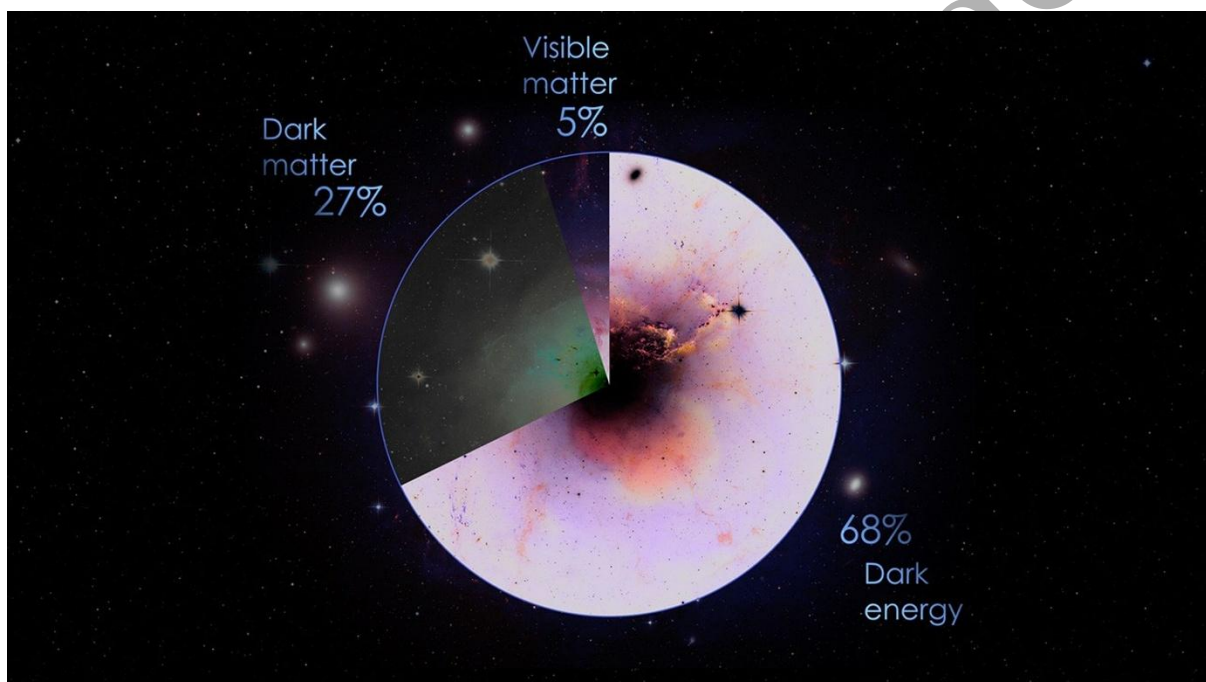


Foundations of the Cosmos: Exploring Dark Matter's Secrets

By Aditya Raj Pandey

Introduction

The universe is definitely full of matter from atomic level right up to the macro level. Matter can be found in all forms and objects present in the surrounding as well as inside the living organism. But at the grand level, i.e., the universe level another aspect of matter comes into existence: the concept of "DARK MATTER". The universe is made up of three type of matters i.e.:



Background

- Visible matter(5%): everything can be touched, or observed with the naked eye or even a telescope can be collated into this class. Most normal matter is made up of atomic particles: There are protons, neutrons as well as electrons. It can be present in gaseous, solid, liquid and plasma state of charged particles. There is scarce any day that we are not in contact with one or the other visible matter in our everyday life.
- Dark matter (27%): Dark matter is matter in the universe that is invisible that is it doesn't emit light or any radiation.
- Dark energy(68%): Dark Energy has been conceived to be the actual cause of the expansion of the universe. Dark Energy Inferred by Scientists Is the Force That Is Causing the Universe

to Fly Apart Rather Than the Force That Reaches out and Pulls Things Together. Since it is a theoretical construct it is hard to know what it is made of and thus how to design experiments to detect it and study the nature of the phenomenon we are proposing. Furthermore, current observations deviate with Hubble rate at the present epoch, thus, we are not quite sure if dark energy is time varying.

History

The first concrete proof of the phenomenon's existence was only gleaned after two opposing teams of astronomers observed the cosmos accelerating in the mid-1990s.

These teams were charting Type Ia supernovae, which are astronomical events resulting from the explosion of large stars and which release light in a very predictable manner, so that they make.

This is because as the universe expands light – from distant sources that is to take a long time to arrive on Earth – has its frequency further “dilated”. Since Red is the colour of the longwave light this brings what astronomers call as ‘REDSHIFT’. In early 1930s, Swiss astronomer Zwicky had measured velocities of galaxies in cluster of Coma and he had found that total galaxy mass required to bind systems gravitationally was at least 400 times more than the observed mass from visible matter. It was until the 1970s, investigators found out that the density of rotation of galaxies was not as calculated for planetary motion through Kepler's laws of planetary motion but was flat.

