A Model of Gravity

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The mechanisms that cause bodies to move toward each other due to gravity remain a mystery. It is shown that the typical dimensions of the gravitational constant are reduced to simplest form. Through analysis they are restored to a more useful form. Once restored, they give insight into why masses are drawn to each other. They support a gravity model where a fluid filling all of space and surrounding all mass is essentially consumed by mass, creating currents of the fluid that ultimately move the bodies consuming it toward each other.

1. Action at a Distance

If we throw a ball into the air, eventually it will fall to the ground. We say that gravity caused the ball to fall. The Earth's gravity pulled the ball toward the Earth until it reached the ground. We take this on faith because we do not see the Earth reach up and pull the ball down. We simply see what appears to be a free ball move on its own toward the ground. The Earth and the ball seem to interact without being connected.

In general, any two massive bodies, M_1 and M_2, separated by a distance, r, seem to act on each other through gravity without any intermediary medium working between them. They follow the Law of Universal Gravity,

$$F_G = G\frac{M_1 M_2}{r^2}, \quad (1)$$

where F_G is force and G is the universal gravitational constant. Each body appears to draw the other towards it, even though the two do not appear connected in any way. This phenomenon is called action at a distance. The bodies act on each other without making contact, directly or indirectly. They seem to will each other to move. When the bodies are comparable in size, as is the case with binary stars, they each move. Binary stars orbit each other because of gravity. However, if one body is much more massive than the other is, the lesser body appears to move toward a stationary greater one. We usually think of this as the greater body pulling the lesser one toward it. The Earth pulls a falling apple to the ground. However, nothing connects the Earth to the apple, so how can it pull the apple? To a casual observer, the Earth is doing nothing to the apple to make it move. That the Earth causes the apple to move does not seem to make sense. It goes against what we know through experience about how objects interact with each other.

Because this action at a distance is so counterintuitive, as a basis for a new model of gravity, let us trust our intuition and propose that something actually connects bodies acting on each other under the influence of gravity. Let us assume that something exists between the apple and the Earth that allows the Earth to impart a force upon the apple. Clearly, whatever connects them is not readily detectable or we would have discovered it long before now. The only way we know that something is there is through what it causes to happen. It causes bodies to move toward each other. It causes the apple to fall to the Earth. It is like an invisible man in a movie [1] who reveals himself by picking up a visible object, causing it to seem to float in the air. Our task, then, is to identify the "invisible man" that causes gravity and describe how he is causing it.

To begin developing our model, we can look around us to find other situations that resemble what gravity does. One common occurrence the behavior of the lesser bodies moving toward a greater one resembles is that of objects caught in the flow of fluid moving toward a drain. Soap bubbles on top of water in a bathtub move toward an open drain. There, the water pushes the bubbles toward the drain as it rushes toward the drain. It is easy to see that the water carries the bubbles. However, if the water were crystal-clear, so clear that it is virtually invisible, the bubbles would appear to be moving toward the drain without any conveyance. The drain would appear to be somehow pulling the bubbles toward it. The drain would appear to act on the bubbles from a distance.

This illusion is very similar to what we see when an object falls to Earth. Like the drain, the Earth appears to pull the object toward it. So: perhaps an invisible fluid is pushing the falling apple toward the Earth, just as the crystal-clear water pushes the bubbles toward the drain? Maybe gravity is just the result of an invisible fluid pushing objects toward each other? To begin to explore these possibilities, let us consider the universal gravitational constant, G. The simplest form of its dimensions is volume per time-squared per mass, which, in the mks system is usually

$$G \equiv \frac{m^3 / s^2}{kg}, \quad (2)$$

where m is meters, s is seconds, kg is kilograms, and here the equivalence sign (≡) stands for "has the dimensions." Expressed as

$$G \equiv \frac{(m^3 / s) / kg}{s}, \quad (3)$$

the dimensions in the numerator appear to relate a volumetric flow rate (m^3/s) of something to mass (kg), and suggest that the rate at which something flows is tied to the mass that a body possesses. So, here we have some confirmation that gravity involves something flowing, and that the more mass involved, the stronger the flow of that something is. But, what is flowing? Nothing detectable is moving around the bodies. Could it, whatever it is, be the "invisible man" that moves the bodies? And, how is it related to the mass?

