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Mystery of the dark matter

Abstract

Dark Matter does not absorb, reflect, emit or even interact with electromagnetic radiation but do interact with gravity. The X-rays coming from the galactic centre has given the stronger evidence that there is some other matter that governs the force of gravity. We are finding the correct proof but still complete evidence yet to be discovered for Dark Matter that the empty space compromise of.

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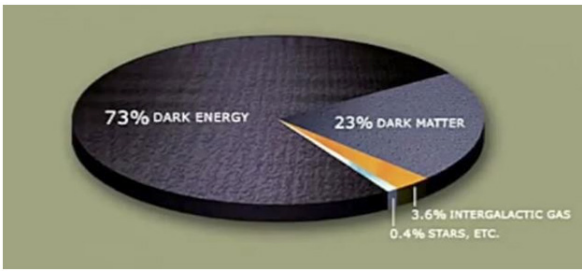
Introduction

Dark Matter research is unresolved. It account for 25% of total energy density. Dark Matter is subject related to particle physics, astrophysics, cosmology. There is other matter other then ordinary matter that binds the galaxies that too 5-6 times the visible matter called as dark matter. Einstein field theory of general relativity also help up to find about Dark Matter by its cosmological constant. Dark Matter presently consider as negative mass fluid which works against the expansion of universe and binds the galaxies together. We can measure the mass of visible matter then we can find out the invisible matter mass. We live in the universe which is 95% dark. Here we will discuss about Dark matter that compromise of 6 times the mass of ordinary matter.

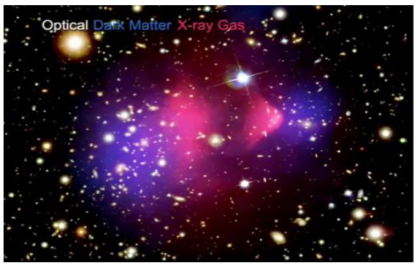


Evidence of dark matter

X-Ray Detection

The first suggestion of dark matter comes from coma cluster in which motion of galaxies is accountable by non-luminous mass also. like the galaxy the cloud of dark matter axion pass through each other and this fig is what exactly where we see lot of matter in violet colour centre on two cluster but this is clearly not the hot gas seen by detector and giving no light i.e. very much look like dark matter. In short we can assemble using algorithm.

Galaxy collide
↓
Huge cluster build up
↓
X-ray emit radiation
↓
Extra matter is seen (other than gas)
↓
Centre of mass is separated form centre
↓
This extra matter is Dark matter

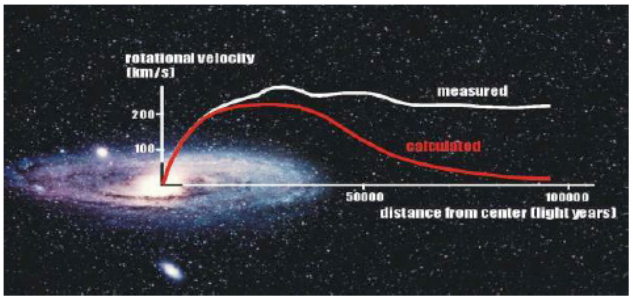


Rotation velocities

The farther the planet or star slower they should rotate due to Newton law of Gravitation there orbital velocities should be decreased but this does not happen as there is some matter that govern make them rotate with the same orbital velocity or sometime larger called as dark matter. The data can be fitted with adding halo and disk curve this means that there must be some extra mater that must be non-luminous matter at large distance in the galaxies.

We know

$$V^2 = \frac{GM}{r} \qquad \text{.....(1)}$$



Now as radius increase mass inside galaxy also increase. But if we go the edge of galaxy M become same but r increase so curve should decrease but that does not happen from equation (1).

As r increase v decrease $\left[centripetal\ force\ decrease\left(\frac{mv^2}{r}\right)\right]$ so star should fly out in outer space force can't stop them. Hence Mass of galaxy must be greater than the observed mass appear to be based on star what we see in galaxy. But this doesn't happen due to extra matter present in galaxies that too not at centre all equally distributed all over.

Observation by gravitational lensing

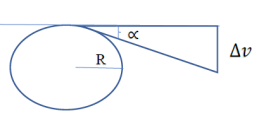
In general relativity light follow geodesics hence it bends when it passes through curve space time. Massive object can act as a lens. A gravitational lens can be considered as distribution of matter between distinct light source and observer. Hence gravitational lens is direct method to detect Dark matter.

