Author name
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Title
The trapped light
ie
towards an electromagnetic theory of elementary particles

Abstract
Examines the possibility of a purely electromagnetic formation of the physical world, and in particular electron.
For this purpose presents a number of parallels between elementary particles and radar signals and radar target.

Introduction

After several attempts I decided to write a short article.
I was not easy to decide the structure. At times I thought I'd present the mathematical treatment, wherever I can. Then I was convinced it was better to remove all formula and number.
If required, this short article can be considered the intrusion of a radar engineer in the world of physics and elementary particles.
It was not easy decision for me even the title.
What we speak, in fact? You might say: "the structure of the electron."
But over the years I happened to write notes, and called it gradually with summary sentences that would also be worthy of synthesizing a title.
One of them was: "everything is light." If he used this phrase as the title, I think that highlights one of the angles of view from which this paper can be seen.
In fact, I got the idea that the world we know consists of a single thing. I will not expand much more than this concept, as has been the subject of philosophical musings from ancient times and then was taken over in many ways even in modern times. However I am an engineer and therefore I need to say something more than a feeling, something more precise.
I actually did not start with this idea, nor interest me that much more, because a debate in these terms would be more a matter of philosophy. We have arrived by reasoning on the hypothesis of a purely electromagnetic constitution of matter, particularly of elementary particles and more particularly the electron.
Who thinks about things that resemble the various "Theories of Everything" circulating on the Internet, in physics inevitably is considered a heretic.
Accordingly, it is used sometimes by them, rely on some alternative physical theory and cite with some contempt, as defensive, that “*Official Science*”. This, in my opinion it is not possible for the simple reason among many that we have nothing more intelligent to replace. In reality, serve new theories expressed in a manner consistent with the mathematical physics.
Potentially, the physical equivalent of a theory of everything is the demonstration that the electron is made of pure electromagnetic field.
The remaining, elementary particles and the rest of the subject, following close behind.
What can we say more?

The idea of a whole Everything

I wrote "Everything" with a capital letter because sometimes it is written that way. The capital gives a sense of importance, the sense of a philosophical theory on the final constitution of the world, of the things, of ... in fact, everything.
It is not my intention to talk about this.
I mention these ideas because they have gone through science, religion and more generally human thought through the millennia. It's inevitable to want to think that here I want to make a connection with an electromagnetic theory of the electron, or of all matter.
I repeat that it is not my intention to deal with this.
Although there is no doubt that an electromagnetic theory of electron a philosophical impact has it.
Leaving aside the religions, but to remind the major scientific and philosophical attempts to bring the world to a single "entity".
I will mention only two, Einstein and the ancient Indian writings of the Upanishads.
Probably who some more approached in a purely scientific way to these unitary concepts is Albert Einstein, with his unified field theory.
Brutally simplifying we can say that there was in Einstein, ultimately, the desire to describe all of reality through a single total field

"…….compared to the pure gravitational field part. The only indication that can be drawn from experience is a vague intuition that the total field is required to contain something similar to Maxwell's electromagnetic field "(A. Einstein).

In ancient times the idea of a single substance is strongly supported in the Vedas, we can consider the books of wisdom of India. In the Upanishads, which form part of the Vedas, the idea of a single substance is repeated several times.
Say for example, the Upanishads (Chandogya Up. 6.15.3):

"Whatever this subtle essence, the whole universe is made of it, it is the true reality, it is the Atman. It is you, or Svetaketu".

That said, let's deal with the narrower issue of the constitution of the electron.

The electron

David Bohm explains well in his book [1] such as quantum mechanics makes us do the math, but did not say to much about what the electron. I quote his piece:

“All that is clear about the quantum theory is that it contains an algorithm for computing the probabilities of experimental results(.....). Or to put it in more philosophical terms, it may be said that quantum theory is primarily directed towards *epistemology* which is the study that focuses on the question of how we obtain our knowledge (and possibly on what we can do with it). It follows from this that quantum mechanics can say little or nothing about reality itself. In philosophical terminology, it does not give what can be called an *ontology* for a quantum system. Ontology is concerned primarily with that which *is* and only secondarily with how we obtain our knowledge about this (....)”

