

Gravity

21 February 1988 "Cohesion, or adhesion, may be the source of gravity. If, as I have earlier presumed, that gravity depends not so much on the quantity of matter, but more so on it's state of compression, then the source of energy for the compression should be found. I cannot imagine two freely floating particles in space seeking each other just because of their presence. I can, however, see how they can wander near enough to each other for molecular adhesion forces to bond them together. In time, as more material gets bonded into this growing community of molecules, the interior comes under compression. This state of compression, or high energy state of strain, could be the origin of gravity. The energy has to be released in some way.

I can see an experiment to test this theory. In a vacuum chamber, build a Cavendish balance. Have a means to exert a compressive stress on one of the masses while measuring the gravitational attractive force on the other.

Task: Derive the quantity of compression to generate a quantity of gravity, i.e. find the mathematical relationship."

The above was composed into my notebook when I was 39 years old. It sounds preposterous, but the idea has not left me alone. We do not know what gravity is, so at this point, any idea is just as valid as any other. This article will explore the science and logic of that crazy idea. It is just a speculation that has consumed my amateur philosophical contemplation for three decades.

There has long been a suspicion that electromagnetic energy and gravity are coupled. That was based on the similarity of the force diminishing as the square of the distance increasing, and the speed of transmission. That is an interesting kinship, except for the fact that electromagnetic energy is dynamic, oscillating positive and negative, while gravity seems to be a static, or at least one sided attractive phenomena. This article will not dwell on that observation, but offer a fresh perspective based on some engineering considerations.

Biology

All biological organisms, bigger than single cells, have gravity sensors. They grow up, not down. A tree is a good example. It's seed falls to the ground at random, then detects gravity and sends

it's shoot up, not down. Insects crawl right side up. Birds fly bottom side down. Animals walk upright. Fish swim topside up in water.

Gravity is a non-obvious force, or an acceleration. It was initially deemed to be a force by Isaac Newton, then later understood by Einstein to be equivalent to an acceleration. We are not directly
35 conscious of it because we are born into it and grow up with it constantly in our presence. Just as a fish is born in water and takes no notice of its surrounding effects. It uses the water for mobility. However, it immediately comes under distress when withdrawn from the water. The absence of its natural environment is what gets its attention. Similarly, creatures born and existing in a gravity field will become immediately aware of its departure. Otherwise, on a daily basis, it is a subconscious force that
40 we have adapted to. We exist with gravity and move around in it, but really, what is it?

Force, or What?

Gravity is a distributed force and a body force. Being distributed means that it does not really act only on the center of gravity point (the c.g.), but rather acts on every piece of matter independently. A body force means that it is not a contact force, but something that acts across space like "spooky
45 action at a distance". Magnetism and electrostatics are likewise body forces.

By not acting at a single point means that there can be more stress on the lower part of a structure than on the upper parts. For biological organisms, the lower joints must be stronger. For tall buildings the lower parts of columns must be thicker because they support the weight of matter above.

Gravity has been taught to be a static force, a singular quantity with a positive sign, that is
50 always attractive, never repulsive. That needs to be qualified. Gravity is now considered to be indistinguishable from a force or an acceleration. Acceleration can be dynamic with a frequency. All natural phenomena are dynamic, so why is gravity the exception? In addition, the perceived sources of gravity, i.e. masses, are in motion and their relative distances are continually changing. So the gravity vector at any point in space is constantly varying. The gravity force, being dynamic, may have a

55 frequency characteristic. It might have a natural frequency with a corresponding amplification factor,
and a possible isolation behavior. This dynamic property of gravity, if accepted to exist, implies
positive and negative forces at any point that constructively and destructively interfere with amplitude
and phase additions. Tides are visible evidence of that.

Just for fun, the gravity force of attraction to the Sun and Moon were calculated for a 160 pound
60 person, and compared the Earth's gravity attraction. The results are:

Earth	160 Lb _f
Sun	0.10 Lb _f
Moon	0.000 543 Lb _f

There is a difference, though. The Earth's attractive force is a static constant 160 Lb_f. The Sun and
65 Moons's gravity force is variable, being positive at night when the Sun is on the back side of the Earth
and negative in daylight. Likewise for the Moon, but being much smaller in magnitude.

The curious observation is that the plus and minus 0.10 Lb_f on a human of 160 Lb_m coincides
with a sleep cycle. That is a small variation when compared to the radiation from the Sun, which would
be dominant. It would be interesting to actually measure this oscillation with a calibrated weight in a
70 controlled experiment.

