Photon models are derived by solving a bug in Poynting and Maxwell theory

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Abstract

It is found that the Poynting theorem is conflict with the energy conservation principle. It is a bug of the Poynting theorem. The Poynting theorem is derived from Maxwell equations by using the superimposition principle of the fields. Hence, this bug also existed at ether in superimposition principle or in the Maxwell equations. Assume it is wrong with the field superimposition, even the Maxwell equations is correct with singular charge, we can still not prove it still correct for many charges. Hence, at least something also wrong with Maxwell equations. The Poynting theorem is corrected in this article. After the correction the energy is not quadratic and hence the field is also not linear. The concept of the superposition of fields need also to be corrected. Hence the new definitions for the inner product and cross product are proposed. The corrected Poynting theorem is the mutual energy theorem. It is shown that starting from the mutual energy theorem, the whole electromagnetic theory can be reconstructed. The Maxwell equations can be proved from the mutual energy theorem by adding pseudo items. Hence if the mutual energy theorem is corrected, the Maxwell equations still can be applied with knowing its problem. Most the problems originally caused by Maxwell equations are solved. Examples of this problems are: (1) zero field infinity which need to be re-normalized in quantum physics; (2) collapse of the electromagnetic field, the waves has to be collapsed to its absorber, otherwise the energy is not conserved; (3) the emitter can send energy without absorber, this is conflict to the direct interaction principle and absorber theory; (4) if our universe is not completely opaque, a electron can continually send energy to the outside of our universe, however there is no testimony supporting that our universe is opaque. The new theory support the exist of advanced wave, hence also strongly support the absorber theory and transactional interpretation of quantum physics. It can offer a equation for photon and a good explanation for the duality of the photon. If photon and electromagnetic field obeys the mutual energy theorem, it is very possible that all other quanta also obey their similar mutual energy theorem. Hence the mutual energy theorem can be applied as a principle for the electromagnetic theory and quantum physics. According to this theory the retarded wave and advanced wave of electromagnetic fields both are

a ability or probability wave, which is also partly agree with Copenhagen interpretation.

1 Introduction

In this article when speak about Maxwell equations, we will explicitly distinguish the two different situations, the first is the Maxwell equations for N (many) charges and the second situation Maxwell equations is only for a singular charge. The first is written as MEQN, the second is written as MEQS. If electromagnetic fields can be superimposed, It is easy from MEQS to prove MEQN. Hence we do not need to distinguish this two concepts, however in this article we will question the superimposition principle, hence we have to distinguish this two situations.

We all know that there is some problem in electromagnetic field theory, especially when it is applied to quantum physics. The examples are (1) zero field infinity which need to be re-normalized in quantum physics; (2) collapse of the electromagnetic wave, the wave has to be collapsed to the absorber so that the energy sends out by the emitter can be all received by absorber; (3) the emitter can send energy without absorber. (4) A electron can continually sends energy to the outside of our universe. According MEQN, the antenna can sends wireless energy even without anything to receive this energy. These all have no problem for electronic engineering, but it is a big problem for physics. If wave can continually send to outside of the system with all charges in our universe, our universe will continually loss the energy. This fact has been known for a long time. Schwarzschild, Tetrode and Fokker derived the theory of action at a distance, it is also referred as direct interaction[?, ?, ?]. From this principle all action and reaction can only take place between two charges. There is no field exist freely independent to the charge. Dirac has applied advanced wave to explain the force of a moving charge[?]. Wheeler and Feynman, designed the absorber theory in which the electron does not only sends retarded waves to the future but also sends advanced wave to the past [?]. Wheeler and Feynman also introduced the concept of the adjunct field[?]. Wheeler and Feynman has clearly point out there is problem in MEQN, but they did not point in details where the problem is and how to revises it. Instead they derived the MEQS from their adjunct field, it is seem even there is problem in MEQS but no thing can replace it.

In the field of electromagnetic field theory, W.J. Welch has introduced time-domain reciprocity theorem[?] in 1960. In 1987 the author has introduced the mutual energy theorem [?, ?, ?]. This is strongly influenced by J. A. Kong's book[?, ?]. In 2014 the author wrote the online publication discussed the relationship between the reciprocity theorem, the mutual energy theorem and the Poynting theorem[?]. Among this work, the author noticed the book of Lawrence Stephenson[?] and read it with great interesting especially the topic about the advanced potential. Afterwords the author begin search the publications about advanced potential or advanced waves, and noticed the absorber

theory of Wheeler and Feynman[?, ?, ?] and John Cramer's transactional interpretation for quantum physics [?, ?]. After read this publications, the author begin to work at building a photo model with classical electromagnetic filed theory[?, ?].

Recently, the author compared the power of a system with N charges to the power calculate by Poynting theorem, found that the Poynting theory has offers more power than the system of N charges should be. If we take away all self energy items from Poynting theorem, it can obtained exactly the same as the power of the system with N charges. From this we obtained the conclusion, there is a bug in Poynting theorem, which should be corrected. The correction can be done simply by taken away all self energy items. After this correction, the Poynting theorem become the mutual energy theorem[?, ?, ?, ?]. Since Poynting theorem is derived from MEQN. MEQN is derived through the superimposition principle of the field and MEQS, if Poynting theorem has bug, this bug is also exist inside ether superimposition or the MEQS. The mutual energy theorem can be also derived from MEQS. But even so, if MEQS have bugs inside, it is possible that the mutual energy theorem is still correct.

When we take away of self energy items form the Poynting theorem, the energy expressed in the Poynting theorem is not quadratic any more, if the energy is not quadratic the field is also not linear. Hence the superimposition principle fails.

This means that even if MEQS is correct, we still cannot derive MEQN, because we have no the principle of the superposition of the fields. Hence we reconstructed the whole electromagnetic theory from the mutual energy theorem[?, ?, ?, ?]. And re-derive the Photon model.

The mutual energy theorem agrees with direct interaction principle and absorber theory, hence the retarded wave and advanced wave of the photon, are not a real wave which can exist independent to the emitter and the absorber. It is adjunct field, hence in principle they can bee seen as probability waves. However the mutual energy current is real in physics, which happens when the retarded wave and advanced wave just synchronized. This synchronized two waves can be seen as the transactional process described by John Crammer. If there is only one wave for example retarded wave, there is no any advanced wave to synchronize to it, it perhaps return to it's source and hence in principle this wave can been seen as probability wave which is also agree with Copenhagen interpretation in quantum physics.

2 Find bug in Poynting theorem and MEQN

2.1 Power of a system with N charges

If the charge move and has the speed $\overrightarrow{v}_i$, where i is the index of the charge, we know the power which of singular charge is,

$$P(\overrightarrow{x}_i) = \overrightarrow{F}(\overrightarrow{x}_i) \cdot \overrightarrow{v}_i \tag{1}$$

$\overrightarrow{x}_i$ is the position of the charge. $\overrightarrow{F}(\overrightarrow{x}_i)$ is Coulomb's force on i-th charge, which can be given as following,

$$\overrightarrow{F}(\overrightarrow{x}_i) = \sum_{j=1, j\neq i}^{N} \frac{q_i q_j}{4\pi\epsilon_0} \frac{(\overrightarrow{x}_i - \overrightarrow{x}_j)}{||\overrightarrow{x}_i - \overrightarrow{x}_j||^3} \tag{2}$$

where q_i or q_j is amount of charge at the place $\overrightarrow{x}_i$ or $\overrightarrow{x}_j$, write,

$$E(\overrightarrow{x}_j, \overrightarrow{x}_i) = \frac{q_j}{4\pi\epsilon_0} \frac{(\overrightarrow{x}_i - \overrightarrow{x}_j)}{||\overrightarrow{x}_i - \overrightarrow{x}_j||^3} \tag{3}$$

which is the electric field of charge q_j to q_i. Hence, we have

$$\overrightarrow{F}(\overrightarrow{x}_i) = q_i \overrightarrow{E}(\overrightarrow{x}_i) \tag{4}$$

$$P(\overrightarrow{x}_i) = q_i \overrightarrow{E}(\overrightarrow{x}_i) \cdot \overrightarrow{v}_i \tag{5}$$