To address the question: What is flowing? consider, what is there in empty space to flow? The initial response might be: There is nothing in empty space. It is void of any matter or energy. From that observation, it seems that if our "invisible man" exists, he is neither matter nor energy, as we know them. The only thing out there in space is the vacuum. So, maybe our "invisible man" is the vacuum? We do not generally think of vacuum as being something because by definition it is nothing. We create a vacuum by removing all gases and particles from a space so that there is nothing left in it. However, by nothing, we usually mean no matter or energy. "Something" to us has to be made of some combination of matter and energy. We cannot detect or "see" something unless it is made of matter or energy. Perhaps then, if vacuum is actually something, whatever it is, it is "invisible" to us because it is not made of matter or energy. Our "something" light shines through it because there is no matter or energy for it to reflect off, just as light shines through, not reflecting off, the crystal-clear water of our hypothetical bathtub.

Let us propose, then, that the vacuum of empty space is a substance, and that the volume component in the dimensions of the gravitational constant refers to volume of vacuum. The gravitational constant describes the volumetric flow of vacuum as it relates to a quantity of mass. With that, it seems we have a prime suspect for the "invisible man" in our new model – the vacuum of space. The vacuum likely flows toward masses, just as the water does toward the drain in our hypothetical. The strength of the flow appears related to the amount of mass present, which would explain why massive Earth would create a strong enough flow to move the meek apple. The vacuum seems the prime candidate for providing the motive force that moves objects for gravity. This vacuum is likely the same entity often called ether in other discussions, but we will continue to refer to it as vacuum in this discussion.

So, how is our "invisible man" the vacuum related to mass? The gravitational constant dimensions contain the term, $(m^3/s)/kg$. It implies that for each kilogram of mass present, a volumetric change in something occurs over time. We have declared that the volume term in the gravitational constant refers to the vacuum; so, a volumetric change in the vacuum occurs over time for each kilogram of mass present. As mentioned earlier, objects under the influence of gravity behave as if caught in draining fluid. Removal of the fluid at the drain causes the flow of draining fluid. This suggests that the removal of something creates a flow of that something toward whatever is removing it in the process producing gravity. We are assuming that the something flowing is the vacuum. If the apple falling to Earth suggests that vacuum is flowing towards Earth, then something associated with Earth is removing vacuum from space. The $(m^3/s)/kg$ term in the gravitational constant dimensions implies that for each kilogram of mass present, something happens to a volume of vacuum each second. It appears that a volume of vacuum is removed from space for every kilogram of mass, every second, creating a flow field moving toward the mass. Therefore, the mass of the Earth is apparently removing vacuum from space.

So, why is the vacuum disappearing and where is it going? It could be draining, but to where? Some may say: Another universe? I say: Probably not. If that were the case, it would mean that all mass has an opening to this other universe, and other than gravity, we have seen no indication of this. Also, if all mass possesses a gateway to another universe, what would stop things from the other side from crossing over to our side? It seems unlikely that the vacuum is draining to another world. The vacuum is more likely being consumed. Having vacuum consumed not only answers the question, why is it disappearing; but also the question, where it is going. It is being used by something. Something is taking it in and converting it into something else. Maybe mass takes in vacuum and burns it to do something the way a car burns gasoline to move. Or, perhaps something associated with matter burns the vacuum to produce the mass like a Bunsen burner burns propane to produce a flame. If the mass is using the vacuum to do something, then what is it doing? All mass seems to do at the fundamental level is exist and take up space. So, if the vacuum is being used to do something, maybe it is used to produce the mass that exists and takes up space. This, of course, takes us to our Bunsen burner analogy. Assuming that something consumes the vacuum, let us say that mass exists because something consumes vacuum. Something consumes vacuum and converts it to mass. We do not know what it is or how it does it. We only know that it takes whatever vacuum is and turns it into mass.

