

The physical nature of the basic concepts of physics

Part 12: Gravitation ⁽¹⁾

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Abstract

In this paper it is demonstrated that falling objects are not attracted to each other by "pulling forces", but that instead proceed naturally to each other under their own power, by a gradual rectification of the internal, rotational-vibrational motion of their basic components into translational bulk motion.

This mechanism, which has the form of a self-excited resonance that is caused by a positive feedback coupling between the involved masses, replaces the present concept of translational force "fields" in gravitational, electro-magnetic, and weak and strong interactions.

1. The historical evolution of the scientific view on gravitation

Gravity is the most fundamental interaction in the universe because, it is felt anywhere and it interacts with everything, mass as well as energy.

- According to the legend, Galileo Galilei (1564 - 1642) dropped objects of different weights from the tower of Pisa and found that they all hit the ground in the same time.

- It was Isaac Newton (1642 - 1726) who, in his Principia, developed the mathematical expression of the gravitational force between a mass 'M' and a mass 'm' who are separated by a distance 'r' as: $F_g = GMm/r^2$.

In that way he intrinsically demonstrated that the gravitational acceleration:

$g = F_g/m = GM/r^2$ is independent of the mass (m) of the attracted object. In Newton's view, the gravitational force is supposed to act instantaneous at any distance on all massive objects, no matter where they are in space.

- At the end of the 18th century, the Hungarian baron Roland von Eötvös (1848 - 1919), after 30 years of experiments with different weights and different materials, has scientifically confirmed that gravitational acceleration is not only independent of the masses of falling objects, but that is also independent of the material that they are made of!

2. Einstein's general theory of relativity

- Albert Einstein's publication in 1905 of the theory of special relativity, which was restricted to inertial frames, was inspired by the question what it would mean if the speed of light were the same for all observers.

(1) Updated edition of the paper "The generation of work in particle systems – Part 4: Gravitation" May 1991 by the same author.

Einstein's Special and General Theories of Relativity are based on two general assumptions:

1. The speed of light in empty space is independent of the chosen reference frame
2. The laws of physics are the same in any coordinate frame. If they were different in some coordinate systems, then that difference could be used to define absolute motion.

The key principle of Einstein's General Theory of Relativity is Galileo's and Newton's observation that the gravitational acceleration of an object does not depend on its mass, but only on the strength of the gravitational field, so that in a given gravitational field, all masses have the same acceleration. And the fact that you don't feel the gravitational acceleration, led him to represent the gravitational acceleration of a falling mass by the acceleration of the chosen coordinate system.

His theory of general relativity that was published in 1916 applies to all frames, including non-inertial effects which are produced either by accelerations or by the presence of gravity fields. It is based on two fundamental facts.

- The first fact is Eötvös' conclusion that in a given point all things, no matter their size, their mass or their composition, fall with exactly the same acceleration. This means that gravitational acceleration in a given point in space and time is completely independent of the characteristics of the attracted bodies. This means that there are no observable differences between a state of acceleration and the effect of a so-called gravitational field. This led Einstein to formulate his equivalence principle: "*The effects of uniform acceleration cannot be distinguished from those of a gravitational field*".
- The second fact is that one day in 1908, while he was working on his theory of general relativity, a painter fell off a roof, but survived his fall. Einstein went to see him and asked him how it felt to fall ^[1]. The painter told him that it felt like he was floating and that he didn't feel any force pulling him during his fall. From this Einstein concluded that in a gravitational field, things behave exactly as they would do in the absence of a gravitational field. It is only when we are restrained to fall that we feel a force that prevents us from falling.

According to Einstein, this means that locally, gravity can be replaced by a non-inertial reference frame with an equivalent acceleration.

These considerations allowed Einstein to conclude that gravity is not an invisible pulling force, but that it is a characteristic of the warped geometry of spacetime in the vicinity of matter. In that way, Einstein's theory of general relativity has banished the gravitational action in exchange for pure geometry in which each mass in space follows its natural state of motion in a curved space-time. Einstein's theory of general relativity is based on non-Euclidean geometry. In that way, Einstein could eliminate the annoying 'action-at-a-distance' of Newton's theory ^[2].