Hence the power of the whole system with N charges is,

$$\begin{aligned} P &= \sum_{i=1}^{N} P_i = \sum_{i=1}^{N} \overrightarrow{E}(\overrightarrow{x}_i) \cdot (q_i \overrightarrow{v}_i) \\ &= \sum_{i=1}^{N} \sum_{j=1, j\neq i}^{N} \overrightarrow{E}(\overrightarrow{x}_j, \overrightarrow{x}_i) \cdot \overrightarrow{J}_i \end{aligned} \tag{6}$$

Where

$$\overrightarrow{J}_i = q_i \overrightarrow{v}_i \tag{7}$$

where $\overrightarrow{J}_i$ is the current of charge q_i. We find when we calculate power, we have used the following summation.

$$\sum_{i=1}^{N} \sum_{j=1, j\neq i}^{N} \tag{8}$$

2.2 The Poynting theorem of N charges

According to the traditional electromagnetic field theory, The Poynting theorem is give as following,

$$-\nabla \cdot (\overrightarrow{E} \times \overrightarrow{H}) = \overrightarrow{E} \cdot \overrightarrow{J} + (\overrightarrow{E} \cdot \partial\overrightarrow{D} + \overrightarrow{H} \cdot \partial\overrightarrow{B}) \tag{9}$$

According to the traditional definition, the electromagnetic field is,

$$\overrightarrow{E} = \overrightarrow{E}_1 + \cdots + \overrightarrow{E}_i + \cdots + \overrightarrow{E}_N \tag{10}$$

$$\overrightarrow{H} = \overrightarrow{H}_1 + \cdots + \overrightarrow{H}_i + \cdots + \overrightarrow{H}_N \tag{11}$$

Hence, we have

$$-\nabla\cdot(\sum_{j=1}^{N}\sum_{i=1}^{N}\overrightarrow{E}_i\times\overrightarrow{H}_j)=\sum_{j=1}^{N}\sum_{i=1}^{N}(\overrightarrow{E}_i\cdot\overrightarrow{J}_j)$$

$$+\sum_{j=1}^{N}\sum_{i=1}^{N}(\overrightarrow{E}_i\cdot\partial\overrightarrow{D}_j+\overrightarrow{H}_i\cdot\partial\overrightarrow{B}_j) \tag{12}$$

2.3 The bug in Poynting theorem and MEQN

In the subsection 2.1 we have seen the summation Eq.(8). But it is not used in the Poynting theorem of N-charge system. Using the summation in Eq.(8) to replace the original summation in Eq.(12) we obtain,

$$-\nabla\cdot(\sum_{i=1}^{N}\sum_{j=1,j\neq i}^{N}\overrightarrow{E}_i\times\overrightarrow{H}_j)=\sum_{i=1}^{N}\sum_{j=1,j\neq i}^{N}(\overrightarrow{E}_i\cdot\overrightarrow{J}_j)$$

$$+\sum_{i=1}^{N}\sum_{j=1,j\neq i}^{N}(\overrightarrow{E}_i\cdot\partial\overrightarrow{D}_j+\overrightarrow{H}_i\cdot\partial\overrightarrow{B}_j) \tag{13}$$

or

$$-\oiint_{\Gamma}(\sum_{i=1}^{N}\sum_{j=1,j\neq i}^{N}\overrightarrow{E}_i\times\overrightarrow{H}_j)\cdot\hat{n}d\Gamma$$

$$=\iiint_{V}\sum_{i=1}^{N}\sum_{j=1,j\neq i}^{N}(\overrightarrow{E}_i\cdot\overrightarrow{J}_j)dV$$

$$\iiint_{V}\sum_{i=1}^{N}\sum_{j=1,j\neq i}^{N}(\overrightarrow{E}_i\cdot\partial\overrightarrow{D}_j+\overrightarrow{H}_i\cdot\partial\overrightarrow{B}_j)dV \tag{14}$$

It is the rest items of Poynting theorem if all self items as following

$$-\oiint_{\Gamma}(\sum_{i=1}^{N}\overrightarrow{E}_i\times\overrightarrow{H}_i)\cdot\hat{n}d\Gamma=\iiint_{V}(\sum_{i=1}^{N}(\overrightarrow{E}_i\cdot\overrightarrow{J}_i)dV$$

$$\iiint_{V}(\sum_{i=1}^{N}(\overrightarrow{E}_i\cdot\partial\overrightarrow{D}_i+\overrightarrow{H}_i\cdot\partial\overrightarrow{B}_i)dV \tag{15}$$

are taken away. Eq.(14) is the mutual energy theorems[**?**, **?**, **?**, **?**]. This formula is correct in two ways. (1), it can be derived from MEQN or from Poynting theorem. If MEQN is correct this formula is also correct, it is easy to prove this. Because we take away all self items which also satisfy Poynting theorem

for a single charge. From the Poynting theorem of N charges take away all corresponding Poynting theorem for single charge, this guarantees the rest items still correct if Poynting theorem is correct. Since Poynting theorem can be derived from MEQN, the rest items also satisfy MEQN. (2) The second way to show this formula is correct because it satisfies also the "direct interaction" principle. The direction interaction principle actually tell us the action and reaction can only happens between two charges, there is no any action or reaction in space sends by singular charge. The direct interaction principle has been further developed to as the adjunct field theory of Wheeler and Feynman[?]. The mutual energy theorem Eq.(14) is agreed with the direct interaction theory and can be seen as a definition of the adjunct field.

2.4 Comparison of the Poynting theorem and the mutual energy theorem

In the following we compare the Poynting theorem Eq.(12) and the mutual energy theorem Eq.(14) and see which is more meaningful. The left side of Eq.(14) is,

$$\oiint_{\Gamma}(\sum_{i=1}^{N}\sum_{j=1,j\neq i}^{N}\overrightarrow{E}_i\times\overrightarrow{H}_j)\cdot\hat{n}d\Gamma \tag{16}$$

which is the power sends to outside of our space if Γ is big sphere contains our universe, it is the energy current send to outside of the universe, it should vanish. If there is only N charge in a empty space, there should no energy current go outside according to the direct interaction principle. We have know from the mutual energy theorem[?, ?] if photon's field either retarded field for the emitter or advanced field from absorber, the mutual energy current vanishes on the big sphere Γ, hence the left side of Eq.(14) vanishes. The second term in the right side of Eq.(14) is the system energy in the space. If started from some time there is no action or reaction to a end time there is also no action and reaction. The integral of this energy vanishes, i.e.,

$$\int_{t=-\infty}^{\infty}\iiint_{V}(\sum_{i=1}^{N}\sum_{j=1,j\neq i}^{N}(\overrightarrow{E}_i\cdot\partial\overrightarrow{D}_j+\overrightarrow{H}_i\cdot\partial\overrightarrow{B}_j)dVdt=0 \tag{17}$$

Substitute Eq.(16 and 17) to Eq.(13), we have the last term,

$$\int_{t=-\infty}^{\infty}\iiint_{V}\sum_{i=1}^{N}\sum_{j=1,j\neq i}^{N}(\overrightarrow{E}_i\cdot\overrightarrow{J}_j)dVdt=0 \tag{18}$$

