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The Origin of the Universe: An Amazing and Mysterious Universe

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THE ORIGIN OF THE UNIVERSE

A Vast & Expanding Universe

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WE LIVE IN A VAST UNIVERSE

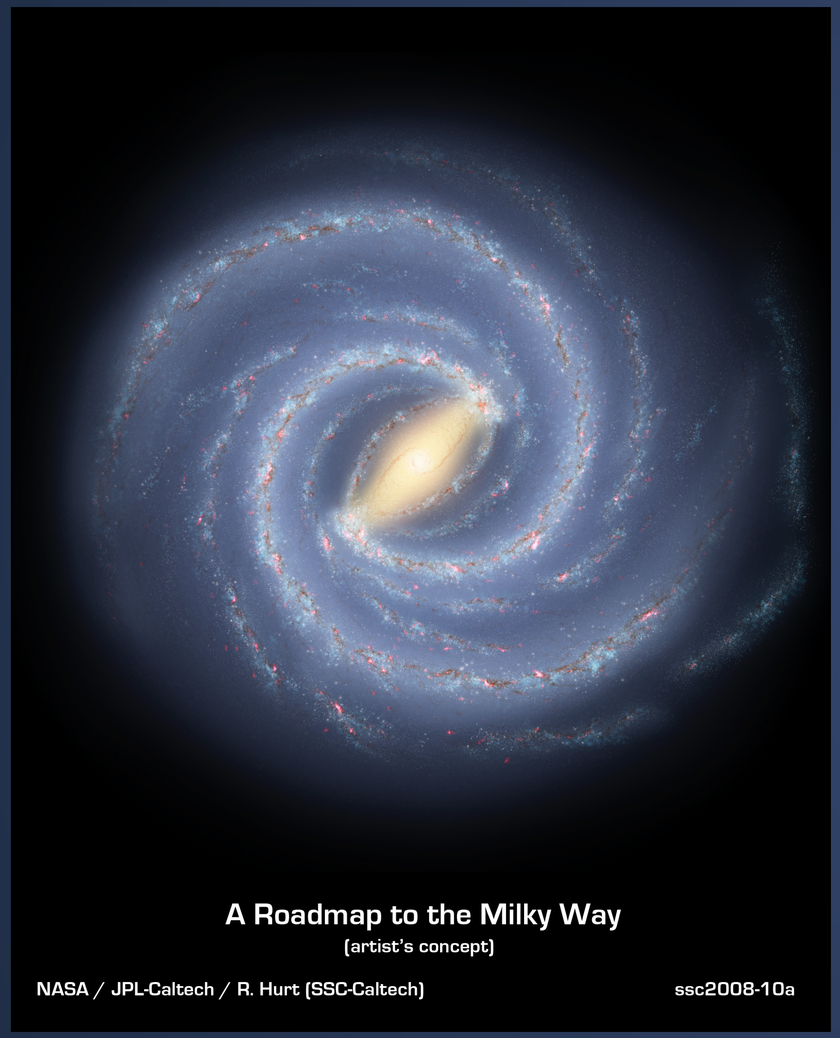
THE ORIGIN OF THE UNIVERSE: A VAST AND EXPANDING UNIVERSE

- 100 billion galaxies, each with 100 billion stars.
- Image of Universe 13 billion years ago.

HUBBLE 1925

- Edwin Hubble with telescopes in Mt. Wilson, California discovered our vast and expanding universe.

BEFORE HUBBLE, ONLY THE MILKY WAY



- We thought the universe was our galaxy: The Milky Way

AN EXPANDING UNIVERSE

- Edwin Hubble: The galaxies are moving away from each other.
- The phenomenon of Redshift.
- We live in an expanding universe.

OUR UNIVERSE STARTED AS A DOT WITH INFINITE ENERGY IN THE BIG BANG

If our universe has been expanding, we can run the movie backwards?

We come to the Big Bang.

From the beginning:

- 10-11 seconds: Matter wins over Anti-Matter
- 10-5 seconds: Protons and Neutrons form from Quarks
- 380,000 years: Cosmic Microwave Background Radiation (COBE)

