Gravity

The Nature and the Strength of the Force of Gravity

By

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Abstract

The amount of the Earth's mass that causes the gravity responsible for keeping our feet on the ground is proportionate to the area of our footprint relative to the surface area of the whole Earth. A quick Google search tells me the surface area of the Earth is 510.1 million Sq. Km. If we had very large feet, then perhaps we occupy just one quarter of a square meter. And so 0.25/510,100,000,000 x 100 means we are standing on just 0.000000000049% of the Earth's surface. This also means that just 4.9×10^{-11} % of the Earth's mass is generating the gravity that keeps our feet on the ground. Not the gravity of the whole Earth as is the assumption. The Earth's mass is 5.9736×10^{24} kg but just 2.927064×10^{14} kg generates the gravity that acts upon each of us.

So 300 trillion tonnes of Earth and our 70 kg bodies mutually attract gravitationally to produce around 686 Newtons of force. So what does this tell us? Well it tells us that gravity is a lot stronger than previously thought. Twenty billion times stronger in this example. This error of a factor of 20 billion doesn't apply universally.

So how much mass of two large spherical bodies like the Sun and Earth or the Earth and Moon is responsible for their mutual gravitational attraction? The portion of each body responsible for the gravitational attraction of the other is in the shape of a spherical sector. I have devised a new formula for calculating the size of the spherical sectors of bodies and new formulas for calculating the force of gravity between two bodies.

Introduction

In this paper I will explain the nature of gravity and explore the strength of the force of gravity.

It's in all the text books, it's what we've all been taught, not just as students of physics but also as children at school. We are all taught just how weak gravity is! We've all sat in science class at school and been told how a small magnet can lift a paperclip against the gravity of the whole Earth or that we can hold our arm out in front of us against the gravity of the whole Earth.

Against the gravity of the whole Earth? I think not. If I stood in London, England and held my arm out in front of me, I'm quite sure that if the gravity of the whole Earth was focused on my arm, it would be torn off! Standing in London, I wouldn't be feeling the effects of the gravity present in Sydney, Australia for example. In fact, the gravity in Sydney would be acting in the opposite direction to the gravity in London.

Time to make some sense of gravity. Gravity is one of the four forces, the others being the strong force, the weak force and the electromagnetic force. What causes these forces is unanswerable. We just have to accept that these forces exist as a natural phenomenon and that your fridge magnet bought for you as a gift from Paris will stick to your fridge. Fact.

Much of this paper will not be revolutionary but the new concepts and formulas introduced are of important consideration. I will explore gravitational moments, gravitational direction, the strength of gravity and on how to calculate just how much mass of a body is responsible for gravitational attraction of another.

Creator of the Universe

Gravity is more than just a force that keeps our feet on the ground. It is the creator of the universe. Perhaps in the beginning, (the beginning being the usual definition of the appearance of the present matter) there were just photons (and other bosons). Photons take up no volume, there is no limit to the number of photons occupying one place. We experience photons usually as visible light and also as radio waves (TVs and portable phones) and in microwave ovens and x-ray machines. It's all the same thing but at different wavelengths. If we stood in a dark room and turned on the light, we would see the light no matter where in the room we stood. The room is completely filled with photons emitted from the light bulb. But wait, we can still listen to the radio wherever we place the radio in the room! The room is full to the brim of visible light but it is also full to the brim of radio waves, of all different radio stations. And yet, we can take out our portable phone and call someone. How can there possibly be room for any more photons? Simply put, photons do not take up any volume in space.

If we take an electron and an antielectron (positron) and bring them together, a photon (or photons) will result. We are taught that matter and antimatter annihilate one another when brought together but they actually disappear in a flash because light is the product (not necessarily visible light). And so, it is fair to say that photons, that take up no volume at all, consist of the components of matter and antimatter (electrons are very closely related to antiquarks and antielectrons closely related to quarks, the building blocks of atoms). So when we wonder, how could the universe with all its galaxies of 100 billion stars each come from nothing? Well, all particles are interchangeable and so when all of the matter in the universe (the fermions) was in the form of photons (bosons), it is more easily visualized knowing that bosons don't occupy any volume.

