Unified Field Theory for Gravity and Electromagnetism and Its Explanation for Dark Matter Observations

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Abstract

This paper defines the gravitational field as a medium with elastic properties, and the gravitational force occurs when matter creates a more concentrated region in the gravitational field. Further, this paper explains how electromagnetic waves are changing concentrations in this field. Hence, the gravitational field and electromagnetic field are the same, called the unified field. Based on this understanding of the unified field, there are attractive forces between electromagnetic waves as defined as:

$$F = Y_1 \frac{f_1 f_2}{r^2}$$

There are also attractive forces between electromagnetic waves and matter possessing mass at rest. This force is defined as:

$$F = Y_2 \frac{fm}{r^2}$$

Dark matter observations support this unified field theory.

Keywords: dark matter, gravitation

Introduction

Since the Theory of Relativity by Albert Einstein was recognized, most people have accepted that the gravitational field can bend which can explain many natural phenomena. If the gravity field is defined as something that can stretch elastically, it can further explain the nature of gravity and many other related natural phenomena.

Section I – How Elastic Properties Create Attractive Forces

A flat perfectly elastic sheet will retain its original shape after subjecting it to stresses. While under no stress, the elastic sheet has no internal forces. While under stress, an elastic sheet's internal forces act to retain the original shape of the sheet. This can be seen when a section of an elastic sheet is gathered and concentrated in a region while the entire sheet still stretches across the same area.

One method of creating such a concentrated region is with a knot. A knot made in the middle of the sheet will create outward pointing internal tension forces that surround the knot in all directions and act to undo the knot.

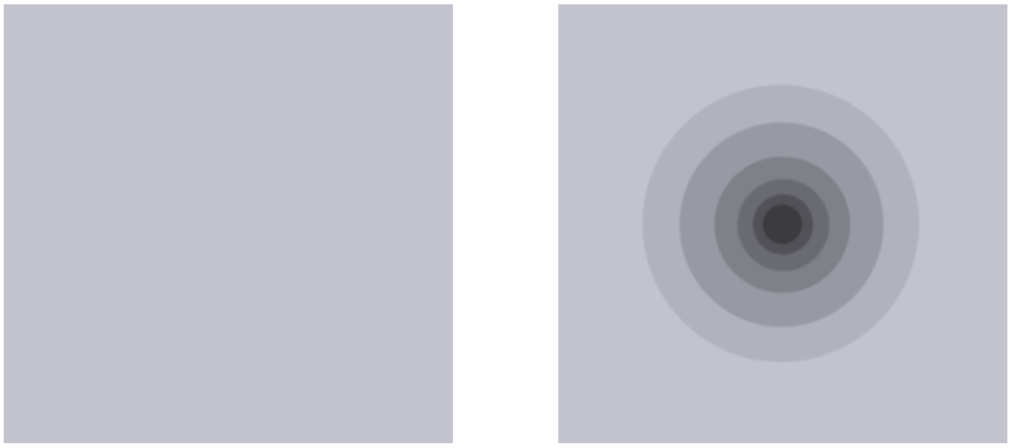

Figure 1.1 – An elastic sheet with an evenly distributed concentration (left) and an elastic sheet with a knot in the centre creating a concentrated region and outward pointing internal forces (right)

When there are two knots, both knots will create outward pointing internal tension forces that surround each in all directions. Because the tension forces point in all directions from each knot, there will be tension forces from each knot that point towards the other knot. These internal tension forces in the elastic sheet will create an attractive force between the two knots.

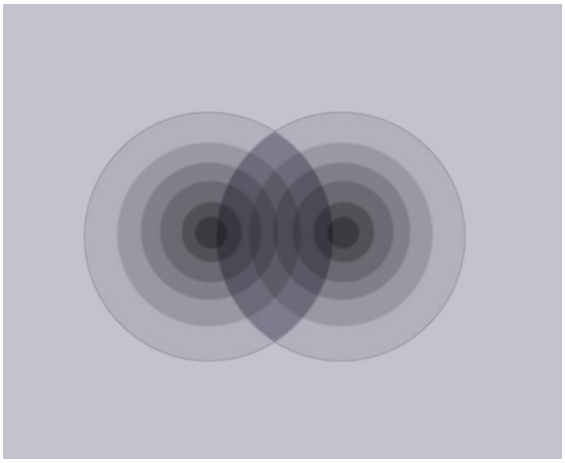

Figure 1.2 – An elastic sheet with two knots and attractive internal forces between the two knots

This demonstrates the mechanism for how an attractive force is created between two knots in an elastic sheet.

Section II - Definition of Gravitational Fields and Gravitational Forces

The mechanism for the attractive force between two objects of matter in the gravitational field is similar to the mechanism described in Section I.

1. The gravitational field is defined as a medium that can stretch elastically to create a region of tension forces.

2. This elastic field will not always be even; it will have regions of concentrated and less concentrated, or thicker and thinner, gravitational field. Where matter is located, the field is more concentrated, or thicker. Where there is a void, the field is less concentrated, or thinner.

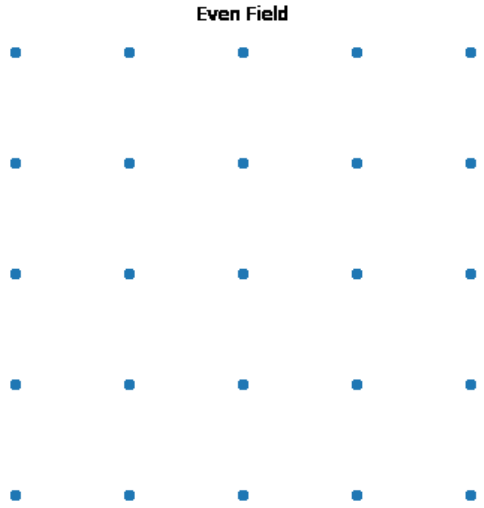

Figure 1.3 – An even field with an evenly distributed concentration found in a void

3. Due to the elastic property of the gravitational field, a more concentrated region creates a tension surrounding it that pulls outward to even out the concentrated region.

