ON A CONCEPT OF THE ELECTROMAGNETIC NATURE OF GRAVITY AND INERTIA

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ABSTRACT

The writer brings back to light the well-known fact that vectors of attractive forces of magnets and electrostatic charges are linear and repulsive forces are tangential. The writer asserted that as the consequence of this fact, the attraction between opposite polarities (of magnets and electrostatic charges) and repulsion between same polarities is not equal due to the different geometry of the field, and therefore different density of the field between two (or more) charges (magnets). This asymmetry actually can account for gravitation. That would bring gravitation to the family of electromagnetic forces.

The writer also elaborates on the idea of possibility of electromagnetic origin of inertia, brought in by late Prof. William (Bill) Hughes from the University of South Dakota.
The consequence here would be an inherence and independence of inertia, in accordance with Newton's views.

GRAVITY

(Kopernicky – Hughes)

Gravity. Surely this force must be capable of an experimental relationship to Electricity, Magnetism and the other forces, so as to bind it up with them in reciprocal action and equivalent effect. Consider for a moment how to set about touching this matter by facts and trial.

Faraday in his Diary on March 19, 1849

UNIVERSAL GRAVITATION IS MERELY RESIDUAL PHENOMENON OF ELECTRICAL ATTRACTION AND REPULSION

(Faraday)

It is well known that gravitational forces vary inversely as the second power of distance and are always attractive. Thus it has conventionally been reasoned that gravitation could not be an electric (or magnetic) phenomenon, based on Coulomb assumption that attractive and repulsive (electrical and magnetic) forces are exactly equal.

However, the writer had, for some (30 +) years, performed experiments with magnets and electrostatic charges with results clearly and repeatedly showing that attractive and repulsive forces differed slightly, the attractive force being greater. Measurements performed in independent laboratories confirmed this finding. Assuming that this fact has to be well known, or caused by known phenomena, and because this phenomenon is relatively easy to observe, the author was reluctant to publicize results of these tests. Since two magnets are really mathematically the equivalents of two dipoles, each consisting of a north and south (pole), the writer assumed that two electric dipoles would behave similarly because each would consist of a positive and a negative charge, providing both – attraction and repulsion. Since the difference shows stubbornly (no single test indicated otherwise), the writer certainly would not tend to discourage any further attempts for peer independent tests.

Only about ten years later, in June 1999, considering significance of the formula $\mathbf{E = mc^2}$ – the writer finally wrote the paper *Gravitation as an Electromagnetic Attractive force.*

He conjectured that if the attractive force between equal and unlike electric charges of matter slightly exceed the repulsive forces between equal and like electric charges, the difference **could account for gravity.** This would mean that the Coulomb assumption that attractive and repulsive forces are exactly equal may led us to misunderstand the nature of gravity for centuries.

The peer reviewer of the paper, Professor Bill Hughes from the University of South Dakota, commented first that it must be very difficult to find and observe the difference between attraction and repulsion. After his experiment with Brook coil and a ring magnet, called an “inchworm experiment”, he assumed that until recently, the observed

difference was just ignored because of the Coulomb assumption of equality taken for granted.
The observed difference between attraction and repulsion led the writer to the realization that the difference is not in differences between polarities. He concluded that the difference must be in the field's geometry.
Therefore, the Coulomb's law for attraction can not fit the same way for repulsion, due to repulsion vectors acting **tangentially**, versus (quasi)**linear** attractive forces.

Fig. 1 shows vectors of the attractive force between two dipoles focused, so is a density of attractive flux (field). Vectors of the repulsive force (red / grey) are diffused, and then also repulsive field area between dipoles must be less dense.

