Why big G is not constant.
The kinetic dipole

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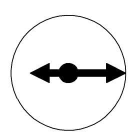
Gravity is a force pushing from within the atomic nucleus where each nucleon generates a linear momentum due to an asymmetric stretch quantum oscillation of quarks and gluons. The atomic nucleus is a kinetic dipole free to change direction. Each atomic species has a specific gravitational signature which renders the big **G** variable. All Cavendish-like measurements are affected by Earth's gravity. A measurement of the proton gravitational constant is proposed.

Since long range interactions are calculated with Newton's law in the electric, magnetic and gravitational fields and electricity and magnetism have their own dipoles, a gravitational dipole may come as a logical step. Further, since inertia and gravitation are considered as having a common cause strongly attached to the notion of mass, said cause may be a more generalized kinetic dipole.

The proposed graphic symbol of a kinetic dipole is shown in Fig.1. Unlike the electric and magnetic dipoles, the kinetic dipole's asymmetry is conventionally given by a head and a tail, the head showing the direction of push.

Tail



Head

Fig.1

The kinetic dipole can be described as an asymmetric stretch quantum oscillator (ASQO) discussed in [1] and the inertial propulsion experiment [2] can give an intuitive understanding of a kinetic dipole, through analogy.

Among all massive stable particles, baryons may be viewed as the most influential kinetic dipoles in the working of the universe. We can think of the universal gravitational constant **G** as being actually derived from the push of a single proton or neutron acting as a kinetic dipole. The difficulty of measuring **G** comes from the fact that the gravitational force varies with temperature [2] and that a gravitational mass is a very complex body in terms of kinetic dipoles.

Attaching to protons and neutrons a new property such as the kinetic dipole may benefit the understanding of the underlying physical processes related to gravity and state of motion.

Protons and neutrons are composite entities. The proton comprises two up quarks and one down quark whose rest masses make 1% of the proton's mass. Most of the proton's mass is due to the kinetic energy of the quarks and of the strong force mediated by gluons that bind the quarks together. The neutron consists of one up quark and two down quarks also bound by gluons. A stable nucleus may have at least one proton. When the nucleus contains more than one proton, stabilizing neutrons are necessary in order to keep the protons together which otherwise repel each other due to Coulomb forces that are stronger than the nuclear force, from a certain distance. The nuclear force is a residual strong force which is attractive at about 1.0 femtometer (fm) and repulsive under 0.7 fm. The maximum attraction occurs at a distance equal to the nucleon's radius (≈ 0.8 fm) and when the spin of the nucleons are aligned without violating the Pauli exclusion principle. When the spins of the nucleons are anti-aligned, the nuclear force becomes so weak that it cannot bind them any more, even if the nucleons are of different type.

From the above very succinct description of the atomic nucleus, it may be seen that nucleons are 99% made of kinetic energy. They also have an orbital angular momentum (spin), as discussed in [4].

In the proposed model, it is assumed that a net linear momentum is constantly generated in the direction of the axis of rotation of each nucleon due to an asymmetric vibration of the quarks and gluons. We may call it Nucleon Kinetic Dipole (NKD).
If the spin of most or all nucleons in a nucleus are aligned such that individual NKDs are aligned head-to-tail, it follows that the whole nucleus generates a total net linear momentum. Thus, the atomic nucleus becomes a kinetic dipole. We may call it Atomic Kinetic Dipole (AKD).

The mass difference between the proton and the neutron may cause their individual linear momenta to be different. The complexity of the nuclear forces also suggests that the net linear momentum of an atomic nucleus is not the sum of the linear momenta of individual nucleons, yet it has a dominant direction.

A body in free space may have its AKDs evenly oriented in all directions, as shown in Fig. 2. As a result, such a body would be at rest, the push of all AKDs cancelling each other in all directions.

The direction of the nucleus' linear momentum can be changed without affecting the overall energy of the nucleus, under certain circumstances. We call this process polarization. One case of polarization of the AKDs is the gravitization, described in [1], as illustrated in Figs. 3-4 showing two masses approaching in free space.

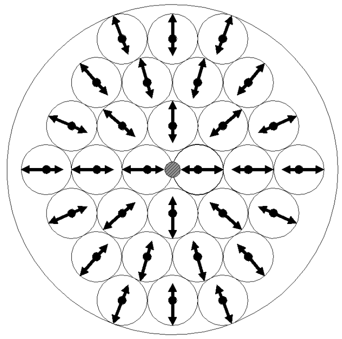


Fig. 2

When two objects come close to each other, the gravitational field may act on the AKDs of both objects in a similar manner as the magnetic field acts on the magnetic dipoles in ferromagnetic materials.