2. Breaking the Code

In the Law of Universal Gravity (equation (1)), the universal gravitational constant, G, is like a black box. You give it some ingredients and it gives you a product. If you give it a mass and a distance, it gives you acceleration. If you give it two masses and a distance, it gives you a force. Black boxes are useful and wonderful tools for generating products. However, you do not know what is going on inside them to produce the products. You do not know what their parts are or how they work. Such is the case with the gravitational constant. We know it works, but we really do not know why. We do not know what it is doing to the ingredients we give it to generate the products it gives us. The key to understanding gravity may lie in understanding how the gravitational constant works.

In the mks system, in addition to those shown in equation (2), the dimensions of the gravitational constant, G, may also be expressed as

$$G \equiv \frac{N-m^2}{kg^2}, \quad (4)$$

where N is Newtons, a unit of force. Since the dimensions of a Newton are

$$N \equiv \frac{kg-m}{s^2}, \quad (5)$$

the dimensions of the gravitational constant can be written as

$$G \equiv \frac{kg-m^3}{kg^2-s^2}, \quad (6)$$

or

$$G \equiv \left(\frac{m^3/s}{kg}\right)\left(\frac{kg/s}{kg}\right). \quad (7)$$

In this form, the gravitational constant seems to be made of two components. One component relates a volumetric flow rate (presumably of vacuum) to mass, which we discussed earlier, and the other appears to relate a mass flow rate to mass. The latter component does not appear to have any physical meaning. However, if we multiply its numerator by m^3/m^3 (multiply by 1), we get

$$G \equiv \left(\frac{m^3/s}{kg}\right)\left(\frac{(kg/s)\times(m^3/m^3)}{kg}\right) \quad (8)$$

$$G \equiv \left(\frac{m^3/s}{kg}\right)\left(\frac{(m^3/s)\times(kg/m^3)}{kg}\right) \quad (9)$$

$$G \equiv \left(\frac{m^3/s}{kg}\right)\left(\frac{m^3/s}{kg}\right)\left(\frac{kg}{m^3}\right) \quad (10)$$

Now, in equation (10) we see the gravitational constant is made of three components. Our manipulation of the second term in equation (7) revealed a second volumetric flow rate per mass component, and a third component that appears to relate volume of vacuum consumed to amount of mass created. With *kg* in their denominators, the first two components probably each operate on one of the two masses; M_1 and M_2, in the gravity law in equation (1), so we will assume their values are the same. The third component appears to establish that a given amount of mass results from the consumption of a cubic meter of vacuum. We will assume that this is a universal conversion factor within *G*. So, now we see that there are separate parts within the gravitational constant black box that use the masses we input.

We can rearrange the dimensions of our gravitational constant expression in equation (10) to give

$$G \equiv \left(\frac{m^3/kg}{s}\right)\left(\frac{m^3/kg}{s}\right)\left(\frac{kg}{m^3}\right) \quad (11)$$

Now, the dimensions of the numerators of the first two components are the reciprocal of the third term. If we call each of the first two terms, a_G, and the third term, b_G, then we can write *G* as

$$G = a_G{}^2 b_G. \quad (12)$$

Since we believe that the relationship between kilograms of mass produced and cubic meters of vacuum consumed is a constant, anytime (kg/m^3) shows up here, it must represent the same value. Therefore, we will assume the values that make up the numerators of the first two components are the reciprocal of the value of the third term. Now, we can write a_G as

$$a_G = \frac{1/b_G}{t} = \frac{1}{b_G t}, \quad (13)$$

where *t* is the time it takes to process one cubic meter of vacuum. The seconds in the denominators of the first two components in equation (11) indicate that, to maintain a mass, the required volume of vacuum must be consumed every *t* seconds. In other words, mass produced by the process only lasts for *t* seconds. Therefore, vacuum must be continuously consumed to maintain a body's mass. Substituting equation (13) into equation (12) gives