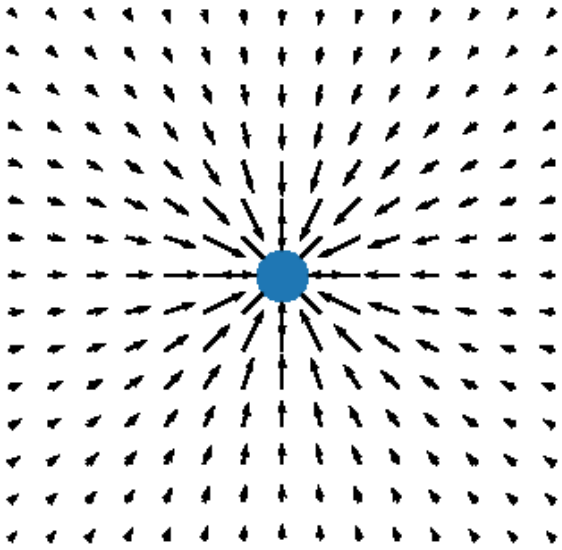

Figure 1.4 – Matter represented as a dot **stretches** elastic field inward

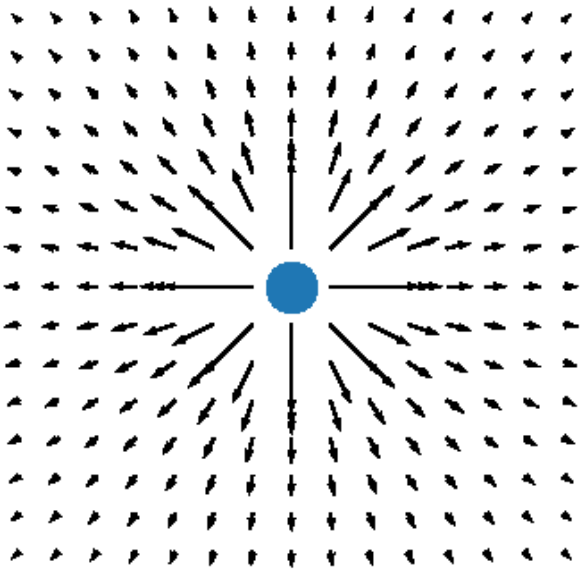

Figure 1.5 – Force on matter due to the elastic field

Compared to the conventional idea of bending in 2D, the elastic field can be implemented in 3D in all directions as seen in Figures 1.6 and 1.7.

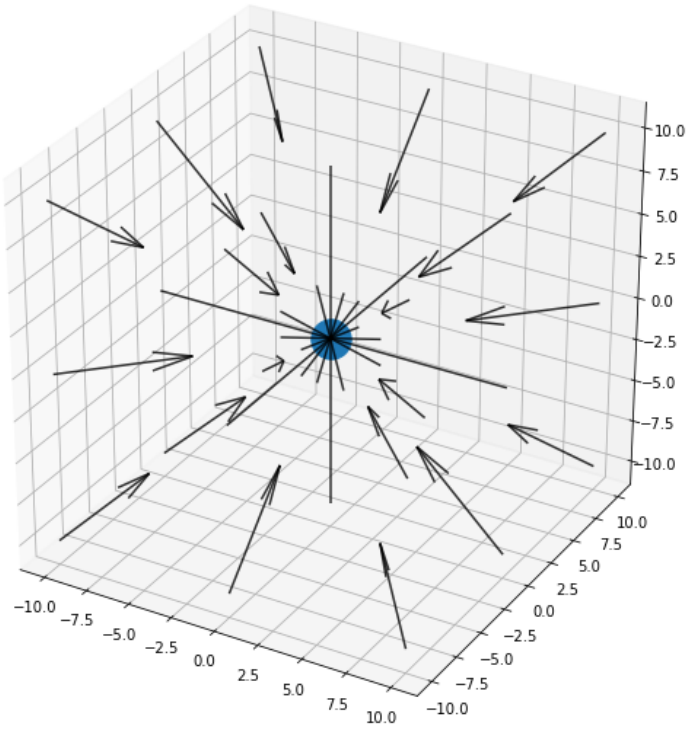

Figure 1.6 – Matter represented as a dot **stretches** elastic field inward in a 3D space