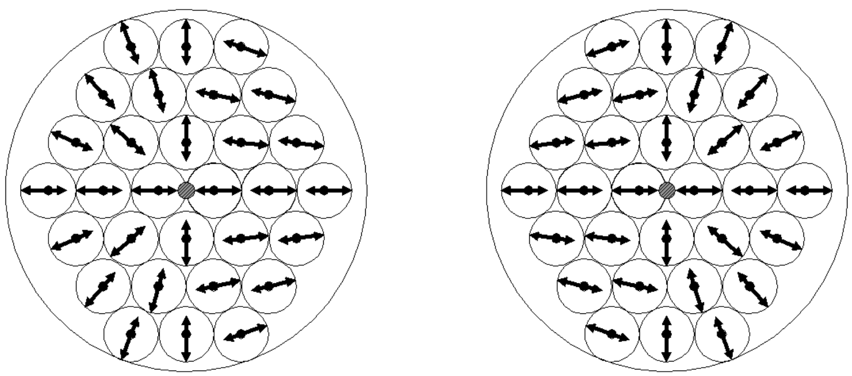


Fig. 3

As a result of the gravitization, the AKDs of each body rotate in the direction of the center of mass of the other body head on, both bodies being pushed towards each other due to the inertial propulsion imparted by their oriented AKDs.

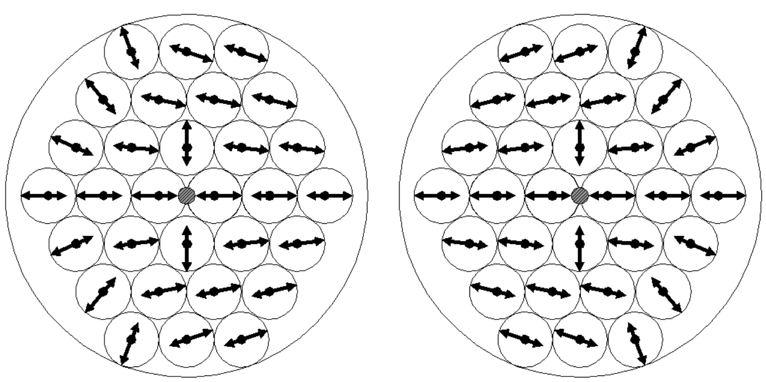


Fig. 4

The Newton's law expressing the force of gravity may reflect the fact that gravitization takes place gradually: the closer they get, the more AKDs of each body are aligned to the direction of the center of mass of the other body and the gravitational force increases with $1/r^2$. Also, the more mass a physical body has, the more AKDs it has which contribute to the imparted gravitational push. What we perceive at macroscopic level is a direct manifestation of a quantum phenomenon described as ASQO.

Therefore, according to this model, gravity is seen as a force pushing from within. Newton's iconic apple fell on the ground not because it was attracted by the Earth but because it was self-propelled by its AKDs oriented to the center of the Earth.

The kinetic dipoles can also be depolarized or randomized by heat, similarly to demagnetization, as discussed in [3] and illustrated in Fig. 5.

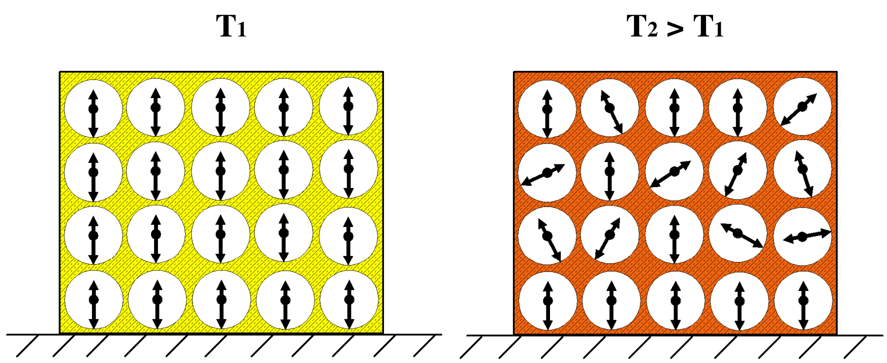


Fig. 5

On the left is shown a massive object at temperature T1, theoretically having all kinetic dipoles oriented downwards, in the direction of the center of the Earth. On the right, the same massive object is shown at temperature T2>T1, in which part of the kinetic dipoles' directions are randomized due to increased molecular vibrations. As a result, fewer kinetic dipoles are available to be oriented downwards which cause what we measure as weight. It was determined experimentally that a body's weight is decreasing with increasing temperature. The overall orientation of the internal kinetic dipoles is also a matter of entropy, as discussed in [1].

