Quantum Time Evolution Inside Black Holes

Mohamed Farah Idris [1], Shawgy Hussain AbdAlla [1], Mubarak Dirar AbdAlla [2]

[1] Department of Mathematics, Faculty of Science, Sudan University of Science and Technology, Khartoum, Sudan

[2] Department of Physics, Faculty of Science, Sudan University of Science and Technology, Khartoum, Sudan

Abstract

The behaviour of black holes is one of the most challenging problems facing cosmologists. It was thought that the behaviour of black holes can be described by quantum laws. In this model, using Schrödinger equation and the ordinary gravitational field equation for spherical bodies, a new quantum gravity equation was proposed to describe the behaviour of the black holes. Assuming that the universe undergo a phase transition to become a black hole or if the solar system is trapped by a black hole, the time evolution will certainly be different from that of our ordinary solar system. This work proves that the distance traversed by the moon in one day inside the black hole is equal to that traversed by the moon in 1000 year.

Keywords: black hole, quantum, moon, Schrödinger equation,

Introduction

Newton law of gravity one of the oldest physical laws which is concerned with describing the universe. According to Newtonian law gravitational field is the dominant field which describes the interactions between astronomical objects [1] . Unfortunately, recent observations concerning the gravitational red shift and the discovery of relic microwave background cannot be explained within the framework of Newtonian gravitational law. This encourages Einstein to formulate the theory of general relativity . General relativity comes as a natural extension of special relativity. According to the special relativity (SR) the laws of Physics take the same form for all frame of references that moves with uniform velocity with respect to each other [2]. These frames   are called inertial frames of references [3] . The general theory of relativity (GR)however is concerned with the frames of reference accelerated with respect to one another. An observer in an isolated laboratory at rest on the earth surface can detect the acceleration of the freely falling elevator . The acceleration causes the space to be deformed. The observer inside the elevator, however can not detect the field . This means that the gravitational field deform the space time coordinate [3,4]. The special theory of relativity is based upon two postulates. The first states that the laws of physics have the same form in all frames of reference moving at constant velocity with respect to each other .

General relativity big bang model (BB) succeeded in explaining a wide variety of phenomena concerning the universe. General relativity can explain the red shift which results from the expansion of the universe, the relic microwave background and the galaxy formation[5] . Unfortunately GR suffers from noticeable setbacks. One of the most important problems is that concerned with the behavior of exotic astronomical objects like pulsars and black holes [6].

 To cure the setbacks of the big bang BB model many alternative models were proposed. Some of these attempts are based on the string and superstring theories using multi dimensional space, in addition to the quantum field theory (QFT), beside unified theories (UT) [7] Quantum gravity is the suitable tool which describes the behaviour of block holes and the early universe [8,9] Many researches were made about the space-time behavior and the existence of extra dimensions in some exotic objects like black holes [10]. In Ibrahim and others work the paper is connected with the existence of short-range force using uncertainty principle [11]. The same researcher suggests transition of particles having critical masses from micro to macro world [12].Introducing the so called the cosmic universal quantum number he link the masses, times and dimensions of the micro and macro world [13]. In his paper, Mohamed S. Amir showed that elementary particles can be generated inside the black hole. This may indicate that the universe may originate from a black hole. He proved that the he masses and dimensions are related directly to Plank mass and radius [14]. This again confirms that the universe may originate from a black hole. The black hole behaviour is described by quantum laws. In the quantum world the ordinary laws of physics will no longer hold. One of them is the special relativity which states that the speed of light is the maximum speed in the classical world. But this will no longer hold inside block holes. This phenomenon was suggested by Mubarak Dirar who proves that the neutrino speed can sometimes exceed the speed of light using his generalized SR (GSR) theory [15].

2.Quantum gravitational model for black holes

Consider a moon of mass m revolving with speed v around the Earth having mass M. In this case:

$$\frac{mv^2}{r} = \frac{G\,mM}{r^2} \qquad (1)$$

Which means that the centrifugal force counterbalances the gravity attraction for the orbit of radius r. According to equation (1), the moon speed v is given by:

$$v = \left(\frac{GM}{r}\right)^{\frac{1}{2}} \qquad (2)$$

On the other hand, the moon speed v can be written in terms of the periodic time T to be:

$$v = \frac{2\pi r}{T} = \left(\frac{GM}{r}\right)^{\frac{1}{2}} \qquad (3)$$

But according to Newton's laws, the total moon energy is equal to the sum of kinetic energy (K.E) and potential energy (V), i.e.:

$$E = K.E + V$$

$$E = \frac{1}{2}m\,v^2 - \frac{GmM}{r} \qquad (4)$$

But from (1):

$$\frac{1}{2}m\,v^2 = \frac{GmM}{2r} \qquad (5)$$

Inserting equation (5) in (4) yields:

$$E = -\frac{1}{2}\left(\frac{GmM}{r}\right) \qquad (6)$$

Let us see how the gravitational energy looks like inside the new world which can be suggested as a very big black hole. According to the present models, the behaviour inside a black hole can be described using quantum laws.