$$G = \left(\frac{1}{b_G t}\right)^2 b_G = \frac{1}{b_G t^2}, \quad (14)$$

or

$$b_G = \frac{1}{Gt^2}. \quad (15)$$

We do not know what the vacuum processing time, *t*, is. If we assume, for now, that $t = 1\ s$; then, since the universal gravitational constant is $6.67428\ x\ 10^{-11}\ m^3/s^2/kg$, b_G in equation (15) becomes

$$b_G = \frac{1}{Gt^2} = 1.49829x10^{10}\,\frac{kg}{m^3}, \quad (16)$$

and a_G from equation (13) becomes

$$a_G = \frac{1}{b_G t} = Gt = 6.67428x10^{-11}\,\frac{m^3/kg}{s}. \quad (17)$$

The expression of the gravitational constant in equation (12) is significant because it gives us insight into what the gravitational constant is doing to the input we give it. The first two components of *G* apparently establish what flow rate of vacuum is associated with each mass input into the gravity law in equation (1). Using equation (12), we can express the gravity law as

$$F_G = b_G \frac{(a_G M_1)(a_G M_2)}{r^2}. \quad (18)$$

Here we see that the gravitational constant applies the factor a_G to each mass to calculate (m^3/s), the consumption rate of vacuum to form M_1, which is also the volumetric flow rate of vacuum moving toward M_1; and the consumption rate and volumetric flow rate of vacuum for M_2. Now, we can see that the gravitational constant generates a vacuum consumption rate R_1 for M_1, which is

$$R_1 = a_G M_1, \quad (19)$$

and a vacuum consumption rate R_2 for M_2, which is

$$R_2 = a_G M_2. \quad (20)$$

Using these, the Law of Universal Gravity becomes

$$F_G = b_G \frac{R_1 R_2}{r^2}. \quad (21)$$

Let us assume that there is infinite continuous backfill of the vacuum consumed by mass and that vacuum is an incompressible fluid. If a spherical body consumes a volume of the vacuum every second; then, every second, an equal volume of vacuum continually passes through every spherical surface beyond the body, concentric to it. The volume of the vacuum passing through any spherical surface per unit time (m^3/s) equals the area of the spherical surface (m^2) times the radial velocity of the vacuum (m/s). So, as the spherical surfaces encountered moving toward the body get smaller, the velocity of the vacuum has to get larger to maintain the flow. The velocity of the vacuum increases as it moves toward the body. Therefore, the consumption of vacuum by a body accelerates vacuum toward the body.

The law of gravity in equation (1) shows that the force created by two bodies due to gravity is inversely proportional to the square of the distance separating them. We now know that this is the case because, at a given distance from a body, the speed of the vacuum the body draws toward it depends on the surface area of the sphere whose radius is that distance. So, it appears that the r^2 in the denominator of the gravity law is an artifact of a surface area calculation of a sphere, $4pr^2$, whose $4p$ has been rolled into the universal gravitational constant G. As it stands, the gravitational constant takes the r^2 that is input into the gravity law and uses the $4p$ built into it to produce the surface area of a sphere of radius r. So, knowing this, we can rewrite equation (12) to show the $4p$ component of G as

$$G = \frac{a_G{}^2 b_G}{4p}, \quad (22)$$

and use it to determine a_G and b_G in equations (17) and (16). Now our a_G in equation (17) becomes

$$a_G = 4pGt = 8.38715x10^{-10}\,\frac{m^3/kg}{s}, \quad (23)$$

and our b in equation (16) becomes

$$b_G = \frac{1}{4pGt^2} = 1.19230x10^9\,kg/m^3. \quad (24)$$

With the modified a_G and b_G, we can rewrite our forms of the gravity law in equation (18) as

$$F_G = b_G\frac{(a_G M_1)(a_G M_2)}{4pr^2}, \quad (25)$$

and equation (21) as

$$F_G = b_G\frac{R_1 R_2}{4pr^2}, \quad (26)$$

so now the denominator is the surface area of a sphere whose radius is the distance separating M_1 and M_2. If M_1 is the center of the sphere, then the surface of the sphere passes through M_2. If M_2 is the center, then the surface passes through M_1.