It had thereby the enormous advantage that it was in some way testable, because in his photon theory, Einstein had demonstrated that light consists of energy particles and in his theory of special relativity he had revealed the equivalence between energy and mass ($E = mc^2$). This allowed him to conclude that light beams ought to be affected by gravity. The first great test in 1919 confirmed his view that the sun bends spacetime and acts like a lens distorting the pattern of stars behind it !

3. Newton's problem: Potential energy out of nothing

By defining '- GMm/r ' as the 'potential' energy of a mass 'm', the present textbooks introduce "the principle of the conservation of energy" as the sum of the kinetic and this so-

called ‘potential’ energy, which is evidently zero at all points in space:

$$K + U = (mv^2/2) + (-GMm/r) = mv^2/2 - GMm/r = 0. \text{ So that: } v = \sqrt{2GM/r}$$

This means that the present concept of gravitational energy of ‘configuration’ is undeniably an excellent mathematical tool to express the speed of a falling object in function of its position ($v = \sqrt{2GM/r}$), but it creates a physical problem by supposing that the ‘kinetic’ as well as this so-called ‘potential’ energy arise out of nothing, while the total amount of energy remains invariably zero in all points in space (Fig. 12.1)!

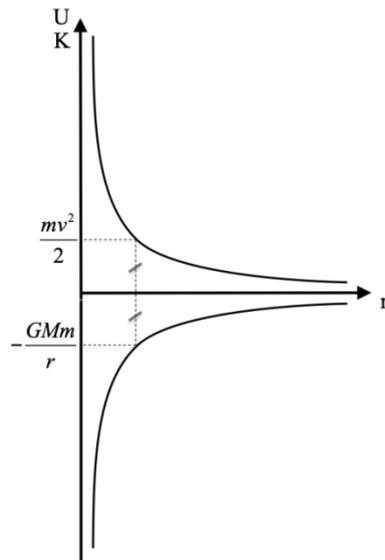


FIG. 12.1

This is demonstrated by the classic example ^[3] of a meteoroid that is initially at rest at a very large distance from the Sun (with $R_S = 6,96 \times 10^8 \text{m}$) and that proceeds, under the influence of the Sun’s mass ($M_S = 1,99 \times 10^{30} \text{kg}$) along a straight radial line.

The total energy of the meteoroid is: $E = mv^2/2 - GM_S m/r = \text{a constant}$

- Initially: $v = 0$ and $r \approx \infty$, so that the kinetic and the potential energies of the meteoroid are both zero, so that its total energy remains zero: $E = mv^2/2 - GM_S m/r = 0$
- At the moment of impact with the Sun: $r = R_S$, so that: $E = mv^2/2 - GM_S m/R_S = 0$
So that the speed of the meteoroid at the moment of impact with the sun (with $G = 6,67 \times 10^{-11} \text{Nm/kg}^2$) is $v_{\text{imp}} = \sqrt{2GM/R} = 618 \text{ km/s}$

This demonstrate that: “*The equations of the conservation of kinetic and potential energy are essentially bookkeeping statements about energy*” ^[4] that don’t give any information about the physical nature or the location of this so-called “potential” energy.

4. The vacuum catastrophe of General Relativity

In Einstein’s General Theory of Relativity the moving orders come from ^[5] the geometry of space and time: spacetime grips mass, telling it how to move and matter grips spacetime, telling it how to curve.

In Einstein’s space-time gravity, masses meander effortlessly downhill in a spacetime landscape. In his book “A journey into gravity and spacetime” John Archibald Wheeler stresses the fact that that in Einstein’s general theory of relativity, gravity is not a force acting at a distance, but that it is a state of free float.

It is obvious that this representation of the physical reality is based on a circular reasoning because it presupposes a downhill spacetime with an acceleration in order to explain gravitational motion.

But on the other side the absence of gravitational pulling "forces" also matches the experience of modern astronauts, who do not notice any difference between:

- on the one hand, orbital motion, in which they move with a constant speed and a constant rotation around the earth
- and on the other hand zero-g flight, in which accelerate with increasing speed to the earth.

