

# Dark matter

February 2, 2021

**In News:** Scientists from the University of Sussex have found a new way to know more about dark matter.

## News About

- Around 95 percent of the Universe is unknown to human beings. It is often referred to as dark which has nothing to do with the colour of any substance but to do with the unknown nature of cosmic entities known as dark matter and dark energy.

## What New ?

- The range they have established –  $10^{-3}$  electron-volts to  $10^7$  electron-volts – is far smaller than the earlier known range of  $10^{-24}$  electron-volt to  $10^{19}$  giga electron-volt.
- This is the first time anyone has thought of using what we know about quantum gravity to calculate the mass range for dark matter

## What Does Research Say ?

- Scientists carried out the research using quantum gravity, a field of study that tries to combine two of Einstein's concepts – quantum physics and general relativity theory of gravity.
- Calmet and Kuipers research shows that the dark matter particles can neither be super light nor super heavy unless there is a force acting on it that is yet unknown.

## Key Points

- Scientists estimate that roughly 68 per cent of the

Universe is made up of dark energy which is responsible for the accelerated expansion of the Universe.

- Another 27 per cent is dark matter whose existence was inferred from the observation that ordinary matter in galaxies, including the Milky Way, is far less than that required by gravity to hold the galaxies together.
- Dark matter's gravitational effects are also necessary to explain the motions of clusters of galaxies and the structure of the entire Universe at the largest scale.
- On smaller scales, dark matter is too diffused to impact the motion of the Solar System, Earth or the origin and evolution of humans in any significant way.

## Why does 'Dark Matter' matter?

- Dark matter's gravitational effects are also necessary to explain the motions of clusters of galaxies and the structure of the entire Universe at the largest scale.
- On smaller scales, dark matter is too diffused to impact the motion of the Solar System, Earth or the origin and evolution of humans in any significant way.
- But the nature of that dark matter is still unclear.

## What Is Dark Matter ?

- For the first 150 million years after the Big Bang, there were no galaxies or stars or planets, The universe was featureless
- As time passed, the first stars formed. Stars collected into galaxies.
  - Galaxies began to cluster together.
  - Those clusters are made up of the galaxies and all the material between the galaxies.
  - Clumps of matter smashed into each other, and the planets in our solar system began to form around the sun.
- Something must hold our solar system, galaxies and clusters of galaxies together. And gravity is that

“glue.

- In some clusters, the space between galaxies is filled with gas so hot, scientists cannot see it using visible light telescopes.
  - The gas only can be seen as X-rays or gamma rays.
  - Scientists look at that gas and measure how much there is between galaxies in clusters.
  - By doing this, they discovered that there must be five times more material in the clusters than we can detect.
  - The invisible matter that we can't detect is called “dark matter.”
- The Swiss astronomer Fritz Zwicky first used the term “dark matter” in the 1930s.
- In the 1970s, U.S. astronomer Vera Rubin and her colleagues confirmed this result by studying galaxy rotation.
  - They also discovered single galaxies, not just clusters, have more mass than their observable light suggested.
  - The work of Rubin and her team helped to firmly establish the notion of dark matter.
- In many ways, scientists know more about what dark matter is not, though they do have a few ideas about what it could be.
  - Dark matter possibly could be brown dwarfs, “failed” stars that never ignited because they lacked the mass needed to start burning.
  - Dark matter could be white dwarfs, the remnants of cores of dead small- to medium-size stars.
  - Or dark matter could be neutron stars or black holes, the remnants of large stars after they explode.
- That's what makes dark matter exciting: It's still one of the great mysteries of science.