In summary, even quantum mechanics tells us little or nothing about what the electron.
However, the electrons are there, they know the properties, even if you can not describe the structure. Are balls? Points are lacking in size? The question then was further complicated by their dual behavior, particle and wave. They corpuscles? Are waves?
A reasonable hypothesis that could be done cheaper on the electron would be: "it is an electromagnetic field”. A lump, an area as dense electromagnetic field. This would force even the idea of a single universal vibration, a single field. The electromagnetic field has, and is able to show all the properties that we recognize to the electron, or more generally to all matter. It possesses in appropriate conditions energy, momentum, mass, velocity, charge. An agglomeration of the electromagnetic field could therefore be a good candidate for describing the electron. When an electron falls apart battling a positron, and what comes out is pure electromagnetic field, it is not outrageous to think that the two were made of the electromagnetic field.
There is also another advantage.
Quantum mechanics associates to the electron a wave.
An electromagnetic field can easily produce a wave, in fact, is by its nature, unless the so-called static fields, a vibration, a wave. The wave characteristics of the electron could thus be explained by the following fact: it is an electromagnetic wave.
Yet along this and other similar directions were made several attempts.
Not possible, or at least we have no exact theory to support it.
We do not have the equations that are able to interpret such things.
Or worse, the equations that we have show us that it is impossible that things go well.
But ... there are indications that instead of inviting us to work persistently in this direction?
What can you say about the hypothesis that the electron is made of electromagnetic field?

Hestenes, yourself for example, has never said the phrase "the electron is made of electromagnetic field", but made a series of assumptions on the electron that are very close [2].
We intend to make us an image purely electromagnetic of elementary particles, and in particular electron.
The attempt, if only based on fantasy, of electromagnetic constitution for the electron and then everything takes to make us a picture of how it could work the whole thing.
What does a electromagnetic constitution of all things?
How are? How they interact?
Will be sufficient to pose the question, and get a picture of the whole, relatively only to the world of elementary particles.
Once we were convinced of their electromagnetic constitution, we might be satisfied. All the rest, atoms, molecules and so on, would be made reasonably explained.
So we can rephrase the question to only the elementary particles.
How are? How they interact?
We need things, the particles which will rest up autonomously.
In a description in words we could say: "Well, they are lumps, agglomerates, areas of dense electromagnetic field". But not enough. Electromagnetic phenomenology we know enough to pretend to give some satisfactory explanation. For example: we can imagine a single particle as a circuit that accumulates electrical energy? We do not know in their hearts because the particles are too small for looking inside, if there is one inside, but we know several circuits that store energy because they are big and we can look inside. We know the mechanisms of operation. So we can get the similarities. We can say: "this small particle is as if done by a circuit that works so-so."
All this concerns the questions that we can do about a single particle.
Turning to the interactions between the particles. The term interactions refer to the fact that more particles, if only two particles, interact with each other in certain ways. Attract or repel each other, or banging against each other giving other particles or stick, and so on. Why? How to obtain a picture of this?
Physics has a clear picture of the world of elementary particles, both as they are made, both on how they interact. This framework is based on decades of experimental data, and related theories.
There are four fundamental forces or fundamental interactions in nature, electromagnetic, weak, strong and gravitational, this explains how the particles are together and interact.
But if you want groped to figure out everything as electromagnetic field, then the objects, the particles must be made of the electromagnetic field. Interactions between objects should be too purely electromagnetic. And this is all that we must at least imagine, with our fantasy, that is reasonable. We can try to do this precisely with the similarities, with the big things, visible, allowing us to imagine things tiny, too small for looking inside.