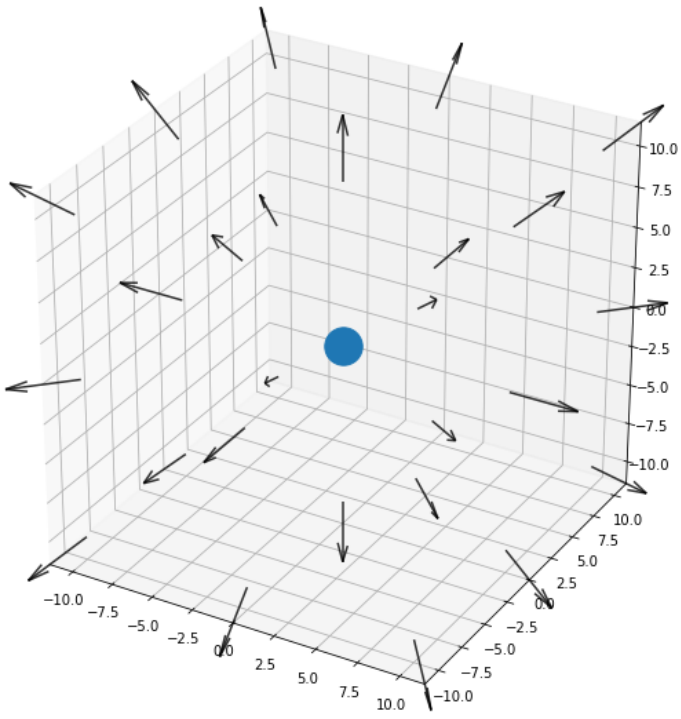

Figure 1.7 – Force of matter due to the elastic field in a 3D space

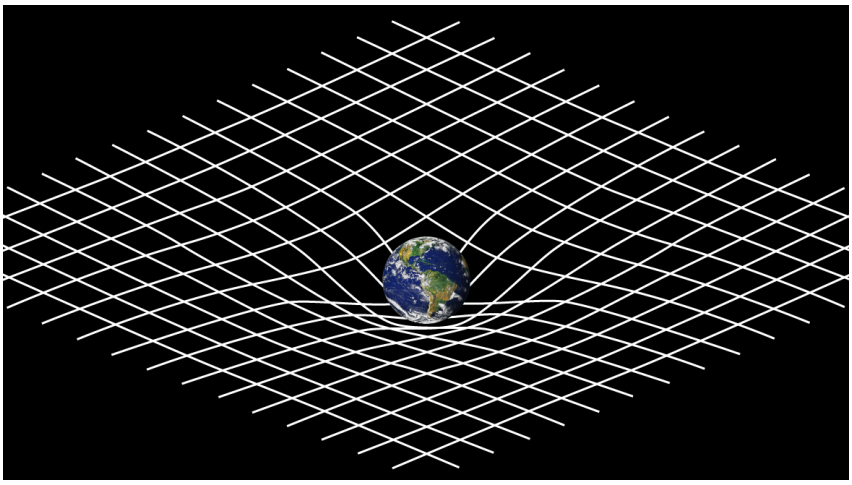

Figure 1.8 – A traditional depiction of space time curvature from Einstein's Theory of General Relativity (NASA 2015)

The typical representation of Einstein's General Relativity only shows a field in 2D, such as in Figure 1.8 above. If Einstein's Theory of General Relativity were to be visualized in 3 dimensions, it would look like Figure 1.7. The idea of an elastic field can show stretching in all directions.

4. When there are two concentrated regions in the field, both create tension that pulls outward from each region as described in Point 3. From the surrounding tension forces created by each region, there will be tension forces from each region pull that towards each other in the elastic space. This attractive force between the two concentrated regions is the observed gravity force.

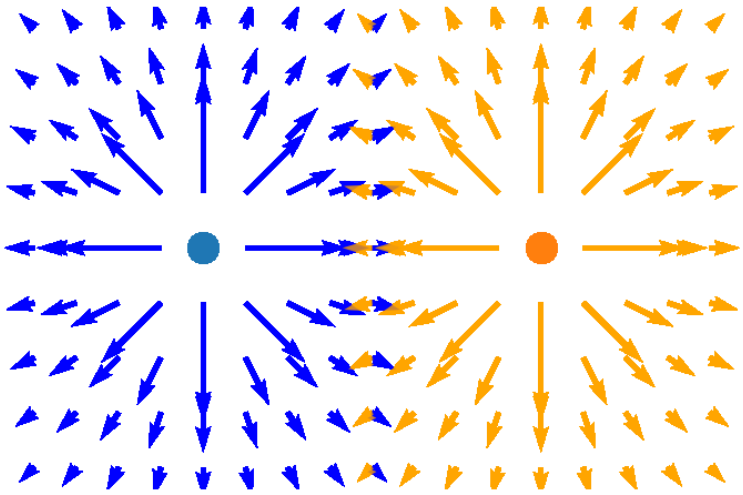

Figure 1.9 – A region of tension forces from two objects of matter in a 2D space

When there is only one object of matter, there are forces around this object, but since the forces pull in all directions with the same magnitude, there are no observable effects. When a second object of matter enters the system, the effects of gravity can be observed as each objects' gravitational field begins to pull on the other object in this elastic field, drawing the two objects closer.

5. Definition of the Gravity Force: The gravity force is the attractive force between two objects of matter due to tension between concentrated regions caused by both objects of matter in the elastic gravitational field.