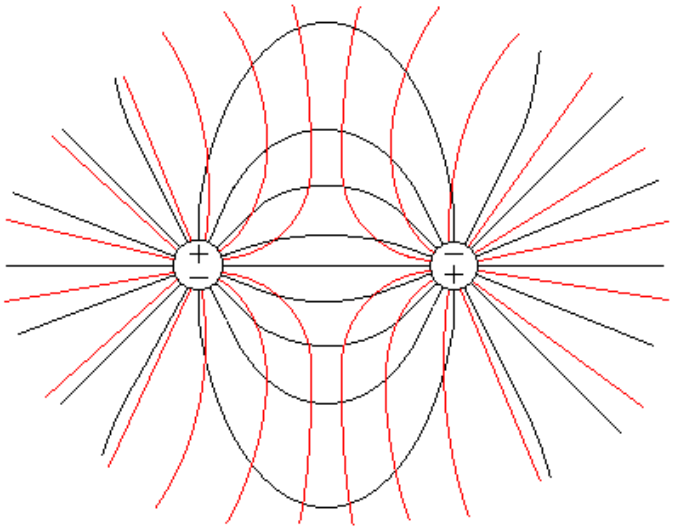


Fig. 1

Vectors or "lines of force" (depicting density and direction in a three dimensional field) of similar polarity are bent *tangentially* by the repulsive force, "stretching" the distance **d** (or ***r***), while vectors of opposite polarity (attraction) are *linear*, therefore attached at the shortest distance. In other words, when switching of polarities in the Coulomb equation, the simple change of + and – doesn't represent the correct reality, because the change of the attractive field to the repulsive (and vice–versa) changes the direction of vectors of the field accordingly. The attractive field connects poles in linear – shortest possible way. The repulsive field is deflected tangentially, thus diffusing density of the field between poles.

As we learned later, Weber, Zollner, Lorenz and also Eddington played with the idea of difference between attraction and repulsion by supposed difference caused by polarity.
Apparently none of them considered the function of *the different geometry* of vectors of the field between electro-magnetic attraction and repulsion.

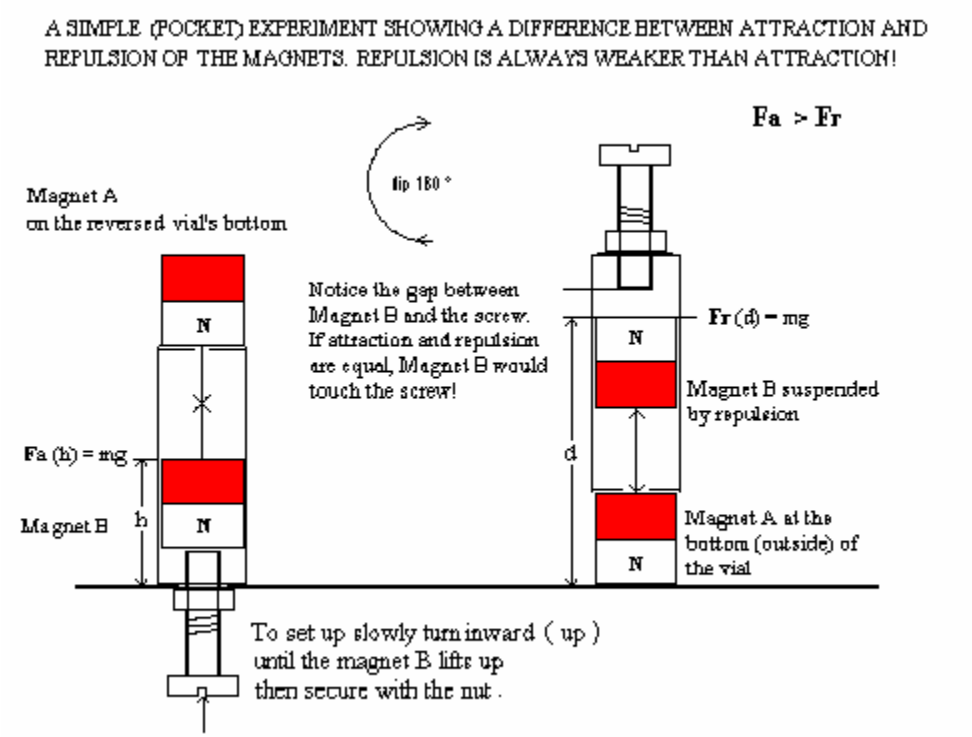


Fig. 2

The "pocket" experiment.
Magnet A is at the bottom (up) of the *reversed* vial. The magnet B is pushed slowly by the screw to the position where **F**a (h) = mg and beyond, until being pulled up (attracted) by the magnet A. Then the screw is secured by the nut.
In the second step, the vial is reversed. Magnet A stays oriented as in the previous step, so the magnet B in the vial is suspended by repulsion. We observe that magnet B doesn't reach the screw. (The gap is exaggerated for clarity). This gap demonstrates that the attraction acts at a longer distance than repulsion. If attractive and repulsive forces were equal as common beliefs expect, then the attraction would start only at the level where repulsion stops. (**F**r (d) = mg - as pointed out by Michael Ibison from Earthtech (Austin Tx)) This, easy to repeat experiment clearly demonstrates the prevalence of attraction versus repulsion.
When Einstein's intents and beliefs are considered all together with his final struggle for the unified theory, we can contemplate, it is trivial to predict in what direction his work would go if he had the above illustrated experiment in his hands in 1915. He was held back by Coulomb as everyone else.