From this we must conclude that in order to understand the real nature of gravitational motion without a massive transfer of energy through the vacuum space, we cannot fall back on any existing mechanical or thermo dynamical model.

Einstein based his General Theory of Relativity on his 'principle of equivalence' which stipulates that "it is impossible to distinguish between the effects of acceleration and of gravitational fields". This made Einstein conclude that everything that can be ascribed to a gravitational field, can as well be ascribed by an accelerated frame of reference. So, in General Relativity, masses are not considered to be 'attracted' by some force, but accelerate along the curvature that is created by cosmic bodies in spacetime around them, or in the words of John Archibald Wheeler ^[6]: "*Mass grips spacetime, telling it how to curve and spacetime grips mass, telling it how to move*".

This is why General Relativity doesn't express itself with regard to the enormous amounts of kinetic energy that are generated in the process of celestial bodies accelerating towards each other. This gravitational acceleration is commonly illustrated by a heavy weight that is put in the middle of a trampoline and that makes small balls, that are put at the edge of the trampoline, roll effortlessly to the heavy weight along the curvature made by it in the trampoline. But this representation is based on a circular reasoning, because it works because of the gravitational pull of the Earth underneath the trampoline.

And this brings us to the energy gap of General Relativity: If gigantic heavenly bodies accelerate to each other due to a 'curvature of spacetime', then the increasing kinetic energy of these enormous masses must necessarily be supplied by spacetime. So the question is: how does the bending of spacetime generate these enormous amounts of energy?

This lack of knowledge is known as "the vacuum catastrophe", which indicates the catastrophic gap between the estimations of the vacuum energy of free space, which varies from 10^{-9} to 10^{113} J/cm³ ^[7], which demonstrates that General Relativity hasn't solved its energy problem ⁽²⁾.

5. The physical nature of potential energy

5.1 The physical nature of molecular potential energy

In section 2.1 "Elastic potential energy" of my paper Part 7 on the physical nature of potential energy, I have demonstrated that in the classic case of a mass-spring system, the sum of the kinetic (K) and the potential (U) energies remains in any point (x) equal to the initial (kinetic) energy ($K_i = mv_i^2/2$) of the moving mass:

$$K_x + U_x = mv_x^2/2 + kx^2/2 = mv_i^2/2 \quad (\text{Fig 12.2}).$$

(2) The physical nature of gravitational potential energy will be analyzed in my paper on the physical nature of gravitation.

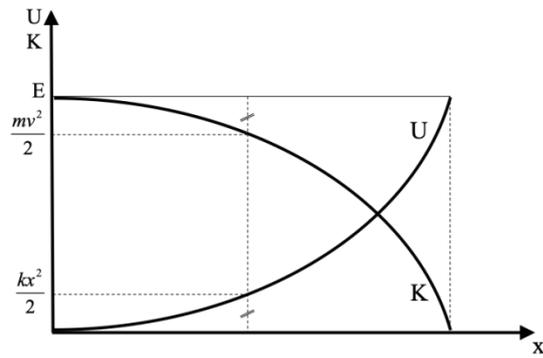


FIG. 12.2

Which allowed me to conclude in section 5 of that same paper, that the potential energy of a perfectly elastic spring is a mathematical expression of the amount of coherent internal rotational-vibrational motion of its basic mass particles. And I concluded that this means that the so-called ‘potential’ energy (U) of a perfectly elastic spring, is in fact a mathematical expression of the amount of reversibly transferable coherent motion, that is present in the spring under the form of internal, coherent, rotational/vibrational motion of its basic mass particles: $U = \sum I_i \omega_i^2 / 2$, so that: $K + U = mv^2 / 2 + \sum I_i \omega_i^2 / 2 = mv_i^2 / 2 = \text{a constant}$.

This may sound a rather peculiar conclusion. To understand it better, I replace the mass-spring system by a system consisting of a cylindrical reservoir filled with an ideal gas at equilibrium. This cylinder is fixed on its left side to a huge mass, and it contains in the middle a frictionless gliding piston with a given mass.