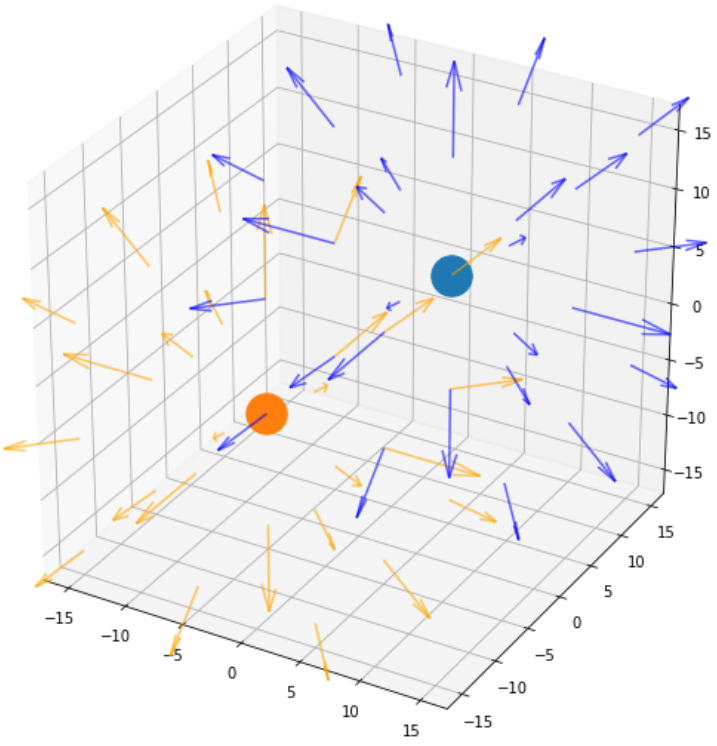

Figure 1.10 – A region of tension forces from two objects of matter in a 3D space

Section III – Description of Electromagnetic Wave

1. Matter can be categorized as two categories: matter with mass at rest and matter with an invariant mass of zero. Electromagnetic waves fall into the latter category.

2. Electromagnetic waves are transverse waves in the elastic field described in Section II. At the same region, the transverse wave changes the concentration, or thickness, in the elastic field.

3. Electromagnetic waves propagate outward from a source in the elastic field much like ripples in water.

4. Electromagnetic waves are moving positions of changing concentrations in the elastic field described above in Section II.

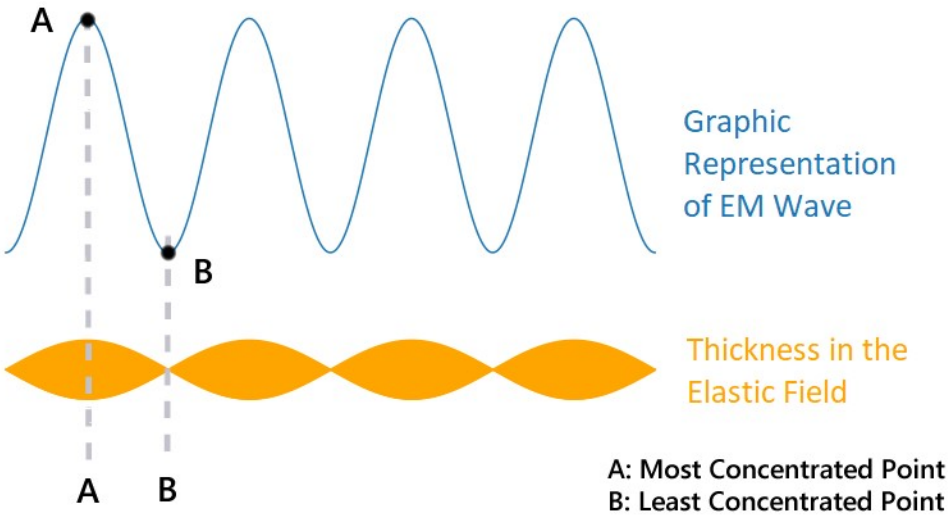

Figure 2.1 – A depiction of an electromagnetic wave and its corresponding thickness in the elastic field

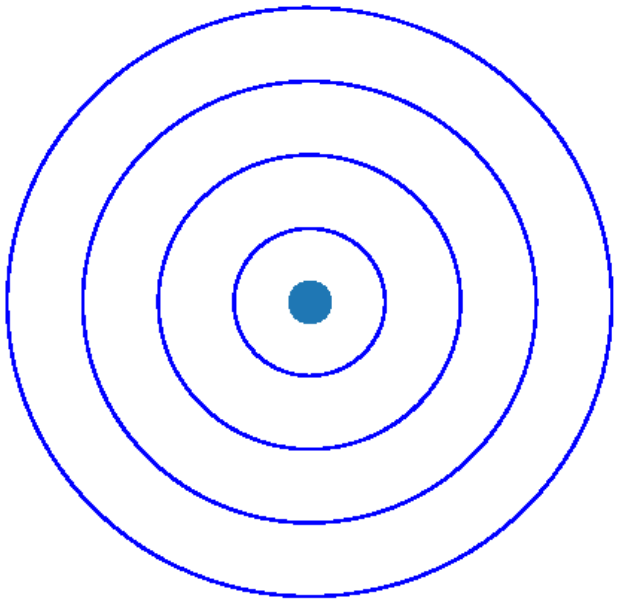

Figure 2.2 – A 2D representation of a wave where the circles designate areas of higher concentration in the field

5. The electromagnetic field that allows for electromagnetic waves to travel is the same gravitational field described in Section II.

6. Because both gravitational forces and electromagnetic waves exist and operate using the elastic properties in the same field, this is a unified field for both gravity and electromagnetism.

Section IV – Gravitational Force Between Two EM Waves

1. Two EM waves have concentrated regions, according to the definition of gravitation in Section II, so they will have an attractive force acting between them, which is the gravitational force of two EM waves due to the elastic properties of the unified field.

2. By using Einstein's Special Relativity, the matter with zero invariant mass can be calculated at the rest frame as its energy divided by the speed of light squared.

