

Dark Energy and Electromagnetism

Author: Moshe Segal

moshe_segal@yahoo.com

Abstract

The paper aims to provide a new tentative, reasonable explanation as related to the nature and the source of the mysterious Dark energy.

The paper concludes that most of the Dark Energy might be related to Electromagnetism.

The paper relies on materials already presented in several published papers. These materials are summarized in this paper and provide a comprehensive, complete framework from which the conclusion presented above is derived.

Because this paper is a summary of several papers which were already published, it does not contain mathematics. The required mathematics is already presented in the above-mentioned published papers and additional papers and theories which these papers refer to or use.

Because this paper presents significantly new ideas, the fact that the reader does not need to delve into complex mathematics should help in delivering these new ideas.

1. Introduction

The notion of the Dark Energy was introduced, into the science of Physics, because of observations related to the state of the Universe, relating to its being stable or expanding.

Initially, the science of Physics assumed that the Universe is stable. Then, observations revealed that the Universe is expanding.

But, in the 20th century, additional observations revealed that the Universe is expanding at a rate much faster than it was assumed and found before.

This observation revealed that the actual rate of expansion of the Universe embeds a mystery, because such a rapid rate of expansion must be supported by a much bigger amount of Energy, existing in the whole Universe, much bigger than the amount of Energy embedded in the Universe, that the science of Physics today can detect or calculate.

As a result of the mystery presented above, relating to the expansion rate of the Universe, the notion of the Dark Energy was introduced into the science of Physics.

That notion states that there is an extra amount of Energy embedded in the Universe, above and beyond the amount of Traceable and Detectable Energy that the science of Physics can Trace, Detect, or Calculate.

That extra amount of Energy, the Dark Energy, is yet Untraceable and Undetectable, and thus presents an unanswered question and a mystery as related to the nature, source, or origin of that Dark Energy.

Current calculations predict that the amount of the Dark Energy in the Universe is about twice the amount of the Traceable and Detectable Energy in the Universe.

However, although the source and the origin of that mysterious Dark Energy is unknown, the most acceptable notion, held by the science of Physics today is that it must be related to Gravity, and should be looked for, in Einstein's General Relativity theory.

This paper suggests an alternate reasonable explanation relating to the source of this mysterious Dark Energy.

The explanation provided is based on analysis relating to unanswered questions, peculiarities and paradoxes as related to Electromagnetism.

This analysis utilizes thinking experiments, logic, and reason.

However, because thinking experiments, logic and reason might not be sufficient in providing a sufficiently convincing explanation as to the source of the mysterious Dark Energy, this analysis also suggests a physical experiment, which if implemented, and its results will be accepted as successful, will provide validity to the conclusions presented.

Also, in the process of the above-mentioned analysis relating to unanswered questions, peculiarities and paradoxes as related to Electromagnetism, additional revolutionary conclusions are derived, such as: The Electric Charge is also a form of Energy, as Mass is already recognized as a form of Energy, following the introduction of Einstein's Special relativity Theory, and what Humans perceive as Space is also just a form (or facet) of Energy.

As already stated, the details regarding the thinking experiments, logic and reason and the proposed physical experiment, mentioned above, were already presented in several published papers.

Thus, these papers are referred to in this paper, and their content is provided briefly also in this paper.

However, this paper, summarizes what was already presented in the above-mentioned published papers, and puts the explanation provided, regarding the tentative new explanation as related to the source of the mysterious Dark Energy, and the additional revolutionary conclusions derived, into a comprehensive, complete framework.

As already stated, because the materials presented in this paper rely on what was already presented in already published papers, this paper does not need to delve into detailed mathematics.

This also helps in presenting the new ideas, because the discussion needs to focus mainly on the new angles and points of views relating to existing issues in Electromagnetism, which were yet ignored, and by not delving into mathematics, these new angles and points of views are better presented, which also helps in presenting the new explanations to the unanswered questions, peculiarities and paradoxes which also still exist in Electromagnetism and were also yet ignored.

2. Unifications of Electromagnetic Waves from separate sources

A significant observation which led to the conclusions derived in this paper is the following observation:

Electromagnetic Waves, from separate sources, can and do unify and consolidate.

That observation contradicts what the nowadays Science of Physics assumes about unifications of Electromagnetic Waves from separate sources.

The acceptable notion held by the nowadays Science of Physics is that Electromagnetic Waves from separate sources cannot unify or consolidate.

An example to the above-mentioned notion, held by the nowadays Science of Physics, about Electromagnetic Waves, is demonstrated by the following paper [1]:

“Does Destructive Interference Destroy Energy?” by Kirk T. McDonald Joseph Henry Laboratories, Princeton University, Princeton, NJ 08544 (January 7, 2014, updated May 8, 2018).

That paper states, when referring to Electromagnetic Waves, the following: “A one-dimensional wave moving in one direction can have only one source, and there can be only one such wave at a given point”, which implies that Electromagnetic Waves, from separate sources, cannot unify or consolidate.

However, several paper [2], [3], [4], [5], [6], published by the author of this paper, provide sound argumentations, that Electromagnetic Waves, from separate sources, can and do unify and consolidate.

The paper [2] also proposes a physical experiment which describes how unification of Electromagnetic Waves from separate sources can be implemented. A schematic of the setup of such an experiment is also provided in that paper.

Following is a brief presentation of the arguments provided which imply that Electromagnetic Waves, from separate sources, can and do unify and consolidate. More details regarding the above can be found in the papers mentioned above.

The Wave facet of Electromagnetic Waves is a direct derivation from Maxwell's equations, which conclude, that an accelerating Electric Charge emits Energy in the form of Electromagnetic Waves, which can be presented by the following equations [7]:

$$E_y = E_0 \cos [2 \pi ((x / \lambda) - f t)]$$

$$B_z = B_0 \cos [2 \pi ((x / \lambda) - f t)]$$

The image below presents a schematic of an Electromagnetic Wave.