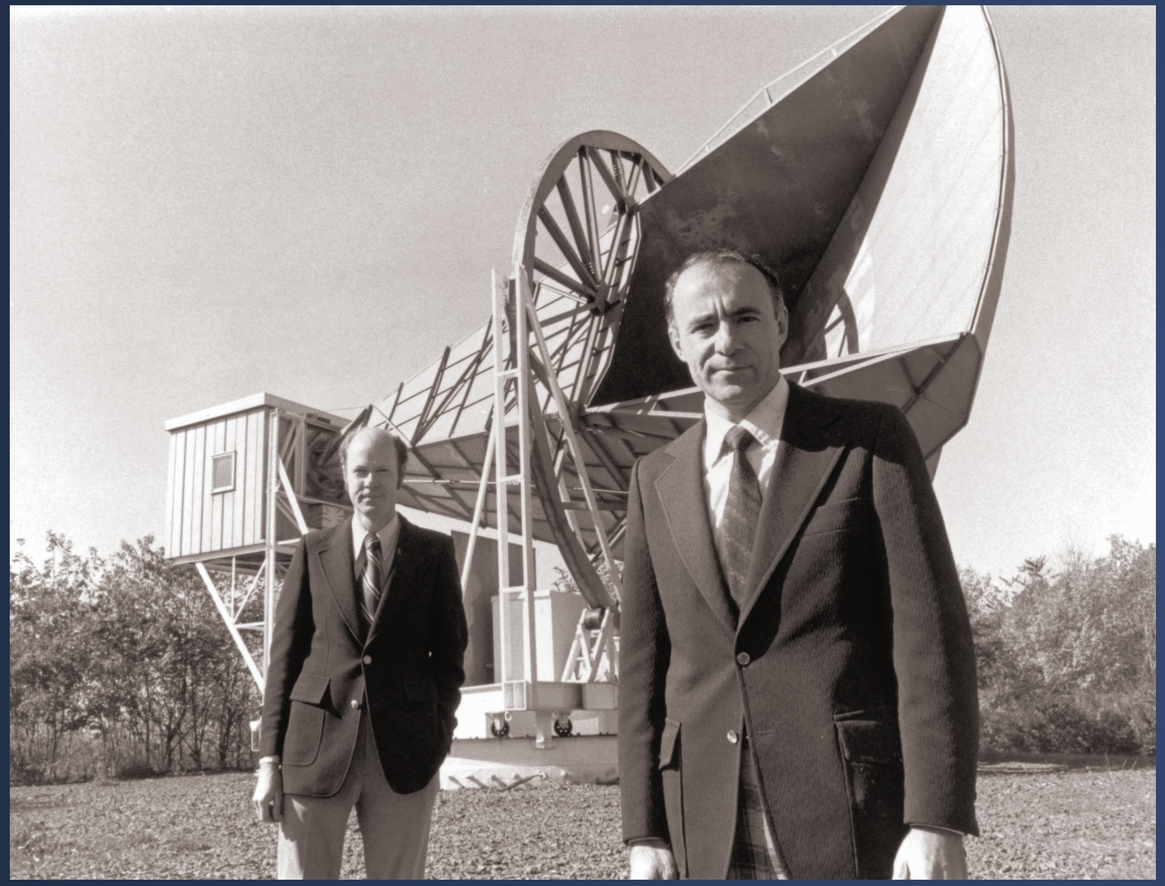
FROM THE FIRST STARS UNTIL TODAY

- 300 million years: Stars and Galaxies form
- 3 billion years: Galaxies and Clusters of Galaxies
- 9 billion years (4.7 billion years ago): Our Solar System forms
- 13.7 billion years: Today

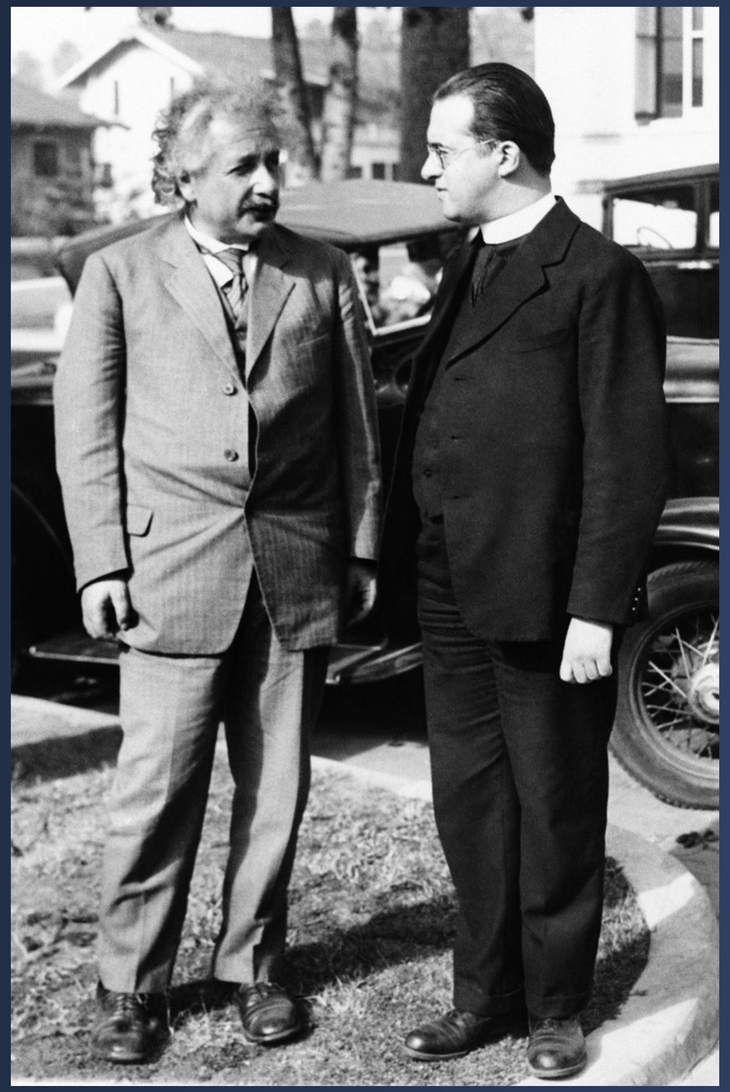
EXPERIMENTAL EVIDENCE FOR THE BIG BANG

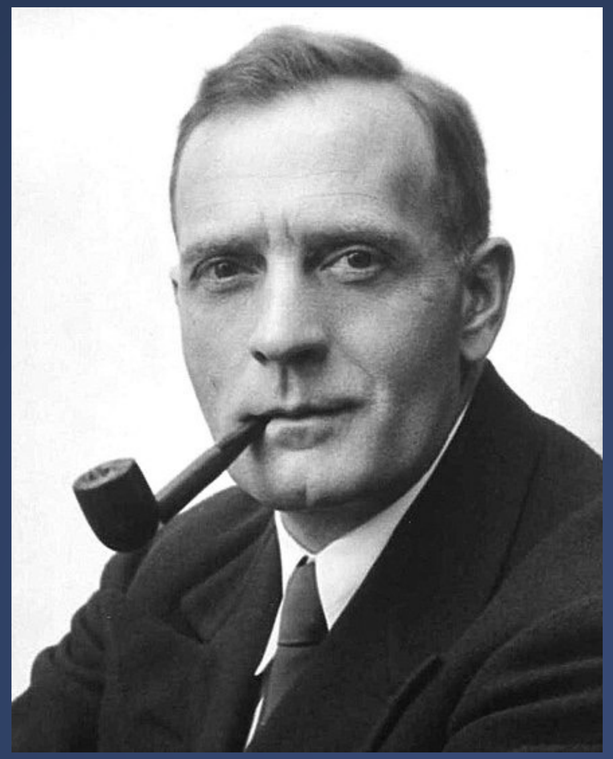
- Physicists showed that the Big Bang should have left a relic.
- Temperature of 5 degrees above absolute zero.
- Absolute zero is minus 273 degrees Celsius.

