

# **Theory of Quantum Gravity**

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## 1. Introduction:

Gravitational force is considered as one of the four fundamental forces of the nature. The other fundamental forces of the nature are

- 1) Strong nuclear force
- 2) Weak nuclear force
- 3) Electromagnetic force

According to the current observation, gravity is the weakest force in nature. But the gravitational force plays the most important role in the formation of structure of the universe or cosmos. The gravitational force dominates in all kinds of large scale structure of cosmos. Our current knowledge of gravitational force explains the entire phenomenon occurring in the nature from very small scale such as apple falling from tree to very large scale such as rotation of planets around the Sun.

The current theories and laws of gravity such as Newton's law of universal gravitation or theory of general relativity are applicable to many of the phenomenon occurring in the nature. In the present scenario the Newton's law of gravitation and Theory of general relativity are the two most accepted by scientific community. But on galactic scale both of these fails to explain the galaxy rotation curve. The galaxy rotation curve is the unsolved mystery from 1932. Jan Hendrik Oort, the famous scientist, first observed this phenomenon in 1932.

Many theories have been developed to reconcile the theory of general relativity and quantum mechanics such as string theory, loop quantum gravity and  $f(R)$  theory etc. None of these theories is able to explain the galaxy rotation curve. This shows that either the some other fundamental force is responsible for galaxy rotation curve or all the accepted laws and theories are wrong or incomplete. Still there is no evidence that the galaxy rotation curve is related to some other fundamental force. All the rotational motions are governed by central forces. All the observations made over centuries and evidences show that the gravity is the most dominant central force. Electromagnetic force plays some role on galactic scale. But it is very small and not significant. Therefore the galaxy rotation curve is related mostly to gravity. Since all different theories and laws are not able to explain the galaxy rotation curve, the only possible reason is that theories are wrong. So I conclude that all these accepted theories are wrong or incomplete.

Then there is need of either correcting accepted theories or developing a new theory. But majority of scientists have adopted a very different approach to solve the problem. They have hypothesized the existence of dark matter. In 1932, John Oort who first observed this phenomenon postulated the dark matter to solve the problem. The material responsible for the extra mass was dubbed, "dark matter", the existence of which was first posited in the 1930s by Jan Oort in his measurements of the Oort constants and Fritz Zwicky in his studies of the masses of galaxy clusters. Since then the scientists are trying to find this dark matter.

We are waiting for many decades to find this imaginary dark matter. Some researchers have claimed the existence of dark matter. But none of these claims are scientifically correct and proved. Philosophically there is no possibility of dark matter. The properties of dark matter make it scientifically not provable. So hypothesis of dark matter is wrong.

From the above discussion I conclude that there is need of developing a new and complete theory. Hence I have developed a new theory of gravity in which force of gravity is quantized. Basically this theory has been developed to propose an oscillating universe. We will discuss this in detail.

## **2. Theory of quantum gravity:**

In this theory all fundamental physical entities such as space, time, matter, force, energy and others are used in their usual meanings as in classical mechanics. The space and time are not related to each other. The space and time are independent.

### **Origin of gravity:**

According to my theory, the matter is the only origin of gravity. The gravitational force originates from the matter. For the existence of gravity matter is necessary. Gravity could not exist without matter.

### **Elementary particle:**

The matter consists of a very large number of very small particles. These particles are called elementary particles. The elementary particle is basic source of spherical gravitational field. The spherical gravitational field originates from the elementary particles. The elementary particles can be protons, neutrons and electrons.

### **Quantum Gravitational field:**

Each elementary particle of matter produces gravitational field all around itself in the form of a large and finite number of lines of force spreading in all directions. These spreading lines of force constitute the gravitational field. The lines of force are distributed evenly in the space. The distribution of lines of force is spherical in geometrical sense. The lines of force are spreading outwards in all directions.

### **Quantum line of gravity:**

Line of force is the basic element of gravitational field. Line of force is the smallest or least quantity of gravitational force. This is called quantum line of force or gravity. The

quantum lines of gravity propagate through the space without any medium. The propagation of quantum lines of gravity in space is instantaneous.

**Nature of force:**

The gravitational force is attractive only. When two distinct bodies interact with each other by gravity, then the force exerted on each other is attractive only. Along the quantum line of gravity the value of force remains constant in space and time. Each elementary particle produces only finite number of lines of force. It is not possible to produce infinite number of lines of force. The smallest value of force exerted by quantum line of gravity is called gravitational quanta

**Interaction between bodies:**

The gravitational force is exerted by one body upon another body at a distance through gravitational field. The gravitational force is exerted instantaneously. The action is similar to the entanglement of charged particles. There is no lag between time of change in gravitational force at one body and time of change in gravitational force experienced by another body at a distance. All gravitational force interactions are mediated through quantized gravitational field.