- In 1930's, Swiss astronomer Zwicky measured the velocities of galaxies within the Coma galaxy cluster and found that the mass required for binding the systems gravitationally was at least 400 times larger than expected from visible components.
- In the 1970s, galactic rotation curves were observed to remain flat at large distances rather than fall off as expected from Kepler's laws.
- In the 1930s, Swiss astrophysicist Fritz Zwicky studied the Coma Cluster of galaxies and discovered that the visible mass of the galaxies was insufficient to account for their observed motions. He hypothesized about some other form of matter that he called “dark matter” being responsible for the gravity at work. Many years later the confirmation that dark matter exists was given by astronomer Vera Rubin. She discovered when studying the rotational curves of the spirals galaxies that the outer region of these galaxies move at a much faster velocities than can be accounted for just

by the available mass. This indicated that there existed a huge unseen material that surrounded galaxies.

Behaviour of the dark matter

- Dark matter does not interact with the electromagnetic waves.
- It is not in the form of dark clouds of normal matter, made up of baryons.(heavy subatomic particles that are made up of three quarks).
- It is not antimatter, otherwise we could observe the unique gamma rays produced when antimatter annihilates the matter.

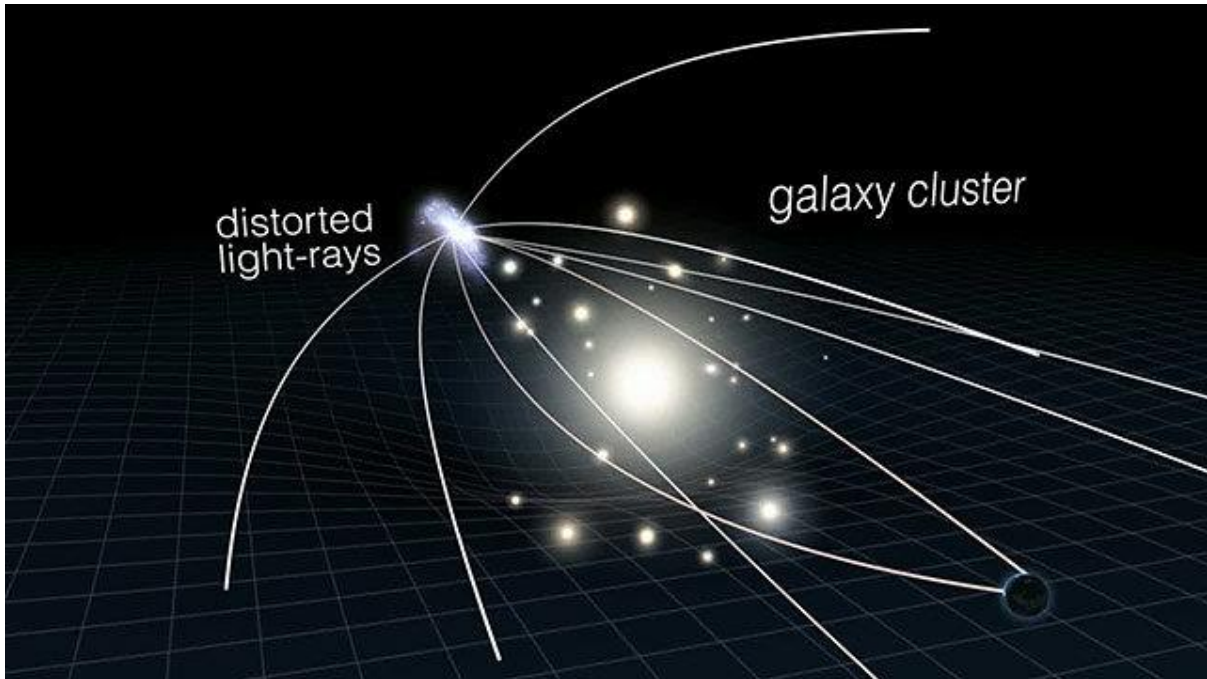
Role of the dark matter in the universe

Dark matter plays a crucial role in the formation and evolution of cosmic structures. Its gravitational influence serves as a cosmic scaffold, shaping galaxies, galaxy clusters, and the vast web-like structure of the universe. Without dark matter, the universe as we know it would be vastly different, lacking the large-scale structures that give it form.

How the dark matter ties the universe

During the early stages of the universe, dark matter acted as a seed for structure formation. As the universe expanded and cooled, tiny density fluctuations in the dark matter field attracted ordinary matter, leading to the formation of stars, galaxies, and clusters. This process is evident in the CMB—the faint glow of radiation left over from the Big Bang—which contains imprints of these primordial fluctuations.

Dark matter also influences gravitational lensing, a phenomenon where massive objects bend the path of light from distant sources. By studying these distortions, astronomers can map the distribution of dark matter and gain insights into its properties.



Pic: in above pic it is showing the concept of the gravitational lensing

Conclusion

To date dark matter remains one of the greatest enigmas in science and technology. One of the things that certainly cannot be seen with the naked eye, but upon which cosmologists agree has a great influence on the formation of the Universe is called dark matter. He said that dark matter influences the motion of galaxy and how structures in space develop. Despite much studies and research by various scientists around the world for decades .

At this moment we are closer to finding new things about what is dark matter. Looking at it offers not only the clue of how the universe operates, but also indicates how much there is still to be discovered.

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