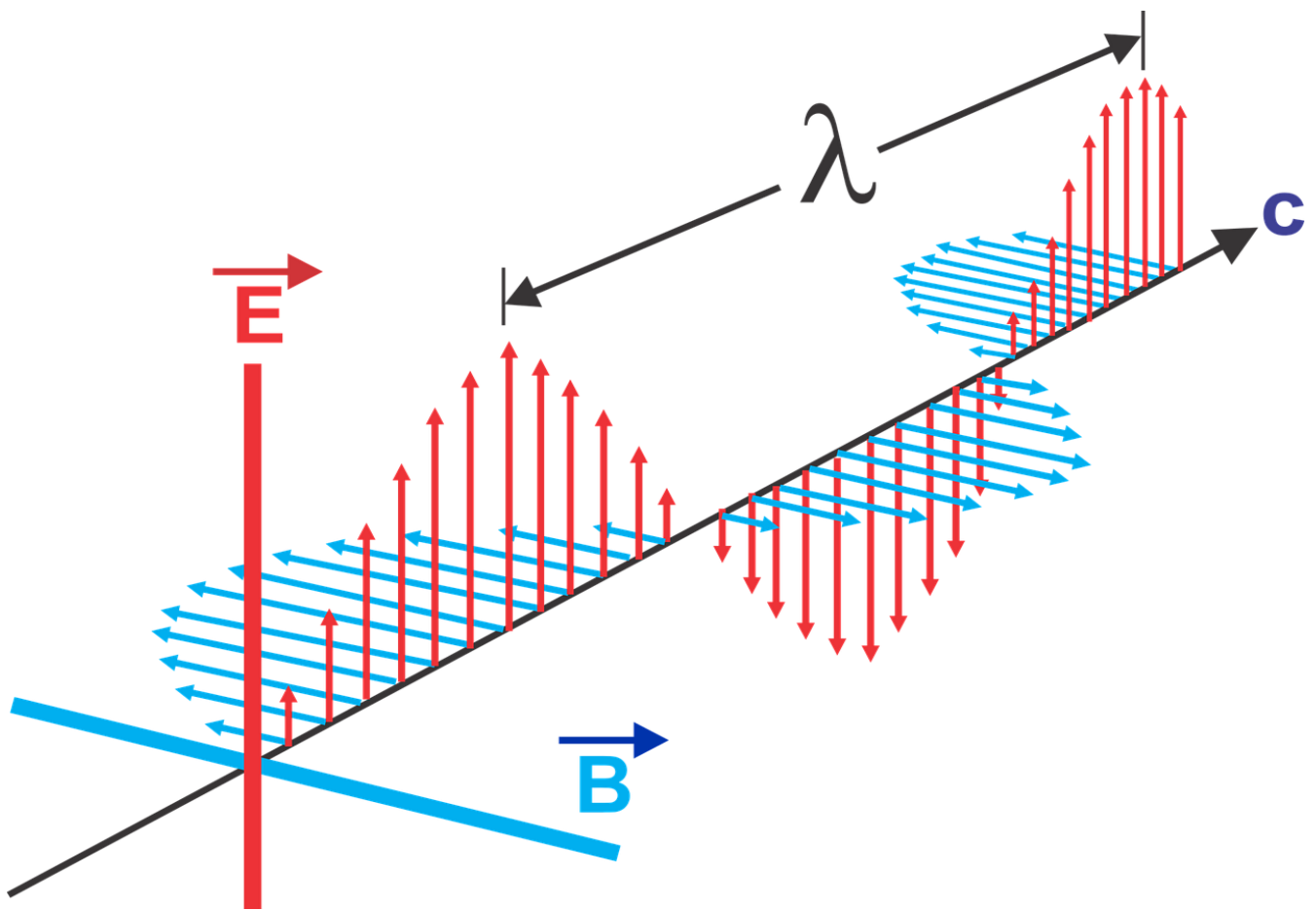


Image source: pixabay.com.

In the equations presented above, of an Electromagnetic Wave, E_y is the Electric Field component of the Electromagnetic Wave and B_z is the Magnetic Field component of the Electromagnetic Wave.

The above equations imply that an Electromagnetic Wave is composed of two propagating and oscillating Energy Fields, a propagating and oscillating Electric Field and a propagating and oscillating Magnetic Field.

The above equations also imply that an Electromagnetic Wave always travels at the speed of Light (c), and each of its fields is perpendicular to the other field, and both are perpendicular to the line of traveling of the Electromagnetic Wave.

Because an Electromagnetic Wave, in its Wave facet, is composed of only two propagating and oscillating Energy Fields, a propagating and oscillating Electric Field and a propagating and oscillating Magnetic field, then, the necessary and sufficient conditions, for two Electromagnetic Waves, from separate sources, to unify and consolidate, are:

The two Electromagnetic Waves, from separate sources, must meet on a point in Space, and following that meeting moment the following must occur:

1. Each Electromagnetic Wave must continue to propagate in the exact same direction that the other Electromagnetic Wave propagates.
2. The two Electromagnetic Waves must continue to propagate on the exact same line in space.
3. The polarization of each of the two Electromagnetic Waves must be such, that, following their meeting moment, the line of oscillation of the Electric Field of one Electromagnetic Wave is the exact same line on which the Electric Field of the other Electromagnetic Wave oscillates.
4. The polarization of each of the two Electromagnetic Waves must be such, that, following their meeting moment, the line of oscillation of the Magnetic Field of one Electromagnetic Wave is also the exact same line on which the Magnetic Field of the other Electromagnetic Wave oscillates.

If the above conditions apply, following the meeting moment of these two Electromagnetic Waves, which initially emerged from separate sources, then, the Electric fields of both waves, following their meeting moment, will always exist on the exact same location and on the exact same line in space, and also the Magnetic fields of both waves,

following their meeting moment, will also always exist on the exact same location and on the exact same line in Space.

Electric and Magnetic fields are vectors, and such vectors which reside on the exact same location and on the exact same line in Space, unify to create a resultant vector, by adding up, or subtracting from each other, depending on their polarities.

Thus, if the above conditions apply, then, these two Electromagnetic Waves, which initially emerged from separate sources, unify, and consolidate, continuously, following their meeting moment, to create continuously, a new consolidated Electromagnetic Wave.

Because the Electric fields of the two original Electromagnetic waves consolidate, as explained above, into one consolidated Electric field, and the Magnetic fields of the two original Electromagnetic waves also consolidate, as explained above, into one consolidated Magnetic field, which implies that the two original Electromagnetic Waves consolidate into one consolidated Electromagnetic Wave.

If the Electromagnetic Waves are also polarized, as described in conditions 3 and 4 above, then a *complete* unification of these Electromagnetic Waves occurs. But even if the two Electromagnetic Waves are not at all polarized, then, a *partial* unification of the two Electromagnetic Waves occurs, and this partial unification still complies with all the discussion provided in the paper [2].

The paper [2] describes a physical experiment which contains two Electromagnetic Waves, from separate sources, which meet on a half transparent mirror and unify after leaving the half transparent mirror into a consolidated, unified, Electromagnetic Wave.

The first original Electromagnetic Wave comes from the transparent side of the half transparent mirror, and just passes and leaves the half transparent mirror, without being deflected by the half transparent mirror.

The second original Electromagnetic Wave comes from a direction perpendicular to the direction on which the first original Electromagnetic Wave propagated, hits the deflecting side of the half transparent mirror where the first Electromagnetic Wave exits the half transparent mirror, and is deflected by the half transparent mirror.

The half transparent mirror is tilted at 45 degrees, relative to the direction of the propagation of the first original Electromagnetic Wave.

Thus, from the above follows, that the second original Electromagnetic Wave, which is deflected by the deflecting side of the half transparent mirror, continues to propagate, after it is deflected by the half transparent mirror, in the exact same direction and the on exact

same line in Space, on which the first original Electromagnetic Wave propagates, after it passes and leaves the half transparent mirror.

Thus, from the above follows, that after the two Electromagnetic Waves leave the half transparent mirror, they both continue to propagate in the exact same direction and on the exact same line in Space.