PROOF OF THE BIG BANG



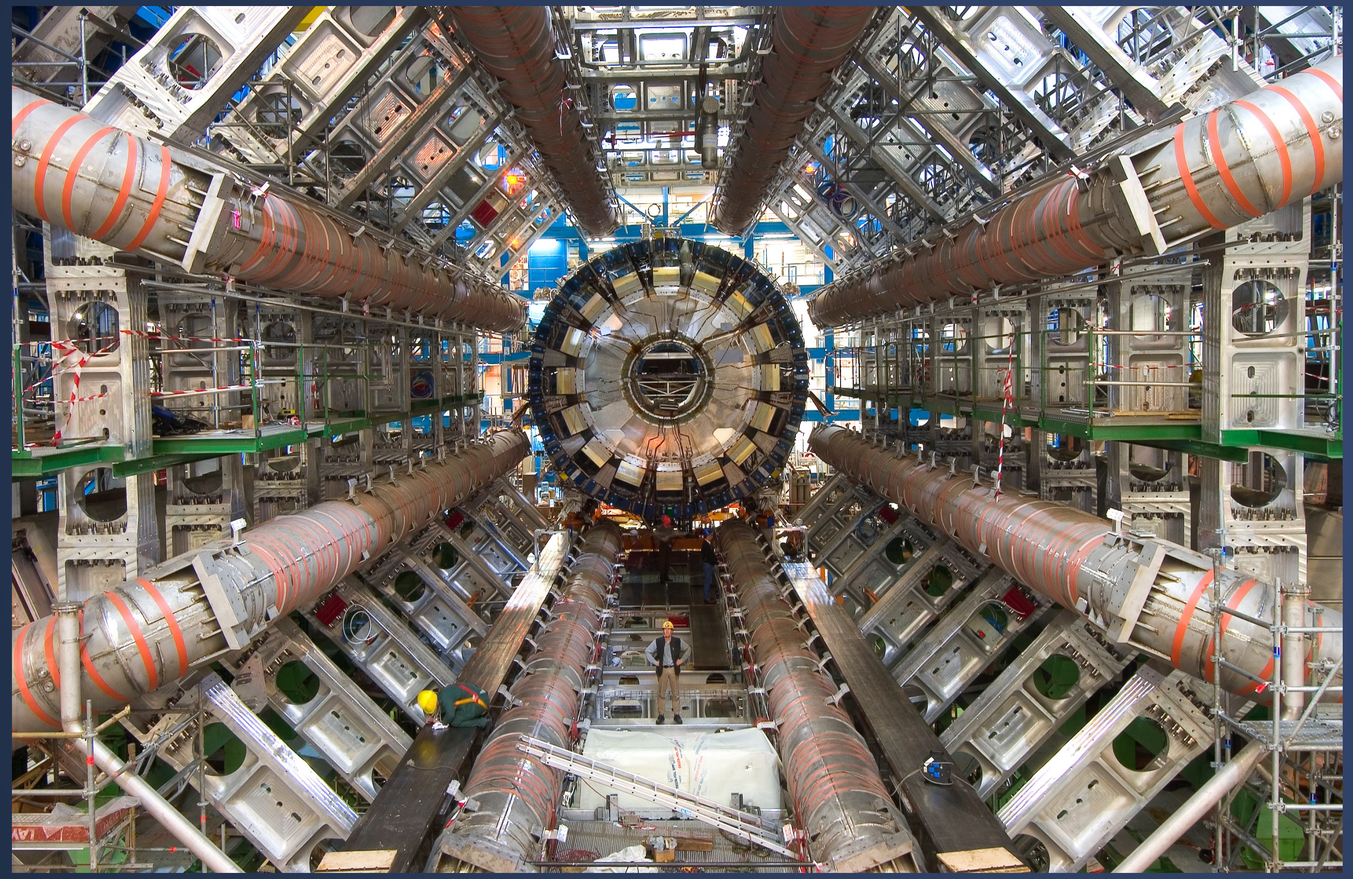
- In 1964, two engineers at Bell labs in New Jersey, Penzias and Wilson, discovered this relic radiation from the Big Bang.
- They received the Nobel Prize.





- Albert Einstein
- George Lemaitre, a Belgian priest
- Edwin Hubble

MOST POWERFUL PARTICLE ACCELERATOR: CERN LARGE HADRON COLLIDER



- Physics Theories predict the existence of particles.
- Colliders “look” for them.
- Finding the particles show our theories are correct.