And so, in the beginning, when photons (rapidly it seems) decayed in to fermions (subatomic particles), a rapid expansion occurred (aka the big bang). Unlike bosons, fermions can not occupy the same space. They are subject to the Pauli exclusion principle and so that was the start of the rapid expansion of the universe, a violent repulsion of subatomic particles. At some point after the big bang, gravity began to sculpt the universe. It clumped together hydrogen atoms into large spheres, squeezing them until they were hot enough to ignite (nuclear fusion). A star is born. Gravity organized these stars in to galaxies and in turn, clusters of galaxies.

These stars then produced all the elements, from helium to iron in a mainstream star, and then in supernovae of super massive stars, all the heavy elements. We literally are made of stardust.

Strength of the Force of Gravity

Gravity has been theorized, most famously by Isaac Newton and Albert Einstein. Newton gave us the amazing formula for working out the force of gravity $F = Gm_1m_2/R^2$ and it works! Rocket scientists use it with great success and cosmologists have even used it to calculate (roughly at least) the speed of rotation of galaxies. But as confirmed by their red (and blue) shift, galaxies are rotating too fast according to Newton's formula. There's too much gravity. And so theoretical physicists have drawn the conclusion that there must be more mass (or matter) in these galaxies than is apparent. And so to balance the equation, the hypothetical 'dark matter' was introduced. Dark matter is nondescript, it doesn't interact with anything, it just generates the gravity unaccounted for by ordinary matter.

But if gravity is stronger than we assume it to be, we can do away with dark matter. We all know that however much we tweak the formula for gravity, a 70 kg man will still be 70 kg. And so going back to what I said earlier on in this paper, about the gravity of the whole Earth acting upon us, and that a small magnet can lift a paperclip against the gravity of the whole Earth, well the examples are fatally flawed.

The amount of the Earth's mass that causes the gravity responsible for keeping our feet on the ground is proportionate to the area of our footprint relative to the surface area of the whole Earth. A quick Google search tells me the surface area of the Earth is 510.1 million Sq. Km. If we had very large feet, then perhaps we occupy just one quarter of a square meter. And so 0.25/510,100,000,000 x 100 means we are standing on just 0.000000000049% of the Earth's surface. This also means that just 4.9×10^{-11} % of the Earth's mass is generating the gravity that keeps our feet on the ground. Not the gravity of the whole Earth as is the assumption. The Earth's mass is 5.9736×10^{24} kg but just 2.927064×10^{14} kg generates the gravity that acts upon each of us.

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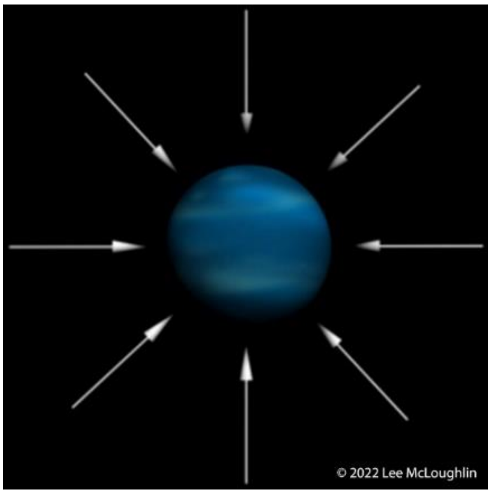
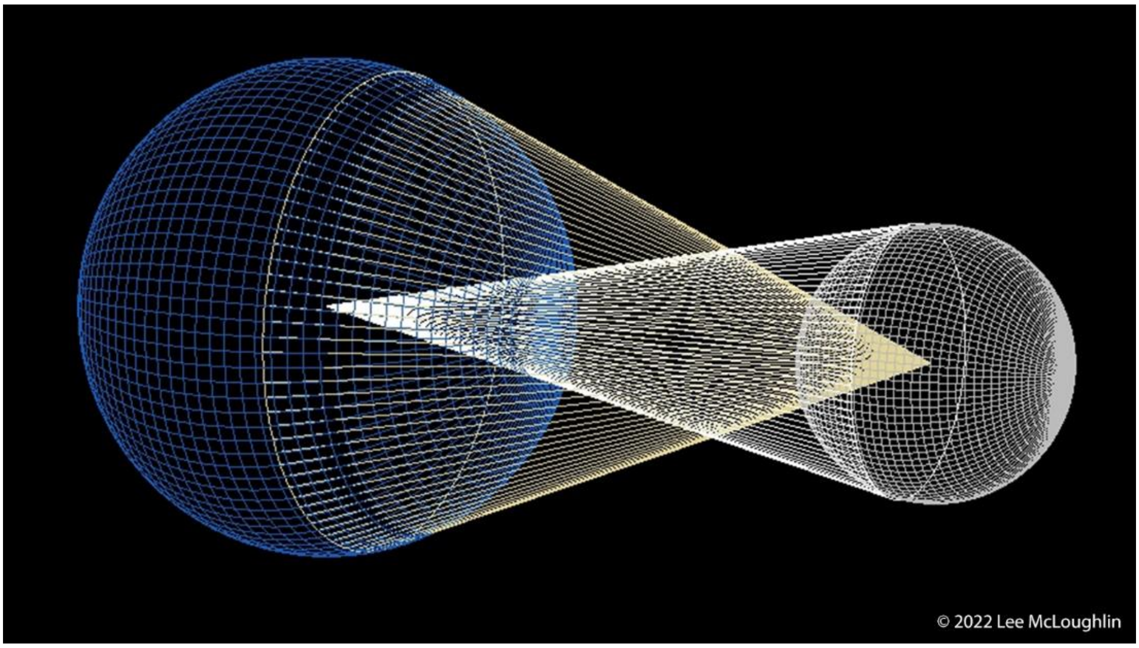
Gravitational Direction

