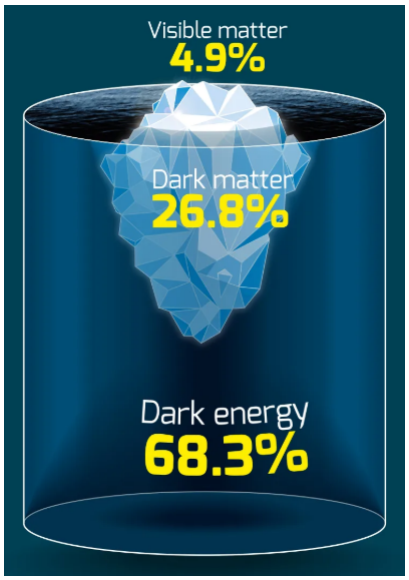
Dark Matter

Why in News?

Physicists have revised the minimum possible mass of a dark matter particle.

- **Dark matter** – It is an enigmatic *invisible substance* supplying five-sixths of the matter of the universe.
- It is said to be *everywhere in the universe*.



- **Coverage** – It seems to outweigh visible matter roughly 6 to 1, making up ***about 27% of the universe.***
- **Properties** – Unlike normal matter, dark matter *does not interact with the electromagnetic radiation* (heat, light, radio, etc,).
- **Hard to spot** - It does *not absorb, reflect or emit light.*
- **Exploration** – The existence of dark matter was inferred *only from the gravitational effect* it seems to have on visible matter.
- The evidence for dark matter emerged in the 1970s when astronomers found an unusual pattern in the rate at which stars in a galaxy rotated the farther they were from the centre.
- **Non-Zero mass** – The particles of dark matter need to have non-zero mass or else the dense and intricate structure of matter on cosmic scales will not form.

In 1922, Dutch astronomer Jacobus Kapteyn studied the motion of stars neighbouring the Sun and concluded the density of "dark matter" (using that term for one of the first times) must be 0.0003 solar masses per cubic light year.

- **Minimum mass** – For decades scientists thought this minimum mass was about 10^{-31} times the mass of a proton.
- In 2024, theoretical physicists revised the limit and pushed it up by an order of magnitude, to ***2.3 × 10^{-30} proton masses***.
- In this case, the wavelength is 200 light years, about the size of a dwarf galaxy.

Leo II is a dwarf galaxy orbiting the Milky Way.

- **R&D** - Experiments at the Large Hadron Collider (LHC) may provide more direct clues about dark matter.
- Dark matter might be newer particles like
    - WIMPS (Weakly Interacting Massive Particle)
    - AXIONS
    - Gravitinos

References

1. The Hindu| Revision of minimum mass of Dark Matter
2. CERN| Dark Matter