This writer asserted in his paper mentioned above, that attraction between opposite polarities (of magnets and electrostatic charges) and repulsion between same polarities is not equal due to the (illustrated) different geometry of the field, and that phenomenon actually can account for gravitation.
Dr. Cynthia Kolb Whitney, the editor of Galilean Electrodynamics asked Prof. Wm. L. Hughes from the University of South Dakota to review the paper.
Realizing that the assertion would direct to serious flaw in Coulomb Law that assumed automatic equality between attraction and repulsion, Prof. Hughes did not expect too much from the paper. He analyzed the problem mathematically, considering two equal point charges of equal absolute magnitude, though not necessary of the same sign, positioned on the x axis at x = + s/2 and x = - s/2.
He assumed a doubly infinite y-z plane at the origin, of infinitesimal but finite thickness. If the two charges, q_1 and q_2 are equal and opposite sign the electric field is everywhere "normal" (linear) to the y-z plane. If the charges are equal and the same sign, the electric field is everywhere tangential to the plane, as shown on illustration of the writer's paper.
If the plane is assumed to have an infinitesimal but finite thickness Δs, then the following integral represents the entire energy contained within the plane.

$$Energy = \frac{1}{2}\varepsilon_0 \Delta s \int_{-\infty-\infty}^{+\infty+\infty} |E|^2 \, dydz$$

Since energy is formulated by force times distance, dividing the integral by Δs is then the force between the charges. Since we have both multiplied and then divided by the constant Δs, we conclude that for two unlike charges the integral over the doubly infinite plane

$$F_{attr.} = \frac{1}{2}\varepsilon_0 \int_{-\infty-\infty}^{+\infty+\infty} E_x^2 \, dydz$$

is the attractive force between them.
For two like charges the repulsive force between them is

$$F_{attr.} = \frac{1}{2}\varepsilon_0 \int_{-\infty-\infty}^{+\infty+\infty} E_{\tan}^2 \, dydz$$

In this case, E_{tan} is the repulsive electric field tangential to the plane.
Because of a cylindrical symmetry around the x axis we need only to calculate the electric field components on the z axis, square them, multiply the result by ε / 2, then multiply by $2\pi z dz$ and integrate from 0 to ∞. The upper equations then become

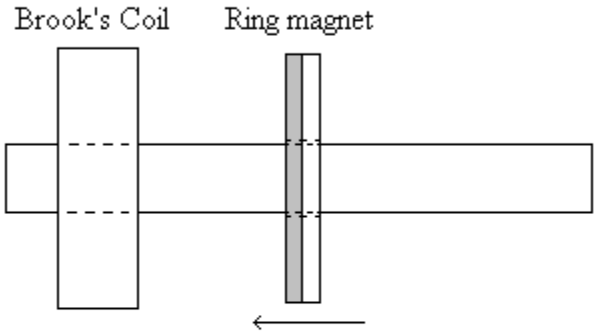
$$F_{attr.} = \pi\varepsilon_0 \int_0^{\infty} E_x^2 z \, dz$$

and

$$F_{repul.} = \pi\varepsilon_0 \int_0^{\infty} E_{\tan}^2 z dz$$

Hughes also experimented independently (peer test of this writer's theory) – instead with two magnets, he used an air core Brooks coil (just a multi-layered solenoid) and a ring ceramic magnet with an inner diameter similar to that of the Brooks coil. This has come to be known as "Inchworm experiment."