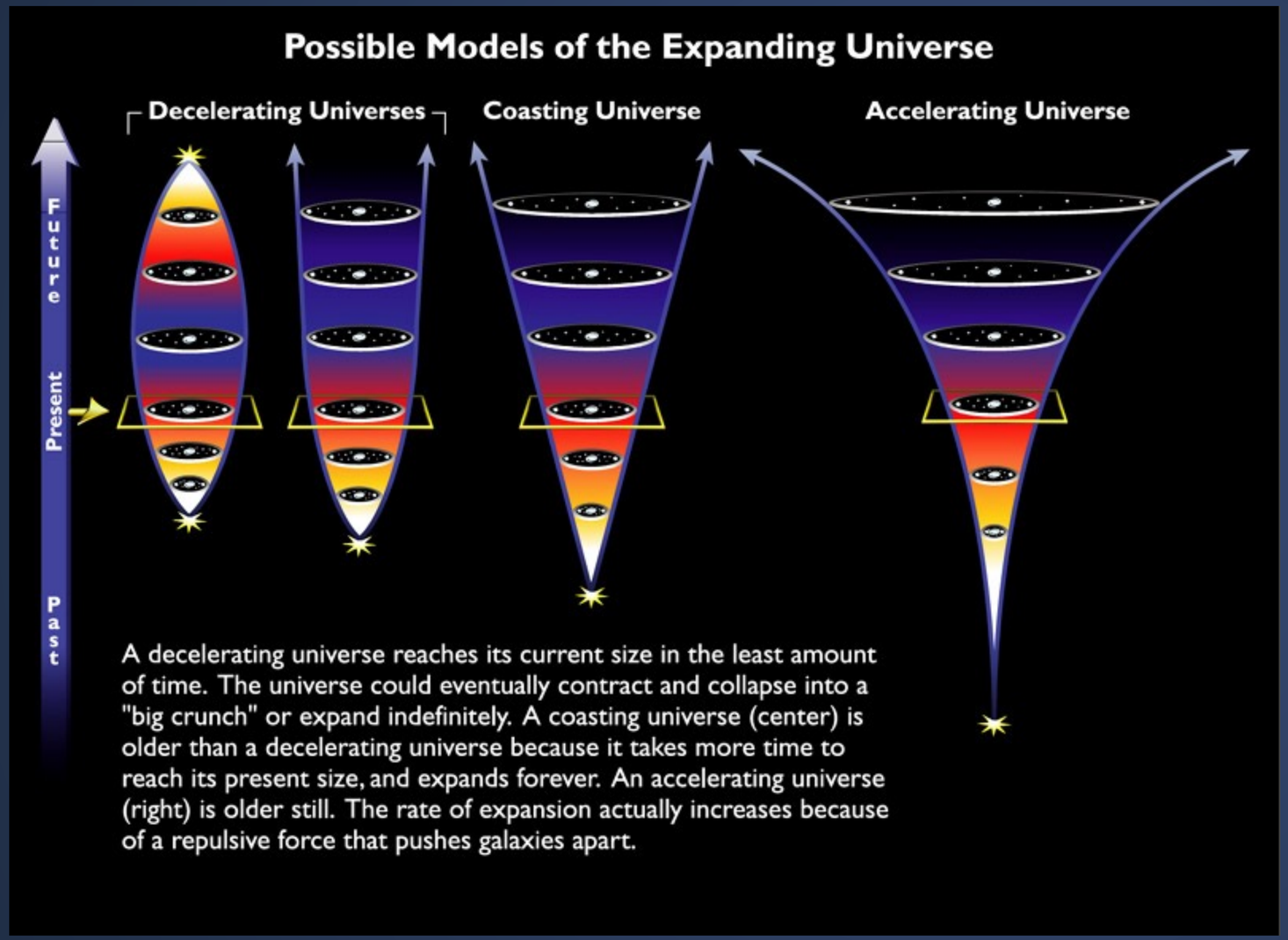
DISCOVERY OF HIGGS BOSON (GOD-PARTICLE)

- Predicted in 1964 by Peter Higgs: To explain why particles have mass.
- July 4, 2012: Announcement that the LHC had detected the Higgs Boson.
- Over 5,000 physicists worked to achieve this result.

THAT WAS OUR PAST, WHAT IS OUR FUTURE?

- In another 6 billion years, our Sun will become a Red Giant.
- Temperatures will rise to 3,000 Fahrenheit.
- Next, the Sun will become a White Dwarf.
- Earth will become cold and frozen.

THE FUTURE OF THE UNIVERSE



THE FUTURE OF THE UNIVERSE (VERSION 1)

BIG FREEZE	The universe will get colder and colder.
HEAT DEATH	Back to the Big Bang.
BIG BOUNCE	The universe will bounce back and expand again.

THE FUTURE OF THE UNIVERSE (VERSION 2)

BIG FREEZE: The universe will get colder and colder.

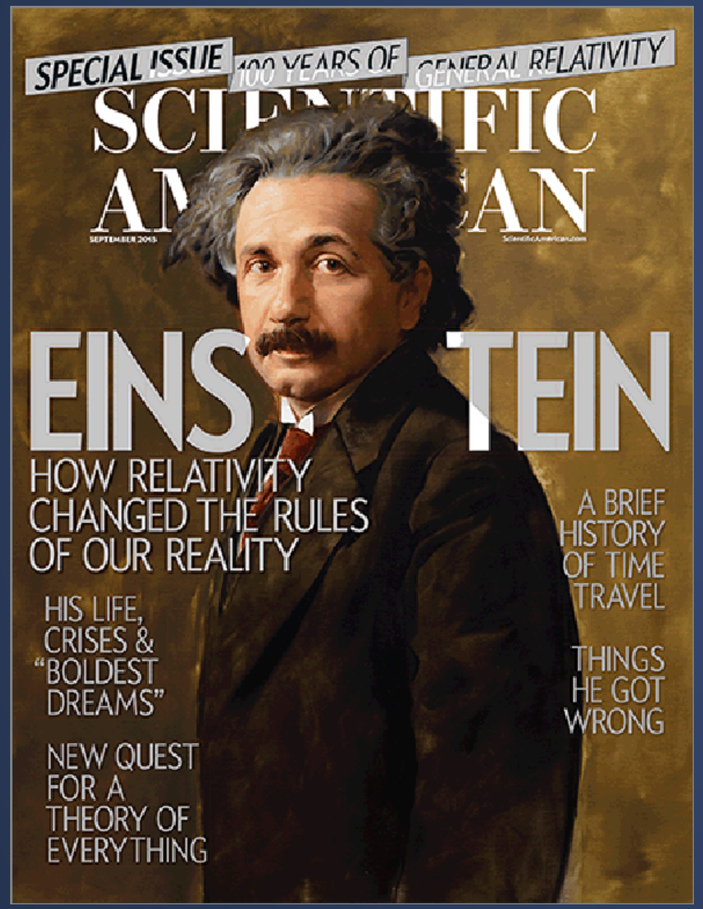
HEAT DEATH: Back to the Big Bang.

BIG BOUNCE: The Universe will bounce back and expand again.