Isaac Newton found that the strength of the gravitational force between two objects is influenced by mass and distance. He found that to double the distance between two objects, the gravitational force between the two would reduce to a quarter. The famous inverse square law. Perhaps what Newton didn't consider is that this law only applies if at least one of the two objects is a sphere.

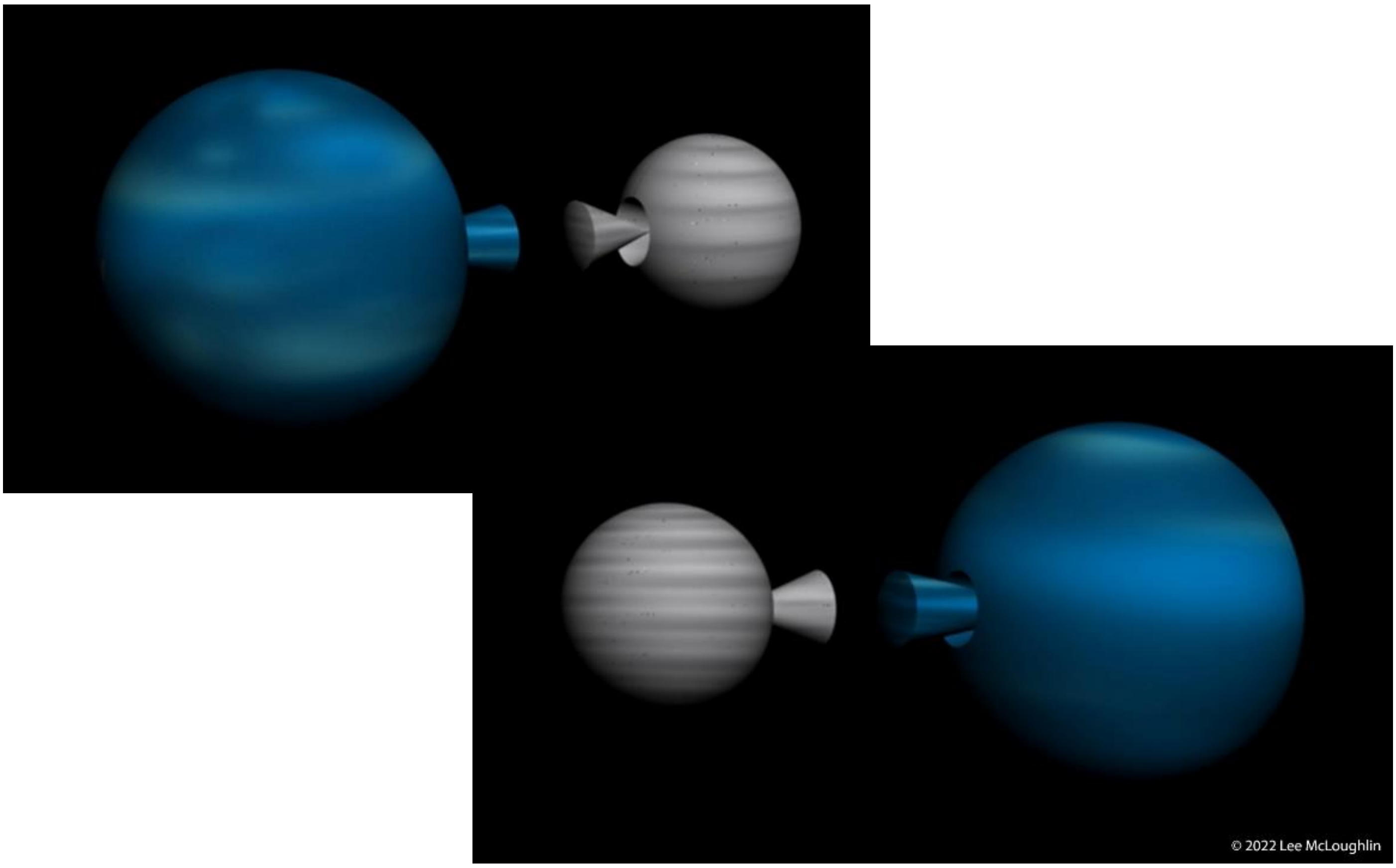
So what does the gravitional force obeying the inverse square law on distance tell us? Well it tells us that the Earth is a sphere for one but what else? Does it tell us that gravity decays over distance? Not quite. Gravity has infinite range and does not decay over distance. Gravity, like light, radiates away from its source equally in all directions. And so, if we position ourselves further from the source of gravity (Earth in our case), the gravity does not get weaker, rather we just get less of it. It would mean less of the Earth's mass is acting upon us gravitationally. It also tells us that gravity travels in straight lines.



