Electromagnetic Selectivity in Membrane Transport of Metal Complexes: A Theoretical Framework Based on Thickness and Dissipation

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ABSTRACT

The investigation began with a senior chemistry unit acquired in 2006 at the University of Sydney, “Metal Complexes – medicinal and materials”. We learned about the manner in which certain (transition) metal complexes interact with DNA, preventing it from replicating. We hypothesise that it would be possible to transport a metal complex through the membrane of a cancer cell, and not a healthy cell. One option would be that if there was any difference in the width of the membrane between cancer cell and healthy cell, we should investigate what electromagnetic processes could get a metal complex through the lipid membrane of a cell. And in saying that, what we are really saying is that we envisage an electromagnetic flux tube crossing the membrane, and that the metal complex will have to be converted from its atomic-molecular existence into a two-fold existence as a dual Maxwellian photon and simultaneously what we have called in our investigations a “weak-strong gauge boson”.

This paper is an investigation into the physical processes that might make such a cancer treatment feasible. It is one of the sections in a document I prepared about various applications of metal complexes. At the time, back in 2007, I took it to and left it with one of my lecturers. When I went back to see him, he said it was “beyond him”. Re-visiting it all these years later, I could see where he would have had difficulty with it. This is an attempt to greatly refine the 2007 attempt, leaving alone the considerable questions about the physics of it that emerge, concentrating on finding an electromagnetic description of our hypothetical successful outcome to the investigation, allowing us to differentiate between cancer and healthy cell on the basis of membrane width. Having succeeded, we stop there, assume this is the correct result, and spend remaining efforts, at ongoing stages, on the purpose of understanding the physics of it better, at least until the time where we have experimental

confirmation or otherwise as to whether this is the correct quantitative outcome of the investigation.

Keywords: metal complex, ligand, electromagnetic flux tube, helical, weak-strong gauge boson, dual Maxwellian photon.

INTRODUCTION

Took a senior chemistry course in metal complexes – medicinal, back in 2006, and scraped through with a pass, thankfully, 50 or 51%. Anyway, we were taught the manner in which a metal complex will attack and destroy DNA. Obviously, the aim will be to develop some technique whereby the metal complex attacks cancer cell DNA without doing likewise to healthy cell DNA. At this point one steps in and says, “how can we transport metal complexes across cancer cell membranes without doing likewise to healthy cells?” And the first thought that comes to mind, well perhaps that could be facilitated if the cancer cells have membranes of different widths to healthy cells, so we seek to devise a mechanism whereby the ability of a metal complex to get across a membrane is dependent on the width of that membrane.

Immediately the thought occurred, perhaps transport of a metal complex across a cell membrane could be facilitated electrically, by manner of a tiny electromagnetic flux tube positioned across the membrane, and that the rate of transport of metal complex by this mechanism is dependent on the length of the flux tube. We did some preliminary investigations of the manner in which this might happen, without investigating the flux tube itself, just considering the region outside the cell membrane versus the region inside. These discussions made it appear indeed an honourable enterprise, but we didn’t get around to a mathematical model whereby suitable photon frequencies can be calculated, and you irradiate metal complexes at the correct frequency such that you get across the cancer cell membrane and not the healthy cell membrane. Nope, didn’t get around to it until a few days ago, October 2025. As a matter of fact, did not even get around to verifying that cancer cells have different membrane widths to healthy cells until October ’25 either!

Google result, October 2025: Cancer cell membrane isn’t a fixed number but can be decreased by lower cholesterol levels, which reduces membrane fluidity and thickness, while changes in lipid composition can also influence its properties. A standard cell membrane has a thickness of about 5 – 10 nm, composed of a lipid bilayer. Cancer cells often have reduced cholesterol in their membrane, which can lead to a decrease in membrane thickness and increased lipid surface area. Altered lipid metabolism in cancer cells affects membrane

composition, increasing elasticity and fluidity. The use of unsaturated lipids, and lower cholesterol in cancer membrane models can increase membrane fluidity.

LITERATURE REVIEW

We are publishing this paper from the standpoint of having acquired substantial matters of physics, quoted in the references. The reader will not be familiar with this large volume of material upon which the present paper is based, I shall endeavour to make the reader conversant with these physical techniques as briefly as possible.

There are three chief topics in the references that we are concerned with, in this paper:

- Electromagnetic flux tubes.
- Spherical metallic photons.
- Metallic conduction processes, dual Maxwellian photons, helically, at the surface of the flux tube, and “weak-strong gauge bosons”, axially, in the interior of the flux tube.

Will explain the aspects of the third point as we go, it is in the references but is difficult to locate. Second point, spherical metallic photons, proposed in my “Chemical Physics”, 1997, [7]. That’s where most of the discussion about it has taken place. I proposed that in metal lattices, lattice points exist as spherical metallic photons, preferentially, i.e. when the metal is not conducting electricity. These are dual Maxwellian photons, confined to spherical orbits. I heard about a metal smelter where a lot of people in the neighbourhood got cancer, I proposed that high energy, carcinogenic spherical metallic photons were leaving their spherical orbits in the molten metal, and propagating as ordinary photons and irradiating the neighbourhood. I tried to get my unfortunate Toth-Maatian publisher, ([8]), Harold Willis Milnes, to publish it, he said just reading about it made him feel ill. So, it never got published, obviously. Specifically, we are proposing a natural process whereupon an atom can be converted to a photon, either spherical metallic photon or ordinary, rectilinearly propagated photon. And we are going to use this proposed mechanism to facilitate the conversion of a metal of a metal complex to a photon, whereupon it propagates across a cancer cell membrane, and into the cell, through an electromagnetic flux tube, embedded in the cell membrane. And, of course, turns back into an atom, or rather molecule, metal complex, on the other side of the flux tube, i.e. when it gets inside the cancer cell.

Now we have, in many investigations, differentiated between Einsteinian space-time curvature, and Newtonian gravitational force. The latter affects planets, the former affects

photons. So in the third point above, metallic conduction processes, we have fermions travelling helically at the surface as dual Maxwellian photons, affected in their helical paths, by Einsteinian space-time curvature. Dual Maxwell photons have two orthogonal oscillations, **E** versus **B**, one carries a fermion and the other a ghost. And these photons do not feel electromagnetic (Lorentz) forces, $\mathbf{E} = -\mathbf{v} \times \mathbf{B}$, [2], p19. But the internal, axially propagated fermions have only *one* oscillation **E** *or* **B**, therefore no Lorentz force negation, they *do* feel an axial electromagnetic force, thereby a dissipation $P = V^2/R = \text{Force} \times v = q_eE \times c$. So when we investigate, in the literature, the third point, metallic conduction processes, we shall also note any material we have come across specifically on the topic of space-time curvature versus force.

Specifically electromagnetic flux tubes

[2] Helical potential, p317, [3] the meaning of electron spin, S(Roll) versus S(Qe), p17, [3] p28, [3] helicity, p175, [3] A final word on helicity of flux tubes, [3] Appendix III, Electromagnetic flux tubes and the Lorentz force, [3] Reverse Higgs boson, (responsible for loading massive fermions onto electromagnetic flux tubes, where they propagate, or *eventually* propagate, masslessly, $v = c$). When is this not obeyed? In the *1st* phase of the operation of the flux tubes, which we investigated in Solar flares, [6], where the axial fermions are propagated *massively*, ($v < c$), p784, [5] Special Relativity and fermion spin, (Quantum entanglement), a pre-requisite for both helical and axial propagation in electromagnetic flux tubes, p293, [6] Reverse Higgs boson resides at entrance to flux tube, p193, [6] Appendix I, Photons of light ("pilot waves"), carry fermions of electric charge, [6] Appendix VI, [6] Appendix VII, the ($\hbar\omega$, $\mathbf{v} \times \mathbf{B}$) 4-vector, electrons and positrons, p334, [6] Appendix XVIII, Special Relativity and Spin(Quantum entanglement = Qe), p499, [6] Appendix XXIX, Electron dynamics, including Spin(Roll) versus Spin(Qe), and categorisation of fermions/bosons, p631.