The gravitational field could be just an action at a distance between atomic nuclei acting as kinetic dipoles. The massless graviton could only be carrying the information on the relative position of the nuclei which determine their respective AKDs to orient towards each other head-to-head. It appears that this information travels via gravitons undisturbed, from molecular to astronomical distances. Not looking into what may happen inside matter at femtometer scale to cause gravitational forces was unproductive so far.

We also should expect each chemical element to have a unique gravitational behavior due to its atomic nucleus which makes it unique. Depending on the number of nucleons and the way they are assembled in the nucleus, it is reasonable to expect each atom species to have a unique gravitational signature in terms of the net linear momentum of its nucleus.

Atoms are pushed towards each other by the kinetic dipoles of their nuclei until they reach a positional dynamic equilibrium due to the electrostatic repulsion of their electron shells and other molecular forces that may be involved. In solids, after the atoms are locked in a crystalline or other type of structure, the AKDs are free to rotate in any direction, individually or in groups, similar to the magnetic domains. Their instant orientation also stresses the molecular forces up to dragging a whole body in one direction or another.

Each type of molecule may also have a specific kinetic dipole called Molecular Kinetic Dipole (MKD). At this structural level, temperature has a clear influence on molecular vibrations which randomizes the direction of individual MKDs and may change the amplitude of MKD's linear momentum.

In this view, all materials and physical bodies made of said materials are very complex gravitational and kinetic structures. All nuclear kinetic dipoles are responding to external influences such as the proximity of other bodies and external forces to which part of them can align with. They also have a crucial role in dilation, phase change and crystallization which are kinetic processes, as discussed in [1].

Assuming that each chemical element has a specific AKD, I would suggest that the universal gravitational constant is not a constant after all, but an average due to the complex structure of real bodies made of various materials with different AKDs and MKDs.

Besides the multitude of publications casting doubts on big **G** as being a real constant due to intriguing measurements results, [8] is remarkably pointing to a root cause of variability of **G** which supports my suggestion. Mikhail Gershteyn et al. show that **G** varies significantly with the orientation of the test masses relative to the system of fixed stars, in repetitive Cavendish-like experiments. The dependence of G on direction in space has been named **G** anisotropy. In my opinion, **G** anisotropy shows that the AKDs in bodies on Earth receive the direction information from surrounding massive objects, including the Moon and the Sun, and reorient accordingly. The authors call the torsion balance "an antenna" for detecting **G** anisotropy signal. In my view, each AKD is an antenna which may be sensitive even to signals from the center of our galaxy and beyond.

Flaws in the measurement of the universal gravitational constant

All Cavendish-like experiments designed to measure the universal gravitational constant G (or big G) are based on three assumptions:

i) The gravitational force measurement in a horizontal direction between a field source mass and a test mass is not affected by the vertical Earth's gravitational field;

ii) The gravitational force measurement between a field source mass and a test mass is not affected by the temperature of the two masses, and

iii) The gravitational force measurement between a field source mass and a test mass is the same, regardless the materials involved in making the two massive objects.

In my opinion, all three assumptions are not sustainable, affecting the results with various degrees, as follows.

i) The experiments are sunk in the dominant gravitational field of the Earth, affecting all the massive objects involved. Applying the kinetic dipole polarization model discussed above, most of the kinetic dipoles inside the massive objects are oriented in the direction of the center of the Earth, leaving a relatively small number of kinetic dipoles to be polarized horizontally, pushing them towards each other from within, as illustrated schematically in Fig. 6.