Consider my wireframe illustration of the two large bodies. You will see that the gravitational attraction between the two is in straight lines. This gravitational reach carves out the portion of each body responsible for the gravitational attraction of the other.



The portion of each body responsible for the gravitational attraction of the other is in the shape of a spherical sector. The following illustrations show the spherical sectors isolated in order to visualise the scale of the margin of error. It is not an error of 20 billion times like with man on Earth but the margin of error is significant enough to account for the alleged missing mass in our universe.



Gravitational Moments

More about gravity travelling in straight lines: We are all familiar with magnets and probably most of us are aware that magnets can only be made from iron and steel (nickel too but there are also electromagnets). But actually, all atoms are magnets, not just iron. Every atom (or subatomic particle) has a magnetic moment but usually these all point in random directions within a material. Magnetic moments are quite stiff, they don't easily change direction but are less stiff in iron and nickel and can be made to all face the same way permanently.

When we enter an MRI scanner, the strong electromagnet aligns all of our magnetic moments turning us in to one large magnet. Once the electromagnet is turned off, all of our magnetic moments spring back to their original direction. The speed at which they return is slightly different for different tissue types, giving the radiologist a readable image.

So what about gravitational moments? Gravity is directional and the gravity of the Earth is always directed towards its centre. Gravitational moments are not stiff like magnetic moments but swing freely, like the needle of a compass. We could pick up a large brick, with all its gravitational moments directed toward the centre of the Earth, and turn that brick over. The gravitational moments within the brick, despite the brick's rotational orientation, will always be directed toward the centre of the Earth.

So what about a large asteroid? With its very small but present gravity. All its gravitational moments are aligned toward its centre. Should the asteroid ever collide with Earth, you can be certain that that all of its gravitational moments will realign to point toward the centre of the Earth.

Speed and Propagation of Gravity

So the big assumption is, gravity travels at the speed of light. Why the assumption? I don't know but what I do know is that the speed of gravity can't be measured. And so, it seems, the speed limit of the cosmos was adopted. So why is their a cosmological speed limit anyway? Well the notion stems from Einstein's Special Theory of Relativity. Einstein theorised that nothing can exceed the speed of light and further more, that light will always travel at the same speed regardless of the velocity of the observer. What made Einstein think that?