The Hughes' "INCHWORM EXPERIMENT"



With AC current in the Brook's coil the ring magnet "inches toward the coil

If repulsion and attraction equals, then with AC current in the Brook's coil the ring magnet would vibrate without the distance changed. But it moves toward the coil even when it inclines under angle. (On his video the level bubble shows the inclination)
The formula $E = mc^2$ is customary to manifest the enormous amount of energy in the body of matter. In the electrically neutral body it represents pockets of energy with a multitude of attractive and repulsive fields.
This custom led the writer to propose **gravity to be represented by the difference** between the **sum of attractive (*a*) forces** of two bodies of mass and the **sum of repulsive (*r*) forces** in the same bodies provided by the total energy of the bodies, in favor of attraction:

$$\Sigma Qm_{1a} . \Sigma Qm_{2a} \quad \left(\Sigma Qm_{1r} . \Sigma Qm_{2r} \right)$$

$$\mathbf{g} = k_\varepsilon \frac{}{d^2} - \left| k_\varepsilon \frac{}{d^2} \right|$$

Expecting that the resulting difference would eventually represent gravity, the equation can be written as:

$$\mathbf{g} = k_\varepsilon \frac{\sum Qm_1 . \sum Qm_2}{d^2} - \left(k_\varepsilon - G \frac{\sum Qm_1 . \sum Qm_2}{d^2} \right)$$

Where the $k_\varepsilon - G \frac{\sum Qm_1 . \sum Qm_2}{d^2}$

This possibly represents the (modified) Coulomb law for repulsion**.**

Assuming that the described dissimilarity and difference in value of the attractive and repulsive forces in the totality of charges in a material body favors attraction and is proportional to the energy - gravity ratio, the writer proposed that:

Between two material bodies appearing electrically neutral, the gravitational force would be a result of the total sum of electrical forces of both polarities represented by an immediate difference of vectors or density of an attractive and repulsive fields of force, which difference would be related to the gravitational constant.

Therefore the attractive and repulsive fields in Quantum scale would be a subject to the *broken symmetry* and then $\mathbf{F}_a > \mathbf{F}_r$ would become an axiom.

If the perfect symmetry required by Coulomb law holds us back in understanding of gravity we might find that it is a perfect *asymmetry* what holds for it.

This difference between repulsion and attraction gives us a beautifully simple explanation of gravity, having the property on which all up-to-date theories suffer - it gives us causality! Every quantum of energy indeed generates an electromagnetic field interacting in the way described above. Esoteric attempts to marry relativistic logic with quantum theory are not needed anymore, thanks to the old good Faradays electromagnetic phenomenon and De Broglies vibrations in matter.

The views on reality are not necessary also popular. It took a hundred years to Copernicus to be widely accepted. We have to understand circumstances of the times of Coulomb. He would be “eaten alive” if he would propose an asymmetry in dipole fields. It is shocking surprise that until now nobody (this writer not excluded) suspected the difference despite that the geometry of fields is well known for centuries.

Equations derived in 1975 by the physicists Sheldon Glashow, Abdus Salam, and Steven Weinberg “unify” electromagnetic and weak forces, showing how these two types of forces can properly be seen as aspect of a single “electroweak“ force. The principle of weaker repulsive forces naturally brings weak forces and strong

forces to the electromagnetic "family". The formula E = m c^2 which Einstein called "somewhat inexact" might be modified to the

$$E = m\frac{\left(\frac{1}{G}\right)}{2}$$

Some readers of the paper *A Challenge to Coulomb's Law: Implications for Gravity and Matter Structure (Jaroslav Kopernicky & WmL. Hughes, Galilean Electrodynamics, September / October 2005)* were lead to the misleading opinion that it was proposed a difference between polarity potentials. Therefore, it is necessary to stress on the difference between **geometry** of the attractive field (between unlike poles) and geometry of the repulsive field (between like poles) showing the difference in densities of the fields. Repulsive field (tangential) is diffused and therefore weaker.

The latest comments on this paper from another important reader pointed out to the serious inadequacy in this writer's explanation of repulsive field. The simple statement that the repulsive field has a tangential geometry actually does not suffice. It is the resulting force between *two* aligned tangential three-dimensional fields what matters. Each end of magnet (or coil) has the field tangentially diffused due to repulsion between "field lines" being of same polarity.