If the original Electromagnetic Waves are also polarized as the above-mentioned conditions 3 and 4 require, then, after the two Electromagnetic Waves leave the half transparent mirror, they meet all the four conditions presented above, which implies, that the two Electromagnetic Waves unify and consolidate *completely* into one consolidated Electromagnetic Wave.

The paper [3] relates also to the above-described scenario and provides additional argumentations, which conclude that the Superposition Principle also implies that such a scenario should generate consolidations of Electromagnetic Waves, from separate sources.

Yet an additional paper, the paper [5] provides an observation, that anybody can experience, every day, that indicates, that Electromagnetic Waves, from separate sources, can and do consolidate.

That observation can be described as follows:

When one looks at items that exist behind a glass, when the illumination around is not intense, one usually can see the items that exist behind that glass and a reflection of himself, looking at that glass.

The Light beams emerging from the items behind the glass, and the Light beams that return the reflection of this person, are Light beams that originate from separate sources (items behind the glass and the body of the person looking at the glass).

Then, some of these Light beams might be travelling in the exact same direction and on the exact same line in Space because these Light beams reach the person's eyes.

And thus, some of these Light beams might meet the necessary and sufficient conditions for Light beams, from separate sources, to consolidate, as presented above, and thus, these Light beams might become consolidated Light beams from separate sources.

The image below demonstrates manikins standing in front of a glass door. One of these manikins might represent the person looking at a glass, mentioned above. In the image the

reflection of this manikin can be seen, along with items on the other side of the glass, the side external to where these manikins exist, which implies that some of the Light beams emerging from the items on the other side of the glass, and some of the Light beams returning the reflection of this manikin, might travel on the same direction and on the same line in Space and thus consolidate.



Image source: pixabay.com.

The experiment proposed in the paper [2] might be very difficult to implement, and requires proper means and funds, which are beyond the reach of the author of this paper, and thus, the author of this paper hopes that this paper will help in achieving the goal of implementing this experiment.

Although such an experiment was not yet implemented, still the question why the Science of Physics today holds the notion that Electromagnetic Waves, from separate sources, cannot consolidate, must be asked, and addressed, based on the many very sound argumentations that Electromagnetic Waves, from separate sources, can and do consolidate, presented above, because the reason and logic, on which these sound argumentations rely seem to be reason and logic which might be difficult to contradict.

Thus, the following might provide a possible answer to the question: why the Science of Physics today still holds the notion that Electromagnetic Waves, from separate sources, cannot consolidate?

It turns out, that unifications of Electromagnetic Waves, from separate sources, *seem* to embed paradoxes, because this scenario *seems* to violate the Energy Conservation Principle.

Because Electromagnetic Waves, in their Wave facet are just two oscillating and propagating Energy fields, an oscillating and propagating Electric field and an oscillating and propagating Magnetic field, then, if two Electromagnetic Waves, from separate sources, unify and consolidate when:

1. Their Electric and Magnetic fields oscillate at the exact same frequency.
2. They embed the exact same intensities in their Electric fields.
3. They embed the exact same intensities in their Magnetic fields.
4. They are at anti phase as related to each other, which imply an exact 180-degree phase shift as related to each other.
5. They have proper polarization, as explained in the paper [2].

Then, the Electric field of one consolidating Electromagnetic Wave, annihilates completely and continuously, the Electric field of the second consolidating Electromagnetic Wave, after the Electromagnetic Waves meet and consolidate.

Also, the Magnetic field of one consolidating Electromagnetic Wave also annihilates completely and continuously the Magnetic field of the second consolidating Electromagnetic Wave, after the Electromagnetic Waves meet and consolidate.

The above implies that the resultant consolidated Electromagnetic Wave has zero Electric and Magnetic fields, which is a Null Electromagnetic Wave.

Because the Energy embedded in an Electromagnetic Wave is proportional to the combined squares of the intensities of its Electric and Magnetic fields, then, the resultant Null Electromagnetic Wave *seem* to embed no Energy at all, even though, the Electromagnetic Waves that created it embedded Energy, which *seems* as if Energy disappeared, which *seems* like a clear violation of the Energy Conservation Principle.

All the above is described in more details in the paper [2].

The above described an extreme scenario in which the consolidating Electromagnetic Waves meet and consolidate when they are exactly out of phase, or at anti phase (180-

degree phase shift), as related to each other, when the Electromagnetic Waves meet and consolidate, which resulted in the creation of a resultant Null Electromagnetic Wave.

The other extreme scenario is the scenario in which the Electromagnetic Waves are exactly in phase (0-degree phase shift) as related to each other, when the Electromagnetic Waves meet and consolidate.

Thus, if condition 4, in the five conditions above, is replaced by:

The consolidating Electromagnetic Waves are at phase as related to each other when they meet and consolidate, which implies a 0-degree phase shift as related to each other, when the Electromagnetic Waves meet and consolidate,

Then, the resultant consolidated Electromagnetic Wave *seem* to embed more Energy, as compared to the combined Energies embedded in the Electromagnetic Waves that created it, which *seems* as if Energy was created out of nothing, which is also a clear violation of the Energy Conservation Principle.

The explanation of why, in the scenario just described, the resultant consolidated Electromagnetic Wave *seem* to embed more Energy, as compared to the combined Energies embedded in the Electromagnetic Waves that created it, is as follows:

In the scenario just described, the Electromagnetic Waves are in phase (0-degree phase shift) when they meet and consolidate, which implies that the Electric fields of both consolidating Electromagnetic Waves add up, instead of annihilating each other, as in the case of the creation of the Null Electromagnetic Wave, when the Electromagnetic Waves consolidated when they were at anti phase (180-degree phase shift).

Then, if E_1 is the intensity of the Electric field in the first Electromagnetic Wave of the two consolidating Electromagnetic waves, then, the Energy embedded in this Electric field of this first Electromagnetic Wave is proportional to E_1^2 , because the Energy embedded in an Electric field is proportional to the square of the intensity of this Electric field.

And, if E_2 is the intensity of the Electric field in the second Electromagnetic Wave of the two consolidating Electromagnetic waves, then, the Energy embedded in this Electric field of this second Electromagnetic Wave is proportional to E_2^2 .

Because, as presented already above, in the scenario just described the Electric fields of both consolidating Electromagnetic Waves add up, then, the intensity of the Electric field of the resultant consolidated Electromagnetic Wave is $E_1 + E_2$.

Then, the Energy embedded in the Electric field of the resultant consolidated Electromagnetic Wave is proportional to $(E_1 + E_2)^2$.

And because $(E_1 + E_2)^2$ is always bigger than $E_1^2 + E_2^2$, then, the resultant consolidated Electromagnetic Wave, *seem* to embed more Energy in its Electric field, as compared to

the combined Energies embedded in the combined Electric fields, of the Electromagnetic Waves that created it.

The above related to the Electric fields of the consolidating Electromagnetic Waves, but similar argumentations apply also to the Magnetic fields of the consolidating Electromagnetic Waves.