3. The force gravity between two photons at a certain point in time is as follows:

Given: The force of gravity, Einstein's Mass–energy equivalence, and Planck's Energy Frequency Relation

$$F = G\frac{m_1 m_2}{r^2}$$

$$E = mc^2 \text{ or } m = \frac{E}{c^2}$$

$$E = hf$$

$$F = G\frac{m_1 m_2}{r^2} = G\frac{\frac{E_1}{c^2}\frac{E_2}{c^2}}{r^2} = G\frac{hf_1 hf_2}{c^4 r^2}$$

(4.1) $$F = G\frac{h^2 f_1 f_2}{c^4 r^2}$$

Where:

F – is the force between two photons [kg m s^{-2}]
G – is the gravitational constant [6.67e-11 m^3 kg^{-1} s^{-2}]
h – is Planck's constant [6.63e-34 m^2 kg s^{-1}]
c – is the speed of light [3.00e8 m s^{-1}]

r – is the distance between a photon in EM wave 1 and EM wave 2 [m]
f_1 – is the frequency of a photon in EM wave 1 [s^{-1}]
f_2 – is the frequency of a photon in EM wave 2 [s^{-1}]

A unit analysis of both sides of the equation shows that the units match.

$$F = \frac{m\ kg}{s^2} = \frac{m^3}{kg\ s^2} \times \left(\frac{m^2 kg}{s}\right)^2 \times \frac{1}{s} \times \frac{1}{s} \times \left(\frac{m}{s}\right)^{-4} \times (m)^{-2} = \frac{m^7\ kg^2\ s^4}{m^6\ kg\ s^6} = \frac{m\ kg}{s^2}$$

Calculating the value of the constants, denoted as Y_1, gives the following value:

(4.2) $$Y_1 = \frac{Fr^2}{f_1 f_2} = G\frac{h^2}{c^4} = 6.67 \times 10^{-11}\ \frac{m^3}{kg\ s^2}\left[\frac{\left(6.63\times10^{-34}\ \frac{m^2\ kg}{s}\right)^2}{\left(3.00\times10^{8}\ \frac{m}{s}\right)^4}\right]$$

(4.3) $$Y_1 = 3.62 \times 10^{-111}\ m^3\ kg$$

This will give the equation:

(4.4) $$F = Y_1 \frac{f_1 f_2}{r^2}$$

A unitless multiple *k* can be included to denote the number of photons at a specific point in each of the two waves. This means that the photons will have to be the same distance away from the point in the other wave. This will give the final equation:

(4.5) $$F = Y_1 \frac{k_1 f_1 k_2 f_2}{r^2}$$

Where:
F – is the force between two points of two EM waves [kg m s^{-2}]
Y_1 – is a constant [3.61e-111 m^3 kg]
r – is the distance between a point in EM wave 1 and EM wave 2 [m]
f_1 – is the frequency of a photon in EM wave 1 [s^{-1}]
f_2 – is the frequency of a photon in EM wave 2 [s^{-1}]
k_1 – is the number of photons at a point in EM wave 1
k_2 – is the number of photons at a point in EM wave 2

Section V – Gravitational Forces Between Matter with Mass and EM Waves

1. According to the definition of gravitation in Section III, any two concentrated areas will create a gravitational force in the unified field, regardless if the concentration comes from

matter that has mass at rest, like a planet, or matter with an invariant mass of zero, like an electromagnetic wave.

2. By using Einstein's Special Relativity, the matter with zero invariant mass can be calculated at the rest frame as its energy divided by the speed of light squared.

3. The gravitational force between matter with mass at rest and matter an invariant mass of zero at a certain point in time is:

Given: The force of gravity, Einstein's Mass–energy equivalence, and Planck's Energy Frequency Relation

$$F = G\frac{m_1 m_2}{r^2}$$

$$E = mc^2 \text{ or } m = \frac{E}{c^2}$$

$$E = hf$$

$$F = G\frac{m_1 m_2}{r^2} = G\frac{\frac{E}{c^2}m}{r^2}$$

(5.1)
$$F = G\frac{hfm}{c^2 r^2}$$

Where:

F – is the force between a photon and an object with mass [kg m s^{-2}]
G – is the gravitational constant [6.67e-11 m^3 kg^{-1} s^{-2}]
h – is Planck's constant [6.63e-34 m^2 kg s^{-1}]
c – is the speed of light [3.00e8 m s^{-1}]
r – is the distance between a photon and an object with mass [m]
f – is the frequency of a photon [s^{-1}]

A unit analysis of both sides of the equation shows that the units match.

$$F = \frac{m\,kg}{s^2} = \frac{m^3}{kg\,s^2} \times \frac{m^2 kg}{s} \times \frac{1}{s} \times kg \times \left(\frac{m}{s}\right)^{-2} \times (m)^{-2} = \frac{m^5\,kg^2\,s^2}{m^4\,kg\,s^4} = \frac{m\,kg}{s^2}$$

Calculating the value of the constants, denoted as Y_2, gives the following value:

(5.2) $$Y_2 = \frac{Fr^2}{fm} = G\frac{h}{c^2} = 6.67 \times 10^{-11}\ \frac{m^3}{kg\ s^2}\left[\frac{6.63\times10^{-34}\ \frac{m^2\ kg}{s}}{\left(3.00\times10^{8}\ \frac{m}{s}\right)^2}\right]$$

(5.3) $$Y_2 = 4.91 \times 10^{-61}\ m^3\ s^{-1}$$

This will give the equation:

(5.4) $$F = Y_2\frac{fm}{r^2}$$

A unitless multiple *k* can be included to denote the number of photons at a point in a wave. This means that the photons will have to be the same distance away from the object with mass. This will give the final equation:

(5.5) $$F = Y_2 k\frac{fm}{r^2}$$

Where:

F – is the force between a point in an EM wave and an object with mass [kg m s^{-2}]
Y_2 – is a constant [4.91e-61 m^3 s^{-1}]
r – is the distance between a point in the EM wave and an object with mass [m]
f – is the frequency of a photon [s^{-1}]
m – is the mass of an object [kg]
k – is the number of photons at a point in the EM wave

4. Using the definitions of gravity forces and EM waves above, matter with mass will affect massless objects through this unified field. This is how celestial objects "bend" light. The body in space creates tension in this elastic field and pulls in the photons, altering their course.

