Force of Quantum Gravity Between Two Bodies

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Consider two bodies A and B separated by distance r. Assume that body A is large solid sphere having radius R_s. 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 a shell of A having radius R. Assume that thickness of shell is dR as shown in figure given below. Let σ be volume density of mass of a given shell shaped body A.

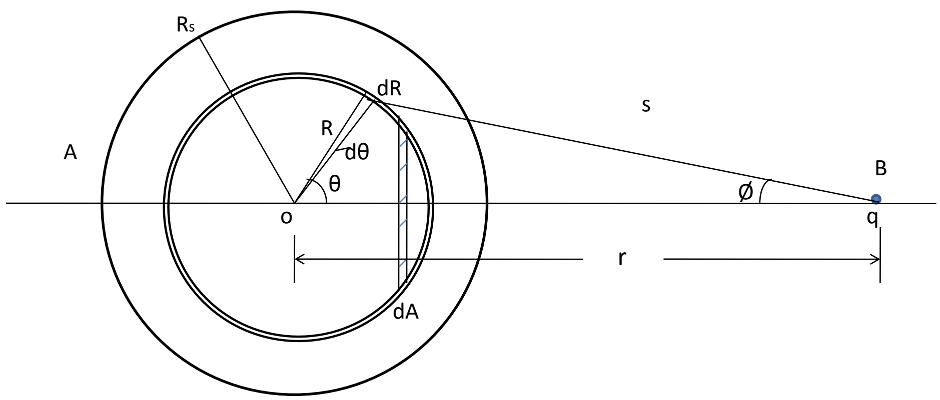

Figure : 1

Let dM be the mass of thin shell of A with thickness dR

$$dM = 4\pi R^2 \sigma dR$$

According to Shell theorem of quantum gravity, the quantum gravitational force dF_q of the thin shell of A on a point mass body B is given by [1]

$$dF_q = \frac{G_s dMm}{r^2} + G_q dMm \left(1 - \frac{1}{3}\sin^2 Ø\right)$$

$$= \frac{G_s 4\pi R^2 \sigma m dR}{r^2} + G_q 4\pi R^2 \sigma m dR \left(1 - \frac{1}{3}\sin^2 Ø\right)$$

The total quantum gravitational force of sphere A on body B can be calculated by integrating the above equation

$$\int_{R=0}^{R=Rs} dF_q = \int_{R=0}^{R=Rs} \frac{G_s 4\pi R^2 \sigma m dR}{r^2} + \int_{R=0}^{R=Rs} G_q 4\pi R^2 \sigma m dR \left(1 - \frac{1}{3}\sin^2Ø\right)$$

$$\int_{R=0}^{R=Rs} dF_q = \int_{R=0}^{R=Rs} \frac{G_s 4\pi R_0^2 \sigma m dR}{r^2} + \int_{R=0}^{R=Rs} G_q 4\pi R^2 \sigma m dR - \int_{R=0}^{R=Rs} \frac{1}{3}\sin^2Ø \, G_q 4\pi R^2 \sigma m dR$$

From figure 1 we know that

$$\tan^2Ø = \frac{R^2}{r^2}$$

$$\int_{R=0}^{R=Rs} dF_q = \int_{R=0}^{R=Rs} \frac{G_s 4\pi R^2 \sigma m dR}{r^2} + \int_{R=0}^{R=Rs} G_q 4\pi R^2 \sigma m dR - \int_{R=0}^{R=Rs} \frac{1}{3}\left(\frac{R^2}{r^2}\right) G_q 4\pi R^2 \sigma m dR$$

$$\int_{R=0}^{R=Rs} dF_q = \int_{R=0}^{R=Rs} \frac{G_s 4\pi R^2 \sigma m dR}{r^2} + \int_{R=0}^{R=Rs} G_q 4\pi R^2 \sigma m dR - \int_{R=0}^{R=Rs} \frac{1}{3r^2} G_q 4\pi R^4 \sigma m dR$$

$$F_q = \frac{G_s 4\pi R_s^3 \sigma m}{3r^2} + \frac{G_q 4\pi R_s^3 \sigma m}{3} - \frac{G_q 4\pi \sigma m}{3r^2}\left(\frac{R_s^5}{5}\right)$$

We know that the mass M of solid sphere A is given by

M = mass density of volume x volume

$$M = \sigma \times \frac{4\pi R_s^3}{3}$$

$$= \frac{4\sigma\pi R^3}{3}$$

$$F_q = \frac{G_s Mm}{r^2} + \frac{G_q Mm}{1} - \frac{G_q Mm}{1}\left(\frac{R^2}{5r^2}\right)$$

$$F_q = \frac{G_s Mm}{r^2} + G_q Mm\left(1 - \frac{R^2}{5r^2}\right)$$

From figure 1 we know that

$$\sin^2 Ø = \frac{R_s^2}{r^2}$$

$$F_q = \frac{G_s Mm}{r^2} + G_q Mm\left(1 - \frac{1}{5}\sin^2 Ø\right)$$

References:

1) Ravindra Sidramappa Mundase: - Theory of Quantum Gravity
(zenodo.org, Publication date10/02/2019, DOI: 10.5281/zenodo2561161)