Thus, the above implies that in a scenario, in which the two Electromagnetic Waves meet and consolidate when they are in phase, the Energy embedded in the resultant consolidated Electromagnetic Wave, *seems* to be bigger than the combined sums of the Energies embedded in the Electromagnetic Waves that created it, which *seems* as if Energy was created out of nothing, which also *seems* like a clear violation of the Energy Conservation Principle.

More details as relating to the above can be found in the paper [4].

The scenario in which a Null Electromagnetic Wave was created, in which Energy *seems* to disappear, which was already described above, and the scenario in which the Electromagnetic Waves consolidated when they were in phase, in which the resultant consolidated Electromagnetic Wave, *seems* to embed more Energy, as compared to the combined Energies in the Electromagnetic Waves that created it, which *seems* as if Energy was created out of nothing, are just two extreme scenarios of consolidating Electromagnetic Waves, from separate sources.

In both these scenarios, the Energy Conservation Principle *seems* to be violated.

However, if none of the conditions presented at the beginning of this chapter apply, it can also be shown, that in *any* scenario of consolidating Electromagnetic Waves, from separate sources, the resultant consolidated Electromagnetic Wave, *seems* to embed either less or either more Energy, as compared to the combined Energies embedded in the Electromagnetic Waves that created it.

This also *seems* like a clear violation of the Energy Conservation Principle, and this is also described in the paper [4].

Because the Energy Conservation Principle is a foundation building block of the Science of Physics, then, consolidations of Electromagnetic Waves, from separate sources, *seem* to embed paradoxes, because they *seem* to destroy one of the foundations upon which the Science of Physics today is constructed

Thus, this might be an explanation to why the Science of Physics today, still holds the notion, that Electromagnetic Waves, from separate sources, cannot consolidate, even though, there are many very sound argumentations, based on logic, reason and thinking experiments, that Electromagnetic Waves, from separate sources, can and do consolidate, logic and reason that seem difficult to contradict.

However, the paper [2] proposes a reasonable explanation to these paradoxes, an explanation which keeps the Energy Conservation Principle intact.

3. The Energy Pairs Theory

Because, as presented above, consolidating Electromagnetic Waves from separate sources exhibit, in one extreme situation, the creation of a Null Electromagnetic Wave, which contains no Electric or Magnetic Fields at all, and, in the creation of this Null Electromagnetic Wave, Energy *seems* to disappear, that Energy disappearance can be assumed to be the creation of Dark Energy, because Dark Energy is also Untraceable and Undetectable.

This paper, and papers [2], [3], [4], [5], [6] present a new theory, the Energy Pairs Theory, which provides a tentative, reasonable resolution to the paradox embedded in scenarios of consolidating Electromagnetic Waves, from separate sources, which might resolve the mystery, in what *seems* to be, a violation of the Energy Conservation Principle.

The new Energy Pairs Theory explains how consolidations of Electromagnetic Waves, from separate sources, can occur, and still the Energy Conservation Principle is kept intact, and it is not violated.

The new Energy Pairs Theory also might unveil part of the mystery relating to the source or the origin of at least part of the mysterious Dark Energy.

Following is a short presentation of the elements embedded in the new Energy Pairs Theory:

The new Energy Pairs Theory states that, in certain conditions, Energies embedded in Electromagnetic Waves can be accumulated and be stored together in pairs.

These Energy Pairs disable each other from being detected, such that the Energies *Exit* but are Untraceable and Undetectable Energies, or *Dark Energy*.

The new Energy Pairs Theory expands the concept of Energy to embed two forms (or facets) of Energy: Detectable Energy and Undetectable (or Dark) Energy.

The Undetectable (or Dark) Energy is accumulated in Pairs of Energies which Disable each other from being detected.

And the new Energy Pairs Theory also states that Photons can carry both, Detectable and Undetectable (or Dark) Energies.

Examples of Energy Pairs might be the two Electric fields, or the two Magnetic fields, of the two consolidating Electromagnetic Waves, from separate sources, which resulted in the creation of the Null Electromagnetic Wave, described before.

These two Electric fields annihilate completely each other, and disappear, after the two consolidating Electromagnetic Waves, from separate sources, meet and consolidate, causing the Energy embedded in these two original Electric fields to *seem* also as disappearing. And the same applies also to the two Magnetic fields, of these two consolidating Electromagnetic Waves, from separate sources.

The new Energy Pairs Theory states that the Energies embedded in these two Electric fields (or these two Magnetic fields), did not disappear, even though the original two Electric fields (or these two Magnetic fields) annihilated each other, and disappeared.

The new Energy Pairs Theory states that the Energies embedded in these two Electric fields (or these two Magnetic fields) still exist. These Energies were converted into Untraceable or Undetectable or Dark Energy, embedded in Space.

If it can be assumed that Space is just a form (or facet) of Energy, then, Space can be a media which stores the Energies of these two Electric fields (or these two Magnetic fields), which annihilated each other, causing also the Energies embedded in them to *seem* also as being disappearing.

The assumption that Space is a form (or facet) of Energy presented above might be also derived from Einstein's four-dimensional Interwoven Space/Time entity provided by Einstein's General Relativity Theory.

Einstein's four-dimensional Interwoven Space/Time entity was introduced for explaining the origin of attraction between Mass bodies. As such, Einstein's four-dimensional Interwoven Space/Time entity is supposed to replace Newton's Gravitational Field, which should be recognized as a form of Energy.

Since the Gravitational Field is a form of Energy, then, the Interwoven Space/Time Entity should also be a form of Energy.

In a speech, in the University of Leiden on May 5th, 1920, [8], Einstein claimed that the Ether should exist to provide physical properties to his Space/Time entity, which implies, that Einstein also agreed that his Space/Time Entity is a form of Energy.

Thus, because Einstein's four-dimensional Interwoven Space/Time entity is just a form of Energy, and Space is just an ingredient in Einstein's four-dimensional Interwoven Space/Time entity, then, this implies that Space is just a facet of Energy.

An analogy to what was presented above, as relating to the new Energy Pairs Theory, might be the rope pulling game named tag-of-war.

The image below presents a tag-of-war game.