Well back in 1887, physicists Albert A. Michelson and Edward W. Morley carried out experiments using light and mirrors to detect the ether. They failed to detect it but observed that light always travelled at the same speed whether travelling towards, away from or perpendicular to its source.

Unfortunately, the Michelson–Morley experiments were fatally flawed and here's why. The great physicist Richard Feynman found when developing his theory of quantum electrodynamics (QED) that light does not bounce off of mirrors. Rather, a mirror (an atom of a mirror) will absorb a photon and then emit a photon. So regardless of the speed of the photon striking the mirror, it will be absorbed and another corresponding photon will be emitted and always at the speed of light (that of 299,792,458 meters per second).

When Edwin Hubble discovered the electromagnetic red shifting of galaxies, the evidence strongly suggested that due to the galaxies travelling away from us at speed, light from those galaxies was reaching us at a slower speed. The Doppler effect. But due to the strong evidence of the Michelson–Morley experiments, there was a conflict. The red shifting of galaxies was attributed to the stretching of spacetime (whatever that is) caused by the expansion of the universe. But, of course, at the time, the Michelson–Morley experiments were not known to be flawed.

And so, is gravity limited to the speed of light? I say not. And the flaw of the Michelson–Morley experiments leads me to conclude that there is no evidence to suport the notion that the speed of light is absolute and that the red shifting of galaxies is evidence that the speed of light is not absolute.

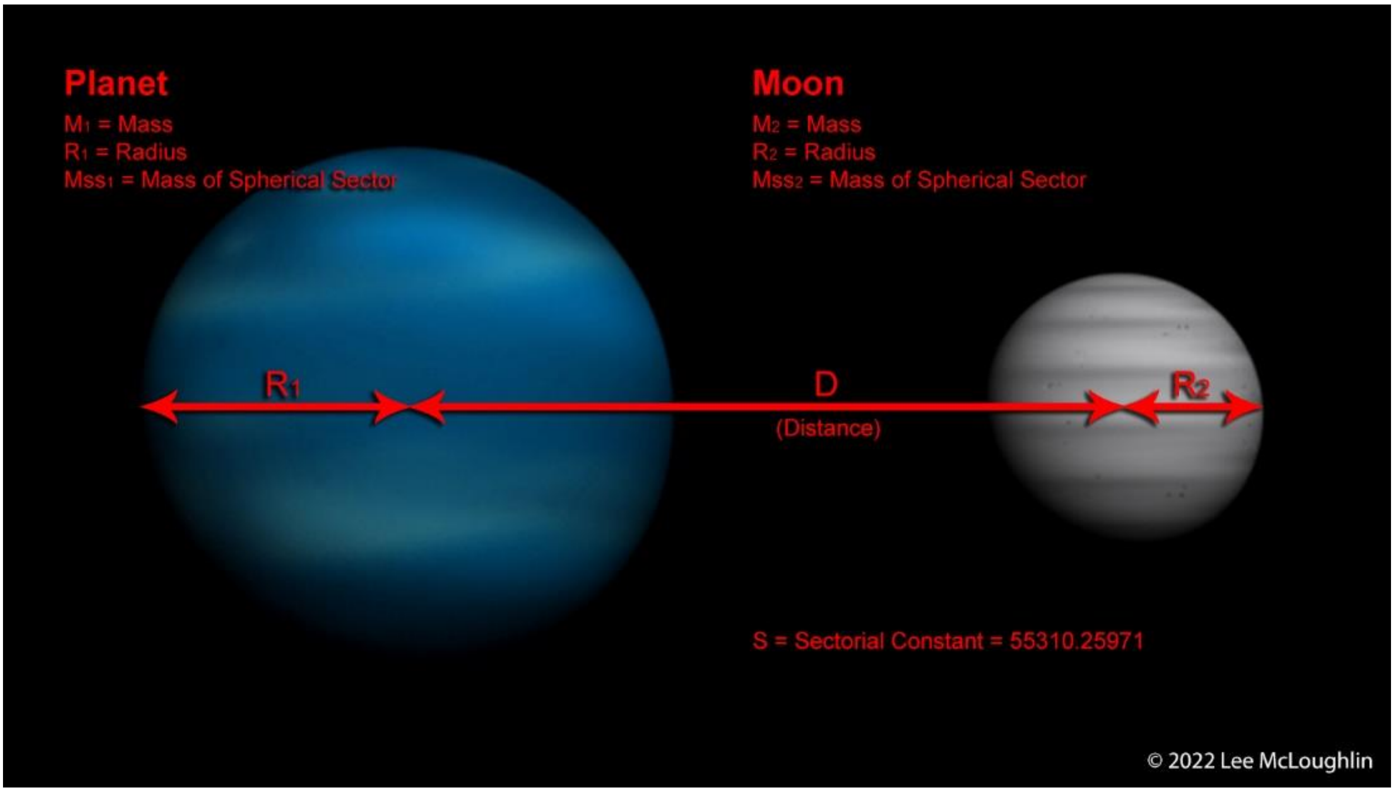
Consider this: A spaceman launches from Earth in his new space rocket. He accelerates to half the speed of light then cruises at that speed. So now consider this: Who's to say the space rocket is travelling at half the speed of light? Relative to Earth maybe but Earth isn't much of a reference point when the rocket is no longer even in the solar system. In fact, relative to other reference points, a star in the galaxy of Andromeda for example, the rocket might well have slowed during its period of acceleration away from the Earth. The point is, nothing has the monolopy on speed (or motion, sorry Isaac). The monolopy in this example is on acceleration, the space rocket and our man experienced the acceleration, nothing else did. Speed is the velocity between two objects. This is difficult to visualise for planet dwellers like ourselves who move and travel around the surface of a large sphere and to do so, we must be the ones doing the accelerating.