INERTIA

(Hughes – Kopernicky)

We are indeed in debt to inertia...
Eddington

EQUIVALENCE OF INERTIAL AND ELECTROMAGNETIC FORCES

Professor Wm. L. Hughes intrigued for many years by possible relation between electromagnetic field and inertia, analyzed the electric field E created at the observation point ρ, ϕ, z, ($\rho\phi$ is the plane of the charge's spin) by the moving charge. When the spinning electric field is forced to move in a_z direction it creates field opposing the acceleration.
When the (chosen) observation point is in a plane parallel to the $\rho\phi$ plane, and when the coordinate z is the same as the coordinate of the moving charge which when accelerating creates field

$$E_z = -\frac{\mu_o q^2 a_c}{4\pi d} = -qE_z = F \text{ (opposed to acceleration)}$$

(μ - permeability of free space, q – charge particle, a – constant of acceleration)

Thus, any accelerating charge generates an electric field opposing its own acceleration, just as in Newtonian inertial force.
Prof. Hughes didn't calculate the amount of energy released by the deformation of the spin due to its relative insignificance to the inertial resistance force.
He also didn't analyze the influence of the gravitational body in the proximity (of the proposed system) on the electric field resisting acceleration.

Since we generally believe that the mass – energy relation of anything is

$$Energy = mc^2$$

it is not hard to believe that the Newtonian inertial force is in fact the same force.
The problem with the acceptance of this reasoning is that this inherent inertia requires being completely independent for every single energy particle in the body of matter or the radiation. This is not correct by recent standards set on Machian views.
Prof. Hughes theorized independently that the deviation of the energy particle spin caused by the outside force generates the resistance (field) against that force. He assumed that the customary reluctance to consider the inherent and independent inertia doesn't mean that it can not to be.
The relative independence, as we will see, is not too difficult to demonstrate.
Ernst Mach was not pleased by Foucault pendulum's independence from the Earth's rotation. This phenomenon contradicted opinion of the influence from outer space.

Inertial navigation, Foucault's pendulum, Coriolis force, accelerometer, seismographic sensor, etc. would be hardly possible without an inertial independence of the material body.

The following experiment this writer published in 1993 further demonstrates the importance to recognize the Newtonian *inherent, independent character of inertia*, which is inevitably connected and giving support to Prof. Hughes' mathematical reasoning.

*Experimen*t:

Let's place an observer inside a round (cylindrical) chamber that represents Newton's bucket (without water!). The observer knows that the chamber uniformly rotates about its axis only from the centrifugal tendency (which some tend to call also gravity) toward the wall of the cylindrical chamber. In the center of the chamber we place the disc that can rotate about axis identical with the axis of the chamber. The calibrated regulator can control the angular velocity and a direction of the disc's rotation. Accelerometers installed at the edge of the disc that is put to rotation relative to the chamber, show different readings for each direction of a disc's rotation and the speed of rotation, relative to the chamber:

- If the disc rotates in the same direction as the chamber, the accelerometers indicate a centrifugal force larger than would be adequate to its angular velocity of rotation relative to the chamber, because of added centrifugal force from the rotation of the chamber at the radius of the disc.

$$\omega_c + \omega_d = \omega_{c+d}$$

- If the disc rotates in the opposite direction of the chamber, and at the angular velocity equal to the chamber, the accelerometers show no centrifugal force. The disc, despite that relative to the observer it rotates, it actually maintains a non-rotating position, making Mach's rotation of the universe somehow confused.

$$\omega_c - \omega_d = \omega_{c-d} = \mathbf{0}$$

The observer inside the rotating chamber has the actual inertial indicator of the direction of the rotation of the chamber and also its angular velocity (in the opposite direction) when the accelerometers show zero acceleration, without need for an outside reference.

The experiment continues:

When the observer places his rotating disc off center, close to the wall of the rotating chamber, he finds that at a certain direction of rotation and angular velocity, the accelerometers show zero centrifugal force when at the side of the discs facing the round wall of the chamber. On that side, the accelerometers travel at the speed equal and opposite to the radial speed of the floor of the chamber, which cancels centrifugal forces at those points.

We can assume that the result does not change with a larger diameter of the chamber, when the bend of the wall is close to the straight line. It means, there is a valid reason why the rotating discs equipped with an accelerometer can also indicate linear and uniform movement **without an outside reference point.** The observer in the chamber is not as impotent as we thought, not to mention that he has also the Coriolis' force at his disposal.

Our observer invented the **inertial indicator of movement** based on the inertial independence of the body of mass in accelerometers. (We coined its name *Mobiloscope* from *mobilis (lat.)* moving and *skopein* (gr.) to see)

A physical explanation is done in the next column with another example of inertial independence and inherence in the movement of the inertial body, on the trajectory of a cycloid.