Mass has an affinity for itself. The material in the universe has collected into round globules.
The universe structure appears to be polarized in relation to energy and gravity. The extremes are stars
at one end with large mass, large energy radiation, and large gravity. At the other extreme are small
clumps of matter with relatively less mass and energy, and little gravity i.e. asteroids. In between are
75 life forms that thrive in a moderate gravity environment with some mass to cling to and some heat
energy within.

I cannot imagine any two passive materials having a desire to clump together just because of
their proximity. I can, however, see adhesive molecular forces and cohesive forces drawing material
into closer contact. Electrostatic forces and magnetic forces are inter-molecular. Matter moves when

80 exposed to electric and magnetic fields. Could these molecular forces of attraction on a microscopic scale be the same source of attraction at larger distances? The speculation here is that electrostatic, magnetic, and gravity fields may be one and the same, scaled for mass and distance.

A body has mass that we assume to be constant as it moves around in space. At a specific fixed location, the acceleration sensed by each different mass is a constant because they all fall at the same
85 rate. Therefore, each body senses a different force. The governing equation at the Earth surface is:

$$F_g = \frac{mM_e G}{r^2} \quad \text{where } F_g = \text{gravity force, N}$$

m = mass of body, Kg
 M_e = mass of Earth, 6.00×10^{24} Kg
 G = 6.672×10^{-11} N-m²/Kg²
90 r = Earth radius, 6.370×10^6 m

The quantity: $\frac{M_e G}{r^2}$ is an acceleration (Nt/Kg). It is a constant at the surface of the Earth.

The two variables in the above equation are the mass and the force that the mass experiences. Nothing
95 new here, except for the interpretation, which is, that each different mass senses it's surroundings and responds to a unique force emanating from a nearby Earth. There is some communication which implies an energy exchange. The force of gravity, F_g , is scaled by the mass so that acceleration of free fall is the same for all masses. So the gravity force is variable, or appears to be.

100 Energy

Energy is defined as the ability to do work. Gravity can certainly cause something to move and motion is mechanical energy. Therefore, gravity is a form of energy. Without gravity, the mass of the universe should diffuse out into the cosmos into a less orderly state, in accordance with the second law of thermodynamics. Instead, it clumps together. Matter has been characterized as "frozen energy". That
105 is not quite accurate, so it needs to be qualified. Freezing is a change of state from a liquid to a solid. Even though matter can be in any one of these three states, that is not the intent of the phrase "frozen

energy". The idea of "frozen energy" is in accordance with Einstein's $E = mc^2$, where nuclear binding energy is used to capture matter into a solid form, preventing it from running loose.

Energy can have a frequency. In the context of matter being "frozen energy", this could be
110 interpreted as the frequency of the energy changing state from a high dynamic frequency to a static, or
very low frequency. Energy, in whatever form floating around in space, may have a tendency to fall to a
lower energy state, just as water flows downhill. So gravity could be the entropy that provides the
trigger for the system to self-organize, or coalesce, into a minimum energy state of equilibrium.
Attraction is a fundamental principle of physics that results in a minimum energy state, based on
115 quantum mechanics. It can also apply to large systems.

The surface of any large body is an area of highest energy density. It is where gravitational
energy is at a maximum. This is similar to grain boundaries in crystals where minority molecules
(contaminants) migrate to, where corrosion is enhanced, the stress level is greater, and generally, the
effects of time are accelerated. Going deeper into the body, gravitational energy decreases, but it is not
120 lost. It must change to some other form. Elevating above the surface, gravity energy also decreases. A
hundred feet above ground level, an aircraft is pulled down by gravity, so gravity energy is radiated
outward beyond the surface and communicates to the aircraft, and to the skydiver, birds, and even
clouds. In summary, large gravitational bodies are energy storage nodes, where mass is the form of
storage, but it is not a closed system. Some energy must and does leak out.

125 Stars are radiating electromagnetic energy. That energy is leaving the star and streaming out into
the cosmos, never to return. If we believe in the equivalence of mass and energy, then the star is also
losing mass. If its mass is decreasing, then the logical result is that its gravitational force, or
acceleration, is also diminishing. Its "pull" on the solar system planets should be getting smaller and the
planet's orbital radius should be increasing. Replaying this tape backwards, the planets were closer to
130 the sun in the distant past and perhaps part of it. How absurd is that?

Being a form of energy, it is plausible to consider that gravity can interact with other forms of energy, in accordance with the first law of thermodynamics that energy cannot be created nor destroyed, but can be transformed from one form to another. As mentioned above, gravity can induce mechanical energy. How gravity interacts with other forms of energy is largely unknown, but based on this reasoning, it is plausible to suggest that any form of energy is capable of affecting acceleration. The effect would be very small, scaled by the speed of light squared.

