The Gravitational Force Of The Relative Emptiness of Space
The missing link between general relativity and a theoretical solution to unsolved astrophysical problems

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Abstract
The problem to fit Newtonian, Einsteinian and Keplerian predictions with observations have been subject for discussion for a long time. The rotational curves of galaxies, the cosmic coincidence problem and astrophysical jets are examples of severe discrepancies between theory and actual observations. The scientific community is currently weighted towards the dark matter solution to the rotational curve problem while Modified Newtonian Dynamics (MoND) still has some support even though MoND over the last couple of years have been subject to criticism most notably for being unable to explain observations of the so called bullet cluster.

What hasn't been done recently is a re-evaluation of our understanding of gravity as a natural phenomenon. Previous works have thoroughly addressed problems separately, but few have examined the similarities and differences between the unsolved problems and searched for a unifying solution.
This paper will seek a common denominator concerning the conditions where the traditional theories are inadequate. Thereafter a theoretical solution will be proposed and tested on each of the astrophysical problems. Finally the solution will be used to describe two fundamental observations of Quantum Mechanics.

Introduction
Evidential support for the phenomenon of dark matter appears waterproof at the moment. Nevertheless the theory of dark matter rests on the assumption that our understanding of gravity as a phenomenon is correct. (http://arxiv.org/pdf/0911.1212v1.pdf) As long as dark matter isn't detected directly it cannot be ruled out that our understanding of gravity is insufficient.

Brief summary of different unsolved problems in astrophysics

1. The rotational curves of spiral galaxies
The rotational velocities of stars orbiting the galaxies are not decreasing as expected. Contrary to the Keplerian predictions the rotational curves seem to be independent of the distances to the centre of the galaxy.

Significant properties about spiral galaxies: the density is rapidly decreasing. The distances are vast compared to our solar system, but in a global scale spiral galaxies are small compared to the intergalactic void between the galaxies. Medium distances between objects, great differences in density. Discrepancies between visible matter and observations are growing with distance from the bulge and onwards.

2. The Coronal Heating Problem

The corona is seemingly violating the second law of thermodynamics, as the corona is several million degrees Kelvin hotter than the surface of the sun. (http://arxiv.org/ftp/astro-ph/papers/0511/0511841.pdf)

Significant properties: the density after the suns photosphere is rapidly decreasing. The distance is very small compared both to the solar system as a whole and even more so compared to the galaxy itself. The mass of the sun is dominating the solar system with 98-99 % of the total mass. The distance between the high-density object and the unexpected phenomena is small.

3. Anomalous increase of the astronomical unit

The average distance to the sun is growing faster than expected. (http://arxiv.org/pdf/1102.4572v8.pdf) If it is the sun losing mass causing the phenomenon the distance is medium. The effect is small and (probably) only measurable because earth is within our own solar system.

4. The Flyby Anomaly

Some spacecrafts are unexpectedly gaining energy during near earth flybys. (http://arxiv.org/pdf/1210.7333v1.pdf).
Significant properties of Earth: earth is losing density very fast after its surface and then have a second slower density loss in the atmosphere. The distance between earth and the phenomena is small and so is the inconsistency with predictions.

5. Accretions disc jets

Near assumed black holes accretions disc jets have velocities near the speed of light in vacuum. (http://arxiv.org/abs/1311.5080)

Significant properties: Ultra high-density object. Distance between origin of phenomenon and the object is small.

6. Cosmic Coincidence problem: Why is the energy density of the dark energy = density of matter

The assumed density of matter in the universe seems to correspond with the energy density of dark energy.

Vast distances involved. Small density differences in between galaxies enormous differences of density between areas – all the way from intergalactic void to super massive black holes.

7. Lack of gravity between distant galaxies/non deceleration of the metric expansion
The intergalactic void between galaxies has extremely small density differences. According to the document "Does gravity operate between galaxies? Observational evidence re-examined by Professor Francis J.M. Farley" the net force accelerating or decelerating the galaxies is apparently zero (http://arxiv.org/pdf/1005.5052v2.pdf).

