(i)

Define Dark Energy and Dark Matter

Dark Energy:

Dark energy refers to mysterious, repulsive force that causes universe expansion to accelerate, acting as an anti-gravity that pushes galaxies apart. Dark energy constitutes about 68% of universe mass-energy content.

discuss these in a bit more detail.....

Dark Matter:

Dark matter is a form of matter that doesnot emit, absorb or reflect light, making it invisible and detectable only through its gravitational effects. Dark matter constitutes about 27% of universe mass-energy content. — ?

2.5

(ii)

Define Big bang and Big Crunch

(ii)

Define Big bang and Big Crunch

Big Bang	Big Crunch
Big bang theory contends that universe begins as a singularity – a point of infinite temperature and density ^ and it continues expanding and cooling ever since. 13.8 billion years ago	Big Crunch is a hypothetical scenario about ultimate fate of universe. Big crunch theory argues that following is the process for ultimate fate of universe.
Process of Big Bang	Process of Big Crunch
i- Singularity Formation The universe begins with a singularity- a point of infinite density and temperature.	i- Reversal of cosmic expansion If the density of universe is high enough, the granita- -tional attraction among all its components will eventually
ii- Rapid expansion of universe The universe undergoes	

rapid exponential expansion.

iii- Quark and gluon formation

~~Protons and neutrons combine to form~~ The universe cools enough to form quarks and gluons. Quarks and gluons combine to form protons and neutrons.

iv- Nucleosynthesis

The universe cools enough to undergo nuclear reactions, forming light elements such as hydrogen, helium and traces of lithium.

v. Release of Cosmic Microwave Background Radiation (CMB)

The universe becomes transparent to light, releasing CMB radiation

overcome the force of expansion (dark energy) leading to reversal of cosmic expansion.

ii- Universal Contraction

The universe would begin to contract under intense gravity bringing galaxies closer together.

iii- Collapse of Cosmic Structure

Galaxies, stars and interplanetary system collapse under intense gravity.

iv- Breakdown of Matter

Extremely high

we detect today.

vi- Formation of Cosmic Structure

Within a few hundred million years, cosmic structures begin to form and by 1 billion years they were largely established. The universe continues expanding and cooling ever since.

temperatures and pressures cause collapse of matter, breaking down matter into sub-atomic particles.

v- Formation of Quark and Gluon plasma

Protons and neutrons further disintegrate to form quarks and gluons as energy levels rise sharply.

vi- Singularity Formation

All matter and energy continue to collapse under gravity until it can reach a point of infinite density and temperature called singularity. ~~This would be the end of universe.~~

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(iii)

Explain Black hole; its formation and how it is discovered?

Definition

Black hole is a ~~got~~ dense, massively packed galactic center formed by attracting every nearby object towards it due to its gravitational pull. Black hole is the region in space where gravitational pull is so strong that not even light can escape it.

a- Discovery of Blackhole

Black hole was discovered for the first time in 1971 with the discovery of Cygnus X-1 — a binary star system. Astronomers observed a visible star orbiting around an invisible companion that was emitting intense X-rays. The mass of this invisible compact object was higher than that of neutron star and this invisible compact object was inferred as blackhole.

b- Other Ways for Discovery of Black hole

i- Observing Accretion Disks

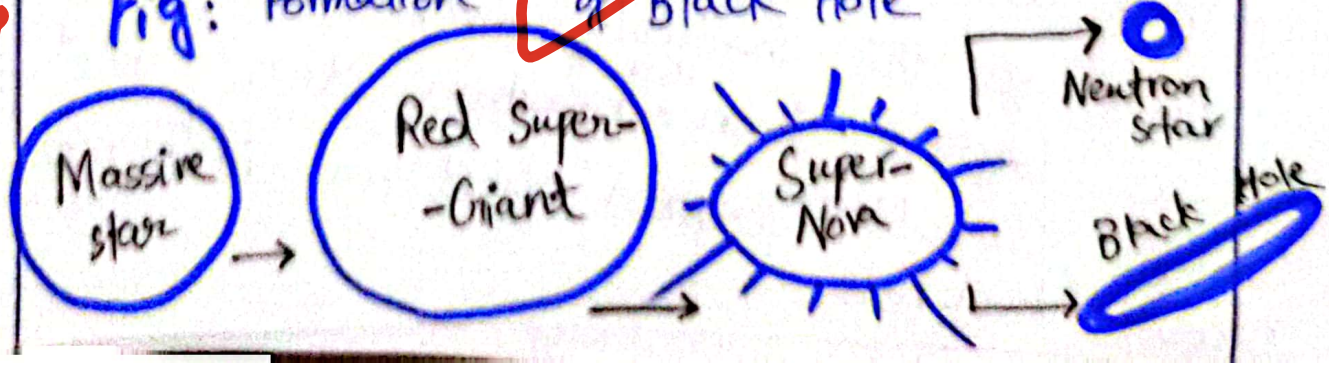
ii- Observing Gravitational lensing effect

iii- Observing Gravitational Waves

c- Formation of Black Hole

As massive star exhausts its nuclear fuel, it can no longer counteract its own gravitational pull. The core collapses under gravity resulting in supernova explosion. If the mass of remaining stellar core exceeds the certain limits the gravitational core collapse continues until it can reach a point of infinite density and temperature called singularity. This is the heart of black hole. The boundary surrounding the black hole is known as event horizon.

Fig: Formation of Black Hole



(iv)

Astronomical System of Units

"It is a standardized set of measurement units used in astronomy to express masses, distances and time of celestial bodies."

Examples

a- Astronomical Unit: Average distance between Earth and the Sun.

$1\ AU = 1.496 \times 10^8\ km$ ~~or 650 m~~

b- Light Year: Distance traveled by light in "vacuum" in one year.

$1\ LY = 9.46 \times 10^{12}\ km$ or 9.46 trillion km

$1\ km = 0.621$ miles

(v)

Milky Way

i- It is a spiral galaxy

ii- We are in Orion Cygnus arm

iii- There are 100 to 400 billion stars in it.

iv- It takes 225 to 230 million years (time) by the Sun or solar system to complete one orbit around center of Milky way.

v- Milky Way's diameter is 100,000 to 180,000 light years.

vi- Distance from Sun or solar system to center of Milky Way is ~~280,000~~ 27,200 light years.

(vi)

Solar System

"Solar system is a gravitationally bound system consisting of Sun and celestial bodies including eight planets and their moons; dwarf planets; interplanetary dust; asteroids; meteroids all orbitting around the Sun within Milkyway galaxy. Solar system formed from a giant cloud of gas and dust 4.5 billion years ago.

Galaxy

"Galaxy is a gravitationally bound system consisting of planets, dwarf planets, interstellar gas and dust (nebulae), black hole, and satellites."

Types of Galaxies

According to Tuning Fork Diagram there are following types of galaxies.

a- Spiral Galaxies: They have flat, rotating disk like appearance having spiral arms and they are rich in dust, gas and young stars.

b- Elliptical Galaxies: They appear as smooth, oval-shaped galaxies and they are rich in old stars.

c- Lenticular Galaxies: They appear as central bulge and disk like spiral galaxies but do not have spiral arms, serving as transitional stage between spiral and elliptical galaxies.

d- Irregular Galaxies: They do not have definite shape and they are rich in

dust, gas and active star formation.