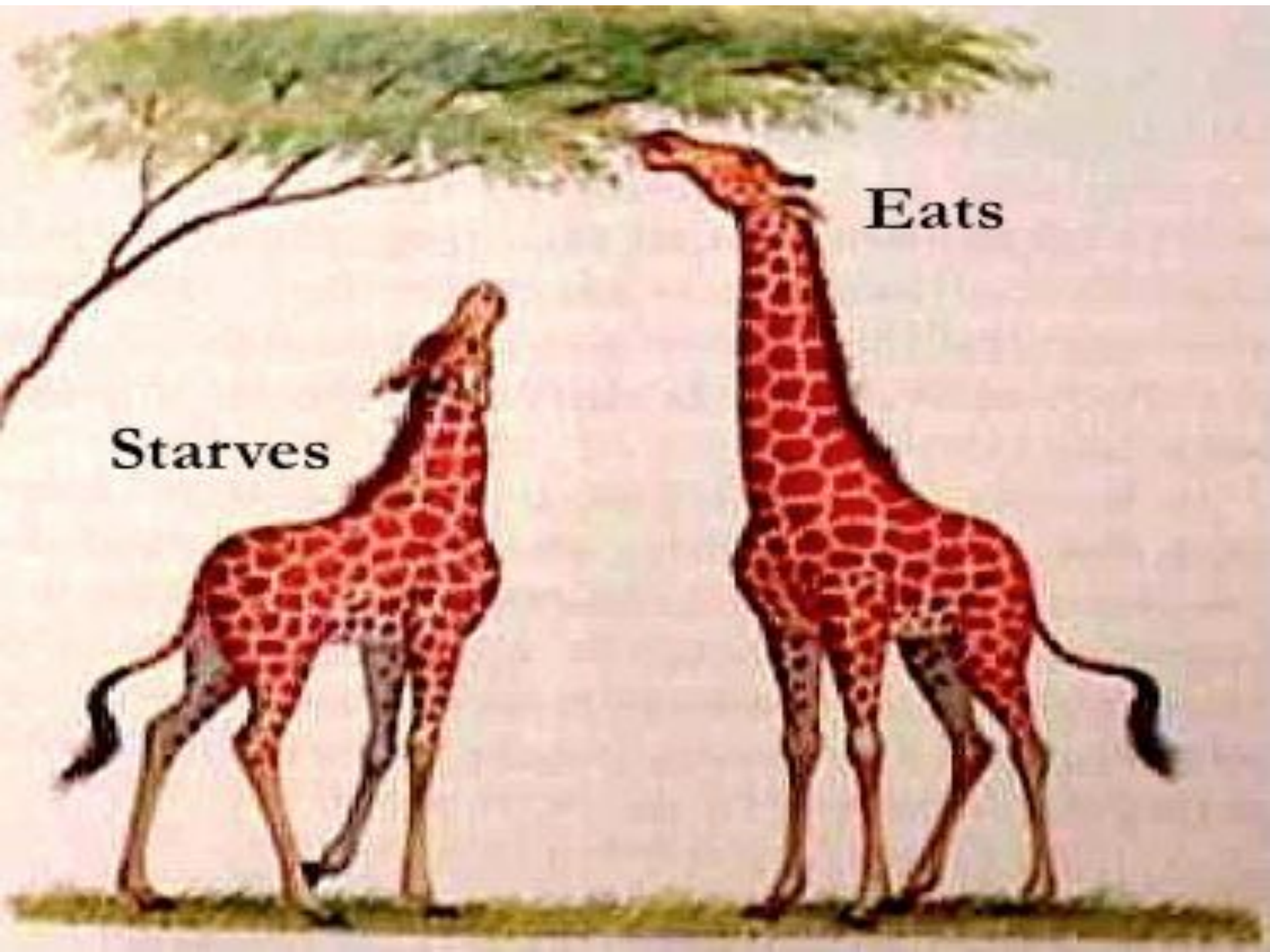
- According to Darwin, There will be variations in the genetic material and upbringing in many of the self-producing organisms