**General law of quantum gravity:**

Now I will explain how gravity works at elementary particle level. Assume that there are two elementary particles located at a distance apart. The particle A is at location 0 and particle B is at location 1. Particle A exerts gravitational force on particle B through quantum gravitational field. The force exerted on particle B is proportional to number of quantum lines of force passing through particle B. Now we will increase the distance between two elementary particles. The particle B is moved to location 2 at a distance  $r_2$ . The number of quantum lines of force passing through particle B decrease. Hence the force of gravity decreases at location 2. Now the particle B is moved to very large distance at location 3. Here only single line of force is passing through the particle B. This is the least amount of force which remains constant irrespective of distance between two elementary particles. Therefore the quantum gravitational force has two distinct components. The two distinct components are variable force and constant force. The variable force is due to the spherical distribution of gravitational field.

The general law of quantum gravity can be stated as the quantum gravitational force is equal to sum of variable gravitational force component and constant gravitational force component. This law is mathematically stated as

$$F_q = F_v + F_c$$

$F_q$ = Quantum gravitational force

$F_v$ = Variable gravitational force

$F_c$  = Constant gravitational force.

The variable gravitational force is directly proportional to the masses of two bodies. The variable gravitational force is inversely proportional to square of the distance between the two bodies. The force is also proportional to geometrical parameter  $\alpha$  related to the geometrical distribution of lines of force.

The quantum gravitational force between two elementary particles or bodies can be mathematically stated as

$$F_q = \frac{G_s M m \cos \alpha}{r^2} + G_q M m$$

$M$  = Mass of larger particle or bodies

$m$  = Mass of smaller particle or bodies

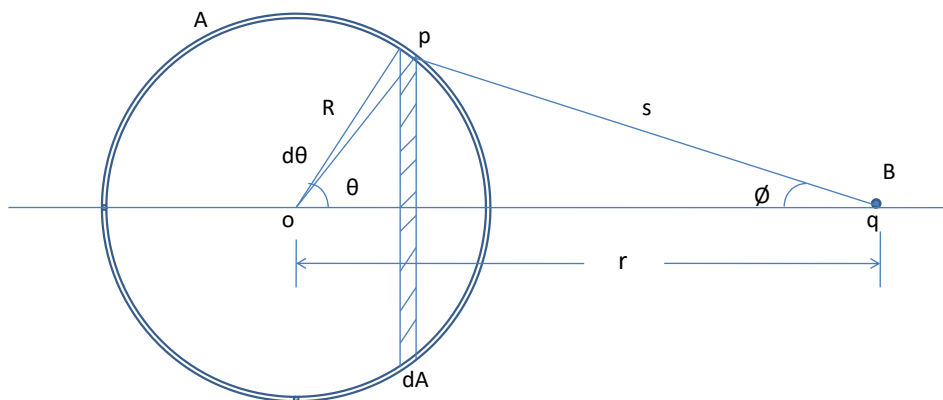
$r$  = Distance between two elementary particles or bodies

$G_s$  = Gravitational constant for spherical distribution

$G_q$  = Gravitational constant for quantum invariably.

### 3. Shell theorem:

Consider two bodies A and B separated by distance  $r$ . Assume that body A is large and shell shaped having radius  $R$  and thickness of the shell is extremely small. Another body B is a point mass. Let  $M$  be the mass of Body A and  $m$  be the mass of body B. Consider a very thin ring of a shell A having very small area  $dA$  and thickness  $dt$  as shown in figure given below. Let  $\sigma$  be the area density of mass of a given shell shaped body A.



Area density of mass of body A is given as

$$\sigma = \frac{M}{4\pi R^2}$$

Mass of small elemental area is given by

$$\begin{aligned} dM &= \sigma dA \\ &= \sigma (2\pi R \sin\theta) R d\theta \\ &= \sigma 2\pi R^2 \sin\theta d\theta \\ &= (\sigma 4\pi R^2) \sin\theta d\theta / 2 \\ &= M \sin\theta d\theta / 2 \end{aligned}$$