How is it possible for one piece of matter to not only detect another piece of matter, but to also perceive its amount and direction? It moves accordingly. This is communication, and all forms of communication are a transfer of energy. Masses are communicating with each other and this can be interpreted as gravity waves. We just do not know more details about this form of energy transfer. The communication is obviously subliminal. We do have sensors to detect gravity, but are desensitized to its ubiquitous presence. We are very observant to the motion that it produces, and are aware of the force, but the mechanism of passing that energy across "empty" space is mysterious. Our communication channel to that energy transfer appears to be closed for most of our conscious existence. Newton was purported to have stated that "like gravity, electricity, and magnetism, there must be other forces in nature as yet unobserved, and just as large bodies act upon each other, there must be forces that act upon 'insensible particles'." He was speculating about our inability to sense that energy, but he did invent the idea of fields to explain our lack of knowledge for action without contact. Fields made energy real, not a material thing, but something that can cause motion.

Quantum entanglement may hold the key to understanding the nature of communication among rocks. In the spirit of science, there must be a mathematical relationship to describe that communication. To expose it may require some statistical analysis of heavenly bodies at low frequencies. This is all just speculation.

The Speed of Gravity

155 This sounds like one of those ridiculous questions. Gravity is not a thing that moves, so it's velocity must be zero. But what we want to consider here is the speed that the communication signal traverses space. That subject came up shortly after Newton proposed the law of gravity. He avoided answering any details about what gravity was or even how fast it could send its signal. He implied that the speed of transmission was instantaneous. Others added descriptive words like "action at a distance".

160 The speed of contact forces can be measured with strain gauges. The speed of sound in any material, including air, can also be measured. In a vacuum, sound does not travel because there is no medium for the wave to go through. The speed of sound in a vacuum is zero.

 The speed of transmission of the gravity force (or the acceleration effect) has not been measured with confidence, at least not directly. It is only theoretical. It is difficult to imagine a constant gravity
165 force, or a static acceleration, traversing through empty space. What could it be pushing on? If you can imagine such a thing, then you have a more lucid imagination than I. It is more likely that the gravity influence is a wave. If so, then the next logical question is "What is the medium that conducts this wave?" The specifics are unknown, but it must be a property of space, or of the field. In a similar manner, we could ponder the speed of magnetic force transmission.

170 Pondering that its speed could be infinite, philosophers posed the imaginary scenario of the Sun magically disappearing instantaneously while the light from it continued to flow at 300,000,000 m/s. The gravity force would immediately cease and the Earth would fly off on a tangent at 30 km per second while the inhabitants of the Earth would continue to see the Sun shine for another eight minutes. This sounds illogical, but then we are considering an impossibility. The Sun cannot magically
175 disappear. Who cares? Well theoretical physicists care, if for no other reason than to understand more the properties of gravity.

 The current thinking is that gravity flows as a wave somewhere near the speed of light. If that was the case, then the disappearance of the sun and its cessation of gravity we would detect simultaneously eight minutes after the real event. We would continue to feel the Sun's gravity and see

180 its light even though it no longer existed. Sounds absurd, but another imaginary concept has crept into
this sensation, and that is time. Sometimes it is fun to imagine impossibilities if for no other reason than
for our entertainment. I suppose it is possible to correlate the speed of gravity to the speed of light if we
could observe an event somewhere in the cosmos with light (or some other radiation) and the arrival of
a gravity wave. That assumes that we know the speed of light with confidence in the medium that it
185 traversed and that we also know the distance to the object under observation.

We cannot stop and start gravity to measure its speed, like we can do for light. It is always
present and surrounds us and everything else in the universe (we think). It does vary locally in
amplitude depending on any nearby mass, but it is never turned off completely. If the theoretical
gravity particle, the graviton, is ever detected, then we may have a chance of measuring it's true speed.
190 Perhaps the graviton is another illusion brought about by our attraction for symmetry. For the time
being we just do not know what the speed of gravity is. Practically, it is a don't care because that
knowledge cannot earn anyone more money, it does now help to grow more food, and will not assist in
your social standing. But it is fun to ponder if you are bored.