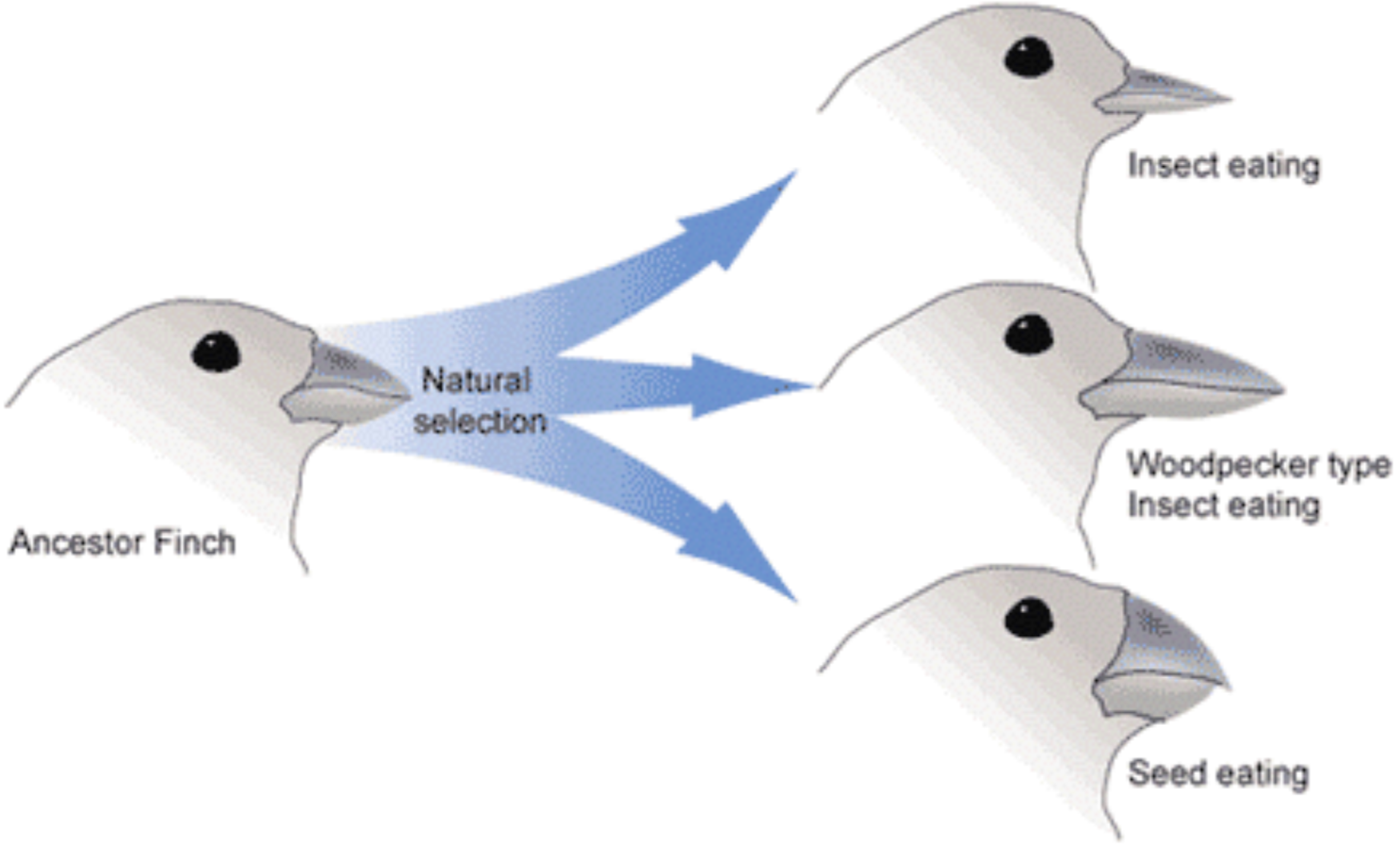
-

10. “The principle of natural selection”- will be applicable to scientific theories too

- These variations mean that some organisms are better than others to draw conclusions about the world around them and act accordingly

- These organisms survive and dominate others


Eats
Starves


Insect eating
Natural selection
Woodpecker type Insect eating
Ancestor Finch
Seed eating

Science has given a survival advantage to human beings

-
- Science and reasoning ability has given human being a survival advantage
- It is true that science had also caused for self destruction of human being
-

Science has given a survival advantage to human beings

- But, as the universe has evolved in a regular way, the reasoning ability which the human evolution has given us would at the end will not lead us into wrong conclusions-

- Let us hope

11. Let us continue our quest for a complete description of the universe

- man always is not happy to see events as unconnected and inexplicable
- Man always searches for the underlying order in the universe
- Therefore, let us continue our quest for a complete unified theory which can explain the origin and evolution of the universe