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An Alternative Perspective on Acceleration and Gravity for Matter in Space

This paper is to provide a new perspective to the Principle of Equivalence in an examination of that foundational point for General Relativity and in the process give a new view on the connection of acceleration and gravity for matter in space. The proposal is that matter and space are truly connected and that connection gives a new interpretation to acceleration and gravity.

Finding Gravity in an Unlikely Place

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This paper is to provide a new perspective to the Principle of Equivalence[1] in an examination of that foundational point for General Relativity and in the process give a new view on the connection of acceleration and gravity for matter in space. The proposal is that matter and space are truly connected and that connection gives a new interpretation to acceleration and gravity.

Newton's Laws, Force and Acceleration

Newton's First Law tells us an object will remain at rest or move at a constant velocity unless acted upon by an outside force. The first part of this Law fits into Einstein's Special theory of Relativity (**SR**) which pertains to an Inertial Reference Frame (**IRF**). In SR gravity is not in the picture. Under constant velocity there is no sensation of an acting force on the IRF; gravity seems to be absent, but with the introduction of acceleration a force is experienced.

The second part of Newton's First Law leads to his Second Law describing this outside force as a product of the object's mass and its acceleration.

$$F = ma$$

Here the mass is defined as Inertial Mass (**IM**), the mass that is being pushed or pulled.

Newton's theory of Gravity: $F= GM_1M_2/R^2$ introduces another perspective on mass, Gravitational Mass (**GM**). Here a seemingly different kind of mass is somehow caught up in the hidden undetectable field of gravity through the void of space.

Principle of Equivalence

The General Theory of Relativity (**GR**) gets connected to Newton when Einstein proposes the Equivalence Principle (**EP**) which says that the IM is equivalent to the GM because the gravitational force experienced on earth is the same 'pseudo force'[2] experienced in an accelerated frame of reference. Inside a closed accelerating rocket ship the occupant cannot distinguish between an acceleration equivalent to what is found on Earth and gravity.

The two measures of mass are thought to be different but empirically they are the same. The inertial mass and the gravitational mass had been considered separate entities but surprisingly they quantitatively agree[4], and Einstein thought this was more than a coincidence.

For Einstein and physics this was a strange but useful coincidence and a consequence of his geometrical space-time theory.[3]

From John Norton's paper-"Einstein's principle of Equivalence":

"While preparing a review article on his new special theory of relativity, he became convinced that ***the key to the extension of the principle of relativity to accelerated motion lay in the remarkable and unexplained empirical coincidence of the equality of inertial and gravitational masses.**** To interpret and exploit this coincidence, he introduced a new and powerful physical principle, soon to be called the "principle of equivalence" upon which his search for a general theory of relativity would be based…" [5]

Inertial Mass (IM) and Gravitational Mass (GM)

The two measures of mass have been thought to be two different things. The difference was established by science, but is it a distinction without a difference? IM shows up in Newton's force equation F =ma; and GM appears in Newton's gravity formula $F = GM_1M_2/R^2$. It was natural to expect that the mass in these two equations would have some inherent difference because gravity and acceleration are perceived by science not to be the same thing and were unrelated per the understanding at the time. Einstein says although they are different, they are equal; not because they necessarily are the same thing, but because an observer cannot find a difference (reference the famous thought experiment for acceleration of a closed in rocket ship).

Why does the sensation of an unknown acting force on an object appear with the acceleration of that object? Is that just Newton's 3rd Law or is there more to it? An astronaut in an IRF in space experiences G-Forces upon acceleration.

**** Italics and bold added here***

Nature's Forces

The four fundamental forces of nature are the Strong interaction, the Weak interaction, Electromagnetism, and Gravity. The Strong force works to keep protons and neutrons together. The Weak force involves radioactive decay and fusion. The electromagnetic force is about the interaction between particles that have charge. Gravity is the unknown that still has not been incorporated into the standard model.

How do the different forces of nature behave?

- The strong force interaction has a limited range.
- The Weak force interaction has a limited range.
- The Electromagnetic force has an unlimited range in theory, but its effect drops off with distance.
- The Gravity force interaction could not be explained by Newton. Einstein has given a complex, difficult, and still controversial theory that marries space and time where now gravity is a kind of pseudo-force that is not real and only emerges as a consequence of the dynamics of Einstein' Space-Time geometry.

An alternative view of the fourth fundamental Force of Nature-Gravity

In a previous paper the author offered an alternative view that space and matter are connected at the smallest scale and that idea is explored more here. [6]

- Space is all continuously connected at the smallest scale and space is connected to matter at the smallest scale.
- That connection is Gravity.
- It is manifested by the interaction of matter under acceleration. Matter is experiencing acceleration at the atomic scale and up to the galactic scale
- The force is a constant changing only with scale and concentration of matter within the defined geometry
- At the smallest scale it is the weakest, but the connection continues throughout.
- As the scale increases for matter, the apparent force and range also increase. The force is tied together throughout.

- At the micro scale the amount of matter/space is small, the effective force and range is small.
- At the macro scale the amount of matter/space is larger, the effective force and range is larger.
- The gravity force behavior is unique. It is seemingly indifferent to all and at the same time in touch with everything.
- Gravity has a unique interaction compared to the other forces

The unique interaction of Nature's Gravity 'Force' with the world is understood with the simple analogy of '*a dog on a short leash'*. (The leash is just long enough not to pull on the dog unless the dog accelerates via a change in speed or direction.) A dog that moves along with his owner in a constant straight line does not sense the hold or force of the leash. If the dog changes direction or accelerates, then the force of the leash is felt. It is always there, but not encountered if there is no acceleration.

It is the same for matter in space. A stationary or a constant IRF in SR would not experience Gravity until there is acceleration and then what was always there responds to the change. Space apparently has no visible interaction with an IRF until the introduction of acceleration. The interaction is still not visible under acceleration, but it is there. The force awakens and it is felt. The presence of a 'gravitational field' is just the confirmation of an accelerating mass, whether an IM or a GM. Newton's Laws are best understood when space is brought into the picture.

Acceleration displays nature's connection to the force of gravity. It is no different for an accelerated object in empty space or a planet moving through space. To space both are accelerating masses. The Inertial Mass and the Gravitational Mass are the same. The large GM could certainly display a different response such as the tidal force[3] if observed closely, but it is still accelerating matter dancing with space.

When an object in an Inertial Reference Frame (IRF) is accelerated, there is an interaction with Space. That interaction can be perceived of as what has long been understood as gravity. Gravity emerges as a natural consequence of an object accelerating in space regardless if the object is an IM or a GM moving in an IRF at a constant velocity.

Gravity is an inherent property permeating the Universe at one with Matter and Space. It emerges where we find acceleration from the smallest atomic scale out to the galaxies. It is not married to Time.

By Kenneth Paul Hoffman © 24 July, 2018

1.) https://en.wikipedia.org/wiki/Equivalence_principle

2.) https://en.wikipedia.org/wiki/Fictitious_force

3.) http://www.einstein-online.info/spotlights/equivalence_principle.html

4.) http://astronomy.swin.edu.au/sao/downloads/HET625-M04A01.pdf

5.) http://pitt.edu/~jdnorton/papers/ProfE_re-set.pdf

6.) http://www.gsjournal.net/Science-Journals/Research%20Papers-Cosmology/Download/7037