Compression

195 Simple work is defined as force times distance moved. If there is no displacement, then
theoretically, there is no work for rigid bodies. But bodies are not really rigid. Rigid body physics is an
idealization that is attractive for simplifying the mathematics of motion, but the reality is that every
material has some elasticity. The fact that everything is "springy" means that it can store energy
internally. The internal strain energy, or work, involves very little motion on a macroscopic scale, but is
200 force applied into a volume. It compresses the material reducing it's volume. It corresponds to the area
under the stress strain curve. Whenever some material is compressed, its temperature increases. That is
work energy transformed into another form – heat. Heat, being a radiation, is an electromagnetic wave
with a frequency, a wavelength, and a speed. So when I compress a material, I am also sending out a

wave of radiation. It travels through some medium, or as a field. The ideas of gravity, fields, waves,
205 and heat appear to have something in common.

The material on the surface of our planet is pressing down (under the influenced of gravity)
onto the material below and raising its temperature. Mass under strain, as in compression, is in a higher
energy state. That energy may be retained within the material stiffness, or some may leak out in another
form, such as heat. Heat is a form of electromagnetic energy with a frequency that interacts with other
210 matter. Theoretically, we should be able to calculate the strain energy stored in the compressed Earth.
Further, we should be able to correlate this to temperature, with some assumptions about the material
properties and the work equivalent of heat.

This strain energy stored within the Earth is probably not fully contained because the Earth is
not a closed system. Some is certainly leaking out as heat, and there could be other forms of energy
215 escaping. Gravity energy could be another form leaking out. There may be a balanced feedback loop
where gravity attracts matter that adds to the compression, which in turn, continues to generate gravity
energy. A test for this idea would be to compress some material, generate sufficient internal energy with
accompanying heat, and measure if any attractive force is detected from a nearby test mass.

Heat is a singular form of energy in nature. That is, it does not have a corresponding dipole of
220 negative heat. There is only positive heat, but heat can flow towards or away from a body. Heat can
flow in three dimensions and is dynamic. That is, it can have an oscillating behavior going positive and
negative with a frequency. Gravity is also a singular form of energy with only positive values of
attraction above zero gravity. There is no perceived dipole of negative gravity. But gravity can also be
three dimensional and dynamic with positive and negative swings as evidenced with tides. It can have a
225 forcing frequency and theoretically a natural frequency.

Microscopically, thermal energy is oscillatory as kinetic energy of motion of molecular
particles. Macroscopically, thermal energy is unidirectional and appears slowly transient. This is the
theoretical basis for the second law of thermodynamics, the idea of entropy, and the direction of time.

On a microscopic scale, gravity is infinitesimally small compared to electric and nuclear forces, but it could also be oscillatory. In that case it would appear averaged away to zero. For all practical purposes at very small scales, gravity can be considered to be non-existent. On a cosmic scale, we can measure gravity as a force or an acceleration. Something strange happens when enough matter clumps together to create a significant mechanical energy effect.

$$\underline{E = mc^2}$$

If energy and mass are equivalent, then we need to consider the consequences of an increase in strain or an increase in temperature. These are internal energies. When a spring is compressed or stretched, then that places it in compression or tension. Its internal energy increases and, therefore, its mass increases. Its mass increase arises from the increased potential energy stored within the stretched material bonds linking the atoms together within the spring. Pressure applied to a material volume (as in compression) represents a sizable quantity of energy.

Likewise, raising the temperature of an object increases its internal thermal energy, which increases its mass. The mass increase with these two examples must consider that the energy increase must be divide by the square of the speed of light ($m = E/c^2$). The increase in mass will then be an incredibly small number.

Gravity, being a form of energy, can be converted to another form, and vice versa. So the source of gravity may not be the mass, but rather the energy associated with that mass under strain. The strain energy generates the heat and perhaps other energies which leak out as macroscopic attractive force that supports the compression that replenishes the heat energy in a closed loop feedback cycle. The big unknown in this idea is "why does the system not cool down?" If gravity energy is flowing away from a celestial body and not being reflected back, then the mass must be decreasing, gravity diminishing, and the whole system cooling down. These parameters should be measurable. They are either changing or not changing.

Celestial systems are not closed systems. They exchange mass and energy continually. Mass and energy are, supposedly, conserved quantities. Taking mass as the one conserved quantity, if our laws of physics are to be believed, then these formulas for mass should be equivalent --

$$m = \frac{F}{a} \quad m = \frac{E}{c^2} \quad m = \frac{F_g r^2}{GM_e}$$

These formulas involve mass, energy, acceleration, and the speed of light, and appear to be interconnected.

Final excuse

The human imagination can produce some good ideas. It is equally, if not more prolific, in producing an abundance of "wild" ones in generous quantities.

Victor Wowk
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