The force exerted by each part of the ring is a vector and we must add these vectors. From the symmetry however the gravitational force on B will be along the axis of the ring. So we need to add the vectors only along the axis. Each infinitesimally small part along the perimeter of ring exerts a force towards it and component of this force along the axis is given as

$$dF_q = \left( \frac{G_s M m \cos \alpha}{r^2} + G_q M m \right) \cos \theta$$

Let  $\cos \alpha = 1$

$$dF_q = \left( \frac{G_s m dM}{s^2} + G_q m dM \right) \cos \theta$$

The total quantum gravitational force of the shell A on a point body B is given as

$$\int dF_q = \int \left( \frac{G_s m dM}{s^2} + G_q dM m \right) \cos \theta$$

$$F_q = \int \frac{G_s m dM}{s^2} \cos \theta + \int G_q m dM \cos \theta$$

Substituting the value of dM, we get

$$F_q = \int \frac{G_s m M \sin\theta d\theta / 2}{s^2} \cos \theta + \int G_q m (M \sin\theta d\theta / 2) \cos \theta$$

$$F_q = \int \frac{G_s m M \sin\theta \cos\theta d\theta}{2s^2} + \int G_q m (M \sin\theta \cos\theta d\theta) / 2$$

$$\text{Let, } F_q = I_1 + I_2$$

From cosine rule we write,

$$\cos\theta = \frac{r^2 + R^2 - s^2}{2rR}$$

$$\cos\phi = \frac{r^2 + s^2 - R^2}{2rs}$$

All three  $\theta$ ,  $\phi$  and  $s$  vary. Let's make the  $s$  an independent variable. Differentiating both sides of equation for  $\cos\theta$  gives

$$\sin\theta \, d\theta = \frac{s \, ds}{rR}$$

We can then substitute this equation and expression for  $\cos \phi$  in our expression for  $I_1$

$$\begin{aligned} I_1 &= \int \frac{G_s M m}{2s^2} \left( \frac{r^2 + s^2 - R^2}{2rs} \right) \frac{s}{rR} \, ds \\ &= \int \frac{G_s M m}{4Rr^2} \left( \frac{r^2 + s^2 - R^2}{s^2} \right) \, ds \\ &= \int \frac{G_s M m}{4Rr^2} \left( \frac{r^2 - R^2 + s^2}{s^2} \right) \, ds \end{aligned}$$

The variable  $s$  varies from  $(r - R)$  to  $(r + R)$ . Using proper limits, the total force due to the shell A on point mass B is given by

$$\begin{aligned} I_1 &= \int_{r-R}^{r+R} \frac{G_s M m}{4Rr^2} \left( \frac{r^2 - R^2 + s^2}{s^2} \right) \, ds \\ I_1 &= \int_{r-R}^{r+R} \frac{G_s M m}{4Rr^2} \left( 1 + \frac{r^2 - R^2}{s^2} \right) \, ds \end{aligned}$$

By using integral calculus we get,

$$I_1 = \frac{G_s M m}{4Rr^2} (4R)$$

$$I_1 = \frac{G_s M m}{r^2}$$

Now we will evaluate the term  $I_2$

$$I_2 = \int \frac{G_q M m \sin\theta \cos\phi \, d\theta}{2}$$

From cosine rule we write

$$\cos\theta = \frac{r^2 + R^2 - s^2}{2rR}$$

$$\cos\phi = \frac{r^2 + s^2 - R^2}{2rs}$$

All three  $\theta$ ,  $\phi$  and  $s$  vary. Let's make the  $s$  an independent variable. Differentiating both sides of equation for  $\cos\theta$  gives

$$\sin\theta \, d\theta = \frac{s \, ds}{rR}$$

We can then substitute this equation and expression for  $\cos\phi$  in our expression for  $I_2$ . The variable  $s$  varies from  $(r - R)$  to  $(r + R)$ . Using proper limits, the total force due to the shell A on point mass B is given by

$$I_2 = \int_{r-R}^{r+R} \frac{G_q M m}{2} \left( \frac{r^2 + s^2 - R^2}{2rs} \right) \frac{s \, ds}{rR}$$

$$= \int_{r-R}^{r+R} \frac{G_q M m}{4r^2 R} \left[ (r^2 - R^2) + s^2 \right] ds$$



$$\begin{aligned}
&= \frac{G_q M m}{4r^2 R} \left[ (r^2 - R^2) s + \frac{s^3}{3} \right]_{r-R}^{r+R} \\
&= \frac{G_q M m}{4r^2 R} \left( \frac{12r^2 R - 4R^3}{3} \right) \\
&= G_q M m \left( 1 - \frac{R^2}{3r^2} \right)
\end{aligned}$$

But from geometry we know that

$$\frac{R}{r} = \sin \theta$$

Therefore,

$$I_2 = G_q M m \left( 1 - \frac{1}{3} \sin^2 \theta \right)$$

Therefore the total quantum gravitational force of the shell A on a point mass body B is

$$F_q = \frac{G_s M m}{r^2} + G_q M m \left( 1 - \frac{1}{3} \sin^2 \theta \right)$$