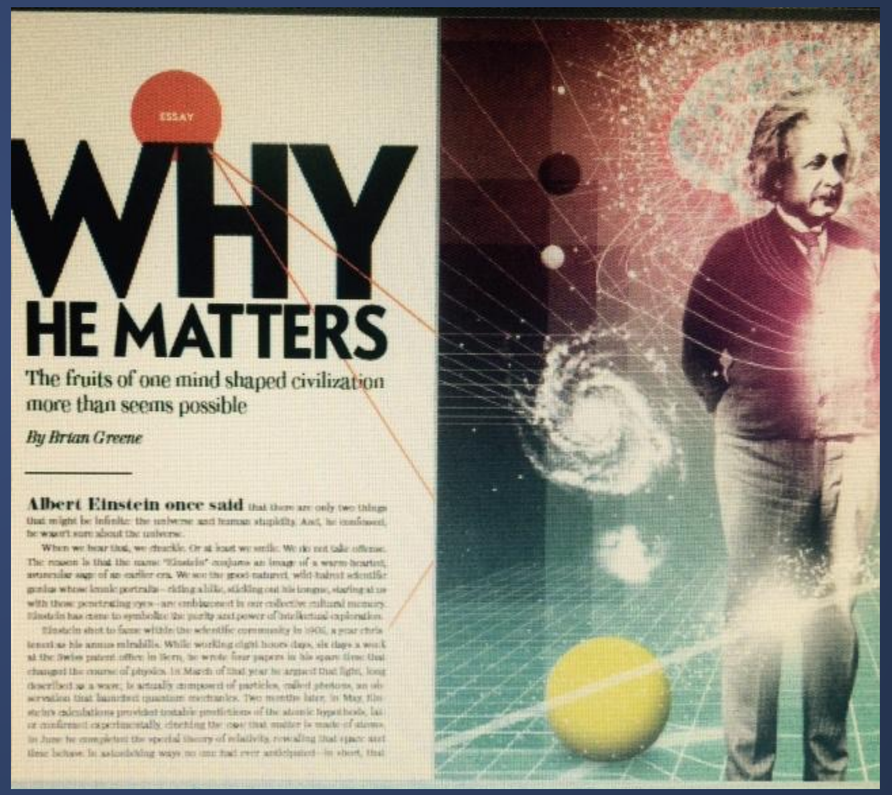
ORIGIN OF THE UNIVERSE

AN AMAZING AND MYSTERIOUS UNIVERSE

1915: General Relativity



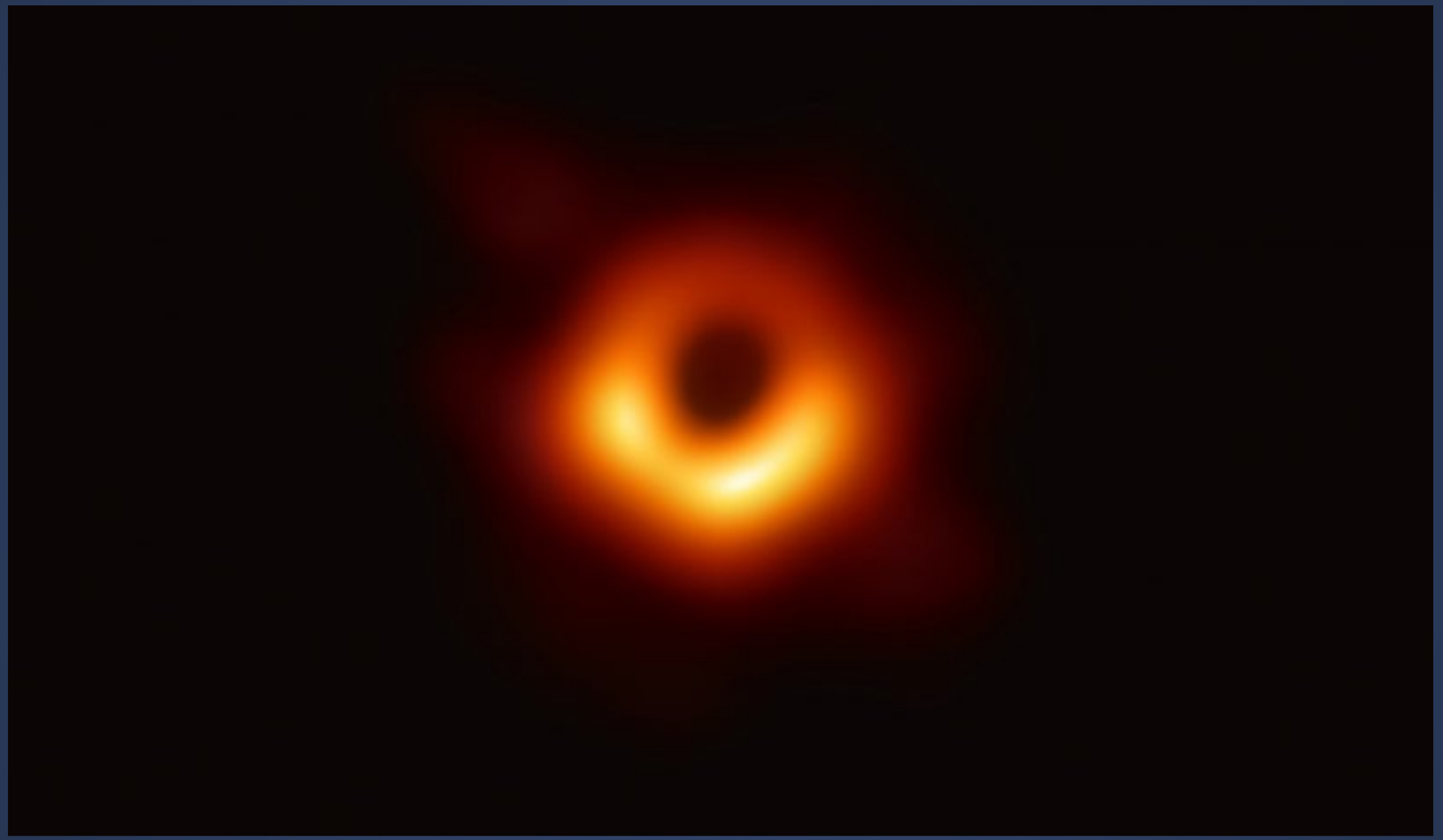
Black Holes
Gravitational Waves



AMAZINGLY, WE HAVE DETECTED GRAVITATIONAL WAVES

- LIGO (Laser Interferometer Gravitational-Wave Observatory)
- February 11, 2016: Gravitational Waves coming from the collision of two giant black holes 1.3 billion years ago.
- Exactly as predicted by Albert Einstein 100 years before.