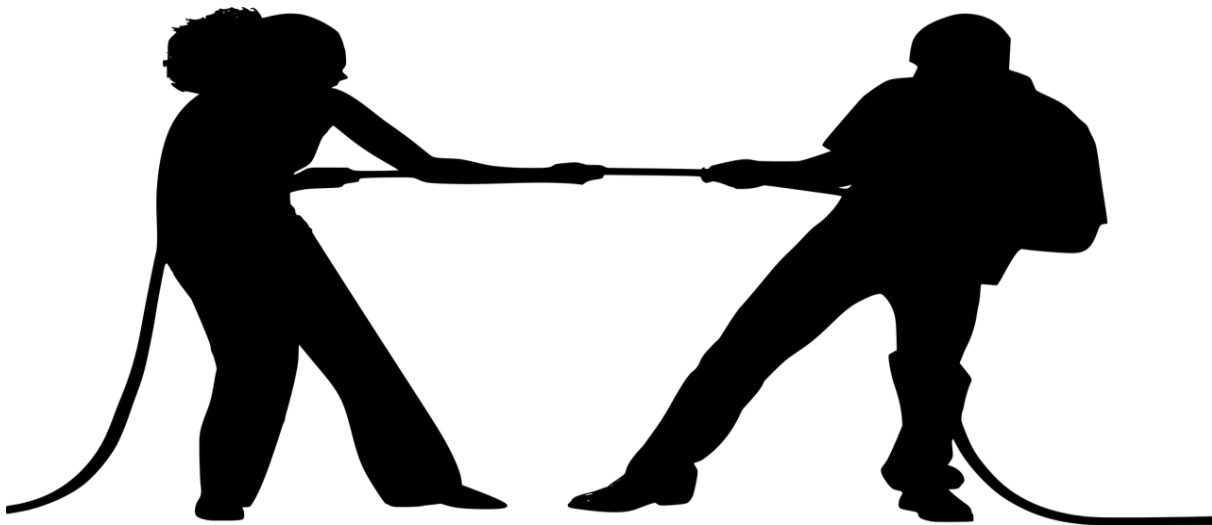


Image source: pixabay.com.

In that game, two persons pull a rope, each from the other side of the rope.

If the magnitude of the force exerted on the rope, by the first person, is equal exactly to the magnitude of the force exerted on the rope, by the other person, the rope does not move at all. This might seem as there is no force exerted at all on the rope, and no Energy imposed on the rope.

But because the rope is a tangible substance, the Energy imposed on the rope can be detected via the tension embedded in the rope, which stores the Energy inserted in the rope, even though, the rope does not move at all.

Similarly, to the above, the two Electric fields (or the two Magnetic fields) mentioned above, do annihilate each other, because they are of exact equal magnitude and opposite polarity, and this also *seems* as if the Energies embedded in them also disappeared.

But the new Energy Pairs Theory states that the Energies embedded in these two Electric fields (or these two Magnetic fields) did not disappear. The new Energy Pairs Theory states that these Energies were converted into Untraceable, or Undetectable or Dark Energy embedded in Space.

And if Space is just a facet of Energy, then, it can store these Energies which *seem* to disappear.

But because Space is not a tangible substance, as the rope is, in the tag-of-war game, the Energies it stores cannot be detected, and are stored as Dark Energy.

Some physicists believe, relating to the Dark Energy mystery, that the media that holds the Dark Energy is Space itself. This is exactly what the new Energy Pairs Theory, also assumes. However, these Physicists believe that the Energies that might be stored in Space as Dark Energy are only Energies related to Gravitation.

The new Energy Pairs Theory assumes that Space might also be the media that stores Dark Energy originating from Electromagnetism. And, the new Energy Pairs Theory also assumes, that *most* of the Dark Energy stored in Space is from Electromagnetism origin. This will be further elaborated later in this paper.

The previous paragraphs provided a partial explanation to how the new Energy Pairs Theory resolves the paradox embedded in consolidating Electromagnetic Waves, from separate sources.

The Following discussion completes the explanation relating to how the new Energy Pairs Theory resolves the paradox embedded in consolidating Electromagnetic Waves, from separate sources.

As already stated above, in the creation of the Null Electromagnetic Wave, the new Energy Pairs Theory states that the Energy did not disappear.

Instead, the Energies embedded in the Electric fields (or the Magnetic fields) of the two consolidating Electromagnetic Waves that created the Null Wave, which annihilated each other, and thus, *seem* as if their Energies also disappeared, can be considered as Energies that were converted together into Dark Energy, that still exist, and stored in Space, as Untraceable or Undetectable Energies or Dark Energies.

It was already presented above, that the new Energy Pairs Theory states that Photons can also embed both, Traceable and Untraceable (or Dark) Energies.

Thus Space, which as presented above, is assumed to store the Energies that *seem* to Disappear, can be also assumed to be able to store this Energy as Photons, which embed Untraceable (or Dark) Energy.

This implies that in the scenario of the creation, for example, of the Null Electromagnetic Wave, the missing or what *seemed* like disappearing Energies, are Photons embedded in Space which carry just Untraceable, or Dark Energies.

The above explained how the new Energy Pairs Theory resolves the paradox of the Energy that *seem* to disappear, in the creation of the Null Electromagnetic Wave.

However, an additional paradox was also presented, the paradox in which Energy *seemed* to be created out of nothing, when the Electromagnetic Waves, from separate sources, met and consolidated when they were in phase.

The new Energy Pairs Theory also resolves this paradox.

In that scenario, the new Energy Pairs Theory states, that Energy was not created out of nothing.

Instead, in that scenario, Untraceable or Dark Energy, stored in the Photons of the consolidating Electromagnetic Waves, converted back into Traceable Energy, embedded in the Photons of the resultant consolidated Electromagnetic Wave.

Thus, the new Energy Pairs Theory provides a tentative reasonable resolution to the paradoxes related to consolidating Electromagnetic Waves, from separate sources.

But the new Energy Pairs Theory provides resolutions also to other unanswered questions. The new Energy Pairs Theory explains two additional paradoxes.

One of these two additional paradoxes relate to the famous Mutual Annihilation process [9]. The second of these two additional paradoxes relate to the famous Pair Production Process [10].

The following refers first to the paradox in the Mutual Annihilation process:

In the Mutual Annihilation process an Electron and a Positron meet and annihilate each other to create Photons.

An Electron is composed of Mass and a Negative Electric Charge.

A Positron is composed of Mass (equal in magnitude to the Mass of the Electron) and a Positive Electric Charge (but equal in magnitude to the magnitude of the Negative Electric Charge embedded in the Electron)

In the process of a Mutual Annihilation, the Energy Conservation Principle implies, that the combined Energies embedded in the Electron and the Positron, which converted to Photons, must be equal to the Energies embedded in the created Photons, because the Electron and the Positron converted into Photons, and Energy cannot disappear.

Photons are recognized as being composed of Energy only, and do not embed any Mass or Electric Charge.

Mass, on one hand, is already recognized as a form of Energy, following the introduction of Einstein's Special Relativity Theory.

On the other hand, Electric Charge is not recognized (yet), by the science of Physics, as being a form of Energy.

From the above follows, according to the Energy Conservation Principle, that the Energies embedded only in the *Masses* of the Electron and the Positron must be equal to *all* the Energies embedded in the created Photons.

The above also implies that the Electric Charges of the Electron and the Positron just *disappeared*.

That disappearance of the Electric Charges *seems* like a paradox.

Electric Charges, along with Mass are the basic building blocks of any tangible substance. Before Mass was recognized as a form of Energy, the science of Physics contained a Mass Conservation Principle stating that Mass is conserved and cannot disappear.