If we then, like in the mass-spring system, start from a situation where the piston is gliding to the left, over a given distance, then the gas on the left side will be compressed and the gas on the right side expanded.

This means that work has been done on the gas particles of the left side, so that their kinetic energy $mv^2/2$, as well as their internal rotational-vibrational motion $\sum I_i \omega_i^2 / 2$ will have increased (in exactly the same way as in the case of the mass-spring system) under the form of internal, coherent, rotational/vibrational motion of its (basic) mass particles:

$$U = \sum I_i \omega_i^2 / 2. \text{ So that: } K + U = mv^2 / 2 + \sum I_i \omega_i^2 / 2 = mv_i^2 / 2$$

These two examples demonstrate that the initial kinetic energy of the spring/piston is used to increase the (internal and external) motions of the spring/gas particles, so that the so-called ‘potential’ or ‘dormant’ energy, is a kind of wild card to conserve the disappeared amount of kinetic energy and to be able to calculate the energy in each point. And it demonstrates that the adiabatic expansion of a spring is similar to adiabatic expansion of a gas that can be explained in the same way as the generation of kinetic energy of bulk motion by means of a unidirectional adiabatic expansion of a particle –system, in which there is absolutely no ‘potential’ energy, except during collisions.

The formula $K + U = mv^2 / 2 + \sum I_i \omega_i^2 / 2 = mv_i^2 / 2 = \text{a constant}$ has the same form as the equation of the internal energy of an ideal diatomic gas ^[8]: “*Diatom gases store amounts of energy in the internal motions of the atoms within each molecule. .. If such a molecule collides with another molecule, it will usually start rotating about its center of mass*”, which simply means that the present (static) spring model for the storage of the so-called ‘potential’ energy, must be replaced by a dynamic ‘flywheel model’ of the internal motions of basic particles of the considered mass particles.

It must thereby be pointed out that the present “spring-model” for the storage of the ‘potential’ energy, is as a matter of fact based on a circular reasoning, because it implicitly supposes that the atoms of the spring are on their turn interconnected by microscopically small springs.

My proposed dynamic molecular flywheel model for the so-called ‘potential’ energy is completely in line with the modern viewpoint of quantum mechanics, as expressed by Robert Adair, who already in 1987 wrote ^[9]: *“In certain specific cases it is possible to show that the potential energy change is actually a change in the kinetic energy of microscopic particles ... If we extend our notion of particles and kinetic energy to encompass the energies of quantum particles contributing to force fields, we may be able to consider all changes in potential energy as changes in the kinetic energies of particles”!*

It is moreover in line with the press release of 29 July 2019 “Scientists film molecular rotation” ^[10]. In that paper, the “Controlled Molecule Imaging” research group (CMI) of the Center for Free-Electron Laser Science (CFEL) ^[11] led by Jochen Küpper of the Coherent Imaging Division (DESY) and Arnoud Rouzée of the Max Born Institute of Berlin, has made a film of the ultrafast rotation of carbonyl sulphide (OCS) molecules spinning coherently (i.e. in unison).

In this way I have been able to reveal the physical nature of ‘energy’ in all its different forms:

- Kinetic energy of bulk motion is a mathematical expression of the amount of congruent translational motion at a given velocity level.
- Kinetic energy of thermal motion (or shortly thermal energy, or heat), is a mathematical expression of the amount of isotropic translational motion at the molecular level and the frequent collisions that this brings about .
- Potential energy is a mathematical expression of the amount of internal, congruent rotational/vibrational motion at quantum level of the basic quantum particles, which explains why the gravitational acceleration is independent of the weight or the composition of the falling masses.

This means that the classical concept of the transformation of different kinds of “energy” into one another while the total amount of “energy” remains constant, means in fact the transformation of different kinds of motion into one another, while the total amount of motion is conserved, so that the general principle of “the conservation of energy” is in fact a mathematical expression of the fundamental principle of “the conservation of motion”.