Space-time curvature versus Newtonian force

[5] p111, p114, [5] General relativity, p111, [5] Expanding universe, would appear to have something to do with space-time curvature, an offshoot of Lorentz spatial contraction and the time dilation, also of special relativity, p107, [4] Expansion of the universe and energy of the universe, p771, [6] The importance of General Relativity, p243. Footnote: the apparent "spatial expansion" of the universe, the Hubble effect, is in fact an expression of the fact that the speed of light is decreasing in near synchronicity across the entire universe, and this is the reason that universal expansion appears in General Relativity, [5] p292, [5] p547, [5] With regard to real/imaginary numbers, p548, [5] p583.

Electronic (positronic) and photon spin

[2] Photon spin, p22, [4] Bohr atoms and Schrodinger atoms, (when a Bohr atom is created from a Schrodinger orbit, the electron spin at the instant of the conversion is converted to respectively clockwise or anti-clockwise movement in the Bohr orbit), p276, [4] More on ghosts, Einstein and de Broglie, (when you consider the *ghost* component of a photon, a Bohr orbit does not carry a ghost in the manner of a Schrodinger orbit, you have to include its spin too, such that $\pm\frac{1}{2} \pm\frac{1}{2} = 0, \pm 1$, and that is why we have Einstein $E = mc^2$ and not $E = \frac{1}{2}mc^2$, and why we therefore have a de Broglie expression $p = h/\lambda$ and not $p = h/2\lambda$, p319), [5] Measuring spin of photons, p271, [6] Appendix XVII, [6] Appendix II, Electrical circuits and spin, p285

Other topics

Other topics emerging as important from our literature review include:

- [2] p6, Insofar as the photonic energy is independent of the electromagnetic intensity, $E^2 \rightarrow (1/\mu) \times \mathbf{E} \times \mathbf{B} = \mathbf{P}$, the Poynting vector.
- [2] Figure 40, p105, Operation of the strong force whereupon individual pairs of neutrons, acting as gauge bosons, tie individual protons together into pairs, *helium nuclei*! And, another association of the strong force:
- [2] p195, The strong force holds the metal lattice together, pushing in from the surface. This compression increases until the *gravitational* interaction between adjacent "spherical metallic photons" of the lattice has risen to match the strong force. Contraction is not allowed to continue beyond that point, because it would imply a larger gravitational than strong nuclear force, which is forbidden, according to our force categorisation specification, [2].

METHODOLOGY

I reviewed my original discourse in Metal Complexes at the University of Sydney, [1], 2007. Initial impression is that my physics has come a long way since then, much of the material appeared to be "off-the-mark". Sure, my definition of "ghost" was not at all the same back then. But that is not an *error*. What did appear to be erroneous was that while I had speed of light propagation in Schrodinger orbits, indeed a good thing, I had *variable velocity of light, c*. Now this is a long time before I differentiated between Schrodinger and Bohr atoms – I didn't get onto that until I was studying a first year physics course in 2018, to make up degree units. At this point the Bohr theory was not under consideration at all, that is, back in 2007. This document was my attempt to account for what I knew about Schrodinger orbits. Starting from a multiple electron Schrodinger atom, moving between various orbitals, I devised a way to calculate successive increases in wave function, i.e. amplitude, of the various orbits, [7], and it was my intention to follow this approach and try to work out from that the intricacies of the Schrodinger orbit. And my starting proposition was variable speed of light for the

various Schrodinger orbits in a multiple electron Schrodinger atom. Of course, you *can* vary the speed of light but still see the same v = *c*, if the dimensions of your "measuring rods" is in proportion to the speed of light. We've seen this in our cosmological investigations, "expanding universe", [4], and we have seen it also in our black hole investigations, [10]. So there is always the possibility that there are two equally valid theories for Schrodinger orbit, one in which the speed of light is a constant and the other where it is variable. In other words, the document [1] could still be relevant, although it appears to be based upon different principles.

We start from the premise that it is a universal fact that it will be possible to devise a mechanism of an electromagnetic flux tube transporting a metal complex across a cell wall. That is, the transport will occur maximally for cancer cells, which have reduced membrane width, by comparison with healthy cells, by irradiating the tumour with radiation of specifically the frequency needed for this to happen. So we go in search of something that relates photon energy hν to two different cell membrane width, R(cancer cell) versus R(healthy cell). And we get an equation that seems to work, and we stop there. We investigate to see if this is the solution we are looking for.

It's a matter of faith, but if you are going to get anywhere, it will depend on immense faith to investigate in the first place. We learned in chemistry about metal complexes, [9], CHEM3914, University of Sydney. They attack DNA, stop it replicating, and the cell dies, eventually, without replicating. There *has to be*, for the good of the human race, a manner to get these complexes across cancer cell membranes, rather than those of healthy cells, via a mechanism of a transport of the complex in some manner, through an electromagnetic flux tube. The investigation takes place as a search for something that is known to exist, not a search for something that is merely hypothetical. If you don't have that attitude, you are not going to find it!

So, I would like the world to see the state of my Schrodinger research from ~ 2007, how far off the mark it was or potentially is not! As mentioned, at least propagation at v = *c* in a Schrodinger orbit, (albeit "*c*" variable), was appreciated. That is really something, because there is no reason to assume from modern quantum mechanics that electrons in Schrodinger orbits travel at the speed of light. Physicists will tell you that electrons cannot travel at the speed of light, or they would have infinite mass. Very strange that physicists and chemists have put 100% of their faith in a model that makes no statement whatsoever about the velocity of electrons in these atomic orbitals. When I learned about the Bohr theory, with variable velocities and electron masses ~ constant = m_e, the electron rest mass, that is, to about 4 significant figures, simply because the Bohr orbit electron velocities are v < *c*/10, once I appreciated that, I was on my way to what I claim to be the "completion" of quantum mechanics, the unification of Bohr and Schrodinger, with commentary by Heisenberg! So far

as I can recall, I was never taught anything in detail about the Bohr theory, either at high school or university. A very strange state of affairs, the Bohr theory predicts the hydrogen spectra just as well as the Schrodinger theory, yet physicists have assigned the "old quantum theory" of Bohr to the annuls of history. And, because of this attitude, proceeded to make no further progress. Quantum Field Theory has gone ahead in leaps and bounds, but quantum mechanics is stuck with the same nonsensical dogma that afflicted the quantum physicists investigating under Bohr at Copenhagen. One wonders what Bohr would have thought had he known by the 21st century his work would be ignored and dis-credited unanimously by the entire physics community. I only learned about it in that first year physics course I took in 2018 because it was a course for life and environmental scientists where calculus could not be assumed, so they presented the Bohr theory because they at least wanted to present some atomic theory / quantum mechanics, even if it was "redundant".

Physicists should learn a lesson from this. They shouldn't be operating on such premises as "Schrodinger and Bohr both predict the hydrogen spectrum, but Schrodinger does it more succinctly than Bohr, and since Bohr appears to be odds with Schrodinger, the orbits are different shapes, Bohr electrons travel at $< c/10$, whereas Schrodinger says nothing about velocity, the Schrodinger theory deals with the amplitude of the wave, the Bohr theory does not, because of these differences, we shall assume that Schrodinger is the correct one, and we won't bother any more about Bohr".

"Bohr's theory was an interim description, the 'old quantum theory', that was discarded when Schrodinger provided a description that enabled physicists to understand Quantum Mechanics better". This is an exceedingly different approach from the one we have taken, seeking to *unify* the Bohr theory with the Schrodinger theory, not *discard* one of them because they appear to be at odds. That is our method of attacking the problem. "Discarded"? Seriously?