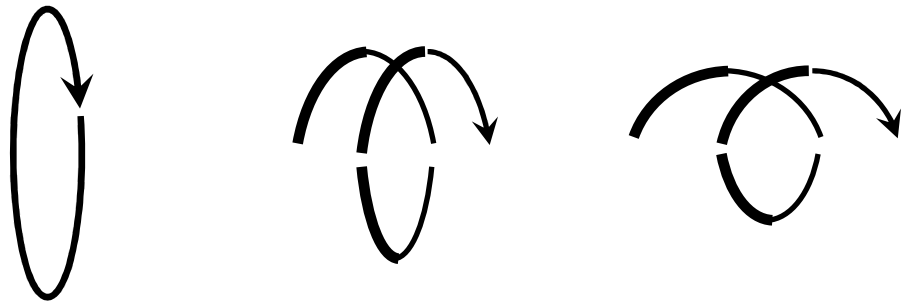
The radar

There is an invention that is the radar in which it operates almost any electromagnetic phenomenon which you might think. In operation of the radar are added a series of physical phenomena that lend themselves well to these arguments.
There are in fact electromagnetic fields that are in place, travelling within a waveguide, which interact changing face, changing into a different form. May be useful?
In a radar pulse is transmitted with the antenna and the reflection is received from a target.
The radar pulse is a short train of electromagnetic waves, we can define various synonyms: electromagnetic wave, radar signal, pulse train, electromagnetic wave packet so on. It is an electromagnetic field that travels with its own internal frequency of oscillation and a total duration, usually very short. The pulse, manufactured in the transmitter, is sent into space with a waveguide and a transmitting antenna. The same happens with a receiving antenna, if necessary the same, which connects to the receiver via a waveguide.
If and when the pulse arrives at a target, is reflected from the target. A sort of echo that is emitted into space and back in particular to the radar receiver.
When we say "the pulse is reflected," we give a simplistic description of a complex interaction of the incoming pulse with the radar target. The outcome is that a pulse output is produced. Note incidentally that the target is not altered because the target is, so to say, hard, matter is rigid, while the pulse is, so to say, a "malleable" electromagnetic wave. This observation will serve us later when we consider the target and the pulse both having the same degree of hardness, or molding.
That said, how we can help the radar to build analogy? In brief we can say:

waveguides teach us the existence of the particles;

the interaction with the target teaches particle interactions.

Considerations regarding the waveguides are easy.
How can the material particles or all matter could be formed by the electromagnetic field? The electromagnetic field in vacuum runs constantly at the speed of light.
But the particles can either travel, or even stay in place.
How can something always run at the speed of light and at the same time stay? One way is, at least in imagination, and is running in circles.
How, therefore, the electromagnetic field could give rise to matter?
A clue is provided by the electromagnetic field that propagates in a circular waveguide.
It under the circumstances, or by its frequency of vibration, is standing in place or travelling.
The two situations are briefly outlined in figure

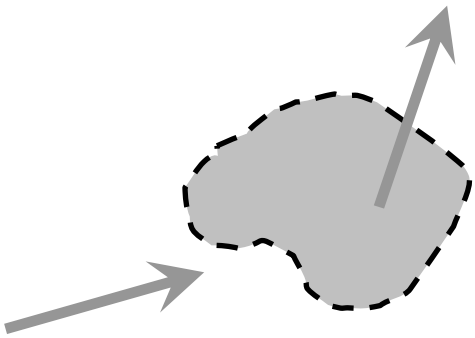


The electromagnetic field when it propagates, it travels within the waveguide as a helix. The extreme conditions are infinitely large frequency, where the helix is very long and the field travelling at the speed of light, and that the so-called "cutoff" of the waveguide, when with increasingly shortened helix the field ends with turn on itself, and it is there. The other helices are intermediates.
We can think of a single photon that is in these conditions. Frequency and energy become synonyms, related by Planck's constant. Both the frequency and the energy obey the relativistic formula linking mass energy and momentum of a particle. The mass appears to be exactly ..... the field energy at rest, the energy that is trapped in the field that revolves around itself.
Light trapped.
This is an indication that there might suggest. The electromagnetic field in the waveguide already behaves as one would expect from a relativistic particle. A trapped electromagnetic field is behaving like a particle.
Furthermore this model would give us free of charge a visual interpretation of why the disappearance of mass energy is liberated: freed from the bond, the field goes into electromagnetic radiation.
Of course, here is the waveguide that acts as a constraint to hold the field. In a vacuum, for a material particle, we should imagine an equivalent situation. But no one knows who or what can justify forcing a field to rotate in a circle. You do not know how to write equations to justify the constraint.
A simple way to solve it is to think that we know not justify it, but *it exists*.
So, in summary, the example of the waveguide is a good example to provide a model of what might be the structure of a particle with mass and spin. The mass of the particle corresponds to the rest energy of the field. spin corresponds to polarization. For the electric charge more problems arise so we limit ourselves to say that we have not an answer.
Let us see what can suggest the radar as regard to interactions.
We can examine what happens when a radar pulse hits the target and generates an echo back, because this helps us to see the interaction between two particles.
With a radar sends a packet of electromagnetic waves on a target. We use the terms "wave train", "pulse radar" so as equivalent conditions.