After Mass was recognized as a form of Energy, following the introduction of Einstein's Special Relativity Theory, this conservation rule was discarded, and Mass was included in the Energy Conservation Principle, stating that the sum of the Energy embedded in the Masses and the Energy which does not originate from Masses, in the Universe, is conserved, because Mass is a form of Energy, and can be converted to pure Energy, as Energy, can be converted back to Mass.

Thus, why the Electric Charge can be let to disappear? Why the science of Physics allows a basic building block of materials, the Electric Charge, to just disappear, while the other basic building block of materials, the Mass, never disappears?

Thus, the Electric Charge disappearance *seems* like a paradox.

The following refers now to the paradox embedded in the Pair Production process:

In the Pair Production process, a Photon, in certain conditions, converts into an Electron and a Positron.

Similarly, to the above, because the Electric Charge is not recognized (yet) as a form of Energy, according to the Energy Conservation Principle, *all* the Energy embedded in the Photon, which converted into an Electron and a Positron, in a Pair Production process, must be embedded only in the *Masses* of the created Electron and Positron.

The above implies that the Electric Charges embedded in the created Electron and the created Positron were created out of nothing.

How the science of Physics can allow, that a basic building block of materials (the Electric Charge) be created out of nothing, while the other basic building block of materials (the Mass) is never allowed to be created out of nothing?

Thus, that creation of Electric Charges, in a process of a Pair Production, also *seems* like a clear paradox.

The new Energy Pairs Theory resolves also the above-described paradoxes.

The new Energy Pairs Theory states that in the Mutual Annihilation process, the Electric Charges did not disappear. They were converted into Untraceable or Dark Energy, and stored in Space, as Photons, which embed Dark Energies (originating from the Electric Charges that *seemed* to disappear), in addition to Traceable Energies (originating from the Masses of the Electron and the Positron that converted to Photons).

The above explanation, of how the new Energy Pairs Theory resolves the paradox embedded in the Mutual Annihilation process, is similar, to how the Energy Pairs Theory resolved the paradox embedded in the creation of the Null Electromagnetic Wave, in which Energy *seemed* to disappear, because the Energy Pairs embedded in the creation of the Null Electromagnetic Wave, in which Energy *seemed* to disappear, were converted into Untraceable or Dark Energies, and stored in Space, as Photons that embed only Dark Energies.

The new Energy Pairs Theory also states, that in a Pair Production process, Electric Charges are not created out of nothing. The new Energy Pairs Theory states, that in a Pair Production process, Untraceable or Dark Energy embedded in the Photon, which converted into an Electron and a Positron, converted into the Electric Charges embedded in the created Electron and Positron.

The above explanation, of how the new Energy Pairs Theory resolves the paradox embedded in the Pair Production process, is similar, to how the Energy Pairs Theory resolved the paradox, in which Energy *seemed* to be created out of nothing, in the consolidations of Electromagnetic Waves, from separate sources, when the Electromagnetic Waves were in phase, when they met and consolidated.

Because in the scenario of consolidating Electromagnetic Waves, from separate sources, when the Electromagnetic Waves were in phase, and Energy *seemed* to be created out of nothing, the new Energy Pairs Theory stated that Dark Energy embedded in Photons, in the consolidating Electromagnetic Waves, converted back into Traceable Energy, in the creation of the resultant Electromagnetic Wave, that *seems* to embed more Energy as compared to the combined Energies embedded in the Electromagnetic Waves which created it.

Thus, the new Energy Pairs Theory states that Electric Charges can be converted into Dark Energy, and that Dark Energy can be converted back to Electric Charges, similarly to what is already recognized and accepted, by the science of Physics today, that Mass can be converted to Energy, and Energy can be converted back to Mass.

Thus, the above implies that Electric Charges are also forms of Energy.

But Mass is always Positive and Electric Charges can be Positive or Negative.

It should be also noted that the Science of Physics does contain a Charge Conservation Principle, which states that the amount of all the Positive Electric Charges in the Universe, must be equal to the amount of all the Negative Electric Charges in the Universe.

It was already presented above, that the Science of Physics today states, that any amount of Mass can be converted to Energy, and any amount of Energy can be converted back to Mass. But, from the Charge Conservation Principle presented above also follows, that Electric Charges can be converted only to Dark Energy, and an amount of Positive Electric Charge can convert to Dark Energy only with an exact same amount of Negative Electric Charge, to keep the amount of all the Positive Electric Charges in the Universe, equal to the amount of all the Negative Electric Charges in the Universe.

Also, from the Charge Conservation Principle presented above also follows, that only Dark Energy can convert back to Electric Charges, but only into a pair of Positive and Negative Electric Charges, where the amount of the Positive Electric Charge created equals exactly the amount of the Negative Electric Charge created, to keep the amount of all the Positive Electric Charges in the Universe, equal to the amount of all the Negative Electric Charges in the Universe.

But still, although Mass can convert to regular Traceable Energy, and Electric Charge can convert only into Dark Energy, Electric Charge must still be recognized as a form of Energy, because Dark Energy is still Energy.

The recognition of the Electric Charge, as a form of Energy, presented above, can be also seen, as an expansion of the Energy Conservation Principle, to include in it the Electric Charge entity, as the Energy Conservation Principle was expanded when the entity of Mass was included into it.

Thus, the new Energy Pairs Theory was shown to resolve also the paradoxes embedded in the Mutual Annihilation and the Pair Production processes, which also resulted in the statement that the Electric Charge is also a form of Energy, similarly to Mass being already recognized as a form of Energy, following the introduction of Einstein's Special Relativity Theory.

4. Electromagnetism might be the source of most of the Dark Energy

The new Energy Pairs Theory presented above provided a resolution for the paradoxes presented in scenarios of consolidations of Electromagnetic Waves from separate sources, and provided the following conclusions:

1. Electromagnetism might be the source of at least part of the mysterious Dark Energy.
2. Electric Charge is also a form of Energy.
3. Space is also just an ingredient (or facet) of a form of Energy.

However, the paper [11], published also by the author of this paper, provide argumentations which imply that Electromagnetism might be the source of *most* of the mysterious Dark Energy. These argumentations are based on the following observation:

The way that the nowadays Science of Physics refer to, or treat, Energy Fields, including the Electric or Magnetic Fields in Space, embed an intrinsic peculiarity (or paradox), and a similar situation applies to the way the nowadays Science of Physics refer to, or treat, the Gravitational Field in Space, and this can be presented via the following argumentation:

On one hand, the nowadays Science of Physics recognizes that an Electric (or Magnetic) Field in Space is generated by Electric Charges, and such Fields embed Energy.

The papers [12], [13] state that the Energy density embedded in such Fields, at each point in Space, is recognized as being proportional to the square of the Intensity of the Electric (or Magnetic, or Gravitational) Field at these points in Space.

Thus, if an Electric Charge (for example, a positive Electric Charge) is the cause of the creation of the Electric Field that surrounds it, and that Electric Fields embeds Energy density, then, if another Electric Charge (for example, a negative Electric Charge) affects a point in Space by inducing into that point its Energy such that it reduces the Intensity of the Electric Field that the positive Electric Charge induced in that point in Space, then, because Energies are not supposed to be annihilated, then, from the above it should be concluded that, although the Intensity of the Electric Field in that point in Space is reduced, the Energy densities induced in that point in Space by both, the positive and the negative Electric Charges, should not be reduced.