As opposed to expected: gravity appears not to be able to slow down the metric expansion of the universe. Vast distances with small differences of density between the objects.

The problems to fit observations with the Newtonian, Einsteinian and Keplerian predictions can be categorised as below:

Category 1: Long distances, low densities

- Gravity between distant galaxies
- Cosmic Coincidence problem Why is the energy density of the "dark energy" = density of matter

Category 2: Short-medium distances, rapidly increasing/decreasing densities.

- Coronal heating problem
- The rotational curves of spiral galaxies
- Flyby anomaly
- Astrophysical jets
- Anomalous increase of the astronomical unit

Conclusion:
The common denominator between all the problems mentioned is that they include the extremes. Either the distances are vast or the distances are short and the density differences are huge.

In between the extremes where distances are relatively short and densities are close to uniform the Newtonian, Einsteinian and Keplerian frameworks seems to adequately predict the gravitational effects of celestial bodies.

Where distances are vast and densities are low as well as when distances relatively short and densities are rapidly declining the frameworks needs to be either modified or dark masses/energies, not currently quantifiable must be added to the equations.

A new theory must therefore involve both density-differences and the distance between those differences.

Searching for a solution:
Since rapid changing densities seems to influence the way gravity operates it is natural to analyse the observations where density differences are steeper than

elsewhere in the universe; the black holes. Not only is the gravitational force enormous near a black hole. It is generally assumed that a point of singularity is residing in the black holes, a point in space where density is infinite (http://arxiv.org/ftp/arxiv/papers/0806/0806.1176.pdf). Despite the enormous gravitational pull accretion disc jets are emitted at velocities near the speed of light at the opposite direction of the gravitational pull.

Even if there might be other explanations of the jets one must assume it could indeed be a gravitational phenomena. It could be argued that gravity might become repellent when infinite densities arise, but that would not explain any of the other problems mentioned above. However; if it is the lack of mass that accounts for the attraction then the theory possible will be transferable to the other problems.

With regards to the above generalisations a theory could be formulated as follows; the emptier a volume is compared to a neighbouring volume the stronger the attraction from the emptiness.

If the theory is correct then, wherever a significant difference of density between two points is at hand there must velocities and/or acceleration of particles/ celestial bodies that differs from what both the Einsteinian and Newtonian theories would foresee. The steeper the difference between the densities the less accurate the Newtonian and Einsteinian equations must be in the surrounding area. The expression relative emptiness of space (RES) will be used throughout this text to point out areas with substantial lower density than neighbouring volumes. The attractive force of that relative emptiness of space will be called RES-pull from here on.

In the next section the theory of RES-pull will be tested as theoretical solution of all of the previously mentioned discrepancies between classical theories of gravity and the actual observations of astronomy:

Fitting RES-pull with observations

The unexpected rotational velocities of Milky Way and other spiral galaxies
The main difference between Milky Way and our solar system is that the mass is not at all as concentrated near the centre. So contrary to our solar system the RES-pull is therefore spread out through the galaxy resulting in a faster than expected rotational curve.

For every drop of density outside the bulge of the galaxy the RES-pull must accelerate celestial bodies. At the same time; every step outwards is a loss of connection of the inner bulge by the classical inverse square law. The constant balancing between RES-pull and gravity determines the rotational velocity of the Milky Way.

Applying RES to the outer part of the Milky Way, where the density drop is severe, stars must be at faster velocity than traditionally presumed. An obvious example would be the velocity of the so called “ultracool subdwarfs” orbiting the galaxy (http://pono.ucsd.edu/~adam/presentations/0909uhertfordshire.pdf). In the RES-model they are not to be seen as an irregularity or a function of an encounter by another galaxy, but to the contrary; predictable events that is more or less inevitable to occur in any galaxy with severe density differences.

The Coronal Heating Problem

There must be a significant RES-pull after suns photosphere. The photosphere is much more dense than the corona. Particles after the photosphere should be moving very fast or be at much higher temperatures than suggested by standard theories. This would solve both the Coronal heating problem and the velocity of the solar wind.