Back to our principle document, [1]. Obviously, first and foremost, we're working on the medical problem, cancer treatment. But elsewhere in that document, we were heavily invested in Schrodinger Quantum Mechanics, and it would indeed be pleasing to preserve that in some manner. We are investigating the matter of variable velocity of light, c, in Schrodinger orbits. We have investigated variable velocity of light in cosmological matters, the expansion of the universe, [4], and we have investigated it in black holes, [10]. An expanding universe is an outcome of General Relativity, and we have in our investigations determined it to be an outcome of a forever decreasing speed of light in the universe. So, it would be nice to establish some connection between General Relativity and Schrodinger theory, in such a manner that variable c in Schrodinger Quantum Mechanics is reconciled with variable velocity of light in General Relativity. And here is the connection:

No calculus		*Calculus*
Special Relativity	→	General Relativity
		↑↓
Bohr atomic theory	→	Schrodinger atomic theory

So we have a theory of an expanding universe, have investigated it extensively, [4], and have concluded that the universe is *not* expanding, so Einstein was correct in introducing his cosmological constant, "Lambda", to "stop the universe from expanding". Rather, the universe *appears to be* expanding, because the speed of light is decreasing uniformly over the entire universe, such that we, and our measuring rods, are being reduced. The stars are shrinking, and us along with them, such that the space between the stars appears to be increasing. We have investigated, and accounted for Hubble's law for an apparent expanding universe, [4]. We account for the increasing red-shift the further stars are away from us as being due to photons "climbing out of the potential wells of their stars", increasing their wavelengths, by the time they get to us. And we seek, simultaneously, a quantum mechanical model, (Schrodinger orbits), with a variable velocity. And we have variable velocity of light as you go inside black holes. The guy inside the black hole, in his plasma-proof space-suit, doesn't perceive that the star has shrunk, with him inside, because the speed of light has decreased. He has an altogether different description. He doesn't see things as having changed from before the star shrank into the black hole, [10]. There is the physics of the guy inside the black hole, versus the physics of the guy outside the black hole, and they are at odds. Simultaneously, we have two Schrodinger descriptions, one with variable velocity of light and the other constant, they co-exist and do not nullify one another. Similarly, the Schrodinger atom does not nullify the Bohr atom!

So this is a very interesting preservation of a "relic" of quantum mechanical theory from ~ 2007, quite a while before we got the Bohr – Schrodinger atomic connection. But it makes sense, what we had then! It appears far off the current description, but there appears to be potential for some reconciliation.

We are seeking to preserve the entire document, [1], not just the medicinal chemistry part of it. We do *not* declare the other material about variable light velocity in Schrodinger orbits "worthless", in the manner that Einstein spoke of his earlier work. We seek to justify the entire investigation. So obviously, from humanity's point of view, the medicinal chemistry part of the document is the most important, but nevertheless we seek to justify the entire document. Because 2007 is 20 years since I became a theoretical physicist, and while I'm willing to overlook a lot of material way back in the beginning in my Toth-Maatian Review publication, [8], I have not been in the business of creating "fanciful" physics since around 1997, [7], even though I was accused of that in my first dissertation submission at Imperial

College, 2000. I was of course permitted to re-submit and my successful second submission, “Duality and M-theory”, served as a basis for a theory of quantum gravity, [4], which was entirely independent of my subsequent theorising of quantum gravity, [4], [5], [6].

The variable light velocity Schrodinger orbit material is or was fine theorising, and should be preserved, as a guide to physicists regarding the progression of ideas. At least the orbital electrons propagate at the speed of light, whether that speed of light is or is not variable. In our current state of knowledge, (October, 2025), we are aware that fermion propagation in Schrodinger orbits is moreless by definition the propagation of light, except that positronic/electronic photons propagate oppositely instead of uni-directionally. They are dual Maxwellian oscillations, carrying a ghost and Lorentz force negated, ($\mathbf{E} = -\mathbf{v} \times \mathbf{B}$), such that they are held in their curved orbits by space-time curvature of these photons, not Newtonian force.

RESULTS

We start with a review of the [1] The medicine of metal complexes – membrane interactions.

“For metal-ligand exchange reactions, which are rapid, there is thermodynamic control quantifiable using k values based upon equilibria and stoichiometry. For slower or catalysed reactions kinetic constants, using k values, are useful in unravelling the competing species”.

This hints at a mechanism whereby the metal complex dissociates into M + Ligands, the metal M transported helically through the electromagnetic flux tube, i.e. at the surface of the flux tube, and the ligands transported axially, through the interior of the flux tube. When they get through the flux tube, into the interior of the cell, the metal and ligands immediately reassemble back into its atomic-molecular state as a metal complex, and then proceeds to get up to whatever it gets up to, once inside the cell.

“A complex, which is formed with thermodynamically strong bonds, may exchange ligands quite readily when offered an equivalent replacement ligand. This is known as bond lability”.

Again, seems to confirm existence of a mechanism whereby ligands can be surrendered to the flux tube by the metal and re-claimed at the other side of the flux tube, extremely quickly, like on the order of the time interval required for the atomic → photonic → atomic processes that occur at the beginning and end respectively of the flux tube. We gather that lability

determines distance from the new equilibrium in the newly assembled ligand complex, hence a driving force that can run a circuit and produce heat, transporting photons in the process. Critically, the more heat generated, the less successful a metal complex will be at getting inside a cancer cell. We discuss this below where we introduce a "Quality factor" to the electrical discussion.

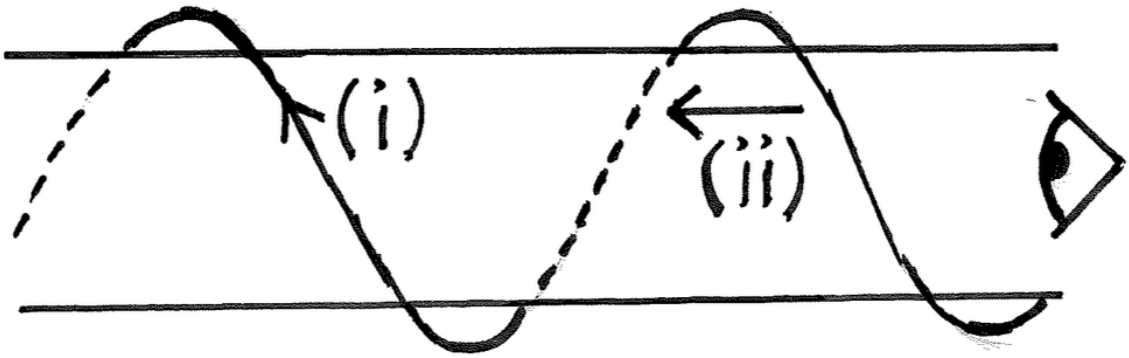


Figure 1: We are interested only in one way propagation in an electromagnetic flux tube. We simply ignore the reverse propagation. The metal complex is transported photonically on the helix, (i), and the ligands are transported axially in the interior, (ii), as "weak-strong gauge bosons"

We are importing a metal complex into a cell, not simultaneously removing a metal complex of anti-matter! It's just a step we decided upon, ignore the reverse process. Normally in a flux tube, for every electron propagating in one direction you have a positron propagating in the reverse direction. Because electron and positron have opposite charges, they both make the same, positive contribution to the current density, **J**, because they are moving in opposite directions.

So there are two manners that a fermion, electron/positron, can propagate in a flux tube. Helically, at the surface, where it propagates as a photon, and is therefore held in its helical path by space-time curvature, and axially through the interior, as a weak-strong gauge boson. In both cases, the speed of the propagation is *c*. The photon has to be dictated to by space-time curvature, because its Lorentz force is zero, $\mathbf{E} = -\mathbf{v} \times \mathbf{B}$, [2], p19. Conversely, the internal, axial fermion has only a singular oscillation, **E** or **B**, not both, therefore it cannot have a negation of the Lorentz force, it knows a lot about the internal, axial field, (a field that is designated to be "electric" rather than "magnetic" or *both, oppositely*, in modern electromagnetic theory).