This term also vanishes. The above formula tell us for the whole system, all energy is conserved. There is no any energy sends to outside of our universe. Hence this a corrected formula. The above formula vanishes means that Eq.(14) satisfy the direct interaction theory. The whole power of the system with all

charges same as the subsection 2.1. It is much meaning full comparing to the Poynting theorem Eq.(12) in which it has the items,

$$\iiint_V (\overrightarrow{E}_i \cdot \overrightarrow{J}_i) dV = \infty \tag{19}$$

Since if the charge is a point, there is $\overrightarrow{E}_i = \overrightarrow{E}(\overrightarrow{x}_i, \overrightarrow{x}) \to \infty$, if $\overrightarrow{x} \to \overrightarrow{x}_i$. It also has the items

$$-\oiint_\Gamma (\overrightarrow{E}_i \times \overrightarrow{H}_i) \cdot \hat{n} d\Gamma \neq 0 \tag{20}$$

The system always has some energy go to outside even where is empty space without other charges. If the system is our universe, it must be opaque to receive all energy. Up to now there is no any testimony that our universe is opaque. It is very strange. The following items in Poynting theorem,

$$\sum_{j=1}^{N} \sum_{i=1}^{N} (\overrightarrow{E}_i \cdot \overrightarrow{J}_j) \tag{21}$$

is not the power of the whole system. It is over estimated the system power. The problem of the Poynting theorem is the cause that a re-normalization process has to be done for quantum physics. This is a bug of the Poynting theorem with N charges. Poynting theorem is derived from MEQN. MEQN is derived from MEQS by apply the principle of superimposition principle. The bug in Poynting theorem is also a bug in either in superimposition principle or in MEQS. But up to know we have not found any problem with mutual energy theorem Eq.(14).

2.5 The confusion of the definition of the electromagnetic fields

Last subsection we have said, it is possible the superimposition principle has the problem. Now let us to see the concept of the field. Assume there are N charges in the system, we can calculate the electric field in the place $\overrightarrow{x}$,

$$\overrightarrow{E}(\overrightarrow{x}) = \sum_{j=1}^{N} \overrightarrow{E}(\overrightarrow{x}_j, \overrightarrow{x}) \tag{22}$$

where $\overrightarrow{x}_j$ is the position of the charge q_j, $\overrightarrow{E}(\overrightarrow{x}_j, \overrightarrow{x})$ is the charge q_j produced field in the position $\overrightarrow{x}$, this definition looks good. However if we need to know the field at a the position of any charges, we can write,

$$\overrightarrow{E}(\overrightarrow{x}_i) = \sum_{j=1, j\neq i}^{N} \overrightarrow{E}(\overrightarrow{x}_j, \overrightarrow{x}_i) + \overrightarrow{E}(\overrightarrow{x}_i, \overrightarrow{x}_i) \tag{23}$$

but

$$\overrightarrow{E}(\overrightarrow{x}_i, \overrightarrow{x}_i) = \infty \tag{24}$$

if the charge are a point charge. Hence we have to change the definition of the field as following,

$$\overrightarrow{E}(\overrightarrow{x}) = \begin{cases} \sum_{j=1}^{N} \overrightarrow{E}(\overrightarrow{x}_j, \overrightarrow{x}) & \overrightarrow{x} \notin I \\ \sum_{j=1, j\neq i}^{N} \overrightarrow{E}(\overrightarrow{x}_j, \overrightarrow{x}) & \overrightarrow{x} \in I \end{cases} \tag{25}$$

$I = 1, \cdots i \cdots N$, it is the set of the index of the charges. The above definition is also not very satisfy. Many people will ague that is this correct that the field is extended to the any position without a test charge? According to the principle of direct interaction, only the action and reaction force can be defined, hence the field can only be defined on the charge which is,

$$\overrightarrow{E}(\overrightarrow{x}) = \begin{cases} No\ difinition & \overrightarrow{x} \notin I \\ \sum_{j=1, j\neq i}^{N} \overrightarrow{E}(\overrightarrow{x}_j, \overrightarrow{x}) & \overrightarrow{x} \in I \end{cases} \tag{26}$$

Hence we have 3 version of the definition about the field, which is correct? The concept of field is very confuse. The magnetic field has the same problem we do not discuss it here.

The reason of this confusion is because that if we measure the field we need a test charge. But how can we prove if the test charge is removed the measured field is still there? According to the direct interaction principle, if the test charge is removed, the field can not be defined as a real physics property. It is only an ability to give a force to the charge, but it is not some thing with real with energy in space.

From this subsection we are clear that the concept of the field is very confuse, actually this means the superimposition principle has problem. There not exist this kind of linear fields which can be simply added together.

In the last few subsections we have said there is a bug in Poynting theorem. If the superimposition principle has problem, we do not mean that the theory of the MEQS need to be thoroughly throw away. Instead the whole theory of electromagnetic fields need to be carefully reconstructed. Since without superimposition principle even if MEQS is correct, the MEQN is still not guaranteed to be correct. We still need to prove MEQN. In the proof we have to point where the approximation is made. This way to allow the MEQN survival with a bug.

Without the superimposition principle, we can still define fields as a collection of all fields of their charges,

$$\overrightarrow{E}(\overrightarrow{x}) = [\overrightarrow{E}(\overrightarrow{x}_j, \overrightarrow{x}), \cdots E(\overrightarrow{x}_j, \overrightarrow{x}) \cdots] \tag{27}$$

or

$$\overrightarrow{E}(\overrightarrow{x}) = [\overrightarrow{E}_1 \cdots \overrightarrow{E}_j \cdots \overrightarrow{E}_N] \tag{28}$$

we have written $\overrightarrow{E}_j = \overrightarrow{E}(\overrightarrow{x}_j, \overrightarrow{x})$ for simplicity.

3 Reconstruction the electromagnetic field theory

3.1 Define the multiplication of fields

We have no the superimposition of the fields. We do not know how to "add" is really correct. However we still can re-define the cross and point multiplication "$\times$", "$\cdot$" by,

$$\overrightarrow{A} \cdot \overrightarrow{B} \equiv \sum_{i=1}^{N} \sum_{j=1, j\neq i}^{N} \overrightarrow{A}_j \cdot \overrightarrow{B}_i \tag{29}$$

$$\overrightarrow{A} \times \overrightarrow{B} \equiv \sum_{i=1}^{N} \sum_{j=1, j\neq i}^{N} \overrightarrow{A}_j \times \overrightarrow{B}_i \tag{30}$$

In the above formula the right side, $\overrightarrow{A}_j \cdot \overrightarrow{B}_i$ $\overrightarrow{A}_j \times \overrightarrow{B}_i$ is the traditional definition of point or cross multiplications for only two singular charges. In the left side is the cross and point multiplications for a system with N charges. In this way the mutual energy theorem Eq.(13) can be written as

$$-\nabla \cdot (\overrightarrow{E} \times \overrightarrow{H}) = \overrightarrow{E} \cdot \overrightarrow{J} + \overrightarrow{E} \cdot \partial \overrightarrow{D} + \overrightarrow{H} \cdot \partial \overrightarrow{B} \tag{31}$$

This looks like the Poynting theorem, according the new definitions of the point and cross multiplications, however, it is the mutual energy theorem.

3.2 Linearization of electromagnetic fields

MEQN and Poynting theorem has a bug, we cannot apply it as a principle, which theorem can be a replacement of the MEQN and MEQS? We choose the mutual energy theorem, the mutual energy theorem can be derive from MEQN does not mean if MEQN is wrong, the mutual energy theorem is also wrong. It only tells us if the mutual energy theorem is wrong then the MEQN is also wrong. We have point out that the mutual energy theorem agrees with the direct interaction principle and energy conservation principle, it should be a very good candidate to be upgraded as a principle instead as a theorem. The only thing left is to see whether or not we can reconstruct the whole electromagnetic theory base on the mutual energy theorem alone.