5.2 An absolute speed equation

In section 4.4 “A new kinematic speed equation” of my paper Part 8 “The physical nature of velocity”, I came to the conclusion that the so-called “elementary” mass particles are not pointlike, monolithic objects, but that they are in fact dynamic 3-dimensional particle systems that are built up from massless particles. In that way, all observable ‘particles’ are in fact multi-level systems built up from massless particles, moving about each other in such a way that the total speed of a such a moving particle (system) is equal to the speed of light.

This allowed me to represent the variable bulk velocity of a mass particle system, as a complex number,

- in which the real number ‘v’ indicates the total amount of congruent velocity of which the particle system moves as a whole in a given (x-)direction, and
- in which the imaginary number ‘q’ indicates the total amount internal RMS-speed ‘q’ in all three directions.

In that way the total velocity of each such particle system is equal to the speed of light:
 $v^2 + q^2 = c^2$ (Fig. 12.1).

In that way mass particles are in reality composite particle systems that consist of entangled wave-particles and that can move with a variable velocity 'v' from '0' to 'c', in function of the degree of congruence of the motions of the basic particles.

Its amount of congruent, bulk motion is: $v/c = \sin \alpha$

And its degree of internal motion is: $q/c = \cos \alpha$

So that the total amount of velocity of each basic, massless particle is: $v^2/c^2 + q^2/c^2 = 1$

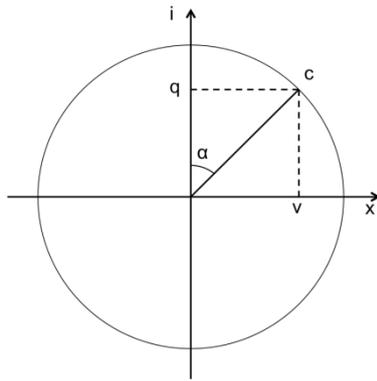


Fig. 12.1

If we suppose that quarks consist of entangled photons, and that these quarks make up protons and neutrons, which make up a nucleus and that such nuclei make up an atom and that atoms make up a molecule, .. then the velocity 'v' of such a moving object is in fact the congruent velocity of its basic particles.

This representation allows us to define the congruent velocity of the particle system by means of the degree of 'rectification', 'coherence', or 'congruence' of the particles' motion, which is equal to the sinus of the mean angle of rectification 'α': $v/c = \sin \alpha$.

In that way the speed of a particle system can simply be expressed as the degree of congruence of the individual particles' motions, as:

$$v = c \cdot \sin \alpha$$

This means that the variable speed of a mass particle system is an absolute physical state of that system, that expresses the degree of rectification of the (invariable) speeds of its massless components.

My conclusion may at first sight look strange, but it is in fact already currently used in physics, when one expresses the variable speed of mass particles as a fraction of the speed of light, such as e.g. muons that move at $\beta = v/c = 0,998$, which means that $\sin \alpha = 0,998$ and that the angle of rectification $\alpha = 86,3757^\circ$.

5.3 The physical nature of mass

In section 7.1 "Mass increase with velocity" of my paper Part 11 on the physical nature of

mass, I came to the conclusion that an accelerating mass particle system undergoes an increasing compression in its direction of motion, which is mathematically expressed as the proportion of its size in its (x-) direction of congruent motion, to its size in the perpendicular (y- and z-) directions: $l_v/l_0 = 1/\gamma = \sqrt{1 - v^2/c^2} = \cos \alpha$

In section 10.1 of that same paper on the physical nature of mass, I have demonstrated that this means that the ‘inertial’ mass, is in fact the ‘force’ that we have to exert on a particle system to give it a unit compression in its direction of (congruent) motion, which allowed me to reveal the relation between the mass increase and the length contraction for any given speed as: $m_v/m_0 = l_0/l_v = \gamma = 1/\sqrt{1 - v^2/c^2}$

In this equation, the length ‘ l_0 ’ of a mass ‘particle’ represents in fact the diameter of the circular area that is repeatedly covered by the motion of its basic particles, when that mass ‘particle’ is at rest.