5. The definition of gravity and EM waves leads to a very simple and direct explanation of why light bends around planets; it is because EM waves and gravitational fields operate using this elastic feature in the unified field.

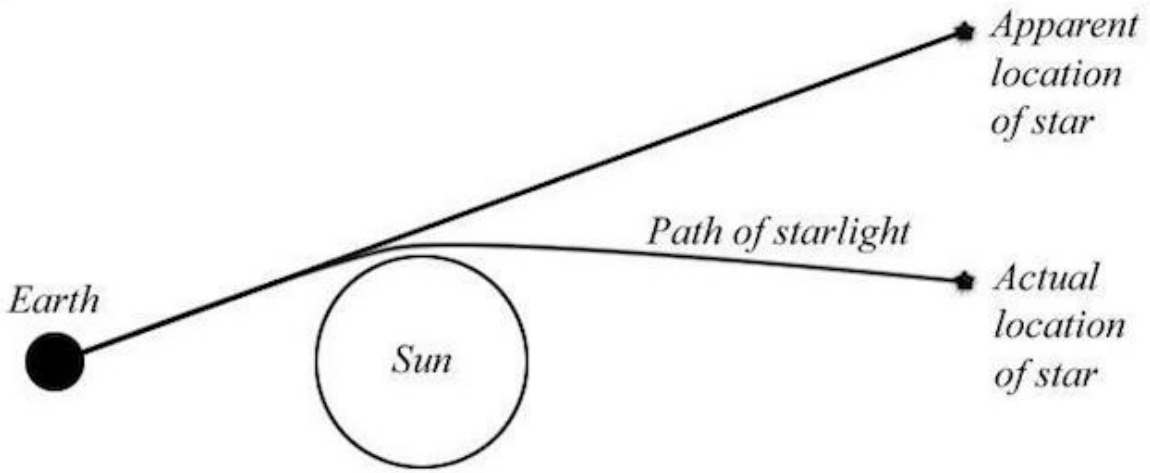

Figure 2.3 – Diagram showing the real position of a star and the observed position due to gravitational deflection (NASA 2017)

6. The opposite is also true: EM waves also pull on objects with mass. The force is equal but opposite.

Section VI – Explanation of Dark Matter Using the Unified Field Theory

So far, all observations of dark matter are based on the results of gravitational forces. Dark matter is the best evidence of this unified field theory and shows how EM and gravitational fields come from the same elastic field. The following dark matter observations can be explained by the unified field theory.

1. Vera Rubin observed that some galaxies have a constant rotation speed at a distance from the centre of the galaxy. (Rubin Ford 1970)

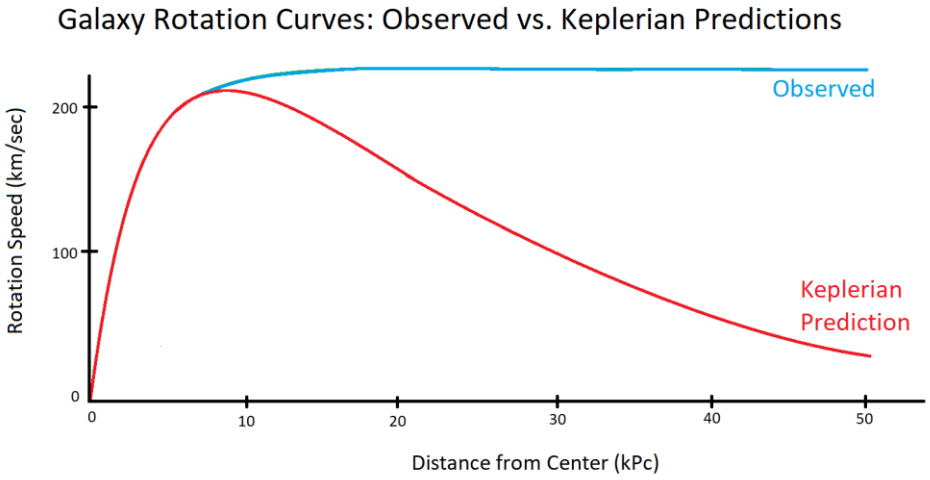

Figure 6.1 – Observed and predicted rotation curve of a spiral galaxy

a. Keplerian predictions and calculations show that the rotation velocity should decrease steadily after a certain distance from the centre of the galaxy.
b. However, observed rotation curves of galaxies show a constant rotation velocity at a distance from the centre of the galaxy.
c. Using current theories, planets further out with the observed velocities should fly out of orbit since there is not enough matter in the galaxy to create a gravitational force that could maintain the planets' orbits.
d. Current theories suggest that there is unseen matter generating the gravity required to hold the planets in orbit.
e. Using the elastic feature of the unified field of gravity and electromagnetism, all celestial bodies and their emitted EM waves will influence the gravitational field as stated in Section V.
f. EM waves in limited amounts will not have a noticeable effect on planets, but on a galactic scale, the observations of the effects can be seen.
g. EM waves from the galaxy create a massive gravitational force in the unified field that is enough to maintain the unexpectedly fast orbit of outer planets in the observed galaxies.
h. By following the ideas of the unified field theory, the observations of Vera Rubin can be explained.