Now we take the mutual energy theorem as the principle, hence started from it to build the whole electromagnetic theory. The fields is not linear, that is not very convenient. In order to make things simple, we can add self energy items to the mutual energy theory.

Even we known that self energy current formula for the singular charge (i-th charge)

$$-\nabla \cdot \overrightarrow{E}_i \times \overrightarrow{H}_i = \overrightarrow{E}_i \cdot \overrightarrow{J}_i + \overrightarrow{E}_i \cdot \partial \overrightarrow{D}_i + \overrightarrow{H}_i \cdot \partial \overrightarrow{B}_i \tag{32}$$

is nonsense in physics, actually that $\overrightarrow{E}_i \times \overrightarrow{H}_i$ is 0, $\overrightarrow{E}_i \cdot \overrightarrow{J}_i$ is 0, but the mathematics calculation that is not 0. We also know that if the charge is point, $\overrightarrow{E}_i(\overrightarrow{x}_i) = \infty$, we can just assume the charge is not a point. But the charge is distribute inside a small sphere region with a radio R. We can choose a any small radio for example $R = 10^{-16}$ meter. Then the above formula can be a correct formula at least in mathematics. It is a pseudo self energy current formula. We can add this pseudo formula to the following mutual energy theorem Eq(14), we obtained,

$$-\nabla \cdot (\sum_{j=1}^{N}\sum_{i=1}^{N} \overrightarrow{E}_i \times \overrightarrow{H}_j) = \sum_{j=1}^{N}\sum_{i=1}^{N}(\overrightarrow{E}_i \cdot \overrightarrow{J}_j)$$

$$+\sum_{j=1}^{N}\sum_{i=1}^{N}(\overrightarrow{E}_i \cdot \partial\overrightarrow{D}_j + \overrightarrow{H}_i \cdot \partial\overrightarrow{B}_j) \tag{33}$$

This formula is still correct as a equation, since we have add same amount values to both sides of the mutual energy theorem which now is assumed as a principle. If the original equation is correct, the new equation is still correct in mathematics.

Keep in mind the above formula is only correct in the meaning of mathematics, not physics. It is a mathematical formula not a physic formula. $\sum_{j=1}^{N}\sum_{i=1}^{N}(\overrightarrow{E}_i \cdot \overrightarrow{J}_j)$ is lager than the total power of action and reaction of the whole system. $\sum_{j=1}^{N}\sum_{i=1}^{N}(\overrightarrow{E}_i \cdot \partial\overrightarrow{D}_j + \overrightarrow{H}_i \cdot \partial\overrightarrow{B}_j)$ is larger than the energy in the space. $-\nabla \cdot (\sum_{j=1}^{N}\sum_{i=1}^{N} \overrightarrow{E}_i \times \overrightarrow{H}_j)$ is also larger than the energy currents to the out side. The formula can be further written as

$$-\nabla \cdot (\sum_{i=1}^{N} \overrightarrow{E}_i) \times (\sum_{i=1}^{N} \overrightarrow{H}_j) = (\sum_{i=1}^{N} \overrightarrow{E}_i) \cdot (\sum_{i=1}^{N} \overrightarrow{J}_j)$$

$$+(\sum_{i=1}^{N} \overrightarrow{E}_i) \cdot (\sum_{i=1}^{N} \partial\overrightarrow{D}_j) + (\sum_{i=1}^{N} \overrightarrow{H}_i) \cdot (\sum_{i=1}^{N} \partial\overrightarrow{B}_j) \tag{34}$$

Write

$$\overrightarrow{E} = \sum_{i=1}^{N} \overrightarrow{E}_i, \quad \overrightarrow{H} = \sum_{i=1}^{N} \overrightarrow{H}_i \quad \overrightarrow{J} = \sum_{i=1}^{N} \overrightarrow{J}_i \tag{35}$$

We obtain that,

$$-\nabla \cdot \overrightarrow{E} \times \overrightarrow{H} = \overrightarrow{E} \cdot \overrightarrow{J} + \overrightarrow{E} \cdot \partial\overrightarrow{D} + \overrightarrow{H}\partial\overrightarrow{B} \tag{36}$$

Hence we obtained the Poynting theorem. We also obtain the superimposition of the electromagnetic fields. Keep in mind this is all mathematical result and is not results in physics. It is a result when we add a pseudo self-energy items to the both sides of the mutual energy principle. From this we know that why sometime we can assume the electron's charge distributes as a small sphere instead of

point, still can obtains correct calculation result. The Poynting theorem can be written as

$$-(\nabla \times \overrightarrow{E} \cdot \overrightarrow{H} - \nabla \times \overrightarrow{H} \cdot \overrightarrow{E}) = \overrightarrow{E} \cdot \overrightarrow{J} + \overrightarrow{E} \cdot \partial \overrightarrow{D} + \overrightarrow{H} \cdot \partial \overrightarrow{B} \tag{37}$$

or

$$-(\nabla \times \overrightarrow{E} + \partial \overrightarrow{B}) \cdot \overrightarrow{H} + (\nabla \times \overrightarrow{H} - \overrightarrow{J} - \partial \overrightarrow{D}) \cdot \overrightarrow{E} = 0 \tag{38}$$

The sufficient conditions of the above formula is

$$\nabla \times \overrightarrow{E} + \partial \overrightarrow{B} = 0 \tag{39}$$

$$\nabla \times \overrightarrow{H} - \overrightarrow{J} - \partial \overrightarrow{D} = 0 \tag{40}$$

We got the MEQN. We did not get the MEQN as a necessarily conditions. But this is enough. In this article, MEQN are not need to be derived, it has a bug anyway! The above derivation of the MEQN is also by dint of the pseudo self energy items. We obtained the superimposition of the field, but that is also dependent to the pseudo items.

3.3 The other two equation of MEQN

The other two equations of MEQN are,

$$\nabla \cdot \overrightarrow{B} = 0 \tag{41}$$

$$\nabla \cdot \overrightarrow{D} = \rho \tag{42}$$

Here $\overrightarrow{B}$ and $\overrightarrow{D}$ are magnetic B-field and electric displacement. Or in the integral formula,

Take div operator or "$\nabla\cdot$" to the two side of Eq.(39, 40), considering $\nabla \cdot \nabla \times \overrightarrow{A} = 0$, here $\overrightarrow{A}$ is any vector, we obtain,

$$-\nabla \cdot \overrightarrow{J} - \partial \nabla \cdot \overrightarrow{D} = 0 \tag{43}$$

considering charge continuous equation,

$$\nabla \cdot \overrightarrow{J} = -\partial \rho \tag{44}$$

we obtain,

$$\partial \rho - \partial \nabla \cdot \overrightarrow{D} = 0 \tag{45}$$

$$\nabla \cdot \overrightarrow{D} = \rho + Constant \tag{46}$$

similarly we have

$$\partial \nabla \cdot \overrightarrow{B} = 0 \tag{47}$$

or

$$\nabla \cdot \overrightarrow{B} = Constant \tag{48}$$

Because we thought the field any way is a problematic, especially in higher frequency we do not care a constant field. Hence for this equations we do not need to derive this constant from mutual energy theorem. In the above we have applied the charge continuous equation. Hence we have to put the continuous equation also to our principle.

