Newtonian Quantum Gravity - Newton Laws from a Revolutionary Perspective

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23 October 2014

Abstract

Newton's inverse square law of gravity is very accurate in predicting the mutual gravitational responses of bodies within galaxies. Its predictions fail however in the outskirts of many galaxies and in cosmological scale analyses of the universe. Dark entities can be hypothesized for maintaining the law intact, yet the possibility that something is faulty not with our qualifications to sense dark constituents of the universe but with the law itself, cannot be ruled out. Through algebraic discussion I show that Newton equations can be interpreted in a new way at least as legitimate as their conventional way of interpretation. According to this new interpretation of Newton equations it comes out that the laws of gravity alter when the ratio between the mass of a gravitational source and the distance from it is smaller from a predetermined value. I indicate that gravitational fields may have a cutoff border at some mass dependent distance, i.e. possibly the influence of gravity is restricted in range and galaxies receding from one another according to Hubble law are gravitationally disconnected. My conclusion is that the common use of GR for cosmological scale analysis of the universe is very speculative and lacks any observational support.

Gravity, a universal law?

For thousands of years The Milky Way and the universe were considered by researchers one and the same. The Newtonian universal law of gravity was established about 350 years ago based on observations within the solar system since no others were available at Newton's era. GR was developed between the years 1907and 1916 regardless of the existence of galaxies. The existence of galaxies other than the Milky Way was an unknown and later on a debatable fact until early in the 1920s when the so called Great Debate between Shapley and Curtis has started to be resolved by the work of Ernst Öpik followed by the work of Edwin Hubble, who proved the Andromeda Nebula to be a distant extra-galactic object as argued by Curtis. So, when Newton and later on Einstein announced their discoveries about gravity, they indeed considered gravity a universal influence, yet in a finite cosmos dominated by the Milky Way and sized accordingly. Nowadays, according to most approximations the count of galaxies in the observable universe exceeds 100 billion. This information *per se* does not place in doubt the universality of gravity. What should be noted, however, is that while observations confirm that the motions of planets within the solar system as well as the motion of stars within galaxies obey Newton laws and more precisely the predictions of GR, confusingly there is no evidence that gravitational interactions between galaxies obey the laws of these theories. Actually, it is unfeasible to test whether galaxies receding from one another according to Hubble law are gravitationally attracted at all.

Any cosmologist aware of these facts should ask himself a serious question: is there a trustworthy basis for the widespread utilization of the conceptions of Newtonian gravity and of GR for cosmological scale analyzes of the universe?

Indeed, the fact that over intergalactic space ranges gravitational force fields are fading proportionally to the square of the distance is a great hint for a radiation like character of field distribution. Radiation, in turn, is known to propagate through space over unlimited distances. This combined information encourages a conventional thinking shared by physicists that gravitational fields behave alike. The galaxies receding from us according to Hubble law, are known to us due to electromagnetic radiation emitted from them, i.e. we are "radiationally" in touch with them by photons, the agents of electromagnetic fields. Why on earth should we doubt we are gravitationally in touch with them similarly, by the agent of gravity whatever it is? This conception, which the purpose of this assay is to challenge, has led the scientific community towards another set of assumptions: it is very firmly believed that the fate of the universe to either expand forever or to start to contract at some point of time depends on its energy density; that 72% of the density of the universe is in the form of dark energy; and that by successfully struggling with gravity a hypothesized field named inflaton field gave rise to the mutual receding of the material content of the universe in the big bang's first fractions of a second. But what if the distribution pattern of gravitational fields whatever it is, differs from that of electromagnetic fields? What if, unlike electromagnetic radiation, gravity is limited in range? What if we can prove algebraically that this possibility is at least as legitimate as the possibility that gravity is unlimited in range?

Let precede the discussion about these ifs with a more fundamental question.

Is it legitimate to conclude causality from the mathematical description of a physical phenomenon?

In order to comprehend the physics behind a math, one would usually organize equations such that causing factors are written on the right-hand side and their result is shown to the left. Things become more complicated when the same factors on the right-hand side of an equation can be formulated in more than one way, each for calculating a different physical outcome. What of such physical outcomes is **directly** initiated by the causing factors?

