Dark Matter

1. Dark Matter

Most scientists accept that the universe contains huge quantities of a material known as Dark Matter. Dark Matter is responsible for providing the gravitational attraction enabling galaxies to form and holds them together once they have formed. Apart from interacting with other forms of matter gravitationally it can't be observed, it does not exhibit the other properties of matter and it is impossible to describe its nature. Using a combined set of observations scientists estimated that the universe contains 27% dark matter.

It is very difficult to determine what dark matter is. First, it is dark, and unlike stars and planets, cannot be seen. Observations show there is not enough visible matter in the universe to make the 27% required by observations. 1) Nor is it in the form of dark clouds of normal matter made up of baryons. This is because baryonic clouds can be detected by their absorption of radiation passing through them. We know dark matter is not antimatter because we do not observe the unique gamma rays that are produced when antimatter annihilates with matter. The existence of galaxy size black holes can also be ruled out on the basis of how many gravitational lenses we see. High concentration of matter bends light passing near them from objects further away, but there aren't enough lensing events to show that such objects make up the required 27% of dark matter contribution.

There is still the possibility that dark matter could be tied up in brown dwarfs or in small dense chunks of massive compact halo objects known as MACHO's. The most common view is, however, that dark matter is not baryonic at all, but that it is made up of other, more exotic particles such as axions or WIMPS (Weakly Interactive Massive Particles). There is a possibility.

Cold dark matter refers to candidates which exhibit a negligible velocity. In some cases there is motivation from some observations, but there is no compelling evidence in favour of any of the following alternatives:

Warm dark matter: It can be hot or cold. Warm dark matter would exhibit some form of free streaming, but if the particles are massive enough this might not have a disastrous effect on galaxy formation. It might have observable effects, such as modifying the central cores of galaxies. There is, however, some dispute over whether the cold dark matter model really matches the observed distributions. 2) In addition there are a number of possible motivations to describe the nature of dark matter but, as pointed out above, there is no compelling evidence in favour of it.

Attempts to detect dark matter using experiments have only been able to set the upper limits on dark matter properties such as the interaction rate. The eventual discovery of a dark matter particle, if it happens, would be a landmark achievement for astrophysics since it would stimulate research in fundamental particle physics.

1), Dark Energy, Dark Matter – NASA Science. http:/science.nasa.gov/astrophysics/focus-areas/what-is-dark-energy/

2). Liddle A. And Loveday J. 2009. Oxford companion to Cosmology. Oxford University Press. 2009.