3.4 Why we still need MEQN?

Perhaps the reader will ask why we need to derive MEQN? We must make clear here. Since we have found the bug in Poynting theorem, Poynting theorem is derived from MEQN, that means the MEQN have the bug too. Actually the problem is at the superimposition of the field. We have said the field is a very confused concept. It cannot be superimposed. If we have no the concept of field for a system with N charges or if the field can not superimposed, even MEQS is correct for a singular moving charge, it still can not prove the MEQN is correct. That is reason we need to derive the MEQN. MEQN still can be applied in most engineer problems. We have proved that MEQN are still correct in mathematics. The only wrong is at how to interpretation of physics meaning of the expressions in MEQN. This is because in the derivation of the MEQN we have add the the pseudo self energy items to the two sides of the Poynting theorem. For example we often say that Poynting vector,

$$\overrightarrow{S} = \overrightarrow{E} \times \overrightarrow{H} \tag{49}$$

expresses energy current intensity, it is not true for a system with N charges, unless the cross multiplication change to the new definition Eq.(30). It is also not true for a system with only one charge. In one charge situation, Poynting theorem tell us there is a energy current sends out from the charge. But according the direct interaction principle there is no this kind of energy current which exist without a absorber.

Understand that we can now easily understand why in quantum physics need a re-normalization process, when it take away all self energy terms in the quantum formula, they got correct result. In the correct physics these all self energy terms actually should be take away. Hence we have two method to solve the electromagnetic problems, (1) Applying the new definitions of the point and cross multiplications or (2) Still apply MEQN, but keep in mind we have added a pseudo self energy items to Poynting theorem.

Perhaps some people will argue that, the Poynting theorem has bug, that is only the wrong of the superimposition, MEQS is still correct. That is also not true in general. Since the solution of MEQS produced a energy current which can be expressed by a surface integral with Poynting vector. This energy does not vanish. A charge continually sends out the energy that violates the direct interaction principle. In the direct interaction principle there is no the field which can exist independent to the charge. There is only the adjunct field

which is depended to the action and reaction of two interacted charges. Hence one singular charge cannot send wave out. Or we can think a charge can send the retarded wave (a real physics wave with energy) out, but since there is no any absorber to send an advanced and synchronized wave to receive this energy, the retarded wave cannot make the energy transaction, it is returned to its emitter.

3.5 What is accurate and what is not accurate?

All things related to the pseudo field are only approximately correct. The first is the electromagnetic field,

A few our often used concept is only approximately correct:

(1) The energy current related to Poynting vector. The replace should be the mutual energy current.

(2) The interaction energy of the whole system calculated from the Poynting theorem. The replace should be the calculation with the mutual energy theorem.

(3) the electric field and magnetic field, since the linearization process has applied the concept of pseudo items.

In electromagnetic field theory, there has lot of problems are not directly solved by using MEQN, but are solved by using Lorentz reciprocity theorem. We have shown that Lorentz reciprocity theorem is only a mathematical transformation of the mutual energy theorem, it change the advanced wave in the mutual energy theorem to a retarded wave[?]. Many results obtained from Lorentz theorem is still correct. For example the directivity diagram of the receiving antenna. We also know that the the theory of the Green function can be derived from Lorentz reciprocity theory hence many results obtained from green function are still correct. All the problems can be solved by Lorentz reciprocity theorem can also be solved by the mutual energy theorem, for example the directivity diagram of the receiving antenna. Apply mutual energy current will offer not only the correct directivity diagram, but also the current of the receiving antenna. As a contract the Lorentz reciprocity theory only offers the correct directivity diagram. We have shown in the lossy media, the Lorentz reciprocity theorem is not correct any more. If a antenna is put in salt water, even the directivity diagram can only be calculated with the mutual energy theorem[?].

4 Photon equations

In macrocosm we have found the bug of the Poynting theorem, however it is still can be used as a mathematics equations. In the one charge alone situation, the MEQS still can offers a retarded solution and also an advanced solution. But this is not true comparing to the direct interaction principle, in which there is no any field exist alone and can be separated from the interacted two charges, one is the emitter and the another is the absorber.

4.1 The mutual energy theorem

The reason, the self energy current is calculated as nonzero is because, the concept electromagnetic field is wrong. The electromagnetic field need a test charge in static field situation or an absorber in light wave situation to measure the field or absorb the field. However this charge or absorber actually joined the creation of the action and reaction. We have measured the field we cannot show whether or not if the test charge or the absorber is removed from the system the electromagnetic field still exist.

Hence there is a continually debate between two group peoples, first group believe action and reaction is only happened between two charges, for example one is the charge its field need to be measured, one is the test charge. If the test charge exist the field to be measured is exist, if the test charge is removed the field to be measured does not defined any more. The people in this group claim direct interaction principle, this action or reaction is only exist in the case there are two electrons, the emitter and the absorber. The field cannot exist without the emitter and absorber.

Another group claim that the field can be exist independent to its source for example charges. This group people are very success in classical electromagnetic theory. MEQN is also belong to this groups. Maxwell theory claims that wave can exist independent to its source. Our traditional electromagnetic theory thought field is a independent concept which exist even without the charges. Without charges we can also obtained the field or waves by solving MEQN.

In quantum physics, they accept the second groups theory, hence the wave can exist without emitter and absorber. But this cause lot of problems in quantum physics, energy perhaps not conserved. Hence in quantum physics they create a concept call wave function collapse. The retarded wave need to be collapsed to the absorber. After add the concept of wave collapse, actually action and reaction can only happened between two charges. In case there is no collapse, the wave is said to be a probability wave in quantum physics. Hence quantum physics actually do not violate the direct interact principle. Even wave function collapse is very difficult to be accept because who can offers a equation of the process of collapse? But the concept of wave function collapse is very useful to avoid the problem of the MEQN/MEQS and also the Schrodinger equation. By using the concept of the wave function collapse, in quantum physics they by using the re-normalization process, quantum physics can still keep the superimposition principle survival.

In order to solve the same problem we notice that the problem is at the Poynting theorem for N charges. This problem cannot solved through the concept field which can be superimposed. But we have successfully solved it through the energy. Started from the Poynting theorem we remove all self items include self energy current, self energy increase and self reaction ($\overrightarrow{J}_i \cdot \overrightarrow{E}_i$). After this removal, the Poynting theorem is changed to the mutual energy theorem.

If self energy current doesn't exist. MEQS are clear wrong, because from MEQS we can got a solution with self energy current does not vanish. It even worse, we can not got a solution with MEQS that self energy vanishes. Hence,

up to now the only way is to amend the Maxwell theory. Take self energy current away and MEQN and MEQS away, the left is only the mutual energy theorem and we can call it as mutual energy energy principle. The above few sections we have shown that the mutual energy theorem can be used to replace Poynting theorem, after this replacement, we got a new "Poynting theorem" which is actually the mutual energy theorem. We also shows the Poynting theorem is equivalent in principle to the MEQN and MEQS. Hence when we can replace the Poynting theorem with the mutual energy theorem, the mutual energy theorem actually can also replace the MEQN and MEQS. After we also show that the Gauss law can also merged to the mutual energy theorem, Hence we can use mutual energy theorem only one formula to replace all 4 formula of the MEQN and MEQS. That is also correct in the philosophy that the principle should be simple.

We also shows the problem of the MEQN, if we add a pseudo field to the two sides of the formula of the mutual energy theorem, it becomes the Poynting theorem, and the Poynting theorem is still correct in mathematics. Hence we also can show the MEQN are also correct in mathematics. It is not correct in physics, we have notice there are pseudo field items. However, most wireless problem which still can be solved with MEQN.