It should be noted that the constant, a_G, in equation (23) indicates that 8.39 x 10^{-10} cubic meters of vacuum are consumed each second to produce one kilogram of mass. It does not take much vacuum to generate mass. The constant, b_G, in equation (24) restates this by indicating that a cubic meter of vacuum can produce 1.19 x 10^9 kilograms of mass. That is about 1.3 million tons. Vacuum is apparently very concentrated stuff.

With the surface area in the denominator of our force expression, we can further refine it. We know that the velocity of the vacuum moving toward a mass at a distance away from the mass is equal to the volumetric flow rate of the vacuum divided by the surface area of the sphere concentric to the mass that the vacuum is passing through. Therefore, the velocity, v_1, of the vacuum passing mass M_2 on its way to M_1 is

$$v_1 = \frac{a_G M_1}{4pr^2} = \frac{R_1}{4pr^2}, \quad (27)$$

and the velocity, v_2, of the vacuum passing M_1 on its way to M_2 is

$$v_2 = \frac{a_G M_2}{4pr^2} = \frac{R_2}{4pr^2}. \quad (28)$$

This means that we can write the gravity law in equation (25) as either

$$F_G = b_G\left(\frac{a_G M_1}{4pr^2}\right)(a_G M_2) = b_G v_1 (a_G M_2) = b_G v_1 R_2, \quad (29)$$

or

$$F_G = b_G\left(\frac{a_G M_2}{4pr^2}\right)(a_G M_1) = b_G v_2 (a_G M_1) = b_G v_2 R_1. \quad (30)$$

Equations (29) and (30) indicate that the force on a body due to gravity is proportional to the rate the body is consuming vacuum and the velocity of the vacuum it is consuming.

3. Moving Bodies

So, our "invisible man," the vacuum, accelerates toward the mass as it is being consumed to form the mass. But, how does it carry the free bodies toward the mass with it? Clearly, the vacuum does not push the bodies directly. If so, when released above the ground, a body would instantly acquire the vacuum's velocity as it fell to the ground. But, that does not happen. The body starts out with a velocity of zero and gradually speeds up as it approaches the ground. So, the body is not caught in a current of vacuum like a boat in a flowing river. However, the vacuum apparently does cause the body to move. Somehow, it passes velocity to the body, indirectly. It does not push or drag the body; it provides the body with the impetus to move on its own. How does it do this? How can the vacuum give a body energy to move without directly interacting with it?

Recall that our mass exists because of vacuum consumption. A process converts the vacuum into mass. This process is not only at work in the larger body drawing the smaller body to it, it is also at work in the smaller body. Consumption of the vacuum flowing around it produces the mass of the smaller body drawn to the larger body. That vacuum has the substance eventually converted into mass, but that vacuum also has velocity. The consumption process extracts the substance from the vacuum and converts it into the mass of the body. It apparently also extracts the velocity from that vacuum and gives it to the body, as well. The velocity extraction is indicated in equations (29) and (30) where the consumption rate of a given body is multiplied by the velocity of the vacuum flowing toward the other body to get the force. The body moves because it is getting velocity from vacuum that it consumes to maintain its mass.

If the vacuum flows toward body A at a velocity V a distance r from A; then as body B consumes that vacuum to produce its mass, it also gets the vacuum's velocity. So, the velocity of body B at a distance r from A increases by V every second. Body B accelerates toward A at V per second. While restrained, the velocity of B is $v = 0$ because the velocity it acquires from the consumption of vacuum dissipates through whatever is holding it. Once released, however, B starts with $v = 0$, but after one second, $v = V$, after two seconds, $v = 2V$ and after three seconds, $v = 3V$, etc. Body B accelerates toward body A at V per second.