For spherical particles, this relation can also be expressed in function of the radius ‘R’ instead of the diameter ($l = 2R$) so that: $m_v/m_0 = R_0/R_v$

Which means that for fundamental mass particles: $mR = \text{a constant}$

In order to have an invariable intrinsic spin angular momentum, we will suppose that these fundamental mass particles consist of basic massless particles that rotate about each other at the invariable speed of light and create in that way a mass ‘m’, and we will see to what it leads us.

So their invariable angular momentum becomes: $L = mRc = \text{a constant.}$

Which for rotational motion, can be expressed as: $L = I\omega$

For rotating photons, considered as a thin hoop rotating about its diameter or as a cylinder rotating about its symmetry axis: $I = mR^2/2$

So that its invariant angular momentum can be expressed as: $L = I\omega = mR^2\omega/2$

This means that when photons with identical frequencies become entangled, they form a thin hoop that rotates with their common frequency $f = \omega/2\pi$.

The moment of inertia of such a rotating loop is: $I = mR^2/2$

So that the intrinsic spin angular momentum is consequently equal to:

$$L = I\omega = mR^2\omega/2 = mRc/2$$

The magnitude of the spin angular momentum of an electron is equal to:

$$L = mRc/2 = \frac{1}{2} h/2\pi \quad (= 0,5272858 \times 10^{-34} \text{ J.s.})$$

So that: $mRc = h/2\pi$

Which means that the equation for the rest is:

$$m_0 = h/2\pi R_0 c$$

This demonstrates ‘mass’ is emergent characteristic of which the magnitude is inversely proportional to the radius of rotation of its (massless) components. .

It follows from my mass equation that: $m_v = \gamma m_0 = \gamma(h/2\pi R_0 c) = h/2\pi R_v c$

This demonstrates that the mass increase of a mass particle from m_0 to m_v , is caused by the compression of that particle in its direction of motion:

$$R_v = = R_0/\gamma = R_0 \sqrt{1 - v^2/c^2}$$

6. A new gravitational working mechanism

The peculiarity of gravitational interaction is that it pulls the masses towards a state where the gravitational attraction increases, which means that it has the characteristics of a “positive feedback system”, in which the result magnifies the cause. This physical observation is confirmed by the differential equation of the gravitational displacement as a function of time: $d^2x/dt^2 - GM/x^2 = 0$

This equation is exactly that of “an unstable, self-excited nonlinear vibration system” as is stated by W. Seto in his "Theory and problems of mechanical vibrations" [12]: "Because there is continuous increase in amplitude of vibration, energy must have been kept adding to the system. Work is therefore done on the system by the damping force. Hence damping for these systems is negative."

Since "damping" is the transformation of coherent bulk motion into internal, isotropic motion, this means that in the case of self-excited vibration systems in general and in the gravitational interaction of two masses accelerating to each other, internal rotational-vibrational motion must be gradually transformed into coherent bulk motion.

This allows me to conclude that gravitational interaction between two masses in a vacuum space, has the characteristics of a positive feedback oscillator, as this is described by A.B. Pippard in "The physics of vibration" [13]: "*A signal derived from an oscillating system is amplified and fed back into the system with such a phase as to encourage the oscillation to grow. This can lead to a spontaneous oscillation very much in the same way as introducing a negative resistance*".

This means that gravitational interaction between particle-systems has the form of a positive feedback coupling between the motions of their basic components. This positive feedback coupling induces a self-excited resonance by which the translational motion of the basic components into each other's direction is amplified at the expense of their internal rotational-vibrational motion.

This new working mechanism for gravitational interaction matches completely with my paper on “Potential Energy” in which I came to the conclusion that the translational velocity of the basic components of a thrown up body is gradually transformed into internal rotational/vibrational velocity and that when the body finally falls back to the earth, the whole process is reversibly reversed and the rotational/vibrational motion is retransformed into translational motion.

In this way I have revealed the physical mechanism by which gravitational interaction realizes a transformation of the internal vibrational/rotational motion of the basic components of the particle systems into translational bulk motion into each other's direction, while the total amount of motion of both particle systems remains constant. In that way gravity works as a kind of a rectifier of the internal vibrational/rotational motion of the involved masses into coherent translational bulk motion.