The packet is reflected from the target, with intensity and shape depending on how it was done early, and on how it was done the target.
The reflected signal "resemble" to what has arrived, but has some differences with respect to it. Meanwhile it is smaller. We can imagine as if only a portion of what comes back.
In addition to this variation of intensity, the reflected signal undergoes changes in frequency, if the target or parts of the target are in motion, and changes in polarization.
The change of polarization is expressed by saying that there is a change of the ellipse of polarization. For example, a linear incident polarization may be reflected in the form, in whole or in part, of circular polarization, and so on.
In the radar technique a parameter is defined , the RCS, “radar cross section", and in its more complete definition the"scattering matrix", which completely determine the type and intensity of the reflected signal from a target.
We can say that all these variations depend on the forms.
What forms?
Meanwhile, the forms of the target: This is not only obvious but it is also perfectly calculated in radar technique. You can tell *exactly* how it affects the shapes of the target.
But we can also associate with the incoming signal the concept of form. For example, a certain incoming circular polarization we can associate to form a helix. If you have a right helix, action will be different from a left helix. The opposite polarization, the shape of the left helix, can lead to dramatically different results. And in fact happens just that.
Another example is that of a linear polarization. If this is vertical and the target has elongated vertical shape, this part of the target will give a strong signal reflection. The opposite happens if one of the two forms is horizontal and the other is vertical.
Another example: a circular polarization that affects a long vertical target completely loses its characteristic of circular polarization. Will be reflected as linear vertical polarization.
Lets add to this the dependence of the reflected signal from frequency.
The intensity of the reflected signal depends on the frequency of the signal incident. How? The reflected signal may decrease with increasing frequency. But in other cases it may also increase, or remain a constant intensity. Depending on the shape of the target.
So far the situation concerning the radar.

Interactions of elementary particles

Now let's see what happens in the field of elementary particles.
Here you conduct experiments in which they clash particles and study the particles produced. The incoming particles have a certain energy (frequency). By varying the energy, intensity of interaction increases or remains constant or falls, depending on the type of interacting particles and the "forces" in play. For example, the weak force is .... weak, but the intensity of interaction increases with energy.
Between the particles in play, aptly the available energy is distributed and you can have exchanges of rotation (spin) between the particles involved.
What is the conclusion?
Imagine these particles as radar signals, an incident signal and a reflected signal. The incident particle is the signal that arrives. His energy is the frequency of the signal that arrives. The radar target plays the function of the particle hit. The reflected signal is then emitted a particle. The changes that the particles are subjected correspond to the action of equivalent forces.



At the same time between the incident, reflected particles and target are valid conservation laws, energy, impulse, angular momentum, and so on. All these conservation laws are axioms and general properties of physics that dominate any phenomenon. Energy conservation, for example, says it reaches a certain energy and distributes a bit here and a bit there, but the budget is such that it appears no more or no less than what's available The conservation of the impulse is said that when a particle strikes the target particle recoils, and once again there will be an equal balance between what is pushed forward and what is being pushed back. The conservation of angular momentum says that there is a balance between the "intensity of rotation". If, for example, what is to come has its own intensity of rotation and a complete loss of rotation takes place the particle hitting the target, then the target particle will forfeit the entire rotation intensity was there before.
We can thus form an image of the interaction between particles. The energy (frequency) of the incident particle, together with shape determines the intensity of interaction and the result of the interaction (what you hear), all under the umbrella of conservation laws.
We just have to make one last flight of fantasy.

That means we must associate the concept of signal or circuit ... .. also the target. The radar is not so, because the target is immutable. Before the arrival of the radar signal the target has a certain form. After the departure of the reflected signal, the target is always to first. This fact is due to the huge difference in the energy situation that exists between the target and the incident and reflected signals. The incident signal is not able to deform the target. But in the case of the particles we think of the incident signal and target as objects of the same degree of deformability. Are on an equal footing. Not even know which of them should have the right to be called the target. It follows that the interaction incident particle, particle-target and reflected particle can lead to changes in all three.

So summarizing the interaction with the target allows us to imagine all the possible mechanisms of interaction of elementary particles.

The only thing we have to admit is the existence in the particle shapes.

We can think of spatial objects or electrical circuits of a certain form. If we admit the possibility, for each particle of being a well-defined spatial signal or space circuit, then we can represent the interactions. Of course, all interactions will thus be of electromagnetic nature. We will have electromagnetic interactions between electromagnetic circuits. But these appear, or better will be more or less intense. Could mimic the action of various types of forces that we are different. An electromagnetic force, a strong force, a weak force.

Of course it is not easy to formulate an exact theory of all interactions as electromagnetic interactions. Nor is it said that it is possible. But we just imagine this possibility.