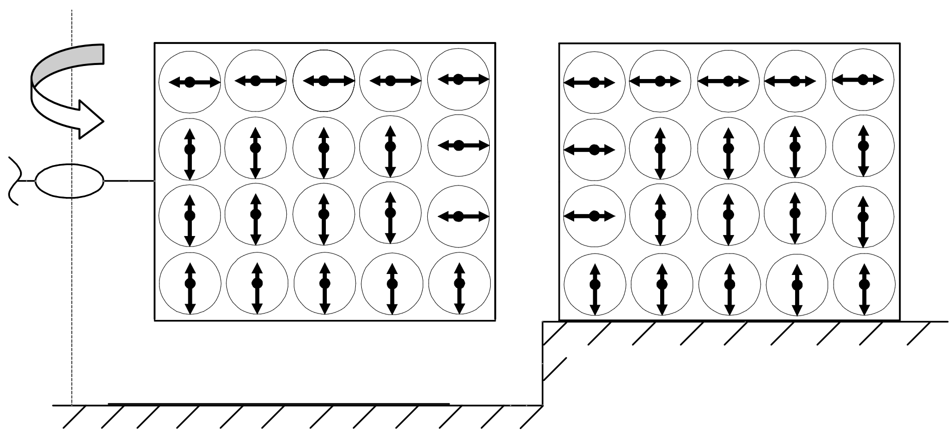


Fig. 6

Another related factor is the site dependency of the measurement. It is general common knowledge that **g** varies according to the local topography and geology. We never know what's under our feet that can change the local value of **g**, such as aquifers, lava currents, etc. A higher **g** results in a larger number of kinetic dipoles oriented vertically in the test and field source masses which diminish the horizontal gravitational forces measured in the experiment.

Therefore, it is reasonable to infer that replicating a measurement of **G** in different locations on Earth may lead to slightly different results, in spite of preserving all other conditions. Also, in any given location, **g** varies in time. The tidal variation of **g** is the most predictable.

ii) In [3] it is shown that an increase in temperature can alter the weight of a massive body. Part of the kinetic dipoles' directions are randomized due to increased molecular vibrations. As a result, fewer kinetic dipoles are available to be oriented downwards which cause the body to be lighter

In the case of a Cavendish-like experiment, the temperature of the test mass and that of the field source mass also alters the number of kinetic dipoles that are available to be oriented horizontally. It is reasonable to infer that a measurement of the horizontal gravitational force at temperature T_1 will reveal a higher value than the same measurement at temperature $T_2 > T_1$. It follows that $\mathbf{G}(T_1) > \mathbf{G}(T_2)$.

iii) The Cavendish-like experiments described in [5] used field source masses made of various materials such as copper, tungsten, lead and stainless steel. Even if the masses are the same in two of the above experiments, the results should be slightly different because the protons and nucleons are assembled differently in different materials and their net linear momentum have different contribution to the gravitational force.

If we could measure the field source mass and the test mass with a resolution of 10 exp (-27) kg, we might be able to determine how many nucleons are in each mass. Additionally, by knowing the nuclear structure of each atomic species, we also can determine how many atoms are in each mass.

For example, in a mass of lead-208 each atomic nucleus has 82 protons and 126 neutrons while in a mass of tungsten-182, each atomic nucleus has 74 protons and 108 neutrons. In any given mass of pure material, there are 1.1428 more atoms of tungsten-182 than atoms of lead-208.
Therefore, practically it is very difficult or maybe impossible to make two identical masses, one of lead-208 and one of tungsten-182 containing an integer number of atoms of each species.
Moreover, the two atom species have different AKDs which multiplied with a different number of atoms in a given mass, will result in a different gravitational force.

In my opinion, using atoms (atom interferometry) to sense gravity instead of conventional mechanical devices such as torsion balances, as disclosed in [6] and [7], is a step in the right direction.

According to the above discussion, it appears that each atomic species has its individual gravitational constant. The proton also should have its specific gravitational constant called Proton Gravitational Constant (PGC) and measuring it could be in the grasp of physicists at CERN.

A proposed way to measure the PGC

The primary operation of the LHC is proton-proton collision. If we could elastically collide in vacuum just two protons and accurately measure their acceleration in a well specified time frame before collision, we may calculate PGC very accurately.

Considering the two protons "falling" on each other with known initial velocity and subtracting the Coulomb force repelling each other, we get the gravitational force pushing the two protons towards each other. The trajectories of the colliding protons should be perfectly aligned and their speed should be accurately measured "stroboscopically" before collision.

Unlike most experiments at CERN, this one would not involve high energy. On the contrary, the lower the energy, the slower the protons, and the higher precision of measuring their speed. Non-relativistic speed should be preferred.
I believe a soft head-on elastic collision would be the best condition for the experiment, without disintegrating the protons. Detectors and the source of single protons could be a challenge.

The advantage of the proposed method is that is "**g**-free". Applying a Coulomb or Lorentz force to a proton results in changing the direction of its kinetic dipole in the direction of the force. If said force is horizontal, the proton's kinetic dipole cannot be simultaneously directed to a vertical direction, freeing the result from the influence of the Earth's gravity.

The question is how different the value of PGC measured through the proposed LHC experiment could be from the value of G recommended in [5]. I believe PGC is up to ten times larger than G. This would render the concept of dark matter less effective since the working of the universe could be explained differently, starting from the basic concept of the kinetic dipole.

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