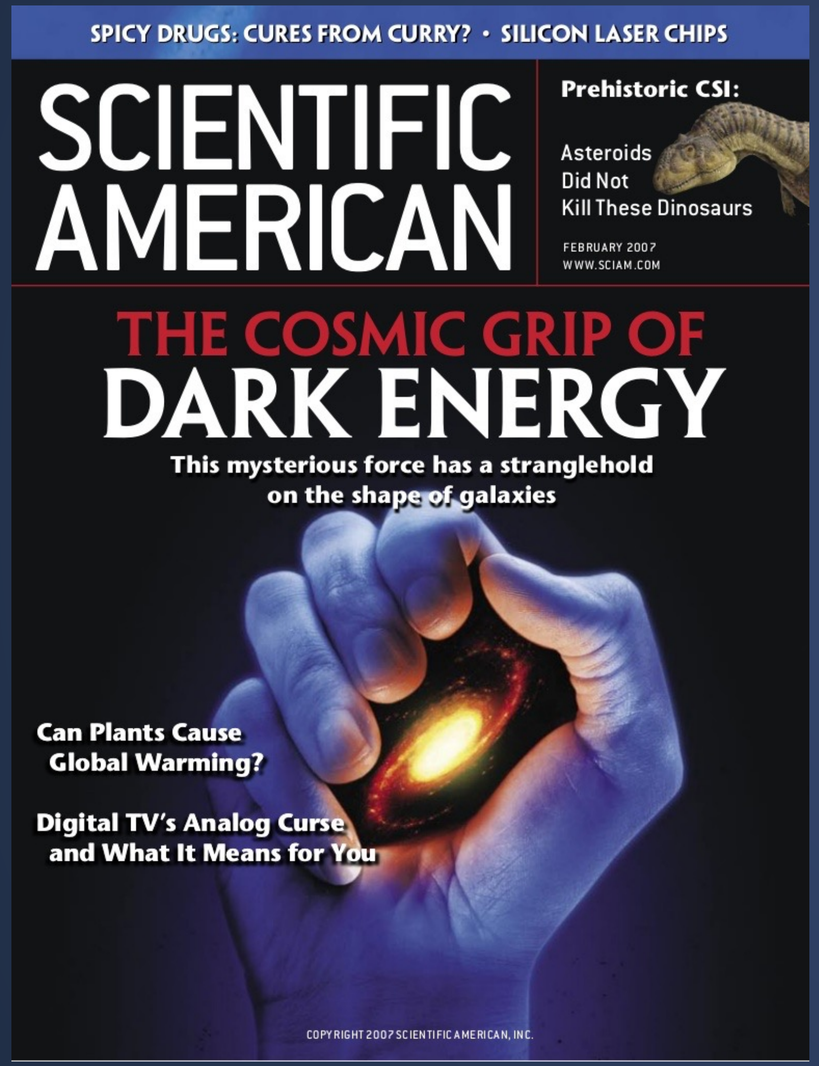
WE HAVE “SEEN” A BLACK HOLE IN MESSIER M87*



EVENT HORIZON TELESCOPE WHICH “TOOK THE PICTURE”

- The ALMA Telescope array in Chile, one of 8 around the world.

BUT THE UNIVERSE HOLDS MANY MYSTERIES: DARK ENERGY



- The expansion of the universe is accelerating.
- An unknown, "Dark Energy", is pushing the acceleration.
- It comprises 70% of the universe.

THE UNIVERSE STILL HOLDS MANY MYSTERIES: DARK MATTER (VERSION 1)

Vera Rubin: the stars at the edges of galaxies are moving faster the laws of gravity predict.

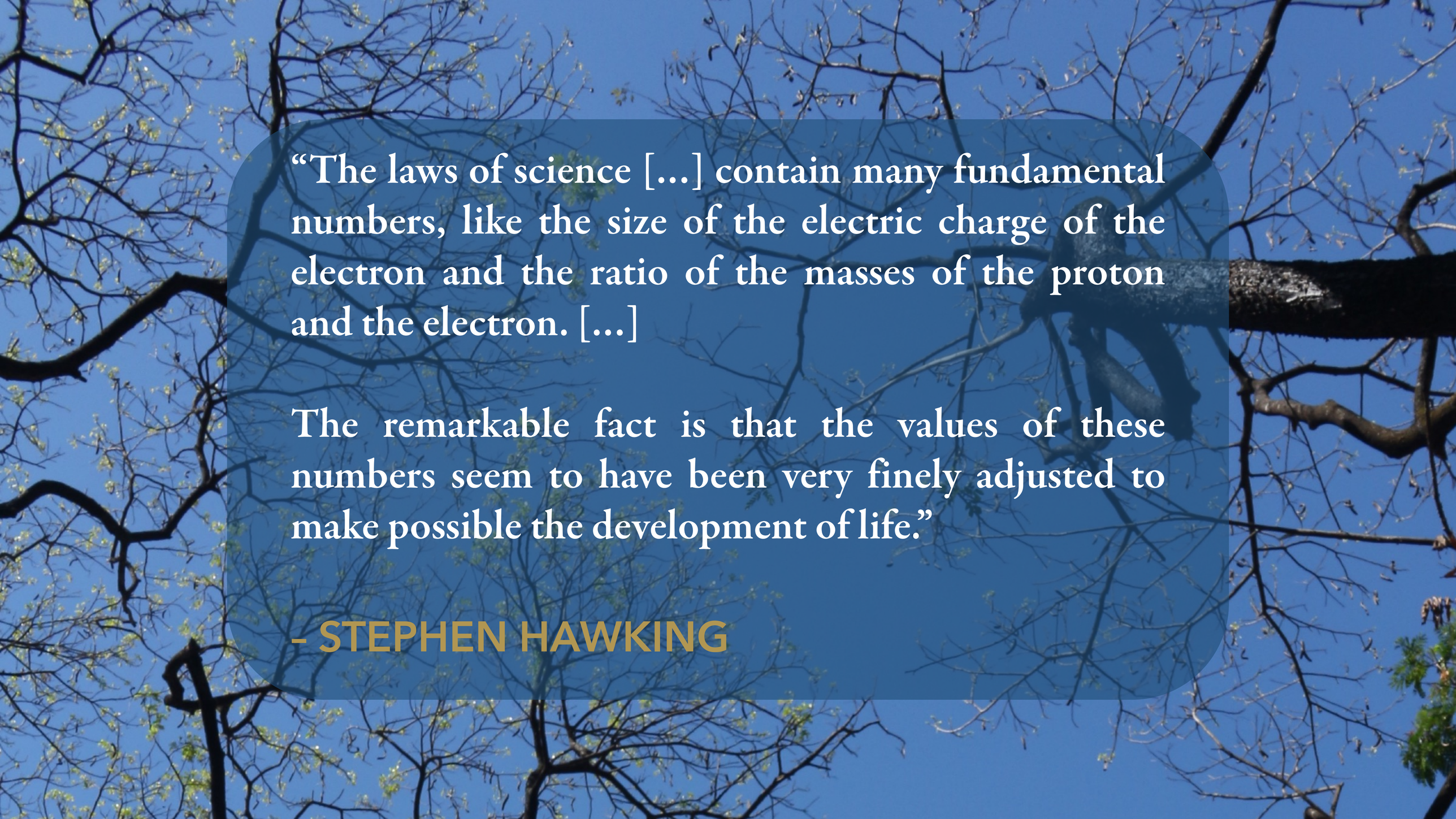
- The Explanation:
  Dark Matter
- It makes up 25% of the universe.
- So we can see only 5% of the universe.
- We live in a mysterious universe.