For simplicity, assume that it obeys Schrödinger equation which is given by:

$$-\frac{\hbar^2}{2m}\nabla^2\psi + V\psi = E\psi \qquad (7)$$

For spherical electric potential:

$$V = -\frac{Ze^2}{(4\pi\,\varepsilon_0 r)} \qquad (7)$$

The energy of the electron is given to be:

$$E = -(m\,Z^2\,e^4)\,/\,(8\,\varepsilon_0^2\,h^2\,n^2)$$

$$n = 1,\ 2,\ 3,\ 4,\ \ldots \qquad (8)$$

Instead of the electron, consider the moon, while the nucleus represents the Earth of mass M. In this case, the potential energy of the moon with mass m is given by:

$$V = -GMm\,/\,r \qquad (9)$$

Comparing equations (7) and (9):

$$\frac{Ze^2}{(4\pi\,\varepsilon_0)} <-> GMm \qquad (10)$$

According to equations (10) and (8), the moon energy is quantized inside the new universe and is given by:

$$E = -\frac{\left(Z^2 G^2 M^2 m^3 \pi^2\right)}{\left(h^2 n^2\right)} \qquad (11)$$

In view of equations (6) and (11):

$$E \ = \ E① \ = \ \frac{GmM}{r} \ = \frac{\left(4\pi^2 G^2 M^2 m^3\right)}{\left(h^2 n^2\right)} \qquad (12)$$

Inserting (12) in (3) gives:

$$\frac{(2\pi r)}{T} \ = \ \frac{\left(2\pi\, G\, M\, m\, \sqrt{m}\right)}{(h\, n)}$$

$$2\pi\, r\, n \ = \ \frac{\left(2\pi\, G\, M\, m\, \sqrt{m}\right)}{h} \ = \ \frac{\left(G\, M\, m\, \sqrt{m}\right)}{h} \qquad (13)$$

Let us now see how the Earth system looks like in the new universe – strictly speaking, how the day, month, and year periods would look like.

To do this, we have to bear in mind that the minimum speed in the new universe must not exceed the speed of light c.

For simplicity, let the speed of the moon in the new universe, which is characterized by Planck parameters, be:

$$v① \ < \ c \qquad (14)$$

Since the speed of the moon v in the present universe is less than that of the new universe, this means that:

$$v \ < \ c \qquad (15)$$

Assuming the velocity to be quantized, thus consider the transformation:

$$n\, v \ \rightarrow \ c \qquad (16)$$

In view of equation (2):

$$n\, v \ = \ n\left(\frac{GM}{r}\right)^{\frac{1}{2}} \ = \ \left(\frac{GM①}{r①}\right)^{\frac{1}{2}} \qquad (17)$$

But fortunately, it was found that:

$$\left(\frac{GM①}{r①}\right)^{\frac{1}{2}} \ = \ c \qquad (18)$$

With M① and r① standing for the Planck mass and radius of the moon. According to equations (3) and (16):

$$n\, v \ = \ n\left(\frac{2\pi r}{T}\right) = \ c \qquad (19)$$

With r standing for the moon radius in the present universe, and T the periodic time is given by:

$$T \ = \ 30 \times 24 \times 60 \times 60 \qquad (20)$$

Thus equation (19) reads:

$$(2\pi\, r\, n) \, / \, (30 \times 24 \times 60 \times 60) \ = \ c \qquad (21)$$

Let us see how the distance traversed by the moon in one day looks like:

$$24 \times 60 \times 60\, c \ = \ ? \qquad (22)$$

According to equation (21):

$$24 \times 60 \times 60\, c \ = \ (2\pi\, r\, n) \, / \, 30 \qquad (23)$$

But numerical calculations of the moon radius gives

$$2\pi r \ = \ \frac{(24 \times 60 \times 60\, c)}{12,000} \qquad (24)$$

Rearranging gives:

$$2\pi r \times 12,000 \ = \ 24 \times 60 \times 60\, c$$

$$\left(\frac{2\pi r}{30}\right) \times 360,000 \ = \ 24 \times 60 \times 60\, c \qquad (25)$$