Such complication is exemplified by Newton equations for two different physical outcomes of the presence of a mass $\boldsymbol{M}$ in some point of space:

$$g = \frac{MG}{R^2} \qquad \{1\}$$

$$V_{ff} = \sqrt{\frac{2MG}{R}} \qquad \{2\}$$

Gravitational acceleration $\boldsymbol{g}$ and the velocity $\boldsymbol{V_{ff}}$ of bodies freely falling from infinity, both are physical outcomes of a mass $\boldsymbol{M}$ of a gravitational source and of the distance from it, $\boldsymbol{R}$. Since the same and only causing factors $\boldsymbol{M}$, $\boldsymbol{R}$ and $\boldsymbol{G}$ appear on the right-hand side of both equations and since each equation is a mathematical derivative of the other, one can legitimately quest: what gravitational fields produce in the first place? Are they the cause of a force which accelerates bodies until they acquire definite velocities i.e. are the local magnitude of the physical field and the local **acceleration** of a body moving freely through the field are in correlation at each point along the path followed by the body, or may be the factors on the right side are the cause of motion of bodies in definite velocities i.e. the local magnitude of the physical field and the local **velocity** of a body freely falling from infinity are in correlation at each point along its path? More briefly speaking, **is the physical gravitational field a force field or a velocity field?** In case it is a force field it should fade inversely proportional to the square of the distance in order to assign actuality to equation {1}. If, however, it is a velocity field it should fade inversely proportional to the square **root** of the distance in order to assign actuality to equation {2}.

Note that the physical content whatever it is of a gravitational field can fade through space one way or another but not both ways. A mass $\boldsymbol{M}$ can govern some property of the heavens to fade either inversely proportional to the square of the distance or inversely proportional to the square **root** of the distance, but surely not in two different proportionalities at once. Also bear in mind that the mathematical description of physical phenomena in general and of gravitational fields in particular, has no obligations to the intuition or preferences researchers may have. Following the discovery of quantum mechanics it became evident that the human brain's logic and the mathematical description of nature may coexist without agreement. It is therefore expected that where a physical phenomenon can be described by two different, yet equivalent, algebraic descriptions, a researcher will not assign priority to the one over the other unless supportive observations compel him or her for doing so.

What if they were wrong?

From said two algebraic equivalents {1} and {2}, Newton and the scientific community in follow of him picked up the first. Gravity to them is definitely an inverse square law field, a field obeying Gauss's flux theorem in a manner reducing to Newton's law as expressed by equation {1}, on the concept of which Einstein has developed his GR field equations. On what observational basis they did so, is a question of must which to my best exploration skills has never been asked nor discussed. Seemingly, they picked up the first without even noticing the existence of an alternative and hence without even noticing the consequences of their implicit choice. Factually, they assigned priority to one concept over the other without presenting observations compelling for doing so. What if they were wrong?

What if the physical gravitational field (rather than its mathematical presentation) is not a force field fading with the square of $\boldsymbol{R}$ as claimed by the first equation rather a velocity field fading with the square **root** of $\boldsymbol{R}$ as claimed by the second? One thing is undoubted: the physical content of a gravitational field is only one, and it fades either with the square of the distance **or** with its square **root**. The force of gravity can either be the cause of motion of bodies through space, or a result of the motion of bodies, but not both.

Gravity from Quantum Viewpoint

Don't let the fact that a body at rest, e.g. a vase standing still on a table, exerts a force (the weight of the vase) on the table to misguide you toward the common perception according which the force of gravity exists independently of motion of masses, i.e., that gravity is a force field. The elemental particles from which vases are made do have masses. The body at "rest" is composed of multitudes of elemental particles frenetically moving in their quantum realm. From a quantum viewpoint, therefore, the force of gravity (the weight of the vase) can be, and surely is, the result of a greater number of quantum motions of these particles towards the center of earth than away from it. The same must be true for a freely falling vase: its earthward motion is surely a summation of a greater number of quantum motions of its constituent particles towards the center of earth than away from it.

Let examine this viewpoint with better scrutiny.

Gravity as a real force

Imagine a test mass $\boldsymbol{m}$ resting on a table in a gravitational field of a planet of a mass $\boldsymbol{M}$. The force $\boldsymbol{F}$ measurable between the table and the mass according to Newton's inverse square law of gravity is:

$$F = \frac{mMG}{R^2}$$

{3}

Based on the other very well known laws of Newton, it is legitimate to substitute the force ***F*** in the equation of above by a change in momentum over time, ***dp/dt***, equivalent to the force ***F***:

$$\frac{dp}{dt} = \frac{mMG}{R^2}$$
{4}

When dealing with freely falling bodies said substitution is agreeable by all. The change in the velocity of a body during free fall unavoidably means a change in its momentum. It seems unacceptable however, that the same substitution is relevant also for cases where the mass is decisively resting on a table. What a change in momentum can be attributed to an object at rest?