The stars at the edges of galaxies are moving faster than the laws of gravity predict.

– VERA RUBIN

THE UNIVERSE STILL HOLDS MANY MYSTERIES: DARK MATTER (VERSION 2.3)

- The Explanation: **Dark Matter.**
- It makes up 25% of the universe.
- So we can see only 5% of the universe.
- We live in a mysterious universe.



"The laws of science [...] contain many fundamental numbers, like the size of the electric charge of the electron and the ratio of the masses of the proton and the electron. [...]

The remarkable fact is that the values of these numbers seem to have been very finely adjusted to make possible the development of life."

– STEPHEN HAWKING

WE ARE HERE BECAUSE MATTER FORMED INTO STARS, GALAXIES, AND THE STARDUST THAT IS US

- At some point, there is slightly more matter than anti-matter.
- Matter forms into protons and neutrons, helium, lithium, and heavy hydrogen nuclei.
- 3 billion years: stars and galaxies form
- The matter in our bodies comes from the stars.

THE 4 FUNDAMENTAL FORCES OF THE UNIVERSE “PREPARED” FOR US

- GRAVITY
- ELECTROMAGNETISM
- WEAK FORCE
- STRONG FORCE

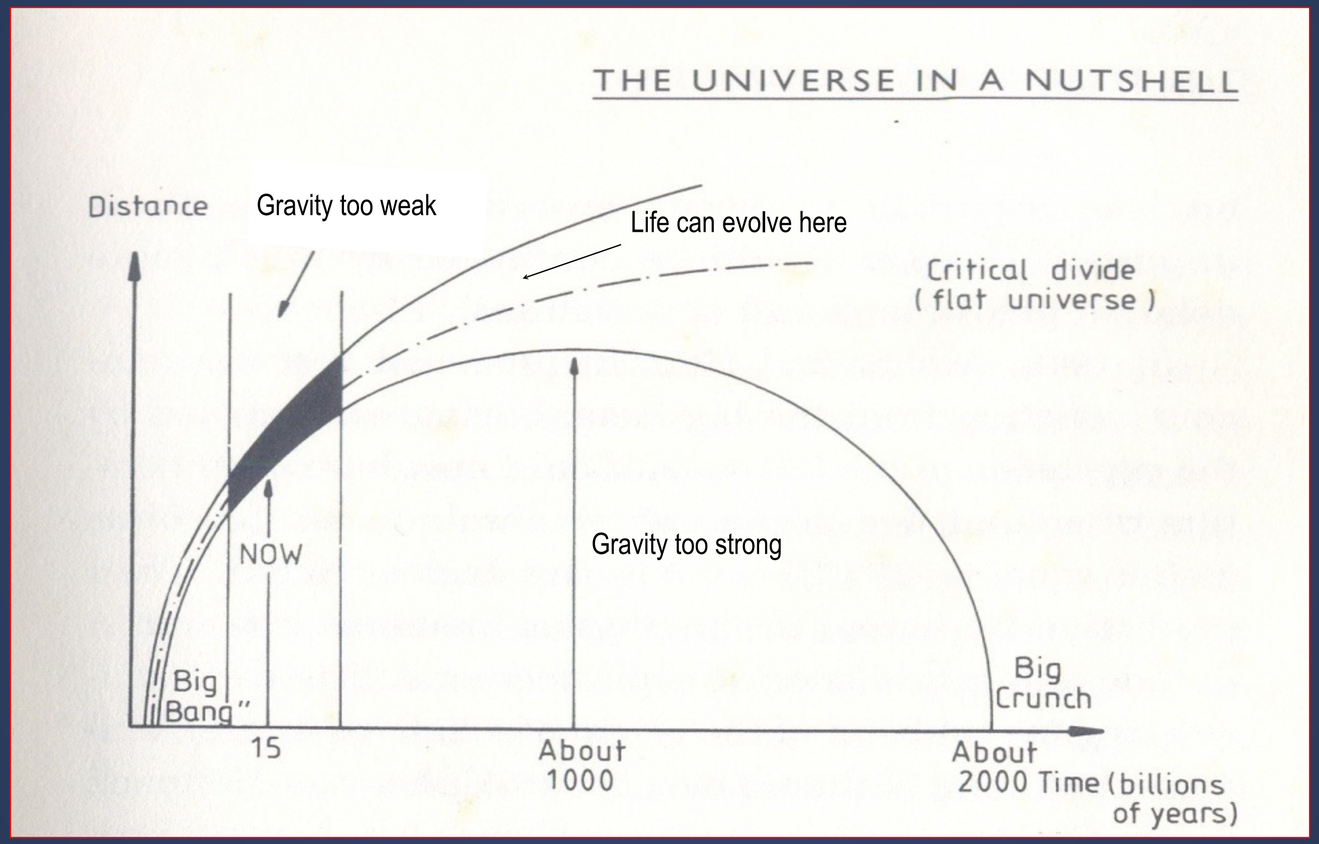
IF THE OTHER FORCES WERE STRONGER

- Stars and galaxies would not have formed.
- The elements in our bodies come from the stars.
- We would not be here.