On the other hand, the nowadays Science of Physics does assume that in the above-described scenario, the Energy density in the above-mentioned point in Space is equal *only* to the square of the Intensity of the *net* (reduced) Electric Field at that point in Space, which seems like a violation of the Energy conservation Principle, because part of the more Intense Energy density induced in that point in Space (for example, by the positive Electric Charge), and all the less Intense Energy density induced in that point in Space (for

example, by the negative Electric Charge) were annihilated, because the negative Electric Charge reduced the Intensity of the Electric Field in that point in Space.

Paper [11], published by the author of this paper, refers, or treats the Electric (or Magnetic) Fields in Space differently.

It assumes that Space embeds *all* the Energies that *all* the Electric Charges in the Universe induce at each point in Space. Thus, in situations in which parts (or all) of the Intensities of an Electric (or Magnetic) Fields in any point in Space were reduced, the Energy density in such a point in Space *is not* reduced. Instead, some of the Energy in such a point in Space turns into untraceable (or Dark) Energy. The above eliminates the violation of the Energy Conservation Principle caused by the way the nowadays Science of Physics treats the Electric (or Magnetic) Fields in Space, and eliminates the peculiarity presented above.

Thus, in view of the discussion presented above, the paper [11] presents a paradox, like the paradox described already in scenarios of consolidations of Electromagnetic Waves from separate sources, because it presents that that Electric (or Magnetic) Fields in Space always annihilate each other, which *seems* like a violation of the Energy Conservation Principle.

Based on the above, the paper [11], uses the novel Energy Pairs Theory introduced in the paper [2], to explain this paradox, and the paper concludes that Space itself is also a form of Energy, that contains continuously, and at each point of it, Traceable and Untraceable Energies, which implies that *most* of the Untraceable (Dark) Energy, is of Electromagnetic origin.

That paper [11], also calculates the total amount of the Dark Energy in Space and concludes that the Energy embedded in the Dark Energy in Space is about two thirds of the total Energy in the Universe, which complies with the acceptable agreement about the amount of Energy embedded in the Dark Energy in the Universe.

Thus, from the above follows that the paper [11] implies that the Dark Energy which originates from Electromagnetism might be *most* of the Dark Energy in the Universe.

It was already mentioned before, that although the nature and origin of the Dark Energy is still a mystery, the acceptable notion held, by the science of Physics today, is that the Dark Energy relates to Gravitation, and must be looked for, using Einstein's General Relativity Theory.

This paper does not discard the possibility that parts of the Dark Energy might be related to Gravitation, because there are similarities between the Mass and the Electric Charge entities such as:

1. The identical structures between Newton's Universal Gravitational Law and Coulomb's Law.
2. Gravitation embeds the entity of Gravitational Waves which is analogous to the Electromagnetic Waves.
3. Analogous to the detection of Magnetism by a spectator external to a moving Electric Charge, a spectator external to a Mass moving at a constant velocity sees a phenomenon denoted as Gravitational Electromagnetism (GEM) [14], which is the analogy of Electrical Magnetism in Gravitation.

All the above-described similarities, between the Mass and the Electric Charge entities implies that like the prediction presented, that parts of the Dark Energy originate from Electromagnetism, parts of the Dark Energy, might originate also from Gravitation.

However, Electromagnetism is much more *potent* as compared to Gravitation, this can be demonstrated by the following:

The Gravitational Force between two 1-kg Mass Objects that are 1 meter apart is $6.67 \cdot 10^{-11}$ [15],

while the Attraction or Repulsion Force caused by the Coulomb's Law, between two 1 Coulomb Electrically Charged Bodies, held 1 meter apart, is

$9 \cdot 10^9$ Newtons [16].

The above clearly indicates that the Coulomb's Force might be more *potent*, as compared to the Gravitational Force, by a magnitude factor of $1.35 \cdot 10^{20}$!

Thus, the above might indicate that *most* of the Dark Energy originates from Electromagnetism, as this paper predicts.

5. The Energy Pairs Theory versus the Pointing Theorem

The new Energy Pairs Theory presented above provided a resolution regarding to the paradoxes that exist in scenarios of consolidations of Electromagnetic Waves from

separate sources, by providing an explanation which indicates that such scenarios also comply with the Energy Conservation Principle.

However, the nowadays Science of Physics already contains a theory which deals with the issue of compliance of scenarios relating to the Electromagnetism, with the Energy Conservation Principle.

That theorem is the Pointing Theorem.

Thus, it might be argued, that the new Energy Pairs Theory is not required.

However, the Pointing Theorem does not provide acceptable results in relation to Electromagnetic scenarios that do contain paradoxes, as presented already in this paper.

Although the Pointing Theorem does provide acceptable results as related to Electromagnetic scenarios that *do not* contain paradoxes, as presented already in this paper, it fails in explaining the paradoxes existing in Electromagnetic scenarios that *do* contain paradoxes, as presented already in this paper, because it assumes that Electromagnetism embeds only traceable Energies, and it does not take into consideration at all, the possible existence of untraceable (or Dark) Energies in some scenarios relating to Electromagnetism.

Thus, in view of the above, the new Energy Pairs Theory is required, because it complements the Pointing Theorem.

The Pointing Theorem is based on the following statement:

The time rate of change of Electromagnetic Energy within a specific volume V in Space, plus the net Energy flowing out of V through its surface area S per unit time, is equal to the negative of the total work done on the Electric Charges within V .

Thus, for a scenario to comply with what the Pointing Theorem states, its ingredients must contain a volume V which contains Electric Charges, and work done on these Electric Charges within this volume V .

However, the scenarios relating to consolidations of Electromagnetic Waves from separate sources, presented in this paper, do not contain Electric Charges or work done on Electric Charges.

If the volume V , mentioned above, is defined as a volume that contains only the half transparent mirror described in the experiment proposed in the paper [2], then, because half transparent mirrors are Electrically neutral devices, no work is done on Electric Charges in such a volume and also there is no time rate of change of Electromagnetic Energy within such a volume, apart from the Energies embedded in the two Electromagnetic Waves that meet on this half transparent mirror, as already presented in this paper.

Thus, from the Pointing Theorem follows, that the net Energy flowing out of that volume through its surface area S per unit time must be also zero.

If in the experiment proposed in the paper [2] the half transparent mirror is *not* tilted at exactly 45 degrees, as presented in the paper [2], then, in such a case, the two Electromagnetic Waves do not consolidate, and the Energies embedded in the two Electromagnetic Waves which enter the volume are equal to the Energies of the two Electromagnetic Waves that exit the volume, which implies that the net Energy flowing out of that volume through its surface area S per unit time is indeed zero, as the Pointing Theorem predicts.