And so our space man, somewhere in outer space in his new space rocket, engines off might as well be stationary. He could accelerate again and again and in between periods of acceleration, he again might as well be stationary. Without any reference points, it would certainly seem so to him. But importantly there is no limit (other than with regards to fuel) to the number of times he could accelerate or for how long each time. Speed is relative.

What about how gravity propagates? Gravitational waves have been detected right? Not quite. That doesn't mean that gravity doesn't travel in waves of course, there's just no evidence to suggest it does. The detection of gravitational waves was announced on 11 February 2016. What I wanted to know at that time was the frequency of the detected gravitational waves. As it turns out, the gravitational waves had a frequency of 150Hz and their source was found to be a binary star system with an orbital frequency of 75Hz. There is the answer. In this instance, gravtitational waves were not detected but rather, as the binary stars orbit one another, fluctuations in distance between each of the two stars of the binary system and Earth represented minute changes of the force of gravity at a frequency generated by the orbital frequency.

Calculating How Much Mass of Bodies is Responsible for Gravitational Attraction

Previously in this paper I've explained how to calculate how much of the Earth's mass is responsible for keeping our feet on the ground (the proportion of our footprint relative to the Earth's surface as a percentage transposed as a percentage of the Earth's mass). But what about two large bodies? Large bodies are always spherical due to gravity. We have to work out the size of the spherical sector of each body in order to work out how much mass of each body is attracting the other. Below is the formula devised by me in 2019 and here I am using a Planet and Moon system as an example.