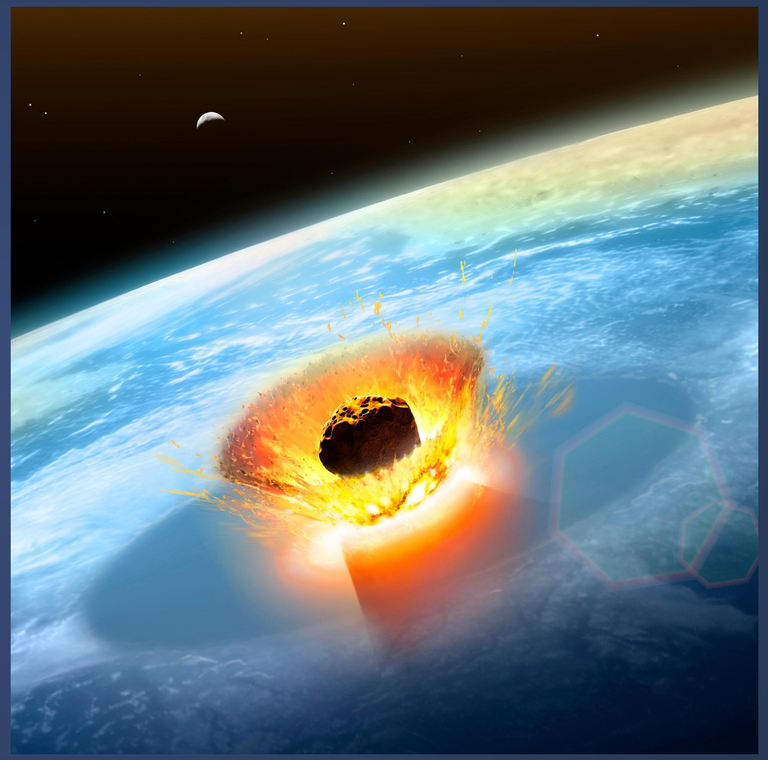
IF THE OTHER FORCES WERE WEAKER (GRAVITY STRONGER)

- Stars and galaxies would have collapsed sooner.
- No time for life to evolve.

LIFE ONLY POSSIBLE IN A NARROW CRITICAL DIVIDE



A CATASTROPHIC ASTEROID COLLISION 66 MAY SET THE STAGE FOR OUR COMING

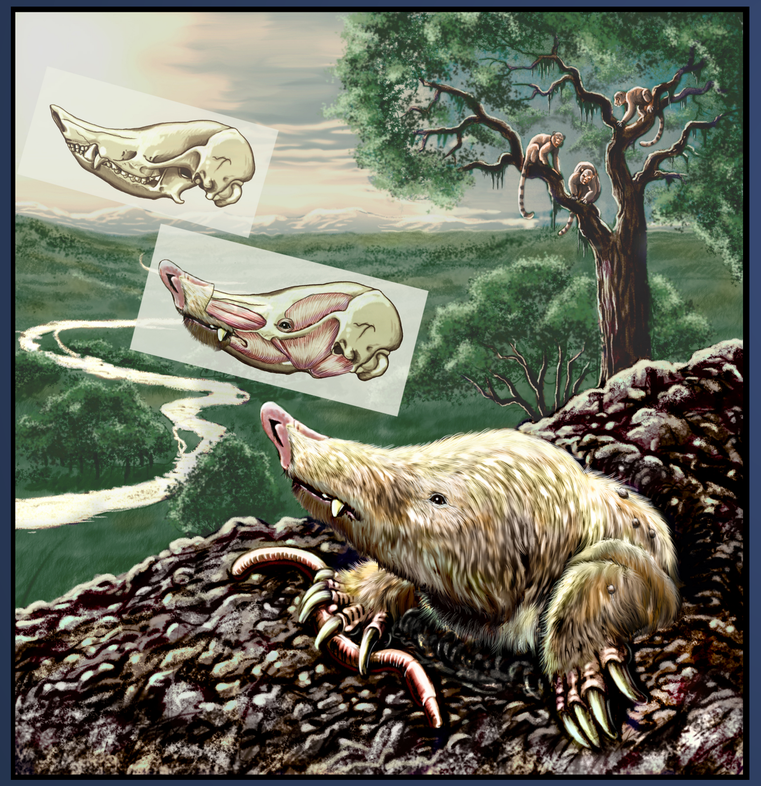


THE DAY THE DINOSAURS DIED

- The dust and soot blocked all sunlight for months. Photosynthesis stopped, killing plant life.
- More than 99.9999 per cent of all living organisms on Earth died.
- The dinosaurs that had ruled the Earth became extinct.

THE AGE OF MAMMALS (OUR AGE) BEGAN

Insects feeding on dead leaves survived the collision



Small mammals survived eating insects

THE EVOLUTION OF THE UNIVERSE HAS BEEN GOOD TO US

- Just an infinitesimal change and stars would not have formed.
- Or the stars would have burned out too quickly.
- Even an accidental asteroid collision prepared for us.
- As one physicist puts it: It seems that the universe knew we were coming.

Multiverse Explanation:

Where are an almost infinite number of universes:
A Multiverse.

- Statistically a hospitable universe would arise.
- But we can not travel to another universe.
- So we will never know.

OR THE "PROVIDENCE OF GOD?"

For believers, we would say this comes from the **Providence of God.**

- The universe knew we were coming.
- Because Providence set the laws of the universe.
- Even the asteroid was Providence.