However, if in the experiment proposed in the paper [2] the half transparent mirror *is* tilted at exactly 45 degrees, as presented in the paper [2], then, in such a case, the two Electromagnetic Waves **do** consolidate completely into a Null Electromagnetic Wave which *seem* to embed no Energy at all, when it leaves the half transparent mirror.

Thus, in that case, the net Energy flowing out of that volume through its surface area S per unit time *seems to be not* zero, because the two Electromagnetic Waves which embed Energies, in this scenario, enter this volume, but no Energy *seems* to exit from this volume.

The new Energy Pairs Theory complements, in such a scenario, the result provided by the Pointing Theorem, by stating that the Null Electromagnetic Wave created, which leaves the volume, does contain the exact amount of Energy that enters this volume, but the Energy that exits the volume is untraceable (or Dark) Energy.

Thus, the new Energy Pairs Theory was required in that case, to complement the result provided by the Pointing Theorem, and to present that also in this scenario, which contains consolidations of Electromagnetic Waves from separate sources, the Energy Conservation Principle is still *not* violated.

About the author

This book was written by Moshe Segal.

Moshe Segal's address is: Ravutzky st. #78 Ra'anana ISRAEL 4322141.

Email addresses: moshe_segal@yahoo.com,

leasegalster@gmail.com,

mirch0@walla.com.

Moshe has a B.Sc Graduated with distinction (Cum Laude) and a M.Sc in Electronics and Electrical Engineering from the Technion, Haifa, Israel.

Some of the papers published by Moshe Segal and presented also in the references section of this book bellow can be also found in the open e-Print archive viXra.org.

Please also note that the paper referenced in reference [2] bellow, whose title is: "Energy Analysis of a Null Electromagnetic Wave" was also written by Moshe Segal and was also inserted in the open e-Print archive viXra.org.

That paper was also published by Physics Tomorrow Letters (PTL) in the Theoretical Physics Journal. The link to that publication is:

https://2edd239a-21aa-41cc-a45e-84832f36b982.filesusr.com/ugd/04176b_f8d75fc7c61d455d8bda102055d6b92d.pdf

Please also note that that paper is under PTL copyright and consent form, signed by the author Moshe Segal with PTL.

Please also note that the paper referenced in reference [11] bellow, whose title is: "The Nature of Space and Dark Energy, Based on Electric and Magnetic Fields' Behavior in Space in the Energy Pairs Theory Framework" was also written by Moshe Segal and was also inserted in the open e-Print archive viXra.org.

That paper was also published by Physics Tomorrow Letters (PTL) in the Theoretical Physics Journal. The link to that publication is:

https://2edd239a-21aa-41cc-a45e-84832f36b982.filesusr.com/ugd/04176b_5e77c3b53281421290d97119d0b90052.pdf

Please also note that that paper is under PTL copyright and consent form, signed by the author Moshe Segal with PTL.

Please also note that the paper referenced in reference [5] bellow, whose title is: "Consolidating Electromagnetic Waves from Separate Sources" was also written by Moshe Segal and was also inserted in the open e-Print archive viXra.org.

That paper was also published by AIRCC Publishing Corporation. The link to that publication is:

<https://wireilla.com/engg/eeej/papers/11222elelij01.pdf>

Please also note that that paper is under AIRCC Publishing Corporation copyright and consent form, signed by the author Moshe Segal with AIRCC Publishing Corporation.

Please also note that the paper referenced in reference [6] below, whose title is: "The Energy Pairs Theory" was also written by Moshe Segal and was also inserted in the open e-Print archive viXra.org.

That paper was also published by AIRCC Publishing Corporation. The link to that publication is:

<https://airccse.com/eeij/papers/9222eeij01.pdf>

Please also note that that paper is under AIRCC Publishing Corporation copyright and consent form, signed by the author Moshe Segal with AIRCC Publishing Corporation.

References

- [1] Does Destructive Interference Destroy Energy? Kirk T. McDonald Joseph Henry Laboratories, Princeton University <http://kirkmcd.princeton.edu/examples/destructive.pdf>
- [2] Energy Analysis of a Null Electromagnetic Wave, Moshe Segal, Theoretical Physics Letters (PTL). https://2edd239a-21aa-41cc-a45e-84832f36b982.filesusr.com/ugd/04176b_f8d75fc7c61d455d8bda102055d6b92d.pdf
- [3] A Discussion relating to the feasibility of a Null Electromagnetic Wave. Moshe Segal. Academia Letters, Article 3600. <https://doi.org/10.20935/AL3600>
- [4] Consolidating Electromagnetic Waves might embed more traceable Energy than the combined traceable Energies embedded in the waves before consolidation. Moshe Segal. Academia Letters, Article 3768. <https://doi.org/10.20935/AL3768>
- [5] Consolidating Electromagnetic Waves from separate sources. Moshe Segal. <https://wireilla.com/engg/eeij/papers/11222elelij01.pdf>
- [6] The Energy Pairs Theory. Moshe Segal. Electrical Engineering: An International Journal (EEIJ) vol. 9, No. 1/2, June 2022. <https://airccse.com/eeij/papers/9222eeij01.pdf>
- [7] Electromagnetic radiation. Wikipedia. [Electromagnetic radiation - Wikipedia](#)
- [8] Einstein: Ether and Relativity. http://mathshistory.st-andrews.ac.uk/Extras/Einstein_ether.html
- [9] Electron-Positron annihilation. Wikipedia.

https://en.wikipedia.org/wiki/Electron%E2%80%93positron_annihilation

[10] Pair Production. Physics.

<https://www.britannica.com/science/pair-production>

[11] The Nature of Space and Dark Energy, Based on Electric and Magnetic Fields' Behavior in Space, in the Energy Pairs Theory Framework, Moshe Segal, Theoretical Physics Letters (PTL).

https://2edd239a-21aa-41cc-a45e84832f36b982.filesusr.com/ugd/04176b_5e77c3b53281421290d97119d0b90052.pdf

[12] Field Energy.

<http://labman.phys.utk.edu/phys222core/modules/m6/field%20energy.html#:~:text=U%20%3D%20%CE%B5E2,volume%2C%20in%20the%20electric%20field>

[13] A Possible Scalar Term Describing Energy Density in the Gravitational Field.

https://www.grc.nasa.gov/WWW/k-12/Numbers/Math/Mathematical_Thinking/possible_scalar_terms.htm

[14] Gravitational Electromagnetism. Wikipedia.
<https://en.wikipedia.org/wiki/Gravitoelectromagnetism>

[15] Attraction Force Between two 1 kg Mass Bodies 1 meter Apart. ER. services. University Physics Volume 1.

[13.1 Newton's Law of Universal Gravitation | University Physics Volume 1 \(lumenlearning.com\)](https://lumenlearning.com/13.1-Newton's-Law-of-Universal-Gravitation)

[16] Attraction Force Between two 1 Coulombs Charges 1 meter Apart. The Physics Classroom.

[Physics Tutorial: Coulomb's Law \(physicsclassroom.com\)](https://www.physicsclassroom.com/Physics-Tutorial-Coulomb's-Law)