In previous works, [6], we have determined that the current carried by the helix is equal to the current carried internally, axially. We propose that for transport of a metal complex through an electromagnetic flux tube into a cancer cell, a current of one metal on the helix,

(propagating as a dual Maxwellian photon of course), is equivalent to an axial, internal current of 6 ligands, again not being transported in atomic-molecular form, but in the form of weak-strong gauge bosons. We propose that similarly, the power dissipated by the surface processes is equal to the power dissipated by internal processes. This seems likely in consideration of the fact that every axial fermion that is ejected from the interior, travelling to the surface of the conductor when it turns into a photon and is radiated outward, radiates outward with the respective anti-photon plucked from the surface helix, [2], [3]. Indeed our investigations appear to indicate that time travel is necessary such that when the fermion from the interior hits the surface and unites with its respective anti-photon, the energy of the two photons exactly matches.

Supposing you look axially down a flux tube, as indicated in Figure 1. Associated with the circular propagation you are observing, associated with the helix, you have an angular velocity, ω, and a torque, τ. Associated with the axial propagation, which is now *into the page,* you have a rectilinear force, F, and a rectilinear velocity, $v = v_{ax} = c$. Then:

$$\text{Power dissipated} = \frac{V^2}{R} = \tau\omega = Fv. \qquad (1)$$

Therefore, it would appear that we have a quantity, "ω", that is crucial in electromagnetic flux tube processes, which is a huge part of physics. So crucial that it has its own 4-vector, ($\hbar\omega$, $\mathbf{v} \times \mathbf{B}$), [5] p 95 - 96, [6] Appendix V (4-vectors in general), [6] Appendix VII, which when extremised, becomes:

$$\hbar\omega = |\mathbf{v} \times \mathbf{B}|. \qquad (2)$$

Noting the connection between ordinary frequency and angular frequency, $h\nu = \hbar\omega$, and noting thar we are considering the voltage source form of the power dissipation function, $P = V^2/R$, and not the current source form, $P = I^2R$, because we are dealing with a photon of energy $h\nu = \hbar\omega$, which constitutes a potential difference of a designated magnitude across the cell membrane.

We are, therefore, very much concerned with rotational processes in analysing a flux tube, torque, angular velocity, *angular momentum* ←→ spin. A photon has spin, right! Well we can institute that photon spin being converted to angular momentum of a spinning metal complex, as the complex absorbs the photon, and immediately prior to hitting the cell membrane, whereupon the conversion molecular → atomic, (complex → metal + ligands) →

photonic/WSGB → propagates into the interior of the cell, then reassembles by the reverse process.

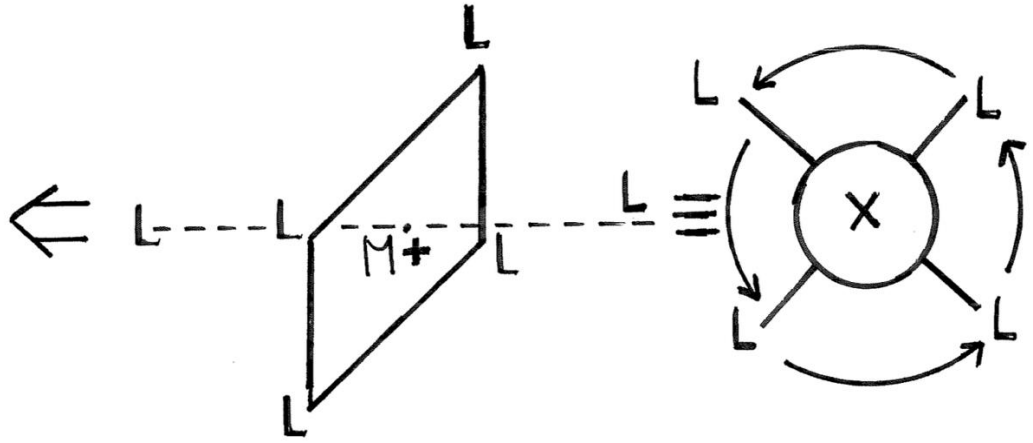


Figure 2: The metal complex absorbs a photon and is (ideally) given an angular momentum corresponding to the photon spin, assuming s = 0 was not an outcome, just ±1, along only one of the metal-ligand axes, as shown, L = ligand, M^+ = metal, "×" = "into page". Apologies, the ligand plane doesn't appear very "square"

So, we are concerned with a metal complex, as follows. You have the central metal, and you have the six ligands supplied in a symmetric fashion. "Octahedral", is that the word for it? Obviously the ligands do not all need to be the same. One would imagine that the octahedral symmetry would be less than exact with various different choices of ligands. Investigate "Cisplatin", [9], I think that was one of the cancer-fighting metal complexes that was mentioned. What are the ligands and what are their arrangement, for cisplatin? We don't bother about all that, in this analysis. Just choosing six identical ligands and an exact octahedral symmetry, such that the molecule has three choices for a propagation axis, each just as good as the other, one axis is selected and then the other four ligands supply the angular momentum, the connection between the photon absorption, and the propagation of the molecule through the flux tube in the form of photon (the metal) + weak-strong gauge boson, (the ligands), and into the cell.

We have investigated "spherical metallic photons" at length. For example, [7], to begin with. In a nonconducting state, lattice points in a metal are not occupied by atoms, metal atoms, but "spherical metallic photons". That is, in the form of photons confined to the surface of a sphere. It would have to be space-time curvature that keeps them in their spherical orbits, because space-time curvature applies specifically to photons (massless fermions, e^+ and e^-), and their massive existence, again e^+/e^-, whereas all of the nuclei in the universe are affected by Newtonian gravity, as opposed to Einsteinian space-time curvature, [3] p 327, [4] p 625, [5], [6].

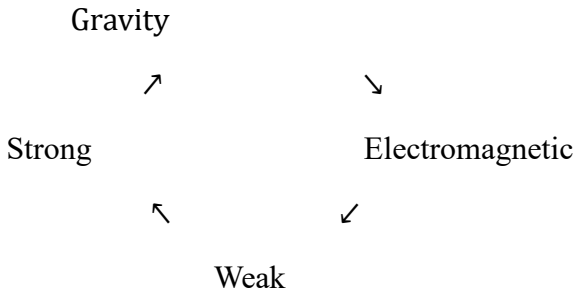
Now what about the flux tube? The surface, helical propagation of fermions is in the form of dual Maxwellian photons. They have dual, orthogonal oscillations, **E**/**B**, with a fermion propagating on one and the ghost on the other oscillation. Because it is a dual oscillation, you have Lorentz force negation, $\mathbf{E} = -\mathbf{v} \times \mathbf{B}$, so again it will be space-time curvature that produces the nonlinear trajectory. So, the metal atom itself, devoid of its ligands, travels on the helix, as a dual Maxwellian photon, at the speed of light. The evidence to support this is in our extensive investigations into these spherical metallic photons, we are just proposing that they are not "spherical", that they are some kind of helical extension of this.

And what about the ligands? It seems a sensible option to assign them to propagate through the flux tube in the interior, axially. Again, at the speed of light, but a very different type of entity. It has only one oscillation, **E** *or* **B**. Therefore it feels an electromagnetic force, not an Einsteinian space-time curvature. That force on the fermion is supplied by the central axial field, $\mathbf{E_{ax}}$, (there is also a reverse axial field, $\mathbf{B_{ax}}$, if you want "electromagnetic duality", [11]). The energy dissipation of the circuit $P = V^2/R$, where $V = |\mathbf{E_{ax}}| \times$ length of conductor. It does not have a ghost, because it has only a singular oscillation, but investigations have indicated a "potential ghost" is likely to exist for example in Bohr orbits, where the propagation is slow, $v < c/10$, total mass ~ m_e, and without ghost attachment. Yet a Bohr atom weighs the same as a Schrodinger atom, without ghosts! So the "potential ghost" actually has a weight in the Bohr atom, and it may well for weak-strong gauge bosons in electromagnetic flux tubes, too. We have additionally proposed that the central axial force, inside the flux tube, is identically an *aether force*, we have investigated the "closed fluid dynamic aether principle" of Muhammad Aslam Musakhail, extensively, [4], [5], [6]. Consider the mass of a Schrodinger atom. It includes the mass of the ghosts propagating with their fermions as dual Maxwellian photons in Schrodinger orbits, (e^+ propagating oppositely to e^-, not in unison as in what we call "dual Maxwellian radiation"). It follows that the fission energy of a Schrodinger atom is *not* $m_{U235}c^2$, it is ½ $m_{U235}c^2$. You only lose the "½" factor when you consider a massive fermion, in free space, because it has neither ghost nor potential ghost, so when you accelerate it, the ghost appears "out of nothing". Of course it is highly unlikely that physicists could determine the outcome of an atomic explosion accurately enough to verify this suggestion.