In the case of light, there is only two charges, one is emitter and one is absorber. This is the place we really need to deal the problem of self energy items. We have calculated that if it exist and does not return to its source, it will contribute half energy transfer from emitter to absorber[**?**]. In this situation the self energy items cannot be omitted. We endorse the direct interaction principle, which leads us to denies all existent of the self energy items. After removal of all self energy items, we obtained the mutual energy theorem or the mutual energy principle. Now we need to looking the solution from the mutual energy principle.

Now we are clear that we actually do not need to calculate the self energy current, which does not exist. Hence, this means that we only need to find a solution which satisfy the mutual energy principle. For the photon situation there is only the emitter and absorber two electrons, we assume the index of the emitter is 1 and the index of the absorber is 2, the mutual energy theorem is list as following,

$$-\nabla\cdot(\overrightarrow{E}_1\times\overrightarrow{H}_2+\overrightarrow{E}_2\times\overrightarrow{H}_1)=\overrightarrow{E}_2\cdot\overrightarrow{J}_1+\overrightarrow{E}_1\cdot\overrightarrow{J}_2$$

$$+\overrightarrow{E}_1\cdot\partial\overrightarrow{D}_2+\overrightarrow{E}_2\cdot\partial\overrightarrow{D}_1+\overrightarrow{H}_1\cdot\partial\overrightarrow{B}_2+\overrightarrow{H}_2\cdot\partial\overrightarrow{B}_1 \tag{50}$$

4.2 The solution of photon equations 1

We know the MEQS are the sufficient conditions of the mutual energy theorem, hence we can got the solution of the mutual energy principle by solving the MEQS. One of the solution of the above photon equation is MEQS solutions

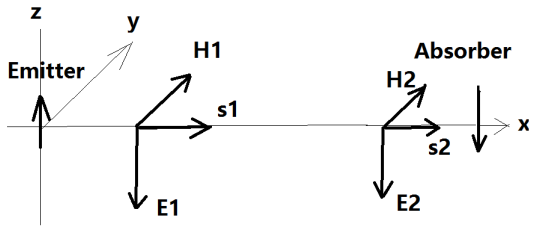

Figure 1: photon model, in this model the field $\zeta_1 = [\overrightarrow{E}_1, \overrightarrow{H}_1, \overrightarrow{J}_1]$,$\zeta_2 = [\overrightarrow{E}_2, \overrightarrow{H}_2, \overrightarrow{J}_2]$ all satisfy MEQS.

which is,

$$\begin{cases} \nabla \times \overrightarrow{E}_1 = -\partial \overrightarrow{B}_1 \\ \nabla \times \overrightarrow{H}_1 = +\overrightarrow{J}_1 + \partial \overrightarrow{D}_1 \end{cases} \tag{51}$$

and

$$\begin{cases} \nabla \times \overrightarrow{E}_2 = -\partial \overrightarrow{B}_2 \\ \nabla \times \overrightarrow{H}_2 = +\overrightarrow{J}_2 + \partial \overrightarrow{D}_2 \end{cases} \tag{52}$$

It must notice that (a) we are looking the solutions $\zeta_1 = [\overrightarrow{E}_1, \overrightarrow{H}_1, J_1]$, $\zeta_2 = [\overrightarrow{E}_2, \overrightarrow{H}_2, J_2]$ nonzero simultaneously. If $\xi_1 = [\overrightarrow{E}_1, \overrightarrow{H}_1]$=0, $\xi_2 = [\overrightarrow{E}_2, \overrightarrow{H}_2] \neq 0$, this is still the 0 solution of the mutual energy principle which is not what we are looking for. Hence the above simultaneously nonzero solution of MEQS is not just the solution of the MEQS but is the solution of the mutual energy principle.

Figure 1 shows the photon model of this kind solution.

Assume we have put a metal place between the emitter and the absorber. We make a hole to allow the light can go through it from the emitter to the absorber. The mutual energy is exist only on the overlap of the two fields $\zeta_1 = [\overrightarrow{E}_1, \overrightarrow{H}_1]$ and $\zeta_1 = [\overrightarrow{E}_2, \overrightarrow{H}_2]$, see Figure 2.

The disadvantage of this photon model is that it can only send the wave with linear polarization. If we need the photon as circular polarized field, we have to make the current $\overrightarrow{J}_1$ and $\overrightarrow{J}_2$ all have two components for example along y and z, or to make the currents rotating along x axis. This is perhaps possible, because the electron is at spin, there current is also possible to spin. In this way the radiate wave becomes circular rotated.

We can take the volume only includes the emitter or only includes only the absorber, this way we can prove that the mutual energy current go through each

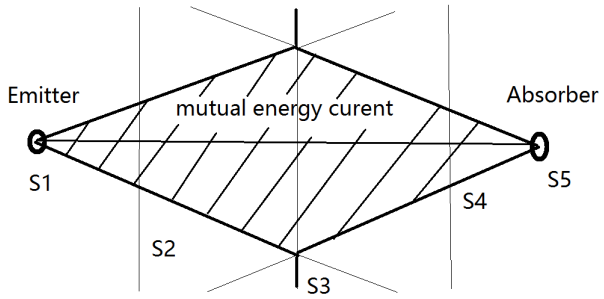

Figure 2: The mutual energy current only exists at the overlap place of the the two solutions of the MEQS. The field of the emitter is retarded wave. The wave of the absorber is advanced wave.

surface S_1, S_2, S_3, S_4 and S_5 are equal that is[?, ?]

$$
\begin{aligned}
&-\int_{t=-\infty}^{\infty}\iiint_{V_1}(\overrightarrow{E}_2\cdot\overrightarrow{J}_1)\\
&=Q_1=Q_2=Q_3=Q_4=Q_5\\
&\int_{t=-\infty}^{\infty}\iiint_{V_2}(\overrightarrow{E}_1\cdot\overrightarrow{J}_2)dV
\end{aligned}
\tag{53}
$$

where

$$
Q_i=\int_{t=-\infty}^{\infty}\oiint_{S_i}\cdot(\overrightarrow{E}_1\times\overrightarrow{H}_2+\overrightarrow{E}_2\times\overrightarrow{H}_1)\cdot d\Gamma dt \qquad i=1,2,3,4,5 \tag{54}
$$

This formula clear tell us the photon's energy is just the mutual energy current. The mutual energy current is equal at the 5 different surface. We know that the surface S_1 and S_5 are very near to the emitter or absorber. This surface becomes so small, hence the wave a beam is concentrated to a very small point. It looks very like a particle. In the middle, the wave beam is very thick. We can put other kind plate for example the metal plate with two slits. In this case the wave will produce interference patterns. This can explains the duality character of the photon.

The left of the formula Eq.(53) can be seen as the energy sucked by the advanced wave $\xi_2=[\overrightarrow{E}_2,\overrightarrow{H}_2]$ from the emitter's current $\overrightarrow{J}_1$. The right of the formula Eq.(53) can be seen as the current of the absorber $\overrightarrow{J}_2$ received the energy from the retarded wave $\xi_1=[\overrightarrow{E}_1,\overrightarrow{H}_1]$.

For the above solution, we have use the the sufficient condition of the mutual energy theorem. It is not the necessary condition. The mutual energy principle

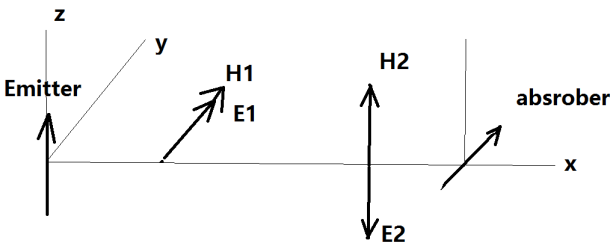

Figure 3: In this photon model, the fields $\zeta_1 = [\overrightarrow{E}_1, \overrightarrow{H}_1, \overrightarrow{J}_1]$,$\zeta_2 = [\overrightarrow{E}_2, \overrightarrow{H}_2, \overrightarrow{J}_2]$ do not satisfy the MEQS. However they still satisfy the mutual energy theorem.

perhaps has some other solution which does not satisfy MEQS, which will be discussed in next subsection.