ON THE CYCLOID PATH

Let's take the rolling cylinder having angular velocity **ω** with the center point **G**, moving in straight line.
Here, the point **A**, located on the rim of the cylinder, moves on its cycloid path.
Since no slipping occurs, at the instant **A** contacts the ground, its velocity is zero:

$$\mathbf{v}\,A = 0$$
$$\mathbf{v}\,G = \mathbf{v}\,A + \omega \times \mathbf{r}\,G/A$$
$$\mathbf{v}\,G = \omega\,\mathbf{r}$$

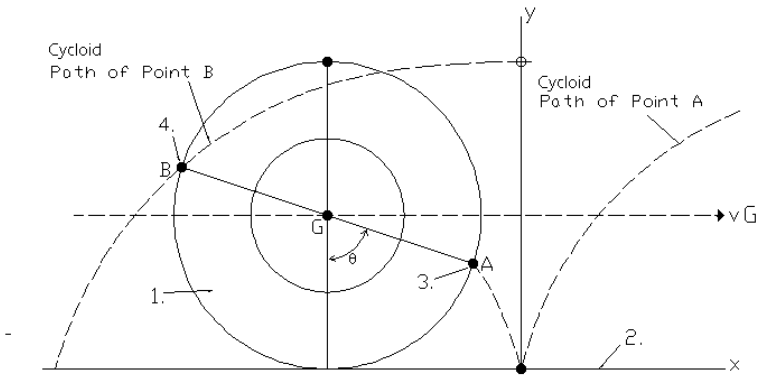


FIG. 1.

For the point **A**, no motion occurs in the **x** direction or the **y** direction during the instant ground contact. (The "ground" is only a stationary reference!)

We have not problem to say that the point G and A are relatively orbiting each other.
Then, because at that instant $\mathbf{v}_A = 0$, at the same instant A becomes the pivot point for G !

The acceleration G is:

$$\mathbf{a}_G = \omega^2 \mathbf{r}_{A/G}$$

Then:

$$\mathbf{a}_A = \omega^2 \mathbf{r}_{A/G} - \omega^2 \mathbf{r}_{G/A} = 0$$

We can also consider that for that instant is:

$$\mathbf{r}_A = 0$$

Then:

$$\mathbf{a}_A = \omega^2 \mathbf{r}_A = 0$$

This result shows clearly that the instantaneous center of zero velocity, point A, **is also a point of zero acceleration.**
Every single mass particle in the rim of the rolling cylinder is forced to cycloid trajectory and is subjected to accelerations changing with its momentary position on the cycloid path, from *0* at the "bottom" of the cycloid to *2v* at the “top” and back.
Accelerometer placed at the point A when moving on the cycloid path would show changes in acceleration of the point A in both axis *(x,y).* Observer in the car due to modern technology can make arrangement to see the accelerometer reading. Since accelerations of the system moving on the cycloid path are detectable, it means we can **not** treat any more the rolling wheel as a stationary rotating by simple change of the observation point or the frame of reference! Thus, the present wheel-balancing technology is not perfect.
This experimental proof of independent character of inertia also supports Prof. Hughes’ mathematical reasoning of its inherence.
This also demonstrates that the physical process can not be influenced by a simple change of the observer’s frame of reference. It is just the subjective interpretation, what changes.
The very important consequence of the detection of a (changing) acceleration of the mass forced to the cycloid path, is the ability to indicate and measure the uniform and accelerated movement **without the outside reference**, bringing it **inside** the system. (Coined by this writer as Mobiloscopic Effect) They are possible consequences of the principle for space and nature, i. e. Galilean inertial cause of tides (“refuted” by Newton) and earthquakes where Moon and Sun functions only as a stimulus.
The other (cosmological) consequence we can find when analyzing the position of Solar system in the Galaxy. Near circular orbits of planet are possible only in places without excessive accelerations acting on the system. Acceleration acting on the solar system would cause orbits of planets to the stretched elliptic shapes with excessive temperature differences. So the galactic zone convenient for life would rest in the vicinity of the bottom of the galactic cycloid, shrinking drastically the Drake’s equation.
Since Galileo's time people were amazed by the fact that bodies of different mass fall at the same speed (acceleration). Newton in his equivalence principle explained: “...namely