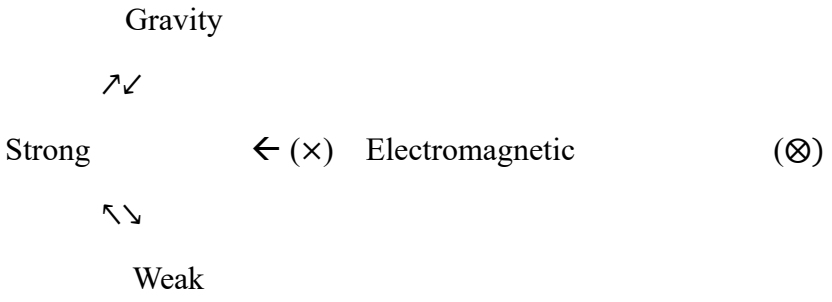
We are led to the conclusion that in the molecular form, the angular momentum is carried by the four "planar" ligands, and the metal carries no angular momentum. But when the metal complex is dis-assembled and transported into the flux tube, it is the metal that carries the angular momentum and the torque, at the surface, on the helix, in the form of dual Maxwellian photons, and it is the ligands, (all of them, not just the 4 "planar" ones), that are transported axially, with no angular momentum, no torque, in the form of weak-strong gauge bosons, [2] pp 49 – 52, "Unification of the gauge bosons", (ghost count).

Therefore, cannot have ligand → photon, because the ligand is not composed of metals, so we make the choice ligand → weak-strong gauge boson. Note that we investigated weak-strong gauge bosons for quite a while before we actually discovered why they were called that! Originally, it was just according to classification of various numbers of ghosts in a gauge boson, [2], "gauge boson" being defined as a messenger particle, carrying a particular fundamental force. We discovered there is a better reason that that, why it is called that, but it is situated somewhere, not immediately available.

Well, what is a weak-strong gauge boson? It has only one oscillation, so the most profound thing you can say about it is that it is *not* a photon. The photon is gauge boson for the electromagnetic force. The geometrical representation of the four fundamental forces is as follows, [2]:



Now how do you "eliminate" the electromagnetic force from this scenario? You employ a dual unification, strong ←→ gravity, and weak ←→ strong, which takes the electromagnetic force completely out of the picture!



Then to take the electromagnetic force out of the picture, we have this two-fold force unification. The strong-grav unification is what holds a metal lattice together, [3] p 265, [4] pp 515 – 525, [5]. The strong force pulls in from the surface, and the harder it pushes the more tightly the spherical metallic photons of the lattice are squeezed against one another, the photons which occupy the spherical surfaces get closer and closer together, eventually their proximity alludes to a gravitational force that equals the strong force. (Photons cannot feel "external" electromagnetic fields, but they can feel one another, gravitationally). Contraction

cannot occur any further, because that would mean the force of gravity exceeds the strong force, which is forbidden. Of course, we are dealing with a lipid membrane, not a metal lattice, so is "strong-grav unification" meaningful in this context?

Anyway, we just proceed as if we were talking about a metal lattice. It's a flux tube, whether inside a metal or inside a lipid membrane, we just proceed as if talking about a metal when we talk about the strong-grav unification. And the other force unification we are discussing is the weak-strong unification, which applies specifically to axial, internal currents in flux tubes, and is the mechanism for transport of the ligand.

Well, the helically propagated photon at the surface is just propagating according to the laws of electromagnetic flux tubes, it knows nothing about what is inside the helix. It simply propagates on the helix at speed = *c*. It would propagate In exactly the same fashion if there were no flux tube, just a solitary axial field, **E**/**B**, and a circular component, $R = mv_{az}/qB$. But the internal, axial fermionic propagation knows all about the strong force pushing in from the surface, if it *is* a metal. But it is not a metal! The interior of the flux tube will behave *as if it were* composed of a metallic lattice, according to the helicity at the surface. So we can be sure that "weak-strong gauge boson" is an accurate description of what is going on inside the flux tube, even though the interior of the flux tube is a lipid membrane, not a metal lattice. So the ligands *are* being transported axially, with no angular momentum, as weak-strong gauge bosons, and the metal *is* being transported helically, carrying the angular momentum of the metal complex after it has absorbed its photon. The rectilinear and the helical parts of the process are equally proportioned, they carry the same current and they transport the same energy, and that is why we have V = photon energy = $h\nu = \hbar\omega$. And it is a voltage source because you are looking at a specific photon getting a metal complex or a weak-strong gauge boson its ligands through the membrane, and only just through the membrane, [1]. So $P = V^2/R$ is the heat dissipated as the photon/weak-strong gauge boson cross, or attempt to cross, the membrane. And that initial photon imparts not only a kinetic energy but a spin to the metal complex.

So how do we go about determining the energy of the photon required such that the metal complex will get into the cancer cell, not the healthy cell, in accordance with the "ground rules" that we have laid down, [1]? We have already mentioned that the greater the amount of heat generated electrically, the less likely it is that the complex will get into the cell, or at least the amount of heat dissipated will be crucial, in some manner, to the process of the complex getting into the cell or otherwise. So consider the "quality factor":

$$Q = \frac{1}{R} \times \sqrt{\frac{L}{C}}. \qquad (3)$$

This describes how underdamped an oscillator or resonator is. It is defined as the ratio of the initial energy stored in the resonator to the energy lost in one radian of the cycle of oscillation. So:

High Q → no (heat) wastage = maximum penetration of metal complex through the membrane. Now a flux tube carries surface current in an helical fashion. That is, it has an inherent inductance, L. The photon absorbed by the metal complex imparts a spin to to it which gives it this helicity, this inductance, L, that is if the spin outcome is ±1 rather than 0. This imparts a same phase difference of the fermion between entry and exit, regardless of the membrane width. So double thickness of membrane → reduce helicity, reduce how "tightly the helix is wound" → reduce helicity → reduce inductance.

$$R = \frac{K}{L}. \qquad (4)$$

$$Q = \frac{1}{R} \times \sqrt{\frac{K}{cR}} = \frac{K\prime}{R^{3/2}}. \qquad (5)$$

Now consider:

$$P = \frac{V^2}{R} = \frac{\hbar^2\omega^2}{R}. \qquad (6)$$

As you increase R, from cancer cell to healthy cell, Q decreases more rapidly than P. We are interested in the quantity "P – Q", this is a measure of the maximum efficiency of getting a metal complex into a cancer cell.