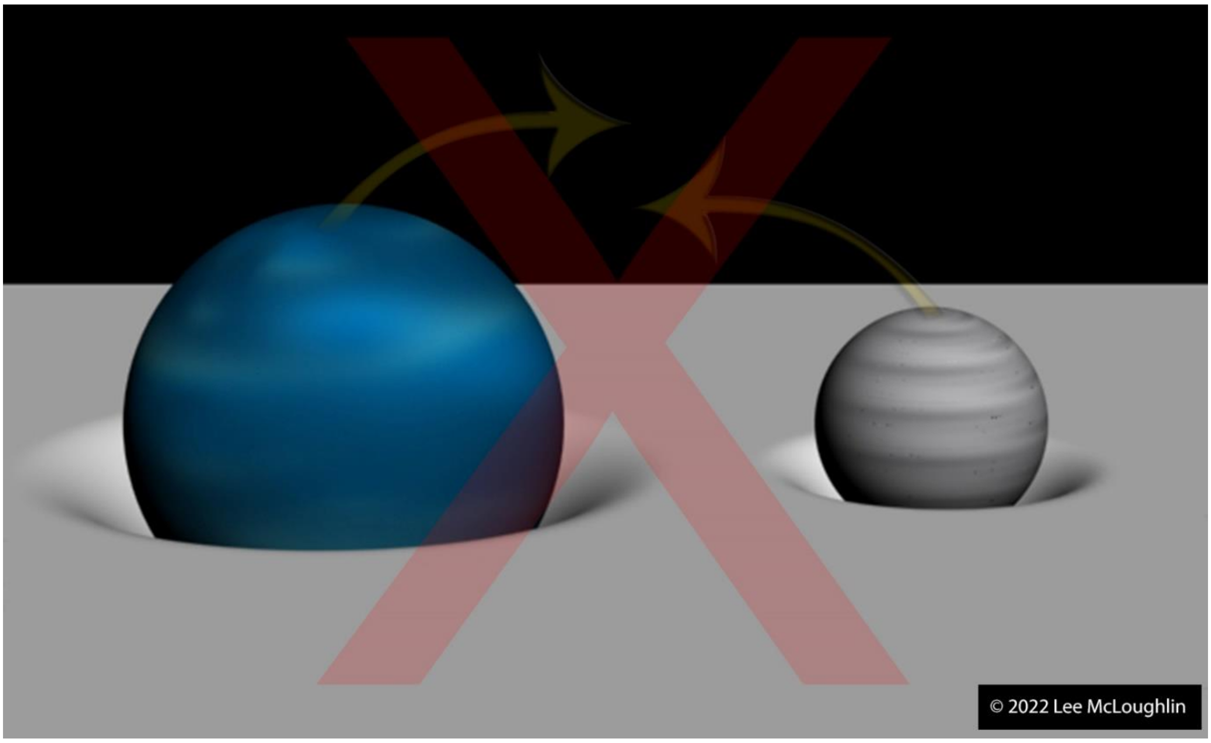


$$Mss_1 = \frac{\left(\tan^{-1}\left(\frac{R_2}{D}\right)2\right)^2}{S} M_1 \qquad Mss_2 = \frac{\left(\tan^{-1}\left(\frac{R_1}{D}\right)2\right)^2}{S} M_2$$

Trying various experimental constants (calculator set to degrees not radians), one will notice that when the distance between the two bodies is doubled, the size of the spherical sectors is reduced to a quarter. This is as expected given that the gravitational force between the two bodies is also reduced to a quarter, the inverse square law.

Conclusion

So how does this alternative theory of gravity fit in with Einstein's General Theory of Relativity? Well, it doesn't. The only way we can visualise Einstein's warped spacetime is in two dimentions. The trampoline analogy seems to be quite popular. The canvas of the trampoline with a cannon ball in the middle causing a dip and everything else falling towards it. Well this just uses gravity to explain gravity. Further, it is impossible to transpose this two dimentional warpage in to three dimensions. And further more, it doesn't take in to account that gravity is a mutual attraction. If we take the Sun and the Earth as an example and the Sun has caused a warpage of spacetime (a dip in the canvas) then General Relativity says that Earth is falling towards the Sun as a consequence of the warpage of spacetime. But by the same theory, the Earth has also caused a warpage in spacetime. The Earth is in its own dip. How can the Earth and the Sun fall in to each other's warpage of spacetime? How can they hop out of their own 'dip' to fall in to the other's? They can't!



I should point out that I have been studying special and general relativity as an amateur since around 1989 and appreciate that general relativity is more than just warpage of spacetime.

So what role does gravity have in store for the future? I wonder if gravity will be the force to come to the rescue when the second law of thermodynamics has its way. When all that is left in the universe is embers and there is no more fuel, will gravity mop up all of the expired stars and black holes and clump them together ready for a hard restart? It's certainly worth a thought.

Before I sign off, remember the golden rule of theoretical physics, never set anything in stone.

Lee McLoughlin

19 September 2022