Three Generations of Quarks and leptons:-

Generations of matter			
Type	First	Second	Third
Quarks			
up-type	up (u)	Charm (c)	top (t)
down-type	down (d)	Strange (s)	botbm (b)
Lepions			
Charged	electron (e)	Muon (μ)	tamu (τ)
neutral	electron neutrino (ν_e)	Muon neutrino (ν_μ)	tau neutrino (ν_τ)

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Universe:-

↳ The universe is all around us, in our vision and beyond our vison. The size of universe is still unknown. Many constituents of universe are invisible and are called dark matter and dark energy.
The branch of science, which deals with the study of the origin, evolution & nature of the universe, is called Cosmology.

Big-Bang:-

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↳ Big bang theory is the most widely accepted and popular theory. It explains not only the origin of all known matter, the laws of physics and the large scale structure of the universe, it also accounts for the expansion of universe and broad range of other phenomena.

Red Shift:-

↳ According to Doppler effect, there is apperent change in wavelength of waves emitted by source when it is in motion with respect of observer. The wavelength is increased if the source is moving away from observer and is decreased if source is moving towards observer.

If the star is moving towards the earth wavelength of light emitted by star will be decreases and it's colour shifted toward violet and the visible spectrum formed by such process is called blue shift.

As, the star in the galary moves away from earth and wavelength of light emitted by star

will increases and shifts towards red and such a visible spectrum toward red end is called red shift.

Let us consider a galaxy moving away from us with a velocity 'v'. Then,

$$\text{red shift } (z) = \frac{v}{c} \quad \text{-----(i)}$$

Where 'c' is velocity of light in vaccum.
If 'λ' be the wave length of emitted radiation by galaxy and λ₀ be the observed wave length on earth. then,

$$\text{red shift } (z) = \frac{\lambda - \lambda_0}{\lambda} \quad \text{---(ii)}$$

From eq^n(i) & (ii)

$$\frac{v}{c} = \frac{\lambda - \lambda_0}{\lambda} \Rightarrow \frac{v}{c} = \frac{\Delta\lambda}{\lambda} \quad [\because \Delta\lambda = \lambda - \lambda_0]$$

$$\therefore \boxed{\Delta\lambda = \frac{v\lambda}{c}}$$

Hubble's Law:-

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According to Hubble's law the speed with which galaxy moves away from us is directly proportional to it's distance from earth.

If 'v' be the speed with which a galaxy moves away from us and 'x' be the distance of galaxy from earth. Then,

$v \propto x$

$\Rightarrow v = H_0 x$

Where, H_0 is Hubble's Constant. It's value is 2.3×10^{-18} s^{-1}.

Significance of Hubble's Constant:-

1) Age of Universe:-

↳ Suppose 't' be the age of universe and 'x' be the size of universe. If galaxy ... then by Hubble's law:

ii) Size of Universe:-

↳ If the size of universe is R and speed of galaxy becomes speed of light. Then, by Hubble's Law,

$$v = H_0 R$$

$$c = H_0 R$$

$$R = \frac{c}{H_0}$$

$R = 6000$ Mega par secs (MpC)

$= 6000 \times 10^6$ pc

$= 6000 \times 10^6 \times 3.2$ Light year

[1 MpC = 10^6 pc
1 pc = 3.2 Light year]

Critical density:-

↳ The density of universe which determine the expanding nature of universe is called critical density. It is denoted by ρ_c.

Let us consider the universe as a spherical volume of radius 'R' and mass 'M'. If 'm' be the mass of radius galaxy and 'v' be it's escape velocity then from the universe then its gravitational p.E. should be equal to K.E.

$$\frac{GMm}{R} = \frac{1}{2}mv^2$$

i.e., $\Rightarrow 2GM = v^2 R$ ---- (i)

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i.e., $\Rightarrow 2GM = v^2R$ ---- (i)

According to Hubble's law:

$$v = H_0R \text{ ---- (ii)}$$

Also,

$$M = \frac{4}{3}\pi R^3\rho_c \text{ ---- (iii)}$$

Using eqn (iii) in eqn (i)

$$2G \cdot \frac{4}{3}\pi R^3\rho_c = H_0^2 R^3$$

$$\boxed{\rho_c = \frac{3H_0^2}{8\pi G}}$$

This gives value of critical density, i.e, 5.5×10^{-27} kg/m^3.

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Dark matter:-

↳ The average density of all the matter in the universe is about 27% of critical density but average density of visible matter is about 4% and most of matter of universe are invisible and doesn't emit any kind of radiation, the invisible matter in the universe which doesn't emit any kind of radiation is called dark matter.

The invisible form of energy which can be source of a repulsive force causing the expansion of the universe to accelerate is known as dark energy.

Black Hole:-

↳ If a spherical non-rotating body with mass M has a radius less than R_s, nothing, not even light can escape from the surface of the body, such body is called blackhole.