$F = ma = \frac{GMm}{r^2}$ so $a = \frac{GM}{r^2}$

$\Delta v = a\Delta t$

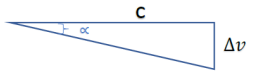
$\Delta v = \frac{GM}{R^2}\frac{2R}{C} = \frac{2GM}{RC}$

$\Delta t = \frac{Distance}{Speed} = \frac{2R}{C}$



Since ∝ is very small (trigonometry)

$\propto = \frac{perpendicar}{base} = \frac{2GM}{RC^2}$ [Newtonian mechanics]



Similarly

$\propto = \frac{4GM}{RC^2}$ [General Relativity]

Here again mass observed of galaxy from gravitational lensing approach is greater then mass calculated by star planets. Hence Galaxy must contain matter that we can't see that matter not to be at the centre but spread throughout galaxy called as dark matter.

Big bang nucleosynthesis

The amount of atom in universe is known quantity calculated using kinematics of star near sun called traces (ρ_{dm}) and the other the global one. Extend it to sun position and determine the density $(\rho_{dm,extr})$. It is assume both density to be same but as time increase the dark matter density change to $(0.2–.06)\ GeVcm^{-3}$. The determination of Dark Matter near sun is based on the known density of the Baryons near sun. In term of mega baron

$$\Omega_B = \frac{\rho_B}{\rho total} = .04$$

Which should be equal to zero. Hence there should be some matter that gives this which is Dark matter which is other than photon neutron and electron. The baryon to photon ration at present is:-

$$\frac{\rho baryon}{\rho photon} \approx 0.6 \times 10^{-9}$$

What can the dark matter be?

Case I

Dark matter can be made of WIMP "Weekly Interact Massive Particle" there might be particle other than "Higgs Particles" that are not yet been detected yet but may consist of massive masses which are holding the galaxies together.

Case II

The additional mass can be accounted for MACHO "Massive Compact Hallow Object". MACHO might be

I. Small black holes

II. Brown dwarf star (star given all energy emitting no light)

III. Star that are colourless having not enough mass to become a star.

No nuclear reaction take place inside them hence they never become bright and spread all over the galaxy "adding to a mass but not in a way to make it visible".

Case III

Mass in the galaxy that we can't see may account for Neutrino. There are billions and billions of neutrino created in star all the time and may be these colourless may have mass. Though they are very very small but if has mass then billions of billions of billions of neutrino will have massive mass that account for additional mass inside the galaxy.

Case IV

MOND "Modified Version of Newtonian Gravity". Dark matter must not be there might be there is problem with Newtonian formula.

$$F = \frac{GMm}{R^2}$$

$$F \propto \frac{1}{R^2}(small\ scale)$$

$$F \propto \frac{1}{R}(l \arg e\ scale)$$

R for different galaxy would be different. So on correction the formula get modified to MOND.

Case V

Idea of Parallel Universe, In General Relativity there are additional dimension. In String Theory the dimension that we can't see which may give birth to additional universe [Parallel Universe]. We can't interact or see parallel universe except that its gravitational affect our universe. This may cause for additional matter in galaxy.

Case VI

CDM (Cold Dark Matter) they have the particle that travel slowly which are require to from galaxy and stars. On the other hand there are Hot Dark Matter (HDM) particle that travel very fast nearly at a speed of light.

Dark matter research

Millions of Dark Matter particle passes through earth every second, but because of there weak interaction they are very hard to detect.

Large Underground Xenon experiment (LUX)

It aims to detect weakly interacting massive particle (WIMP) dark matter interaction with ordinary matter. This experiment uses liquid xenon detection mass in a time-projection chamber.

Large Hadron Collider (LHC)

LHC at CERN can detect dark matter produced after collision of photons coming in opposite direction at high energy and speed nearly equal to speed of light. Though we can't detect dark matter there but the missing energy can give proof that there is something missing other than normal matter.

Dark matter annihilation

When two dark matter particle annihilate or decay they produce gamma rays that can be detected by space or ground based gamma ray telescope. Many detectors are placed deep underground to avoid cosmic rays. As cosmic rays are constantly coming to earth surface and collide with upper atmosphere and create a shower of particle. So it's important to remove cosmic rays. Hence these detectors are building deep underground.

Conclusion

By detecting Dark matter we can find out the ways how to travel faster than speed of light. We can use Dark Matter particle to learn what the universe was like a billionth of a sec after Big Bang. If hawking radiation is the only thing that can escape Black Hole then can that be Dark Matter or Dark Energy. It will help us to solve our ultimate fate of the Universe.

Acknowledgments

None.

Conflicts of interest

The author declares there is no conflict of interest.

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