My gravitational mechanism confirms Einstein's view, that masses are not attracted to each other by pulling forces, but that they accelerate to each other. The specificity of my gravity mechanism is that it is clear where the gravitational energy comes from and it doesn't need an energy carrying spacetime between the masses accelerating to each other.

In my gravitational mechanism the earth gives an identical acceleration (g) to any falling

object, whatever its mass, because the falling masses produce the same angular rectification for each basic mass particle, so that all falling objects will automatically have the same speed increase, regardless their total mass.

The only thing that our new gravitational working mechanism needs is that the vacuum space accomplishes a kind of “coupling” or “transmission signal” between both masses. This "coupling" or "transmission signal" does not need any "mass" or "energy" transport, because the masses proceed to each other on their own power. We can compare gravitational motion in that way with the motion of a remote controlled airplane, where the airplane flies on the power of its own.

This coupling between both attracted masses doesn't mean a violation of the conservation laws, because the total motion is conserved and is completely symmetric, so that this coupling must simply be considered as a characteristic or a ‘curvature’ of spacetime.

7. A unified mechanism for interactions-at-a-distance

It can at first hand seem strange to consider gravitational “attraction” as a rectification of the internal motion of the basic components of a mass particle system. This original working mechanism for interactions-at-a-distance is however not so new as it seems, because it is very similar to the classical working mechanism for magnetic “attraction”.

Magnetic attraction is based on the fact that charged particles are continually moving. These charged particles have rotational motion (internal spin) and orbital motion (electrons orbiting around the nucleus and protons orbiting inside the nucleus) which form electric currents that generate magnetic fields. Due to this magnetic fields, most atoms behave like small magnetic dipoles. In normal conditions, these magnetic dipoles are randomly oriented and their resultant magnetic field is zero. But in the case of opposite charges, these orbiting charges gradually rectify their motions in each other's directions.

The classical working mechanism for gravitational attraction says that, if these magnetic dipoles are influenced by an external magnetic field, the dipoles tend to align. This means that in the classical theory for magnetism, the magnetic interaction induces a rectification of the magnetic dipoles, which means that the magnetic interaction induces a rectification of the internal motions of the particles of the considered particle-system.

This magnetic working mechanism is exactly the same as my gravitational working mechanism, in which the gravitational influence induces an alignment or a rectification of the internal motions of the particles of the considered particle-system.

That the transformations of internal rotational motion into linear bulk motion is possible has been demonstrated by R. Saykally of Lawrence Berkeley Laboratory of the University of California, who uses adiabatic expansions for the studying of the weak forces between molecules. In his report about this experiments Jim Bagott reports ^[14]: "*As the molecules and atoms expanded, collisions between them helped to transfer the energy from the internal motions of the hydrogen chloride molecules - their vibrations and rotations - to the energy of bulk motion*".

In that way we have come to exactly the same working mechanism for gravity, magnetism and for the strong and the weak interactions. All these interactions make the basic particles align their motion to the direction of the interaction. The particularity of gravitation is that the alignment only takes place in one sense (towards each other), because it concerns identical (mass) particles, where the alignment for electric interactions, with equal and

opposite charges, can also take place in the opposite direction.

The originality of my new universal working mechanism for interactions-at-a-distance, as well gravitational as the other interactions, is that I consider the generated motion, not as a result of pulling forces or deformations of spacetime, but as an interaction between the internal motions of the basic components.

8. Conclusion

So my working mechanism for interactions-at-a-distance gives a clear, logical explanation for the generation of translational bulk motion in the case of gravitational interaction.

My interactive feedback mechanism replaces the static concept potential energy fields, that I we have proven to be wrong. This means that my gravitational working mechanism, in which the actions of translational forces-at-a-distance is replaced by an interactive, self-exited resonance mechanism, is universally valid for all interactions-at-a-distance in which till now, the existence of static "potential energy fields" was supposed.

Its dynamic interactive nature forms also the basis for an obvious explanation for some curious quantum mechanical phenomena, such as e.g. "quantum tunnelling".

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