Newton laws dictate, however, that it is legitimate to assume that the gravitational force measurable between the table and the mass is the result of a change in momentum, and thus a kosher answer to said question would be that in the quantum realm there is no rest. While the vase apparently rests on the table all its particles frenetically move and jostle in every direction. Statistically speaking, however, elemental particles may be assumed to respond to an external gravitational field with more frenetic motion, i.e. with an excess motion, namely with more jostle, towards the center of the field than towards the opposite direction. A force will then be exerted by the mass 'at rest' straight on the table which bars the earthward excess motion of the constituent particles of that mass. This force, which we use to refer to as "the gravitational force", is hence nothing more or less than a change in momentum (which is equivalent to the excess motion barred, times the mass). The principle just described can probably be expanded to include all forces in nature: a force, any physical force, is nothing more or less than a change in momentum. Actually, may be there are no forces at all, only changes in the momentum of elemental particles in response to different types of velocity fields, one of which is the gravitational field as expressed by the velocity equation {2} above.

If this is true (if it isn't, i.e. if net motion of each particle towards earth in the quantum realm is statistically speaking zero, why objects weigh rather than simply float?), then the change in velocity, namely acceleration, of a freely falling mass is not the result of a gravitational force: it's the translation of a local gravitational potential into an excess motion toward earth. The translation of the local gravitational potential into earthward motion is performed by the elemental particles constituting the mass which, as suggested above, respond to an external gravitational field with more frenetic motion, i.e. with more jostle, towards the center of the field than towards the opposite direction. As the gravitational potential changes along the path followed by the particle, the earthward velocity of the particle changes respectively. Rearranging equation {4} to contain on its left side a dependant result of independent causing factors written on its right side, we are provided with an equation stating that over time a gravitational field is a cause of a change in velocity:

$$dv = \frac{MG}{R^2}dt \quad ,$$
{5}

All the factors on the right side of this equation are both causing and independent of their resultant change in velocity written on the right side. Choosing a time unit for ***dt***, i.e. 1 sec in a conventional system of units, the equation states that the force of gravity exerted by the weight of a body at rest on a table as a result of the net change in the velocity of the elemental particles (and hence in their momentum) constituting the body, is inversely proportional to the square of the distance from the center of the field. The net change in the velocity of a constituent particle of a body at rest is equal to the net velocity such particle develops towards earth in a unit of time. This velocity is repeatedly zeroed due to the resistance set by the (particles constituting the) table to the net earthward quantum motions of the particles constituting the vase.

Let's label V_r the net (i.e. excess) earthward velocity developed in a unit of time towards a mass M by elemental particles of a body at "rest" and define it as the "quantum rest velocity" to be abbreviated Quarv. Knowing that the whole body remains at rest, i.e. at a velocity of 0 ms^{-1} respective to earth and regardless of the Quarv developed by each of its particles, the net change dv in the velocity V_r of a constituent particle of a body at rest due to the resistance set by the barrier by which the rest state of the body is maintained, is equal to $Vr - 0$. Accordingly $dv = V_r$. and

$$V_r = \frac{MG}{R^2}$$

{6}

with units of $m \cdot s^{-1}$.

This result is, however, at odds with equation {2} above according which V_{ff} is proportional to the square **root** of MG and inversely proportional to the square **root** of R. If a gravitational field is indeed a velocity field, why Quarv, the net earthward quantum motions of particles constituting a body at rest differ in amount from Quaffive (abbreviation of "quantum free fall from infinity velocity"), the net earthward quantum motion of particles constituting a body freely falling from infinity? Why particles of a body at rest respond to the gravitational field of earth with a different earthward velocity comparing to the earthward velocity of particles of a body freely falling from infinity? Bear in mind that in this assay we refer to a possibility according which each particle translates the gravitational field it feels directly into velocity without the intermediation of a force (we actually deny the existence of forces at all and refer to forces merely as the summation of changes in momentum during a time unit). So, why a particle freely falling from infinity and a particle at rest translate the gravitational field of earth differently? To answer this serious question we must return to the 'happiest thought' of Einstein.

Happier than happiest

Einstein named 'happiest thought' the idea which has led him to discover the 'equivalence principle' and consequently develop GR. The idea is that freely falling masses feel no forces, i.e. they inert. Only masses that are not in free fall in a gravitational field feel the force of gravity, a feeling which is indistinguishable from the feeling of accelerated motion in free space under the thrust of a force equivalent to that of gravity. This line of thought enabled him to incorporate accelerated motions into the framework of special relativity, thus making it general.

So, according to Einstein's approach, particles freely falling from infinity differ from particles at rest and from particles freely falling not from infinity in that the first have never been acted by forces while both latter did[I].