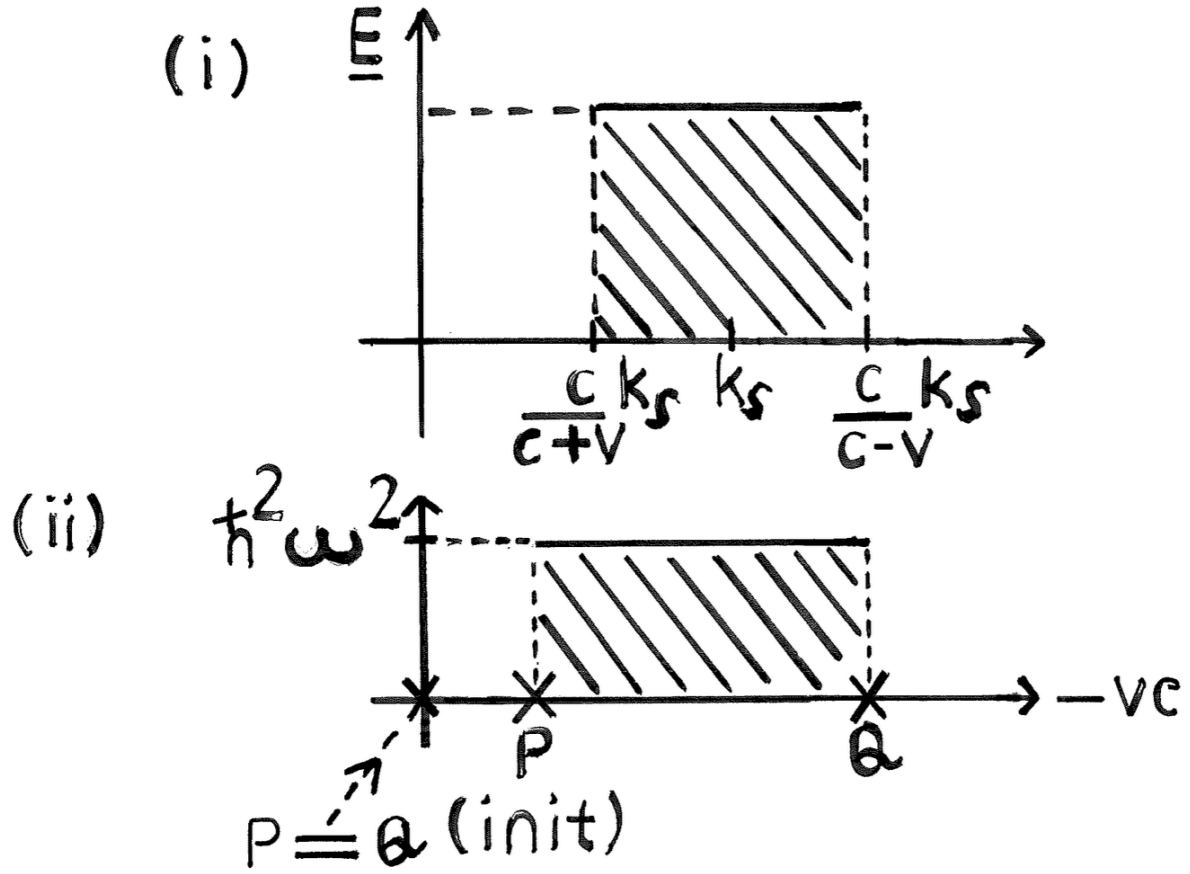


Figure 3: The "spectral area analogy", (i) the QTE spectrum, [2], [3], versus (ii) the "P – Q" spectrum, both spectra are enforced to have constant area

In our QTE investigations, [2], [3], we succeeded in proving Planck's law, $E = h\nu$, from first principles. We constructed a wavepacket, photon, creating a variation in the wavenumber (spectrum), according to the non-relativistic Doppler shift, for a moving source:

$$k_S' = k_S \times \frac{c}{c \pm v} \quad . \qquad (7)$$

So the height of the wavenumber spectrum is the electric field amplitude. You have created a photon, a wavepacket. Now keep electromagnetic frequency constant, you only vary the *intensity*, (E^2). So the energy of our photon should not vary, right? And you obtain that condition by specifying that the area of the wavenumber spectrum is a constant, as you vary E, E^2. So that is the analogy we are making, with our "P – Q" spectrum.

We proceed as follows. Choose K' such that:

$P(R_{cancer}) = Q(R_{cancer})$. (8)

Then you increase R. And enforcing the "constant spectral area principle", as in Figure 3 above. So:

$\hbar^2\omega^2\Delta(PQ) = \text{constant}$. (9)

And that, very simply, tells you the radiation frequency required. So to begin with, in investigating this result, suppose R(cancer cell) = R(healthy cell). Then:

$\Delta(PQ) = 0 \rightarrow \hbar^2\omega^2 = \infty$. (10)

Right? If you can't differentiate between membrane width, only a photon with infinite energy will do the job! Don't be too bothered about providing an interpretation for that! It's a bit like escape velocity, give a projectile the escape velocity from the earth's surface, it will eventually "escape" the earth, i.e. "get to ∞", but when it does it will have zero speed. Try and interpret that! So anyway, our primary initial deduction will be that a very high energy photon indeed could be required if there is only a small difference in width between the membrane of the cancer versus the healthy cell.

Effectively, in QTE, the process of preserving the spectral area of the photon is a process of considering an individual photon, not a collection of photons. Do all you want with electromagnetic processes, in electromagnetic circuits chiefly we are concerned with the Poynting vector, $(1/\mu) \times |\mathbf{E} \times \mathbf{B}| \rightarrow E^2$, or B^2. So just one photon, we do away with all that. We take the electromagnetic force out of it, replace it, replace it with the strong force, as in the arrangement (⊗) above.

Well, that is the whole thing about the strong force, it only occurs *individually*, you have two protons, exchanging continuously a pair of neutrons, neutron is gauge boson for the strong nuclear force. As opposed to the GBs for the electromagnetic force, photons, where you can get a whole stream of them.

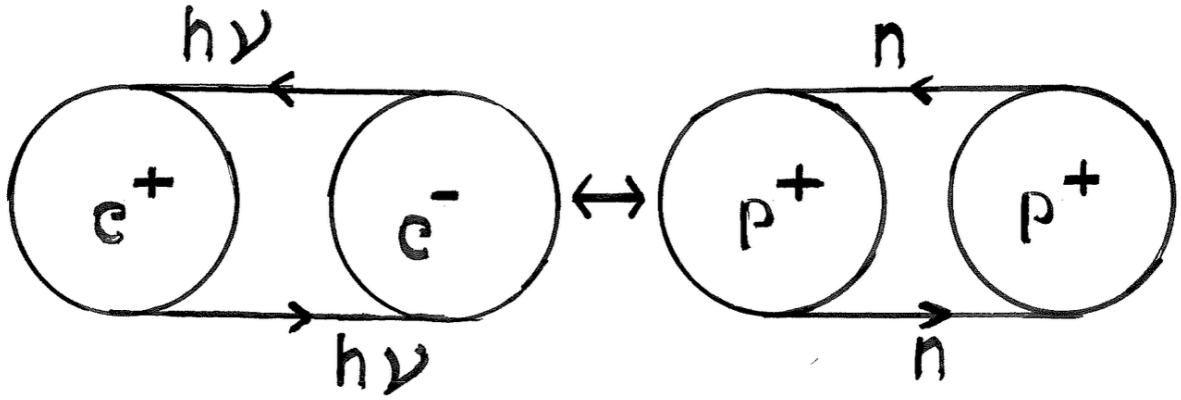


Figure 4: (Left) The neutron acts (as a pair of GBs) being exchanged by the two protons that are being squeezed together into a helium nucleus, and similarly (Right) for the electromagnetic force, the "exchange particle", the GB, is the photon

QCD enthusiasts will insist the strong force GB is the gluon, not the neutron, we have various things to say about that too, [2] pp 211 – 213. So what is a neutron? It is exactly analogous to the ordinary dual Maxwellian photon, the two oscillations, but instead of one fermion and one ghost, two fermions, e^+ and e^- on the one quantum. Ghosts have all the usual properties of fermions, most notably spin and mass-energy, but not electric charge. A photon contains the fermion and the ghost of the anti-fermion, a strong interaction exchanges the neutron which has the fermion and the anti-fermion, no ghosts. And these two fermions cannot overlap with one another. With a ghost, you can imagine a boundary, a "radius", but it does not matter if the fermion impedes this region. That is, ghosts have an "imaginary boundary" associated with their spin. Quite differently for the neutron, the strong gauge boson, the two fermions must be distributed inside the wavepacket at locations that do not involve the two fermions overlapping.