2. Galaxies are typically flat, yet their observed gravitational fields are spherical.

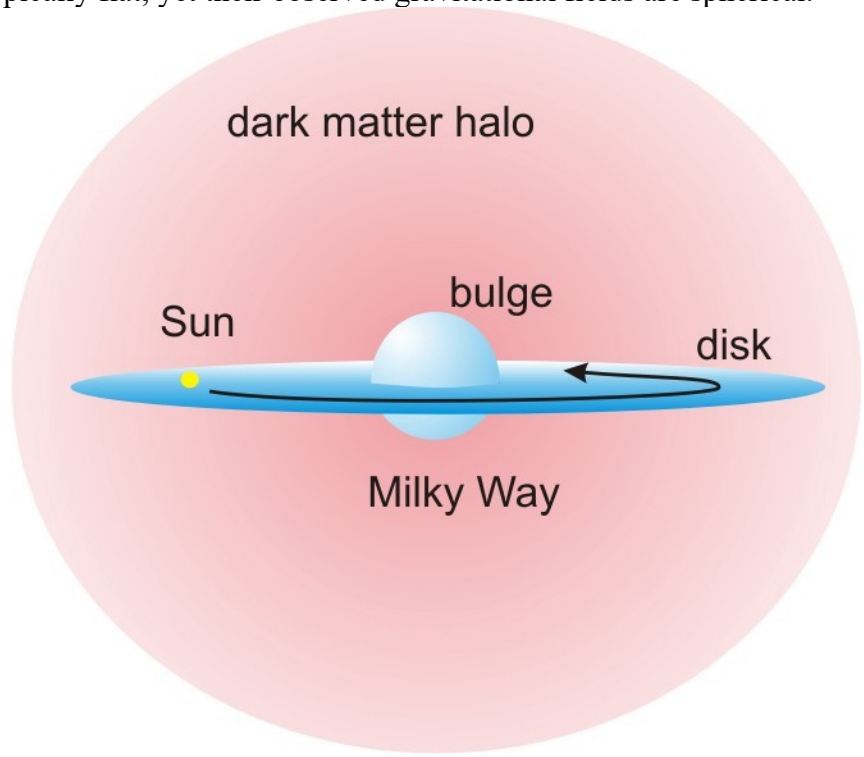

Figure 6.2 – Diagram of the dark matter halo around the Milky Way galaxy (Hossenfelder 2015)

a. For spiral galaxies, the general shape of the galaxy is a relatively flat disk surrounding a centre bulge.
b. Since most of a spiral galaxy's matter is in the galactic disk and galactic bulge, current theories on gravity predict that the gravitational field should follow the shape of the galactic bulge and galactic disk.
c. This is not the case as many spiral galaxies are observed to have a spherical, not a flat, gravitational field.
d. This can be observed as a spherical halo around the galaxy.
e. Current dark matter theories say that the halo is made of dark matter and use it to explain the observed rotation curves of galaxies.
f. Using the unified field theory presented above, the EM waves generated by the galaxies create a massive gravitational force in the unified field that produces the observed gravitational effects.
g. EM waves are emitted in all directions from the galaxy, producing the spherical gravitational field.
h. EM waves in limited amounts will not have a noticeable effect, but on a galactic scale, the effects can be observed.
i. As EM waves move further out, their energy dissipates, decreasing their concentration, and having a lesser effect on the gravitational field. This explains why galaxies have less material further out.
j. The unified field theory explains why flat galaxies have spherical gravitational fields.

3. Gravitational lensing

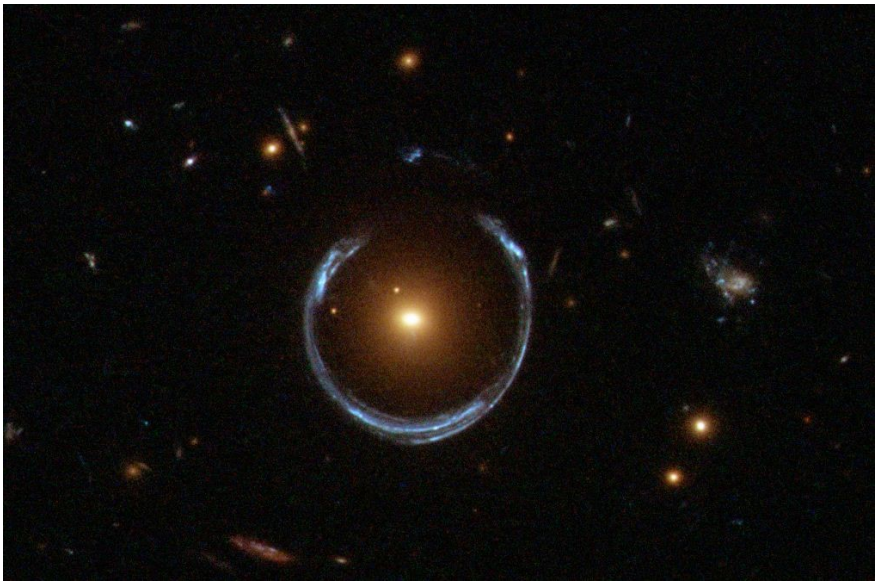

Figure 6.3 – A cropped image from the Hubble Telescope showing distorted light due to gravitational lensing (ESA/NASA 2011)

a. Using the current ideas of gravitational lensing, a massive celestial entity, such as a galaxy, will distort and bend the light passing around it.

b. However, the observed lensing is much stronger and does not match the predicted results.
c. Current theories only use the mass of the celestial entity to calculate the lensing.
d. Using the idea of the unified field in Section IV above, EM waves affect each other in the gravitational field.
e. The additional gravitational force generated by a galaxy's emitted EM waves would lead to an increase in calculated gravitational lensing that would match observations.
f. This theory explains the observed gravitational lensing and why it is greater than calculated results.