Adhering to the assumption that gravity is a velocity field i.e. particles respond to gravitational fields by moving in a velocity corresponding to the local potential of the gravitational field they feel, and knowing that at any chosen location in a gravitational field particles that have never been acted by forces exemplify a different velocity than particles that did, the conclusion that the action of force on a particle changes the way it feels the gravitational field is unavoidable.

This concluded understanding answers our question of above why the gravitational field of a planet as felt by a mass freely falling from infinity differs from the same field as felt by a mass at rest: only particles that have never been acted by forces, such as particles freely falling from infinity without acquiring initial velocity by forced acceleration, are free of disturbances in their feeling of external gravitational fields. All other particles feel external gravitational fields with a disturbance, which reflects the summation of the forced momentum changes acquired by the particle since its moment of creation.

It is straight forward to assume that a disturbance in a gravitational field of a given mass $\boldsymbol{M}$ is a gravitational field by itself, superimposed on the gravitational field of the mass $\boldsymbol{M}$. Unavoidably we come to the conclusions (i) that the disturbance, which as mentioned above reflects the summation of the changes in momentum acquired by the particle during is lifetime is a disturbance in the self gravitational field of the particle superimposed on the net gravitational field of the mass $\boldsymbol{M}$ thus felt by the particle, and (ii) that the self gravitational field of a particle which did acquire changes in momentum differs in some manner from the self gravitational field of particles which did not. Momentum may be assumed accordingly the response of the elemental particle to the gravitational field of itself. Consequently, a particle **at rest** in the gravitational field of earth has a skyward momentum expressed as a self gravitational field which distorts the particle's feeling of the gravitational field of earth and reduces its influence on the particle (in the ratio expressed by {7} hereinafter). Such distortion is absent in the self gravitational field of a particle freely falling from infinity, which has **never been acted** by forces thus can feel the gravitational field of earth as is, without distortions.

The net earthward velocity (Quaffive) experienced by particles freely falling from infinity is thus greater by a factor of

$$\sqrt{\frac{2R^3}{MG}}$$

{7}

[I] A particle freely falling not from infinity is by definition a particle maintained or created in a system which at least once was acted by a force and the momentum it acquired was not canceled out by a later forced action.

from the earthward velocity (Quarve) experienced by particles at rest, a factor which is the ratio between equations {2} and {6}.

Back to causality

As can be appreciated by far and as long as no one knows what gravitational fields are composed of and by what mechanism they are generated and distributed[II], relating to gravitational fields as velocity fields is at least as legitimate as relating to them as force fields.

While like two sides of a coin the two approaches are algebraically equivalent as discussed, there are several far reaching consequences to the treatment of gravitational fields as velocity fields. The first such consequence I have chosen to discuss within the framework of this assay is that no infinite influence range can intuitively be attributed to gravitational fields in case they are velocity field. As I explained, the distribution through space of the velocity field must obey an inverse square **root** law in order to maintain the integrity of Newton laws. The distribution through space of a field obeying an inverse square **root** law is most likely not radial. Thus, according to the alternative approach suggested herein, that the distribution of gravitational fields indeed obeys an inverse square **root** law, peculiar behavior and deviation from the inverse square law of gravity at sufficiently large distances should be expected, as will be immediately explained.

The range of influence of gravitational fields:

Using geometrical reasoning, it is simple to explain why radiations diminish proportionally to the square of the distance from their sources. The Newtonian inverse square law of gravity is thus very reasonable once we choose to relate, as Newton did, to gravitational fields as force fields. Doing so, we implicitly determine that gravitational fields diverge in radiation like character of distribution, i.e. without range limitations.

Now, whatever the machinery by which a field can fade proportionally to the **root** of the distance is, it is **not** the intuitively simple machinery by which radiation is distributed. We can thus rest assured that if gravitational fields are velocity fields, which nothing proves otherwise, their physical content is **not** distributed from their center points along straight lines, hence not with unchanged radial velocity.