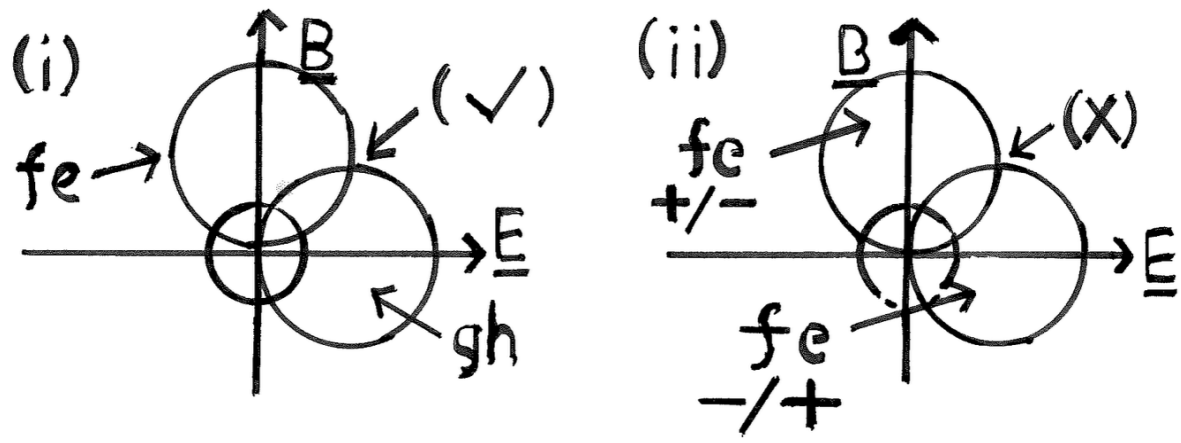


Figure 5: This is the profile of fermions/ghosts propagating upon electromagnetic oscillations. Propagation is out of the page. In any given interaction, *one* fermion

interacts with *one* wavepacket, you have a sphere "sitting" on a plane wave, [4] p 720. (i) ghosts can overlap with fermions, (ii) fermions cannot overlap with fermions

Okay, so this is the way it works. Consider Figure 3 above. How do we get P = Q (init), i.e. "initially" being when the cancer cell and the healthy cell have the same membrane width. Consider equations (5) and (6). We then require:

$$K' = \hbar^2\omega^2, \qquad (11)$$

That sounds fair enough. And we require:

$$\frac{1}{R^{3/2}} = \frac{1}{R}\,. \qquad (12)$$

That is, "R = 1", natural units. That is the radius of the cancer cell, R = 1. Then putting the "spectral" area = constant.

$$(P - Q) \times \hbar^2\omega^2 = \text{constant} = \eta.$$

$$\hbar^2\omega^2 \times \left(\frac{1}{R} - \frac{1}{R^{3/2}}\right) \times \hbar^2\omega^2 = \eta\,. \qquad (13)$$

$$\hbar^4\omega^4 = \frac{\eta}{\frac{1}{R} - \frac{1}{R^{3/2}}}\,. \qquad (14)$$

Now what is the significance of the angular frequency raised to the power of four? What immediately springs to mind is the "c^4" term in Einstein's equations of General Relativity. We built on that quite considerably, using this c^4 term to account for the "expansion of the universe" by manner of a universal steady decrease in the speed of light, correlated near instantaneously across the entire universe, and this has been going on since the dawn of creation. So we are seeking to correlate "speed" with "frequency". Well supposing you double the speed, v, of a wave, keeping wavelength λ constant, therefore momentum p constant according to the de Broglie wavelength, p = h/λ. Therefore you double the frequency, which is what we are looking for. But what, in the physics of electromagnetic flux

tubes embedded in cellular lipid membranes, transporting metal complexes, is the significance of “p = constant”? Does it have something to do with the “spectral area” = constant = η? We have not at this point devised any manner of calculating the value of the constant, η!

DISCUSSION

Well, the original investigation, carried out in 2007, [1], indicated that there is a large chance that a frequency can be selected whereupon a metal complex can accept a quantum of photon energy, E = hν = $\hbar\omega$, propagating into the cell, without simultaneously propagating out of the cell through the membrane on the other side. And given that this is the premise of the investigation, we have investigated above the limit R(cancer cell) = R(healthy cell), infinite photon energy required. Now for the other limit, R(cancer) = 0.

→ ΔPQ = ∞ = R(healthy) – 0. That is: (15)

R(healthy) = ∞ × R(cancer)

= 0 × ∞.

Then $\hbar^2\omega^2 = 0$. This implies that a photon of arbitrarily small energy will “tap” the metal complex into the cancer cell, because it has no membrane. However, if $\hbar\omega$ increases to even a very tiny extent greater than zero, the metal complex will *not* be trapped inside the cell, because there is no membrane on the other side of the cell either, the metal complex just drifts on to oblivion, assuming it doesn’t just happen to hit a chromosome before it does so.

We are working on the premise that Rate absorption (cancer) : Rate absorption (healthy) = K : 0, ($0 < K < \infty$), if the correct irradiation frequency, $\hbar\omega$, is selected. And with the investigations carried out in October, 2025, hopefully we have determined that frequency.

It is probable that in the process of “fine-tuning” the frequency $\hbar\omega$ such that passage into cancer cells is preferred over passage into healthy cells, and we in our optimism expect nothing less than *zero* propagation of the metal complex into healthy cells, that the absorption into the cancer cells would be up to greatly reduced too, although obviously not zero absorption into the cancer cells. So the “dose” would have to be correspondingly increased, either the intensity of the radiation or the concentration of the metal complex, or both, but at

least in the knowledge that increasing the dose won't make any difference to healthy cell absorption, zero.

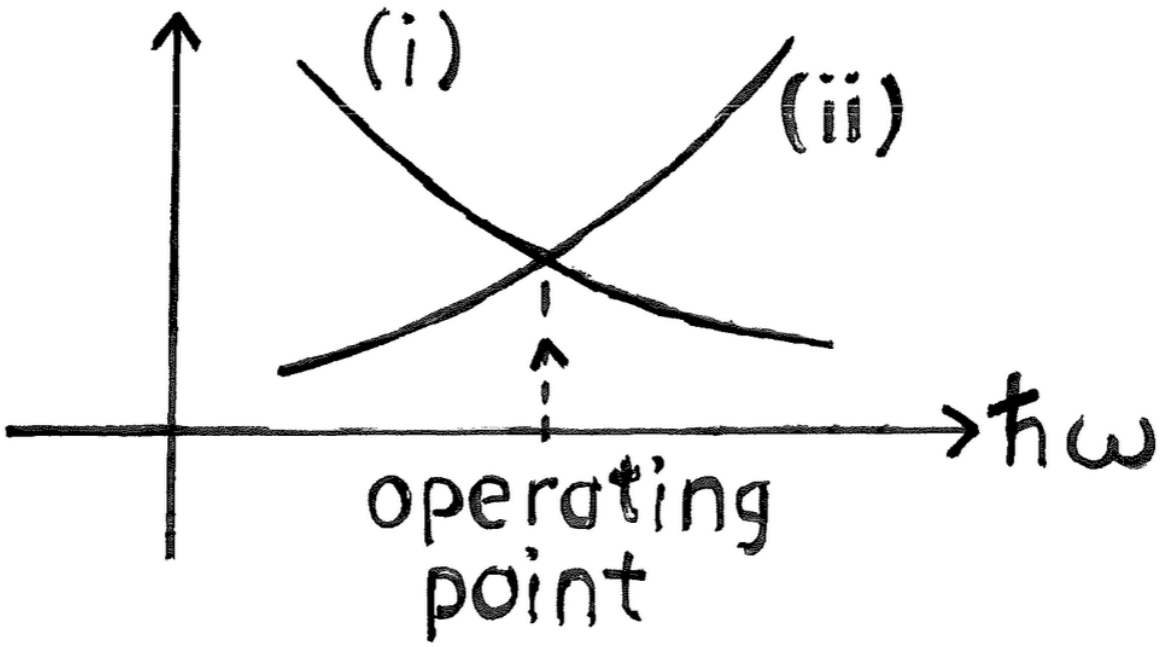


Figure 6: We have a range of frequencies dedicated to a healthy cell being tuned to reject a photon, and similarly for the diseased cell being tuned to accept a photon, and the "operating point" is where the two curves meet, this occurs at $\hbar\omega$, according to the calculations above. (i) diseased cell tuned to accept photon, versus (ii) healthy cell tuned to reject photon

We are obviously missing out on a large part of the underlying mechanism. Since we seem to have achieved at least a possible mathematical solution for the problem we have devised, getting the metal complex into the cancer cell, let's see if it works before we get too heavily into theorising! That is, before we investigate the nature of those proposed opposing curves in figure 6. If the cancer treatment works, then it is no longer theorising or proposal. Just a few final comments however.

