

## Cosmology

## Introduction

## Astrophysics

- ❑ **Definition:** Cosmology is the scientific study of the large-scale properties of the universe as a whole. Its about the study of various aspects of Universe which ranges over the entire Timeline.
- ❑ **Cosmic Background:** This is the residual thermal radiation from the Big Bang, filling the universe and providing a snapshot of the universe when it was just 380,000 years old.
- ❑ **Dark Matter:** About 85% of the universe's mass is believed to be dark matter, which doesn't emit light or energy.
- ❑ **Inflation Theory:** This theory posits that the universe underwent a rapid expansion (inflation) immediately after the Big Bang, solving several puzzles in cosmology, like the horizon and flatness problems.
- ❑ **Multiverse Hypothesis:** Some cosmologists speculate that our universe might be one of many in a multiverse, each with different physical laws and constants.

- ❑ **Definition:** Astrophysics is a branch of astronomy that deals with the physical properties and underlying processes of celestial objects and phenomena.
- ❑ **Stellar Evolution:** Astrophysics studies the life cycles of stars, from their formation in nebulae to their eventual death as white dwarfs, neutron stars, or black holes.
- ❑ **Exoplanets:** Astrophysicists study planets outside our solar system, known as exoplanets, to understand their formation, composition, atmospheres, and potential for hosting life.
- ❑ **Relativity:** Einstein's theory of general relativity is crucial in astrophysics, particularly for understanding gravitational phenomena like black holes, the bending of light around massive objects and expansion of Universe.
- ❑ **Cosmic Rays:** High-energy particles, mainly protons and atomic nuclei, that travel through space.

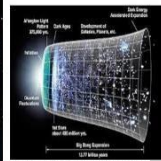
## DIFFERENCE BETWEEN ASTROPHYSICS AND COSMOLOGY

❑ Cosmology is the discipline that deals with the nature of Universe as a whole. It is a sub field of astrophysics.

❑ **Astrophysics** is the branch of astronomy that deals with the physics of universe, including the physical properties of celestial objects as well as their interactions and behavior.

Researches in astrophysics include:

- stellar evolution – how stars are born
- Blackholes – examines the properties of blackholes
- Exoplanets – researches planets outside our solar system



❑ Astrophysicists study stars, galaxies, black holes, neutron stars, and other celestial bodies, seeking to understand their formation, evolution, and the physical processes occurring within and around them.

Researches in cosmology include:

- **Big Bang Theory:** Researches the origin of the universe and its early development.
- **Cosmic Microwave Background (CMB):** Studies the afterglow of the Big Bang
- **Dark Matter and Dark Energy:** Investigates mysterious components affecting the universe's structure and expansion.

❑ Cosmologists study the origins, evolution and eventual fate of the universe, including the Big Bang theory, cosmic inflation, dark matter, dark energy, and the overall structure of the

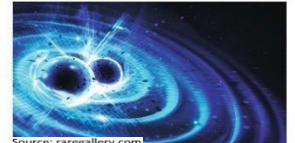
## THE FUTURE OF COSMOLOGY

The future of cosmology holds exciting prospects as new technologies and theoretical advancements continue to expand our understanding of the universe. Key areas of focus include:

- 1. Dark Matter and Dark Energy:** Scientists aim to uncover the nature of dark matter and dark energy, which together constitute about 95% of the universe's total mass-energy content.
- 2. Cosmic Microwave Background (CMB) Studies:** Future missions, such as the Cosmic Microwave Background Stage-4 (CMB-S4) experiment, will refine measurements of the CMB.
- 3. Exoplanet Exploration:** Continued discoveries of exoplanets and advancements in observational techniques will enhance our understanding of planetary systems and the potential for life beyond Earth.

## The Future of Astrophysics

- ❖ Upgradation to powerful instruments.
- ❖ Use of Origins space telescope.
- ❖ Multi-messenger astronomy.
- ❖ Observatory astronomy.
- ❖ Advanced degrees.
- ❖ Growth of employment in astrophysics.



## THE ROLE OF TELESCOPE AND OTHER OBSERVATORIES IN COSMOLOGY AND ASTROPHYSICS

❖ Telescope and the observatories have been indispensable tools in the field of Cosmology, enabling to explore and understand the evolution and eventual fate of the vast universe.

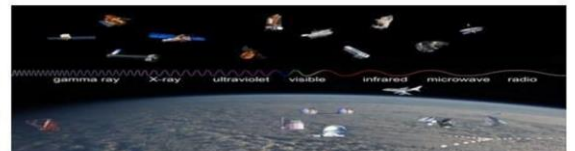


❑ **Observation of distant objects:** High-resolution imaging and spectroscopy enable detailed study of distant galaxies, quasars and black holes.

❑ **Detection of cosmic Microwave Background (CMB):** Telescopes like the *Planck Satellite* have measured the CMB radiation, which is the afterglow of the Big Bang.

❑ **Exploration of Cosmic Phenomena:** Observatories help in the study of transient and energetic phenomena like supernovae, gamma-ray bursts, & CMB radiation, which provide insights into the life cycles of stars and the early universe.

➤ These observations provides insights into extreme physics, such as the behaviour of matter under intense gravity and the creation of heavy elements.



❖ In Astrophysics, telescopes are essential tools for understanding the physical properties and processes of celestial objects and phenomena.

❑ **Observation of Celestial Structures:** Telescopes capture light and other electromagnetic radiation from stars, planets, galaxies & other celestial objects. It can be equipped with spectrographs that break down lights into its component colours which helps to determine the chemical composition, temperature, velocity & other characteristics of celestial objects.

❑ **Exploring Exotic Objects:** Instruments like radio and X-ray telescopes detect non-visible radiation from exotic objects such as black holes, neutron stars & supernovae.

## Results

The exploration of astrology and cosmology reveals a fascinating dichotomy between popular belief and scientific evidence. While astrology remains a culturally significant and widely followed practice, its claims do not align with empirical scientific findings.

Recent cosmological studies, including detailed measurements of cosmic background radiation and refined estimates of dark matter and dark energy, offer profound insights into the universe's structure and evolution. This distinction underscores the importance of continued exploration and education in both fields, fostering a deeper appreciation of the universe and our place within it.