In view of equation (23):

$$\left(\frac{2\pi r}{30}\right)n \; = \; 24 \times 60 \times 60 \; c \qquad (26)$$

Thus the appropriate quantum number is:

$$n \; = \; 360,000 \qquad (27)$$

According to equation (25):

24 × 60 × 60 c = the distance travelled by the moon in one day in the new universe

$$= \; 2\pi r \times 12 \times 1000$$

= the distance travelled by the moon in 1000 years in the present universe   (28)

Discussion

Treating the black hole as spherical body of radius r obaying the ordinary gravitational square law as shown in equations (1) and (6) then using Schrödinger quantum mechanical equation a useful expression for the gravitational energy was derived. This is done by using the Schrödinger solution for the electron revolving around the nucleus and comparing the expressions of the electric potential in (7) and (9). The expression of the gravitational energy (11), indicated that the gravitational energy is quantized. Comparing this relation with the radius dependent relation in (6) together with the expression of the velocity in equations (2,3) the velocity is also quantized according to (13). To see how the time in the solar system in the new black hole universe looks like, this requires velocity transformation of moon speed from the ordinary universe to the new universe which is characterized by Plank era where the moon speed equal to the speed of light ad shown in equations (16,17). Equation (19) indicated that the speed of the moon multiplied by a quantum number n is equal to the speed of light which is the moon speed in the new universe. When this quantum number was found from equation (19) the results obtained indicated that the distance traversed by the moon in one day inside the black hole is equal to that traversed by the moon in 1000

Conclusion

The quantum gravity model for black holes indicated that the time evolution for the solar system inside the black hole is different from that of our ordinary solar system. The distance traversed by the moon in one day is found to be equal to that traversed by the moon in 1000 year.

References

1. Raymond A. Serway Physics for Scientists and Enginears with modern physics (saunders college publishing, USA, 2004
2. Derek, F., Lowden, An Introduction to ensor Calculus and Relativity, (John wiley and sons, New York, 1982)
3. M. Nakahara, Geometry, Topology and Physics, (Adam Hilger, Bristol, 1990).
4. S. Winberg, Gravitation and cosmology, (John wiley and sons, New York, 1972) chaps 5,6.
5. R. Adler, M. Bazin, M. schiffe Introduction to general relativity, (Mc Graw hill, New York, 1965
6. Mohammed Saeed Dawood, etab generation of Elementary particles inside black holoes at plank time, international J. of innov. Sci. Eng. And Tech., V.s, I Jan (2018
7. K. Huang, Quantum Field theory, (iley VCH, Weinheim, 2010).
8. Becker, K., M. Becher, and J.schwarz, String Theory and M-Theory: A modern Introduction, (cambrige university press, New York, 2007).
9. Susskind L., and J. Lindesay, An Introduction to black holes, information and string theory , world scientific, sirigapore, 2005.
10. Sami Abdalla Ahmed*1, Mubarak Dirar Abdalla2, Asim Ahmed Mohamed Fadol3 & Mohammed Merghani Rashed, emission of gravitational waves by black holes according to the generalized gravitational equations International journal of engineering sciences & Research technology , ISSN: 2277-9655, [Ahmed et al., 10(6): June, 2021] Impact Factor: 5.164, IC™ Value: 3.00 CODEN: IJESS7.
11. H. M. Kamal, M.Dirar, A. Eltahir, on the probability of the growth of density perturb during inflation , Sud. J. Basic. Sci.(M) No.4, (2005)
12. Ibrahim Hassan Hassan, Mohamed Ismaeil Adam, space-time correspondence of macro and micro world, journal of faculty of science, October (2015).
13. Ibrahim Hassan Hassan, Tagwa Mustaga Quantum scales, journal of faculty of sciencies, v.5, Nov (2018).
14. Mohammed Saeed Dawood, etab generation of Elementary particles inside black holoes at plank time, international J. of innov. Sci. Eng. And Tech., V.s, I Jan (2018).
15. M. Dirar, etal, Neutrino speed can exceed the speed of light ithin the framework of the generalized special relativity and savick as model, Nafural science 5 (2013).