4. Dark matter cannot be observed by traditional EM wave detecting methods
    a. From the CERN website, "dark matter does not interact with the electromagnetic force. This means it does not absorb, reflect or emit light, making it extremely hard to spot. In fact, researchers have been able to infer the existence of dark matter only from the gravitational effect it seems to have on visible matter."
    b. Most current methods of searching for dark matter are looking for a particle (Gelmini 2008; Baudis 2017).
        i. Large Hadron Collider – smashed atoms together to observe the creation of weakly interacting massive particles
        ii. XENON1T detector – uses liquid xenon to improve the detection of weakly interacting massive particles
        iii. AMS-02 Experiment – attempted to observe radiation from dark matter annihilation
        iv. ADMX experiment – attempted to look for axions when they convert to photons
        v. CAST experiment at CERN – looked for axions produced in the sun's hot interior
        vi. DM-Ice17 – aims to detect WIMPs 2457 meters below the South Pole (Jo 2016)
    c. Using the unified field theory, EM waves create the gravitational effects that are attributed to dark matter. Dark matter itself is the EM waves produced by galaxies.
    d. Dark matter does not interact with itself nor does it reflect EM waves.
    e. Dark matter is not dark. With this unified field theory, it is simply an EM wave and all around.
    f. Dark matter has no observable reaction with light since it itself is an EM wave.
    g. Since dark matter is an EM wave, it is invisible to traditional methods of searching which are looking for a particle.
    h. This explains why current methods of searching for dark matter have failed.

5. Dark matter can go through itself

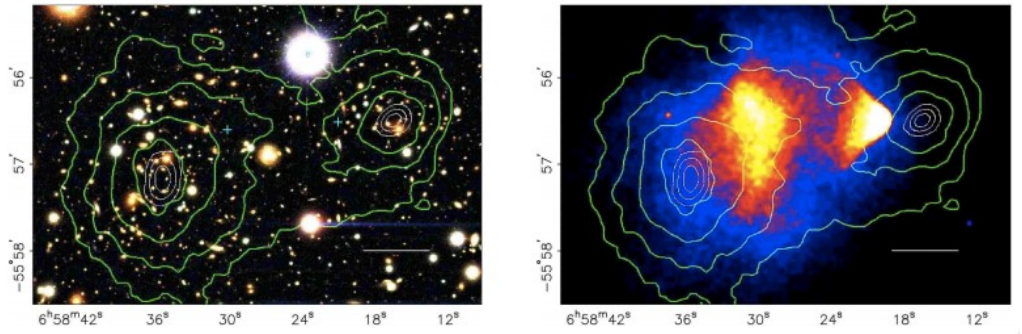

Figure 6.4 – Images of the Bullet Cluster showing the spatial centre found from gravitational lensing (Clowe et al. 2006)

a. The Bullet Cluster was created when two galaxies collided.
b. After the centre of masses of the two colliding galaxies slowed down, the observed centre of gravity of each galaxy did not slow down.
c. Measurements from gravitational lensing showed that the baryonic centre of mass is far away from the observed centre of gravity.
d. This means that the observed gravitational field of each galaxy appears to have moved far away from its expected position after collision.
e. From the unified field theory, EM waves also affect the gravitational field, and it is known that EM waves can pass through other EM waves without interference.
f. Dark matter can pass through itself because it is EM waves that are affecting the gravitational field.
g. The baryonic matter slowed down, but the EM waves from the two galaxies did not.
h. The unified field theory described in Section II to V explains why the Bullet Cluster had two moving centres of gravities from the two colliding galaxies after the collision.

6. Every single attempt of finding the dark matter particle has failed (Baudis 2017).
    a. List of theorized dark matter particles
        i. WIMPs – weakly interacting massive particles
        ii. Axions – ultralight particles that can transform into photons
        iii. GIMPs – gravitationally interacting massive particles
        iv. Sterile neutrinos
    b. If dark matter is a particle, it should not be able to pass through itself
    c. Haloes should not exist if dark matter is a particle.

7. Particles should decay into another particle, but dark matter does not decay
    a. Current theories on dark matter suggest that dark matter is a particle.
    b. However, the theorized dark matter particle does not decay like any other particle.
    c. EM waves do not decay, but the waves do dissipate.
    d. Dark matter appears to be constant. This is because the rate of generation and dissipation of EM waves on the galactic scale is roughly equal.
    e. Using the unified field theory, dark matter is simply an EM wave.

f. The unified field theory described above explains why dark matter does not decay; it is an EM wave.

Dark matter has not been observed, only its effects have. If all research is aimed at finding a dark matter particle, this is the wrong direction. Research should be directed towards finding what is gravity. Then we can research the observations caused by dark matter. The new gravity force theory in the unified field for both gravity and electromagnetism can explain all the above dark matter observations.

Conclusion

This paper defines the gravitational field as a medium with elastic properties, and the gravitational force occurs when matter creates a more concentrated region in the gravitational field. Further, this paper explains how electromagnetic waves are changing concentrations in this field. Hence, the gravitational field and electromagnetic field are the same, called the unified field. Based on this understanding of the unified field, there is gravity between electromagnetic waves as defined as:

$$F = Y_1 \frac{f_1 f_2}{r^2}$$

There is gravity between electromagnetic waves and matter possessing mass at rest. This force is defined as:

$$F = Y_2 \frac{fm}{r^2}$$

This new unified field theory can explain the troublesome dark matter observations.

Acknowledgements

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