that property of body that regulates its response to an applied force must be *equal* to its weight." The conclusion was that all bodies, large and small, light or heavy, regardless of their composition should fall in the same gravitational field by the same acceleration.
The gravitational accelerating force of the Earth coincidentally gives us the convenience to measure the force (pressure) needed to accelerate the tested body of mass to 9.8 m/s^2. We can also say that the **force needed to accelerate the body of mass at the rate 9.8 m/s^2 is called "weight".** It becomes apparent that this force is the same for all means of acceleration. Therefore, the bodies of different masses accelerate equally in equal conditions for the acceleration, either by gravity - toward the same gravitational body at the same distance - or due to centrifugal tendency, when radius and the angular speed are equal for all bodies. Inertial resistance of the body proportionally equalizes the accelerating force.
Here we can ask **why a single apple would fall slower than the bunch of apples**.

DISCUSSION

In the relatively recent discussion with Michael Ibison from Earthtech (Austin, Texas) he brought an argument that magnets do not influence the light and gravity does. This argument demonstrates how easily the demonstrations with magnets can be misinterpreted. In that discussion appeared the importance of frequencies of energy spins. It can be a different spin of electrons generating the magnetic field and different frequency of the photon. Simplifications of magnet demonstrations do not indeed describe the enormous amount of (De Broglie's) frequencies involved in gravitation. On the other hand magnets do influence electrons.
Experiment with neon plasma shows that North Pole of the magnet bends neon plasma to the right, south pole causes bending of plasma to the left, in accordance with the right hand rule. It also did show a spontaneous spin of plasma when surrounding the magnet. The high-speed camera (800 fps) shows clearly the plasma formation in the cup orbiting.
Arguments brought up above generate obvious reactions and questions mushroom to try at first to devaluate, which is natural with the intent justified. The most widely used (and also the lamest) is the one: - Why nobody came with this before? The problem with this question is that it is used as an argument in the same way as was done for ages.
Most outrageous must appear the denial of the symmetry for which men of science strive for ages but which seems to be the last thing the nature needs.
The reader has to feel free to test the phenomenon to reach the honest, impartial conclusion involving the repeatable experimental fact of the difference between attractive and repulsive fields which is due to its geometry. The inherent and independent nature of inertia – the writer insists – has to be treated in the same manner.
Particle scientists have an opportunity to investigate if an influence of matter – energy on the space-time (if it actually is) is rather in the microstructure instead of macrostructure. It is not too difficult to conjecture what Einstein would do after observing the "Pocket" or the "Inchworm" experiment, or if he would find from geometry the existing difference between attraction and repulsion. Considering his uncompromising attitudes, we can expect that he would gladly work on revision of the Coulomb law.

When the proposed electromagnetic origin of gravity and inertia is considered, it provides the room to allocate *both (gravitational and inertial) properties in the same (one) mass.*
Newton never proposed two different masses. He found "*both these forces conspiring together"*. Only recent Newtonologists try to implant the separate identity of gravitational and inertial mass as a "deepest principle of Newtonian mechanics".
The proposed possibility of electromagnetic origin of gravity and inertia would also satisfy the Einstein's rightful argument about the previous incompleteness of the Quantum Theory. Then, perhaps, this monogram can lead to the Theory of Quantum Gravity and Inertia.
In most probability it can also to lead us to the ability to manipulate both gravity and inertia through the knowledge that both of them might have an electromagnetic origin.
To conclude the discussion, we can not resist placing the question difficult to answer: *Are we ready for such a revolution?*
The writer's answer is another question: *Do we have a choice?*
A revolution appears to be the slowest way to implement the desired change anyway.
Alfred North Whitehead wrote in his Lowell Lectures 1925:
A clash of doctrines is not a disaster – it is an opportunity.
...Two experimenters, the late Lord Raleigh and the late Sir William Ramsay, found that if they obtained nitrogen by two different methods, each equally effective for that purpose, they always observed a persistent slight difference between the average weights of the atoms in the two cases. Now I ask you, would it have been rational of these men to have despaired because of this conflict between chemical theory and scientific observation? Suppose that for some reason the chemical doctrine had been highly prized throughout some district as the foundation of its social order: -would it have been wise, would it have been candid, would it have been moral, to forbid the disclosure of the fact that the experiments produced discordant results?...
Eventually the element Argon was found.

A treasury box for seekers of the truth, can be Pandora box for those who seek their own fame.

(Unknown)

Professor Bill Hughes passed away in February 2007. It is at least prudent to dedicate this emergent treatise to him.

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