

# **A discussion relating to the feasibility of a Null Electromagnetic**

## **Wave**

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### **Abstract**

This article presents the statement that a Null Electromagnetic (EM) Wave, which is a propagating EM wave which contains no Electric or Magnetic fields at all, can be feasible. The common existing notion held by physicists is that such a Null EM wave does not exist. The article reviews the existing acceptable notions that such a Null EM wave is a fiction which does not really exist and provides arguments to the contrary. The author of this paper published an article [1], which describes how such a Null EM wave can be implemented and analyses it. The discussion relating to the feasibility of such a Null EM wave is an important discussion, because if such a Null EM wave can be feasible, surprising, and significant conclusions are derived.

### **1. Introduction**

The common acceptable notion held by physicist is that a Null Electromagnetic (EM) Wave, which is a propagating EM wave which contains no Electric or Magnetic fields at all, is a fiction. An example to this notion might be the Article: "Does Destructive Interference Destroy Energy?" By Kirk T. McDonald [2], which states: "it appears that the trivial case of a null wave (with zero energy) is often mistakenly described as an example of destructive interference of two waves moving with opposite amplitudes (but the same energies) in the same direction, which has led to the misimpression that destructive interference can destroy energy.", and "We can write  $0 = \sin(kx - \omega t) - \sin(kx - \omega t)$ , but this mathematical identity does not have the physical implication that two distinct waves are present, each with nonzero energy". That article discusses the issue of conservation of Energy in any EM interference and does not include in that discussion the above-mentioned Null EM wave, because it states that "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, such that wave interference is not a relevant concept here."

However, contrary to the above statement by Kirk T. McDonald's [2], the author of this article published an article titled: "Energy Analysis of a Null Electromagnetic Wave" [1], which presents an astonishing, surprising scenario in which such a Null EM wave can be implemented. In that scenario two EM waves, from two separate sources, meet over a half transparent mirror, combine, and, in certain suitable conditions, continue to travel together as a Null EM wave, which also implies that the original two EM waves disappear. This is clearly contradictory to the statement in Kirk T. McDonald's article [2] that "A one-dimensional wave moving in one direction can have only one source". The article mentioned above [1], also analyses the implications of this scenario, from which surprising conclusions are derived, relating to unresolved issues in the scenario of a "Mutual Annihilation" in which an Electron and a Positron annihilate each other to create photons, and in the inverse scenario of a "Pair Creation" in which colliding photons create an Electron and a Positron. It also provides surprising new insights and conclusions relating to the Nature of the Electric Charges, and a possible alternate explanation to the mysterious Dark Energy. An article published recently over the media titled: "Colliding photons were spotted making matter. But are the photons 'real'?" [3], describes a "pair Production" experiment, in which colliding photon create Matter, which might support the above-described surprising conclusions brought about by the article mentioned above [1].

Thus, because the conclusions derived in the above-mentioned article [1] are new and significant, it is important to discuss the issue if a Null EM wave can really exist.

### **2. Arguments that a Null EM wave is a fiction**

The Theory that usually covers the issues of Energy Conservation related to Electromagnetic constellations is the Poynting Theorem [4] which states that: "The rate of energy transfer (per unit volume) from a region of space equals the rate of work done on a charge distribution plus the energy flux leaving that region".

This theorem assumes, that in any Electromagnetic Constellation all the Energies involved are conserved and are Detectable Energies.

Thus, in a constellation as described in the above-mentioned article [1], in which two EM waves, from separate sources, meet on a half transparent mirror, combine, and create a Null EM wave, because that Null EM wave does not have Electric and Magnetic Fields at all, and thus, its Energy **seems** to disappear, this contradicts the Poynting Theorem, which implies that such a Null EM wave cannot be created.

Even though the above-mentioned article [1] concludes that the Energy of that Null EM wave did not disappear, and it still exists as untraceable Energy in the Null EM wave photons, which might convert back, in certain conditions, to traceable Energy, since this is an untraceable and not a traceable Energy, it still contradicts the Poynting Theory, which implies that such a Null EM wave cannot be created.

### 3. Arguments that a Null EM wave can be created

The above-mentioned article [1], describes in detail the scenario of creating a Null EM wave. In this description two EM waves from two separate sources, meet on a half transparent mirror, combine, and continue to travel together as a Null EM wave. One wave comes from the transparent side of the half transparent mirror, thus it passes the half transparent mirror. The second wave comes from another direction, such that it is deflected by the deflecting side of the half transparent mirror, and in certain suitable conditions, the two waves combine to one travelling Null EM wave.

If that scenario is broken into two separate scenarios and is described as a combination of these two separate scenarios, one containing only the EM wave that passes the mirror and the other only the EM wave that hits the deflecting side of the mirror, then no Null EM waves are created, the Poynting Theorem is not violated, and it is agreed that each of these two separate scenarios does occur.

Thus, since the described constellation is a linear constellation, from the Superposition Principle [5] which states that “for all linear systems, the net response caused by two or more stimuli is the sum of the responses that would have been caused by each stimulus individually” it turns out that the combinations of the results of the above-described two separate scenarios, would indeed produce a Null EM wave.

In addition to the above, although the Poynting Theorem is the theorem that is used to cover issues of Energy Conservation related to Electromagnetic constellations, also issues which **seem** to contain Energy losses, such as some destructive interferences [2], because this theorem is based **a priori** on a statement in which Energies are assumed **a priori** as being **always** conserved as **detectable** energies, it might not be a suitable tool to analyze scenarios in which Energies might be conserved, but not as detectable energies, as in the scenario of the creation of the above-mentioned Null EM wave. Thus, the acceptable notions among physicists that a Null EM wave is a fiction because it contradicts the Poynting Theorem might not be correct, after all.

### 4. Summary and Conclusions

The above-mentioned article [1] describes a creation of a Null EM wave, and, as such, proposes a lab experimental constellation how such a Null EM wave might be implemented. This article argues that the common notion among physicists, that such a Null EM wave is a fiction, should be put to the test by implementing such a lab constellation, and trying to create such a Null EM wave. This argument is based on argumentation provided by this article that such a Null wave can be implemented, and it is not a fiction, after all. The discussion related to this issue is also important because the above-described article [1] also arrives at new and significant conclusions if such a Null wave is created and analysed.

### References

[1] Energy Analysis of a Null Electromagnetic Wave. Moshe Segal. Theoretical Physics Journal by Physics Tomorrow Letters (PTL).  
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[2] Does Destructive Interference Destroy Energy? Kirk T. McDonald Joseph Henry Laboratories, Princeton University. <http://www.physics.princeton.edu/~mcdonald/examples/destructive.pdf>

[3] Colliding photons were spotted making matter. But are the photons 'real'?

<https://www.sciencenews.org/article/colliding-photons-matter-particle-physics>

[4] Poynting's Theorem [https://en.wikipedia.org/wiki/Poynting%27s\\_theorem](https://en.wikipedia.org/wiki/Poynting%27s_theorem)

[5] Superpositions principle [https://en.wikipedia.org/wiki/Superposition\\_principle](https://en.wikipedia.org/wiki/Superposition_principle)

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