4.3 The solution of photon equations 2

In this situation perhaps we can find a solution which is not the solution of MEQS, but it still satisfy the mutual energy principle.

If it is true this solution is also possible the solution for electromagnetic fields, that means we have found other photon model.

We can easily prove the above Figure 3 satisfy mutual energy theorem even it is not satisfy MEQS. We can see that this model is just a rotation from the Figure 1. We know that the photon model in Figure 1 satisfy MEQS, that guarantees it also satisfies the mutual energy theorem. Now we have rotated $\overrightarrow{J}_2$, $\overrightarrow{H}_2$ and $\overrightarrow{E}_1$ along the x axis 90 degree. Hence $\overrightarrow{E}_1 \times \overrightarrow{H}_2$ and $\overrightarrow{E}_1 \cdot \overrightarrow{J}_2$ don't change. This guaranties all the items in the mutual energy principle do not change, if it is satisfied before the rotation, after the rotation the equation should still be satisfied.

Even this model do not satisfy the MEQS, it has 3 advantages.

(1) Since field $\overrightarrow{E}_1 || \overrightarrow{H}_1$ and $\overrightarrow{E}_2 || \overrightarrow{H}_2$ the self energy current vanish automatically. We do not to tell the reader the self mutual energy current is 0, even when we calculated it, it is not zero.

$$\oiint_{\Gamma} \cdot(\overrightarrow{E}_1 \times \overrightarrow{H}_1) \cdot d\Gamma = 0, \qquad \oiint_{\Gamma} \cdot(\overrightarrow{E}_2 \times \overrightarrow{H}_2) \cdot d\Gamma = 0 \tag{55}$$

(2) we can see that, $\overrightarrow{E}_1 \perp \overrightarrow{J}_1$ and $\overrightarrow{E}_2 \perp \overrightarrow{J}_2$, we have clear that the self energy action vanish automatically.

$$\iiint_{V} (\overrightarrow{E}_1 \cdot \overrightarrow{J}_1) dV = 0 \tag{56}$$

$$\iiint_V (\overrightarrow{E}_2 \cdot \overrightarrow{J}_2) dV = 0 \tag{57}$$

(3) this model are easy to support circular polarization. Because not $\overrightarrow{E}_1$ and $\overrightarrow{E}_2$ also perpendicular. We know it is difficult to explain that why electron is so small it still can send circular polarization waves. In our antenna experience we need very complicated antenna to send circular polarized waves. When two electric field are perpendicular if the two fields have 90 degree phase difference, we have obtained circular polarization.

Even this solution do not satisfy MEQS, it has 0 self energy current and 0 self action and can offer a simple current to support the circular polarization. It looks as a miracle.

Even this is not a physic solution of photon, using the mutual energy theorem as principle still much better than to take the MEQS as the principle, considering the economy principle. The mutual energy principle is only one equation, but the MEQS for two charges perhaps need 4 equations plus the condition ask the solutions exist simultaneously for two charges. And also need to explain why one need to be the emitter sending the retarded wave and another need to be an absorber sending advanced wave. And have to explain why the self energy current should vanish even it is calculated as nonzero. Started from the mutual energy principle all this is avoid. Only a retarded wave and an advanced wave synchronized together is the solution of the mutual energy principle.

4.4 Is light satisfy MEQN or MEQS?

Many people ask in the internet the question whether or not the field of light satisfy MEQN? We need to distinguish the problem in microcosm and in macrocosm.

In microcosm deal the problem of photon, the photon is a small system only with two electrons one is the emitter, the other is the absorber. From above discussion we know that photon satisfies the mutual energy principle. We also know that the MEQS is the sufficient condition of the mutual energy principle, hence, it is possible that the retarded wave and advanced wave of the photon satisfies the MEQS. But it is also possible photon satisfies the mutual energy principle but do not satisfy the MEQS.

In macrocosm, many photos do not satisfy the MEQN, the reason is that the photon is energy package, here, the energy is linear. For example one photon the energy is 1, 2 photons have the energy 2. If energy is linear, its field can not be linear. Hence in macrocosm, many photons also do not satisfy the MEQN. This result is different with wireless wave. In case of wireless wave, the wireless wave satisfy linear (if we omit the effect of pseudo fields) and hence still satisfy MEQN.

According the above discussion that the field of emitter and absorber of one photon is possible does not satisfy MEQS. There is the possibility it does not satisfy MEQS but it still satisfy mutual energy principle.

However to make things simple we still assume for each photon, the emitter and the absorber still satisfy the MEQS. For a system with big number of photon N, there is $2N$ emitters and absorbers. If the field of the light can be superimposed, then it is clear the $2N$ system also satisfy MEQN.

If

$$\begin{cases} \nabla \times \overrightarrow{E}_i = -\partial \overrightarrow{B}_i \\ \nabla \times \overrightarrow{H}_i = +\overrightarrow{J}_i + \partial \overrightarrow{D}_i \end{cases} \tag{58}$$

is satisfied it is clear that

$$\begin{cases} \nabla \times \sum_{i=1}^{2N} \overrightarrow{E}_i = -\partial \sum_{i=1}^{2N} \overrightarrow{B}_i \\ \nabla \times \sum_{i=1}^{2N} \overrightarrow{H}_i = +\sum_{i=1}^{2N} \overrightarrow{J}_i + \partial \sum_{i=1}^{2N} \overrightarrow{D}_i \end{cases} \tag{59}$$

However the field of photon is not linear and cannot superimposed. There are two reasons we speak the field of light is not linear. The first reason is we have mentioned before in last few sections because of the pseudo self field. The second reason is photon as energy package and hence its energy is linear. N photons energy has N times of energy of one photon. Energy is linear tell us that the field is not linear. if the field is linear the energy must quadratic.

Hence in general that the field of light does not satisfy MEQN.

4.5 Is the wireless wave are composed as photons?

Some people ask in the internet that is the wireless wave also composed as many photons or there is frequency limit beyond that frequency all energy be come packaged as photon. We thought this is a very good question and would like make it clear here.

In the antenna system one transmitting antenna can send the energy to many receiving antennas. It is not send a package of the energy to only one antenna in a time and randomly send the the energy to another antenna. It send the energy to all space if any antenna can receiving this energy.

This is a system with charges more than two. All these receiving antennas can synchronized with the transmitting antenna with frequency and orientation. This kind of energy is not a energy package. Hence wireless wave is not composed as photons. Actually in high frequency, waves become photons is only because the field of the emitter and the absorber is too difficult to be synchronized.

4.6 Are all current changes happened on the emitter or absorber will send photons out?

Assume in the emitter it has a current change for example a electron has from a higher energy level jump to a lower level, does this current change send a photon? We think the answer is no. This current change will send the retarded potential but if the retarded potential can not meet a synchronized advanced wave of any absorber, there will be no energy transfer. The photon does not

send out. The electron charge has energy perhaps it will return to its original higher level. And next time it will jump to low level again try to find a matched advance wave.

In the case only there is only an emitter and an absorber, the current change of the emitter produced a retarded. The absorber produced a retarded wave. If the retarded wave of the emitter has synchronized to the advanced wave of the absorber, there is a photon which is sent from the emitter to the absorber.

MEQS cannot tell us if there is a current advanced wave or retarded wave should be associated to this current. Hence Wheeler and Feynman assume there always half advanced wave and half retarded wave associated to the current.