Anomalous increase of the astronomical unit

The density differences in our solar system are small after the rapid density decrease at the outer part of the sun itself. 98-99% of the total mass is located within the sun. This calls for much RES-pull near the sun, but almost none past the sun. Consequently the orbits of the planets should not be heavily affected by RES-pull and the Keplerian model will be relevant. Nevertheless; as sun is losing mass outwards because of the solar wind not only will earth gain distance because of the decreasing gravity from the sun, but also because the density differences will be expanding towards earth resulting in stronger local RES-pull near earth pushing earth away. The average distance to the sun will therefore grow faster than expected by Newtonian and Einsteinian predictions.

The Flyby Anomaly

Earth is losing density very fast after its surface; therefore the RES-pull will be located close to the object. However the RES-pull must be somewhat smoothened out because of the density decrease of the atmosphere.

As stated by a team evaluating possible Dark Matter solutions of the phenomena: "In addition, the dark matter must be confined well within the moon's orbit and depleted near the earth's surface" (http://arxiv.org/pdf/0805.2895v4.pdf)

"As a result, the yet unknown origin of the flyby anomaly could signal the presence of new or "exotic" physics at play, a possibility which should not be taken lightly: indeed, while a new force could perhaps account for the flyby anomaly, it should also modify a plethora of other phenomena, from planetary orbits to E¨otv¨os-type experiments" (http://arxiv.org/pdf/1210.7333v1.pdf)

The area they are suggesting for a possible dark matter halo corresponds very well with where the local RES-pull would be located. This leads to the following conclusion: there is no need for dark matter explanation if the theory of RES-pull is correct. Since the dark matter explanation also needs to justify why the halo should be present at that exact position one might conclude that Occam's razor strongly favours the RES-theory.

Astrophysical-jets – A very strong indicator of the correctness of the RES-theory

The density loss is greater north and south of the accretion disc near a black hole. Consequently the RES-pull there must be much stronger there than elsewhere around the black hole. Since there is alleged to be a singularity of infinite density inside a super massive black hole the RES-pull must be enormous. As previously stated; the steeper the density difference the stronger the RES-pull. The only variable stopping the RES-pull from being equal to the speed of light is the density surrounding the black hole. Observations are in full accordance with the RES-theory: "Only very little energy (~ 10 ^48 erg) is contained in the relativistic jet with initial velocity about 0.94 times the speed of light" (http://arxiv.org/pdf/1104.0754.pdf)

According to framework of Einstein the only thing changing when adding energy to a particle closing in to speed of light is its mass. For the relativistic jet to be sustained at such an high velocity the energy added must be extraordinary.

If a black hole compresses a mass to a density close to infinity a relativistic jet close to the speed of light is an obvious answer to the extreme density of a black hole. As the density difference in the black hole approaches a singularity the acceleration of any particle the RES-pull approaches light speed.

Other problems of physics where RES might be relevant

The hierarchy problem

Is RES-pull the reason gravity appears to be about 10^36 weaker than the electric force? (In a hydrogen molecule gravity pulls the two protons together with a force about 36 powers of ten weaker than the electric force between them).

When applying RES-theory to the hierarchy problem it seems to disappear. A lone hydrogen molecule in a low-density area would be surrounded by a very strong RES-pull since the density is very high relative to its surroundings, but if 10^36 molecules are drawn together by gravity the density will be uniform enough for gravity to overcome the RES-pull. In other words: the location of the RES-pull would have been relocated outside the high-density area. The ultimate transfer of RES-pull within the universe would be the area next to a singularity.

If the RES-theory is correct the hierarchy problem says more about how closely RES-pull and gravity are related in strength than about how "weak" the force of gravity is.

Cosmic Coincidence problem: Why is the energy density of the "dark energy" = density of matter

A RES-pull is directly proportional to density-differences. A changing average density pattern of universe will also change the "shape" of the universe. Since the density "outside universe" is zero the average density of matter inside brane equals the RES-pull from outside brane. When density at any point inside universe increases (so the total density differences increases) the RES-pull from outside brane would increase. This is manifested by a metric expansion of space.