Dirac equation and electroweak interactions

Confine ourselves to consider the electromagnetic interactions and weak interactions. The weak interactions are those in which intervenes the "weak force", one of the so-called four fundamental forces of nature, the electromagnetic, the weak, strong and gravitational.
Along the way, the weak have become *electroweak* interactions, ie the weak and electromagnetic interactions are unified. This gives us an advantage, because the electromagnetic interactions are more familiar, if only because everyone at least once took the shock, he knows the TV and know roughly what is a radar pulse.
What does this mean that the weak interactions are unified with the electromagnetic? Brutally said, is like saying that..... are electromagnetic. Just who are weak. Or rather, they are weak at low energies, and become as intense as those electromagnetic at high energy (or high frequencies or at small distances).
The electron "feels" both the electromagnetic interactions and the weak interactions.
That being said, we need to say a few words of quantum mechanics.
The electron in quantum mechanics is described by the Dirac equation.
The Dirac equation describing the electron and its electromagnetic interactions, does not describe its weak interactions.
Why the Dirac equation does not describe the weak interactions of the electron? (since, after all, are *electro*weak .....).
Start over and make some considerations about the Dirac equation.
We started with the intent to examine a working hypothesis, namely that the electron was somehow a lump electromagnetic, an electromagnetic wave, a packet of electromagnetic field.
A kind, really, the package of electromagnetic field, all to understand.
But a true package of electromagnetic field is something well known.
The technique radar sending packets of electromagnetic field toward the target to detect. They travel at the speed of light. Can be produced in linear or circular polarization.
Similar packages can be made to travel within a waveguide. Here, according to the frequency, however, travelling at speeds less than that of light, and wishing can also go very slow. Travels slowly if the frequency is slightly higher than the cutoff frequency of waveguide or, which is a synonym, if the guide is narrow.
When a packet travels in a waveguide is inside the waveguide. It 'so big as the waveguide, a little smaller to get in and can run. A typical packet has a dimension of the magnitude of the wavelength, since this is the waveguide, which is built based on the packets that must lead. A typical packet is rather long various wavelengths, according to project needs. Say one hundred wavelengths.
What is the wavelength?
In the technique they are used a lot. Especially in the radar wavelengths usual may be in the decimeter of centimeters of a millimeter, depending on the application. In other applications, the wavelength can be meters, hundreds of meters, km ... ...

In a large waveguide could hypothetically come in, or get us into the instruments, and measure point by point the electromagnetic field. On certain special occasions and for some particular reasons why we do it. The field obeys the Maxwell equations. This you know, and the measures it happen. If, therefore, passes a wave packet can be measured, or think to measure the characteristics point by point, and find that the field obeys the Maxwell equations.
So in essence a packet electromagnetic knows everything.
However, already for the millimeter wave waveguide is tiny.
Worse still if we considered an optical fiber, "waveguide" for the electromagnetic field (or light). This is a hair.
Now he has a condition that has nothing to do with quantum mechanics or the uncertainty principle or philosophy, but it has to do with technology. If the packet is very small, we can not look inside for the simple that is too small for us to enter the instrumentation tools.
So we can only study it from outside.
We can then do the following reasoning.
Suppose, how we intend to demonstrate that the electron is a kind of electromagnetic packet. But it is very small. Instead an electromagnetic packet is normally great. But sometimes it can become very small.
How to describe an electromagnetic packet so small if we can not ever look inside?
That is, there may be an equation that, deliberately ignoring the characteristics of the field that is Maxwell's equations, describes an electromagnetic packet treating it as a particle of quantum mechanics?
That is, giving only the overall characteristics, seen from outside?
(wavelength, velocity, energy, mass, polarization, etc.)
Should consider a field in free space, but also in the waveguide, in order to have an electromagnetic packet at all speeds possible, even staying, as a particle.
The algebra developed by Hestenes lends itself well to this investigation.
The result is this:

this equation exists and is the Dirac equation.

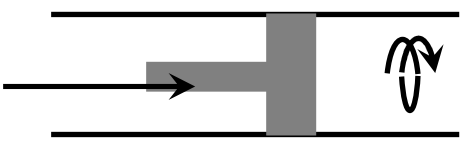
I have shown this elsewhere [3].
We must say a few words about this result, to evaluate their significance.
The Dirac equation is the equation of the electron (and neutrino). It describes very well all, or nearly so, the behavior of the electron but does not tell us anything about how it's done inside. Assuming that there is an inside.
David Hestenes has tried to dig into the Dirac equation to figure out if there is any information on the structure of the electron, but that's not what interests us here. What interests us is that the Dirac equation describing the electron from the outside, and informs us on wavelength, energy, speed, polarization and so on.
If now we find that even an electromagnetic wave packet is described in the same way, there are two alternatives:

or the electron is an electromagnetic wave packet, or it resembles him a lot.