How do you "tune" for rejection of a photon by a healthy cell, versus acceptance by a cancer cell? Suppose the probability:

$$P(\hbar\omega \text{ accepted}) = 1 - P(\hbar\omega \text{ not accepted}). \qquad (16)$$

Our first impression would be that P($\hbar\omega$ accepted) would form a very thin "strip" in possible outcomes, and a relatively *thick* strip for P($\hbar\omega$ not accepted). Which appears to be at odds

with Figure 6 above, whereupon “healthy cell rejects photon” and “diseased cell accepts photon” are both “singular” outcomes.

Solution: Firstly consider the event “complex gets into cell” and then consider the event “but gets out a macroscopic instant ~ simultaneously, on the other side of the cell”. So you have:

(1) The microscopic process, the metal complex, or photon, as it has become, penetrates the first membrane, a singular outcome, versus:
(2) The *secondary* microscopic process, having penetrated the first membrane, the complex proceeds to penetrate the second membrane i.e. the membrane on the other side of the cell, “simultaneously” such that the net result is not getting into the cell. The view from inside the cell is that it is a singular outcome, that photon getting through the membrane on the other side.

It is always a singular outcome, when you view the net process as a two-phase process. But the net process, *not* deconstituted, in this manner, is *non*-singular. That is, for the photon incident on a cancer cell, P(absorbed by cell) = 1 – P(not absorbed by cell). That is, “*doesn't* get into cell” is not only a description of the complex not penetrating the first membrane, but also incorporating a combination of the process (i) *does* get through the “first” membrane, and (ii) *does* also penetrate the membrane again, on the other side of the cell.

How do we rationalise the height of the QTE spectrum = $|\mathbf{E}|$, versus the height of the “cancer spectrum” = $\hbar^2\omega^2$? One is a square, the other isn't. Well, consider the cancer spectrum. It is a voltage source, power $P = V^2/R \propto \hbar^2\omega^2$. Then power = Force × velocity = $q_e \times E_{ax} \times c$, where $E_{ax} = |\mathbf{E}|$ is the central axial field of the electromagnetic flux tube, that the weak-strong gauge bosons interact with. The two spectral heights are entirely consistent with one another.

CONCLUSION

Okay, we have the critical process, complex (as photon/weak-strong gauge boson) gets through the membrane to get into the cell, but doesn't (near) simultaneously get through the membrane on the other side of the cell, thus not ending up inside the cell, [1]. So we envisage an electromagnetic flux tube that extends through the entrance portion of the membrane, across the cell and then back through the membrane on the other side, ending just outside the membrane. We invoke our knowledge about “terrestrial electromagnetic flux tubes”, i.e. your ordinary everyday electric circuit. The region of this miniscule electromagnetic flux tube, the

portion of it *between* the two membranes, not inside the membrane, corresponds to a "zero resistivity" region in an electric circuit.

According to the theories we have devised concerning electrical circuits, in QTE, [2], [3], every fermion entering the circuit will at some time before it gets to the end of the circuit radiate outwards as a dual Maxwellian photon, in the company of another photon of exactly the same frequency, but the "anti-photon". That is, if it is radiating outward as an electronic/positronic photon, it will be joined at the surface as it radiates by a positronic/electronic photon, same energy, from reverse circuit processes, (we are not, beyond this, concerned with reverse circuit processes in this paper, we are just concerned with one-way transport). As to why the two photons have identical frequency-energy, we haven't got beyond a theoretical time travel, such that when the fermion from the interior gets to the surface and unites with a dual Maxwellian photon in the helix, then we go back in time and ensure that helical photon radiates away exactly the necessary amount of heat in the process such that at the rendez-vous, its frequency matches its partner from the interior.

Anyway, the critical point is that in a region of zero resistivity, the fermions, dual Maxwellian versus weak-strong gauge boson, there is no generation of heat. Equally, there is no occurrence of fermions from the interior hitting the surface and radiating outwards with a photon from the helix. Every fermion that enters the region of zero resistivity exits it, without radiating outwards. The exact quantity of fermions, electric charge, carried in the region of resistivity is the quantity required for dissipation processes further down the flux tube, (i.e. in the "outer" portion of the membrane). Whatever current, I, is required for dissipation downstream, that is the quantity of current carried in the zero resistivity region. That is:

$I = \frac{V}{R} = \frac{0}{0}$ = whatever it has to be, (many discussions of division by zero, [6]), because:

the potential difference across a region of zero resistivity, V, is zero, as of course is its resistance, R. The essential facet is that if you put the flux tube all the way through the interior of the cell and through the membrane, again, on the other side, that the inter-membrane region has zero power dissipation – no radiation, no *heat*, such that the interim region of the flux tube that is *not* participating in these processes is therefore not affecting our "quality factor calculations" above. So we get two for the price of one. Just from a theory about a complex crossing a membrane, you effectively get *two* membranes, *ignore* the intracellular space, so the physics is "enriched" by the dual process to consider, firstly, does the complex get across the first membrane, and then if it does, does it also get through the second membrane, negating the fact that it got through the first membrane, or otherwise?

Okay, so perhaps this is it. It is a voltage source, V is the photon energy, power $P = V^2/R$. We know high (heat) dissipation equates to non-success in getting metal complex into cell. Therefore small resistance, R. The metal complex either goes right through the cell, passing through the membrane twice, or else simply "bounces" back off the first membrane, back from where it came, but with reduced kinetic energy, owing to the dissipation. Either case small resistance, whereas if the metal complex gets trapped, permanently, in the cell, that constitutes a very large resistance, because at one moment the complex was just doing its usual thing, according to Newton's first law, and then the next moment it is trapped in a tiny, stationary cell, that constitutes some maximal "resistance" to the process. So the crucial point is that the momentum $\mathbf{p} = m\mathbf{v} = \mathbf{E}c$ is the *same* in the flux tube, whether in the membrane of the cancer cell or the membrane of the healthy cell, the difference to the process between the two circumstances is in the resistance, R. We addressed this matter above, with respect to our analysis of equation (14), we were forced to conclude, "momentum = constant". Note that we are equating an internal axial field **E** that a WSGB is propagating upon with the amplitude of that propagating fermion $|\mathbf{m}| = |\mathbf{E}|/c^2$, where we have taken the modulus of the two vectors because, while they are of the same magnitude, they are pointing in orthogonal directions.

So, irradiation frequency is related to cell membrane width in the manner described by equation (14). You increase photon energy, then the potential difference across the flux tube increases not by increasing $\mathbf{E}_{ax}$, but by increasing the width of the flux tube, hence the potential $V = \mathbf{E}d$. According to "momentum = constant". This would indicate, would it not, that the theory we have devised is correct? In particular, equation (14), and at this point it only needs experimental confirmation, that would be the indication!

Final comment: Regarding equations (1), (2). The helical process that occurs simultaneously with the axial process, we have helical current = axial current, and power P has equal contributions, correspondingly, for torque (helical) versus force (axial), is vital because it deals with an "innate inductivity" of even a straight piece of conductor, and we therefore have an inductance $L \propto$ helicity, which plays a vital role in the quantitative outcome of our investigation, most particularly, in generating equation (14). So why do we not have to bother about "innate helicity" → inductance in "macroscopic" electric circuits? Perhaps it is just the scale of the flux tube? As you shrink, surface processes become dominant over volume processes, for example, when you cut potatoes into smaller pieces, they cook faster, because surface area is increased. Similarly, when you consider microscopic flux tubes embedded in cell membranes, as opposed to "macroscopic" electromagnetic flux tubes. A macroscopic inductor, L, such as we see in "terrestrial electromagnetic circuits", has nothing to do with any kind of surface process, it is equally "axial" as helical.

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