The next acceptable machinery for propagation and distribution of physical fields may be some kind of volumetric divergence. This makes much sense bearing in mind that gravity is comprehended as a phenomenon of space itself and not of discrete points within space. Walking, however, through this path it is required to dispense with the unverified[III] relativistic hypothesis according which gravity is limited to light speed. This is because the radial speed of distribution of a fluid diverging from a center and filling up a volume of space decreases with the cube of the distance. Starting even

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[II] Richard Feynman, The Character of Physical Law (1965), MIT Press (1985) p. 39
[III] see for example reference No. 7, Measurement of the Speed of Gravity by Yin Zhu

with 10^5 times faster than light propagation speed near the center of a mass, the radial propagation speed of volumetrically distributed gravity will approach zero at post galactic distances. To emphasize this, let assume the gravity of the solar system reaches 200AU in one second, that is averagely 10^5 times **faster than light**. In a volumetric distribution model this means that the gravity of the solar system fills up a volume of 200AU radii sphere every second. Assuming that the solar system is not ancient than 5 billion years, the volume its gravitational field could fill up, since its creation and up to today would not exceed a sphere of a radius of 530 parsec, a very small sphere of influence in cosmological scales. The above is an unbinding example only for emphasizing why in a divergence model other than radial, the range of influence of gravitational (or any other sort of) fields can not be automatically or intuitively concluded. In an article to follow I will present a mechanism by which gravity is distributed instantaneously (i.e. at infinite velocity) to a mass dependent range, thereafter becoming repulsive while continuing to propagate volumetrically to a time dependent range and at a decreasing velocity as suggested in said unbinding example.

A second far reaching consequence of the treatment of gravitational fields as velocity fields to be discussed in the framework of this assay is the immediate emergence of a mechanism for gravity. While 350 years of treating gravity as a force field ended without a clue for a possible mechanism of gravity, treating it as a velocity field leads to the following simple mechanism by which matter can find its path through gravitational fields.

Space tells quantum translators how to move

The most fundamental existence of mass known to us is the mass of elemental particles. The very basic attribute that distinguishes between massive particles and massless ones is that massive particles have rest masses, while massless particles do not have and are always speeding up at light speed. Devoted to the aforementioned understanding regarding what is "rest" in the quantum realm, rest mass can be imagined to be a tiny construction frenetically moving to every direction, one direction at a time, with the statistical summation over time of such movements towards a specific direction equaling zero. While each such frenetic movement of the mass may be considered "spontaneous", the above assumed tendency of a mass to respond to a gravitational field with more movements towards the center of a field than towards the opposite direction, can teach us that the frenetic movements are not really spontaneous rather obey some discrete function which takes the local magnitude of the gravitational field as a variable. The tiny massive construction should accordingly feel infinitesimal differences in the local magnitude of the gravitational field so as to perform (over a given time interval) more quantum movements towards the center of the field than towards the opposite direction. We can imagine the tiny massive construction as a tiny spherical array comprising multitudes of quantum translators each of which is separately taking the local magnitude of the field as an input and is translating it according to some discrete function to a time dependent number of directional and equal distance quantum leaps, as an output. With every such single directional leap the tiny construction as a whole will leap, such that over time the tiny construction, i.e. the elemental particle, will advance through the gravitational field in a velocity that is a statistical summation of the total activity of its multitudes quantum translators in response to the local magnitude of the field.

Guessing that the discrete function followed by each of the quantum translators constituting the spherical array returns per a unit of time a predetermined number of quantum leaps inversely proportional to the local magnitude of the gravitational field and in a direction towards the center of the particle, we surprisingly find out that the spherical array of quantum translators, namely the elemental particle, precisely obeys the Newtonian velocity law defined by equation {2} above.

So, according to a path followed by Newton, Einstein and the scientific community in follow of them, gravitational fields fade proportionally to the inverse square of the distance, but no one was able to invent up to today a mechanism that explains how matter traces such fields in its motion. According to a mathematically equivalent model suggested in this present paper, gravitational fields fade proportionally to the inverse square **root** of the distance, and a plain mechanism emerges that provides particles with a knowing around and with the capability of finding their paths through space.

A third far reaching consequence of the treatment of gravitational fields as velocity fields is the unavoidable conclusion mentioned above that inertia is the response of every elemental particle to the gravitational field of itself. An exciting fact about this conclusion is that the same mechanism that provides elemental particles with the knowing around that allow them finding their paths through space is also a mechanism providing for inertia. Gravitational mass and inertial mass are the workings of one mechanism responding to two coexisting gravitational fields: the gravitational field generated by masses external to the particle and the gravitational field generated by the particle itself.

Conclusions

Mathematically speaking, and so long as experimentally not proved false, the possibility that the agents of gravity are distributed volumetrically is at least as valid as the possibility that they are distributed along straight radial lines. The main conclusion one should take accordingly (even if doubting the actuality of the particular quantum mechanism just disclosed) is that the conception that galaxies (or clusters of galaxies) receding from one another according to Hubble law are gravitationally bound is very highly dubious. The Consequent conclusion is that the use of GR for cosmological scale analysis of the universe is very speculative and lacks any observational support.

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