From my experience I would thought only one kind wave can associated to the emitter and absorber in a time. That means the electron charge can only be ether an emitter or an absorber but both. This is from the experience of antenna system, if the absorber also send half retarded wave, then there should not have black body. The absorber become very bright. We never seen this phenomena.

We do not know the emitter first sends the retarded wave or the absorber first send the advanced wave. If the electron charge jump from the high energy to lower energy, we can assume there is a advanced wave have been reached at the place of the emitter, if the emitter run against the advanced wave, it will send energy out and hence sends a photon. When the retarded wave reached to the absorber. The electron charge in the absorber runs along the retarded wave, it will send the advanced wave out to receive a photon. We can assume that the emitter can self excitated to send retarded wave and the absorber also can self excitated to send advanced wave. In case this waves just synchronized, there is a energy current from emitter to the absorber which is the photon.

The retarded wave is not real wave, it is only offers the ability or possibility to support a absorber to receive it. If this absorber appears by producing a current synchronized with the emitter. the energy will send from the emitter to the absorber. If there is no absorber to receive this energy, the energy of the emitter can not send out . There is no any energy is lost to the space and can move in the space independent to the emitter and the absorber.

4.7 Retarded potential

We know that the mutual energy theorem endorse the direct interact theory, hence the retarded wave is not a real thing. If there is no absorber or the advance wave, the retarded wave cannot send the the energy out. This tell us the retarded wave is only offers the ability to send out the energy but doesn't really offers the energy. This is real reason of the probability interpretation of Copenhagen. However now we know that the probability interpretation of Copenhagen is at least correct at about the retarded wave. The retarded wave is only offers the ability to do some thing. It is not send real energy, the real energy is sent only in case there is a advanced wave to match it.

In this way we actually endorse both the Copenhagen interpenetration of the quantum physics and also the transactional interpretation of John Cramer

in which allows the retarded wave and the advanced wave.

When we speak that the retarded wave is not real, actually we also means the advanced wave is also not real, no energy is send by advanced wave, only if the retarded wave and the advanced wave meet together, the energy current is send from emitter to the absorber which is the photo.

4.8 The probability wave

Most electromagnetic engineering believe the electromagnetic wave especially the retarded wave is a real wave and does not like the wave in quantum physics which is probability wave. In this article we have shown that the electromagnetic wave, the retarded wave and the advanced wave dose not carry any energy if it is alone. The energy is carried through the mutual energy current which needs the retarded wave and advanced wave have been synchronized. Hence in principle, if there is only retarded wave, it only offers a ability to transfer the energy. The real transfer energy need an advanced wave to react it. Hence the retarded wave still not a real wave with energy on itself, it can be interpreted as ability wave or probability wave. If you do not satisfy this result, perhaps you can think the retarded wave is still a real wave carries the energy and transferred the energy in the space, but if there is no advanced wave to receive it, this energy is returned to its source. Hence the retarded wave returns to emitter and the advanced wave returns to the absorber. This is similar to the transactional process in the bank, if some thing wrong, the money can not transferred from A to B, then it must return to A. Energy is same as money if it does not transferred from A to B, the energy conserved law do not allow it disappear in the space. Hence this energy must returned to its source. This way it can guarantee for the whole system the energy is conserved.

We can assume the emitters and absorbers all can randomly send the retarded waves and advanced waves. If in the time of the retarded wave send out just has a advanced wave match it. The energy is transferred through the mutual energy current from the emitter to the absorber. Otherwise the energy in the retarded wave or in the advanced wave just returned. The wave return is a time reverse process, which cannot satisfy by Maxwell equations, but can perhaps satisfy a time-reversed Maxwell equations, which is,

$$\nabla \times \overrightarrow{E} = \partial \overrightarrow{B} \tag{60}$$

$$\nabla \times \overrightarrow{H} = -\overrightarrow{J} - \partial \overrightarrow{D} \tag{61}$$

The energy return process can described with equations, it is not like the wave function collapse process which cannot be described with any equations.

It should be noticed that if the retarded wave is a real wave with energy in space, it must be returned if there is no the transactional advanced wave. Actually even there is a photon sends out, that is only the mutual energy current, the self energy is still in the space and it also need be returned. The self energy current help the mutual energy transfer the energy. After the transfer energy

process, either the energy is transferred or not, the self energy current of the emitter returns to emitter.

The wave energy is returned when the transactional process does not happen is only a good explanation why the wave is a ability wave or probability wave. Important thing to us, the energy is only transferred by the mutual energy current. Photon is nothing else just the mutual energy current. Wireless wave is not composed by many photons. Wireless wave obeys MEQN, photon obey MEQS. If wireless is photon it cannot obeys MEQN.

The amount of photon energy $\omega\hbar$ is decided by emission and absorption process. That is only because the antenna inside the atom can only send that amount of energy. The macrocosm wireless antenna sends energy is not a energy package. It is still a continuous wave. Only continuous wave can obey the MEQN.

5 Conclusion

A bug is found in Poynting theorem, which is also inside the MEQN. When the bug is removed from the Poynting theorem, it become the mutual energy theorem. Since the MEQN have also the same problem, the whole electromagnetic theory is reconstructed through the mutual energy theorem which is treated as a principle for electromagnetic theory. It is referred as the mutual energy principle. The Poynting theorem is derived by add pseudo self field items. We find that the Poynting theorem is still correct as a mathematical equations. However the superimposition principle of the electric fields, the energy current of bast on Poynting vector, the whole energy of the system shown in the Poynting vector all depended to the concept of the pseudo field, and hence is only approximately established. MEQN can be derived from Poynting theorem as sufficient conditions of Poynting theorem. The whole electromagnetic theory still can be further derived from MEQN as a approximate theory.

The mutual energy principle is applied to photon to derived two kinds of photon models. For both models, the emitter sends retarded wave, the absorber sends the advanced wave, the two wave must exist or synchronized. For the first kind model, the wave of the emitter and the absorber satisfy MEQS. For the second kind model, it does not satisfy MEQS, instead it satisfy the mutual energy principle alone. Both kind models support circular polarization waves. The first kind model need the a little bit complicate currents inside the emitter or absorber to support the circular polarization. For the second model even a simple charge move along a line, it is still possible to produce circular polarized wave.

Electromagnetic field is a confused concept, because if we measure it we have to put a test charge in the place, however after we removed the test charge, we cannot prove the field we have measured is still there. Field is the ability if there is a test charge. In this situation the field can offer a force on the test charge. When the the test charge is removed the field is not defined any more. Hence if we still think the field is some thing real in physics and assume after

the removal of the test charge it is still there, we actually over estimate it. Even field cannot properly defined, the power or energy of the system still can be well defined. In this article we have shown that the correct energy of the system should be calculated with mutual energy theorem instead of Poynting theorem. The energy current should be calculated with mutual energy current instead of the energy current of Poynting vector.

According to the mutual energy principle the electromagnetic field, the retarded wave alone and the advanced wave alone does not transfer energy. The energy is transferred by the mutual energy current which exist only when both waves exist and synchronized. That means the wave for example the retarded wave need a current to drive, after the drive, the retarded wave propagates in the whole space, this can be called as the action. If there is no any advanced wave appear to react it, there is no any energy emitting from the emitter. Hence the retarded wave can be seen as a ability or probability wave. This agrees with the Copenhagen interpretation of quantum physics. It is same for the absorber it send the advanced wave is also the ability or probability wave. If this advanced wave has not meet the retarded wave. Since we also applied both retarded wave and advanced wave, this photon model also support the absorber theory and the transactional interpretation of John Cramer.

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