The total density-differences of universe remains unchanged:

- A density-difference increase should result in a corresponding metric expansion.
- Accelerated, increasing density-differences should result in an accelerated metric expansion.
- Decelerated increasing density-differences should result in a decelerated metric expansion.
- A density-difference decrease (unlikely on a global scale at present state) would result in a metric contraction.
- An accelerated decrease of density-differences should result in an accelerated metric contraction.

The present "dark energy" is nothing else than the manifestation of many local increasing density-differences.

Gravity between distant galaxies
According to the document "Does gravity operate between galaxies? Observational evidence re-examined by Professor Francis J.M. Farley" the net force accelerating or decelerating the galaxies is apparently zero. The prediction of the RES-theory is clearly supported by observation.
(http://arxiv.org/pdf/1005.5052v2.pdf)

The observation is the fundamental consequence of the balance between RES-pull and gravity. The metric expansion is not decelerated by gravity since the metric expansion IS the effect of total gravity/RES-pull of the universe.

M-sigma relation
(http://arxiv.org/pdf/1204.0144v2.pdf)
The more massive a black hole is the greater the total change in RES-pull have been over time. The velocity of celestial bodies must heavily depend on their individual position as the RES-pull progressed through the bulge as the black hole gained mass. Thus; the more massive the black hole the greater differences of velocities within the bulge.

The relationship between the velocity dispersion in the bulge and RES will be dealt with after the Quantum Mechanical implications of RES have been examined.

The white hole/the big bang according to RES.
"In the classical theory of general relativity one cannot predict how the universe would have begun because all the known laws of science would have broken down at the big bang singularity" (A brief history of time – Stephen Hawking p. 260)

With the theory of RES-pull one natural law would prevail the singularity of the pre-big bang state: Any singularity with no corresponding density surrounding it would be surrounded by an infinite RES-pull. Such a state is determined, with the slightest quantum mechanical change of state, to instantly produce a white hole sending relativistic jets in all directions.

If it is true that RES-pull survives when all other laws of science breaks down, even at singularity, it must mean that the theory of RES-pull is relevant in Quantum Mechanics.

The Correlation Between Relative Emptiness of Space and Quantum Mechanics

Single slit experiment as a proof for RES

To understand the implication of RES on quantum mechanics it is important to remember that if two objects at distance of 1 unit are separated by a void the void is relatively emptier than a void of same density but the distance between the objects is greater than 1 unit.

Hence; If there is a wall of high density with a low density slit; the smaller the slit is the greater the corresponding RES-pull will be. The consequence of a greater RES-pull will be that particles further away in all directions will be more affected by the RES-pull. That must mean incoming particles at greater angles. The end result will be a wider distribution of particles after the slit.

The theory of RES-pull is in absolute accordance to the single slit experiment. "If light consisted strictly of ordinary or classical particles, and these particles were fired in a straight line through a slit and allowed to strike a screen on the other side, we would expect to see a pattern corresponding to the size and shape of the slit. However, when this "single-slit experiment" is actually performed, the pattern on the screen is a diffraction pattern in which the light is spread out. The smaller the slit, the greater the angle of spread."
(http://en.wikipedia.org/wiki/Double-slit_experiment)

Double slit experiment with one quanta at the time

Stephen Hawking in his book 'The Grand Design': "That means that particles that would have landed in the area of the dark band if, say, only slit one was open, do not land there when slit two is also open. It seems as if, somewhere in their journey from source to screen, the particles acquire information about both slits."

The question arises: how does a single particle "know" that another lid has been opened? Without RES-theory the answer is a mystery. With the understanding of RES-pull the answer is obvious; the RES-pull make the very same thing for quantum mechanics as the Einsteinian space-time does for celestial bodies. It creates a curvature in space that particles/waves are bound to follow.

Solutions to the route of a certain quanta must be considered as the RES equivalent to the N-body problem in general relativity.

Conclusions.
The gravitational Force/Curvature of the Relative Emptiness of Space appears to be an adequate theoretical solution of unsolved Astrophysical problems as well as a fundament for better understanding of Quantum Mechanical observations.

The mathematical framework is still under progress and is expected to be completed during 2014.

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