This pattern of increasing velocity is consistent with the behavior we observe bodies falling near the Earth's surface exhibiting. The mass of the Earth, M_E, is about 5.975×10^{24} kg. Using our vacuum consumption rate per kilogram, a_G, from equation (23), and equation (19), the consumption rate of vacuum for the Earth, R_E, is

$$R_E = a_G M_E, \quad (31)$$

$$R_E = (8.38715x10^{-10} \frac{m^3 / s}{kg})(5.975x10^{24} kg), \quad (32)$$

$$R_E = 5.011x10^{15} m^3 / s. \quad (33)$$

This makes the flow rate of the vacuum moving towards the Earth 5.011×10^{15} m^3/s. The Earth's radius, r_E, is 6.371×10^6 m, so the velocity of the vacuum near the surface of the Earth is

$$v_E = \frac{R_E}{4pr^2}, \quad (34)$$

$$v_E = \frac{5.011x10^{15} m^3 / s}{4p(6.371x10^6 m)^2}, \quad (35)$$

$$v_E = 9.8 \ m / s, \quad (36)$$

with the vacuum moving toward the center of the Earth. This means that the velocity of a free object, consuming vacuum near the Earth's surface, increases 9.8 m/s toward the Earth every second. Its acceleration is -9.8 m/s per second or -9.8 m/s^2. Of course, the acceleration due to gravity at the Earth's surface is -9.8 m/s^2. Our model calculating the proper acceleration at the Earth's surface appears to validate the value of a_G determined in equation (23) and the assumption $t = 1$ s used in equation (16) and equation (17).

Another example of a body acquiring the velocity of the vacuum it consumes is the orbit of the Moon around the Earth. The Moon is held in an orbit that is an average 238,857 miles from Earth by the Earth's gravitational pull on it. The 238,857-mile orbital radius of the Moon converts to 384,403,000 m. This makes the Moon's orbit 2,415,275,282 m long. It takes the Moon 27 days, 7 hours, and 43 minutes, or 2,354,208 seconds to complete this orbit. Therefore, the Moon is traveling along its orbit at 1,026 m/s. As shown in equation (33), the Earth consumes 5.011×10^{15} m^3/s of vacuum. At 384,403,000 m from Earth, the surface area of the sphere through which the vacuum is passing is 1.8569×10^{18} m^2. So, the velocity of the vacuum passing the Moon is 0.0027 m/s. At a velocity of 1,026 m/s, the Moon tries to move 1,026 m tangent to its orbit in one second. Using the Pythagorean theorem with one leg of the right triangle being the radius of the Moon's orbit, 384,403,000 m, and the other leg being the 1,026 m; if the Moon were unrestrained, it would move to a distance of 384,403,000.00137 m from the Earth in that second, so that it moved 0.00137 m away from the Earth. However, during that second, the Moon consumed vacuum moving at 0.0027 m/s toward the Earth, so its acceleration, g, toward Earth is 0.0027 m/s^2. Therefore, during that second, it moved 0.00135 m closer to Earth ($d = ½ gt^2$). The two opposing distances essentially cancel, keeping the Moon in its orbit.

4. Conclusion

To summarize our new model of gravity, the vacuum of space is a substance. A process inherent to matter consumes the vacuum to produce a body's mass. As a body consumes the vacuum, it creates a flow of the vacuum that accelerates towards it. As this moving vacuum flows passed other bodies, they consume it to produce their masses and they acquire its velocity. By continuously consuming the flowing vacuum, the bodies maintain their masses, but increase the amount of velocity they possess. This literally accelerates the bodies towards the other bodies.

So, it seems that the action at a distance that is gravity is likely the result of an invisible fluid, the vacuum, continuously and indefinitely being consumed by something to produce mass. We can speculate on what the entities are that convert the vacuum to mass, but at this point, speculation is all it would be. Whatever they are, they clearly reside and operate at the most fundamental level of matter. They are the core of matter. Therefore, for lack of a better term, we will call these entities cores.

Cores are apparently the entities (maybe particles, maybe not) that produce the fundamental units of matter that go into creating the Universe as we know it. If they are particles, then they, like vacuum, are probably not entities we can detect directly. It is only through the presence of matter or energy that we know cores are present. Cores and vacuum appear to be two of the basic components that make up our Universe.

References

[1] Laemmle, C. Jr. (Producer) & Whale, J. (Director), (1933), *The Invisible Man* [Motion Picture], United States, Universal Pictures.