One might object:
"Okay, so. But it is only because it is an isomorphism , namely, the two problems are the same type of problem".
We can well accept that the two problems are isomorphic, but this just makes the thing interesting. Indeed, the internal constitution of the electron there is invisible, while the other problem we have before our eyes.
And 'as if we discovered that the same equations that describe in all respects the behavior of a tiny virus, just or not visible in the electron microscope, also describe in detail a kangaroo.

Kangaroo we have before our eyes and we can reason.
And that is what interests us here.
What interests us here is to try to understand something more on the electroweak interactions.
Perhaps it is now possible: the most remote meaning of the Dirac equation are controlled as in this case refers to a visible problem. There are clear meanings of various parameters.
We have analogies that are "visible".
What are the similarities of behavior that gives us the Dirac equation [3] [4]?
Firstly, an electromagnetic field wrapped as an helix inside a waveguide is analogous to the electron.
Second: an electromagnetic field that travels in a vacuum at the speed of light is similar to the neutrino (the cousin of the electron, without mass and without charge, and always travels at the speed of light).
Continuing the study and used the analogy, you can do more: you can not interpret the action of the photon, or the "electromagnetic force, which deflects or changes the speed of the electron.
In the electroweak theory the action of the particle "photon" is represented by a mathematical operator.
We take this mathematical operator and uses it in case "visible" to us comes from the analogy.
Take this mathematical operator and we apply the electron, the electromagnetic field wrapped as helix inside a waveguide.
The action of the photon becomes the action of a visible object.
And what is this object and what it does on the electromagnetic field in the waveguide?
I have shown elsewhere the result [4].

Him a push.



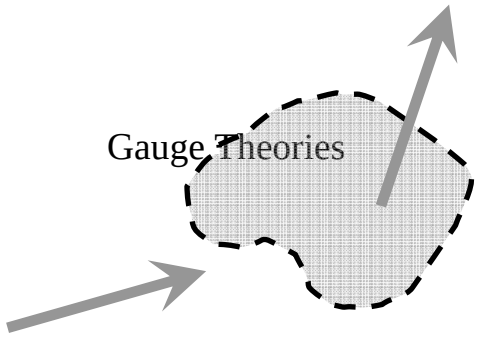
In the radar-electromagnetic analogy the action of electromagnetic force is that of a "push" that accelerates or slows down the field in waveguide.

This is very interesting and suggestive.

Since "the appetite comes with eating", how it appears instead, and if it appears as one interprets a weak interaction?
I can summarize in a concise and simplified [4].
Firstly, an electromagnetic field that travels in a vacuum at the speed of light knocks on a target, is reflected, and this is the action of Z °.
Second: an electromagnetic field that travels in a vacuum at the speed of light is captured by a "horn antenna", is wrapped at helix and becomes a field in a waveguide, and this is the action of W.
Incidentally Hestenes says that the mechanism of circular motion and / or as an helix may be able to give him the mechanism of the electron mass, without the necessity of involving the hypothetical Higgs particle, which some have called with imagination the God particle.
Basically it would rest energy or mass, because the light gets to travel like a vortex.

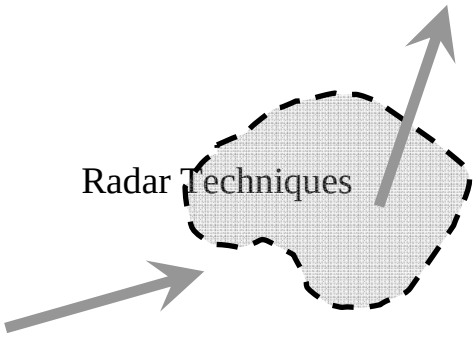
Further developments

Obviously the ideas set out here needs further research.
There are two interesting possibilities for study.
One concerns the radar technique, the other on the philosophy or the theory of elementary particles.
From the perspective of the radar technique, opens up the possibility of a spinor theory of scattering or the radar-target interaction, developed with the gauge theories of quantum mechanics.



Spinor theory of radar scattering

In terms of philosophy or theory of elementary particles, presents the opportunity to study particles in analogy with extended targets and radar signals, with the techniques of interaction between radar signals and radar target.



Extended Target model of Elementary Particles

Conclusions

I have summarized a number of similarities that exist between elementary particles and radar signals and radar target.
The similarities suggest the possibility of a mutually beneficial interaction between the study of radar target and that the interaction between particles by the methods of quantum mechanics.

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