Resonant energy absorption and the CTF hypothesis

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ABSTRACT

Antennas in resonant circuits can present an effective energy absorption cross-section much larger than its physical dimensions to the impinging EM waves. Similarly, atoms can absorb energy from fields with energy densities so low that the atom must have an effective interaction cross-sectional diameter on the order of tens of microns. It appears that resonant energy absorption exhibits a sort of "suction" effect by the absorbing dipole, or a "pushing" effect by the field, or a combination of both. This allows the field energy to converge from a larger volume into a smaller region. We will argue that this effect may actually correspond to the *field* preferentially *directing* energy into such resonant systems, and discuss how this provides further evidence for the utility of our proposition of a universal, complex tension field (CTF). We have proposed that CTF can support propagating field gradients, like EM waves, as well as resonant, localized and self-looped oscillations representing various particles. Different gradients in the CTF, generated by different kinds of particle-oscillations, represent the various forces experienced by particles within each others' physical domain. Even time emerges as a secondary property. Thus, the CTF postulate provides an excellent platform to re-invigorate attempts to build a unified field theory.

Keywords: complex tension field, ctf, ctf hypothesis, resonant absorption, unified field theory, particles, forces, time

1. THE CTF HYPOTHESIS

Much observational evidence, such as the wave-like propagation of the electromagnetic field and the possibility of converting electromagnetic energy into mass through pair production, suggests the existence of a universal, complex* tension field (CTF)[1,2] that can support both, linear and non-linear perturbations. This field represents the fundamental entity, different kinds of undulation of which make up what we call our observable universe. We cannot claim this idea of CTF as novel. It has existed, in different guises, for a long time. The probably best known incarnation corresponds to the luminiferous æther of the 19$^{\text{th}}$ century, which seems to have gotten quite a bad reputation with the introduction of Relativity.

The problem with the majority of previous æther concepts resides with the idea of its *independent* existence, i.e. as a substance *separate* from "ordinary" matter and EM waves. This introduces all sorts of problems and requires a lot of back-tracking and increased complexity to make theories based on such an æther work. The CTF hypothesis, on the other hand, posits CTF as the *only* and the *fundamental* physical field that exists. Everything else emerges due various kinds of undulations and perturbations of this field.

This definition of an æther, unlike its abandoned predecessors, makes physics conceptually much simpler, especially in light of high-energy physics' still large number of elementary particles with uncertain origin, many of which, like the quarks and gluon, we cannot actually detect.[3] Just as Occam's razor served as an argument for abandoning the *historical* æther concept, so must it now encourage us to adopt the simplifying assumption of the *modern* æther posited here as CTF.

Electromagnetic waves, for example, represent perturbations within the locally linear restoration capabilities of CTF. The electromagnetic wave equation captures this behavior well mathematically. We hypothesize that the universal substrate (CTF) itself cannot absorb dipole induced perturbation energy. This causes it to continually "push away" such linear electromagnetic disturbances from their current location, in order for CTF to return to its original equilibrium state. This, in effect, gives rise to, and an intuitive explanation of Huygens' principle:

*We don't use the word *complex* in the mathematical sense of *complex numbers* here. When we speak of a *complex (tension) field*, we refer to its physical complexity and ability to support a multitude of different perturbations and gradients.

the source of energy for the "secondary wavelets" results from the tendency of the tension field to return to its quiescent state. The velocity, c, with which these perturbations propagate depends solely on the electromagnetic parameters of the CTF (ϵ_0, μ_0), just as in the case of other "tension waves" in systems such as *i*) mechanical tension fields held by wires, *ii*) pressure tension fields held by gases, *iii*) surface tension fields held by liquid surfaces, etc. Material substrates (wire, gas, liquid) in a state of some physical stress give rise to their respective tension fields, which all have the tendency to push away external perturbations, which lies at the heart of perpetually propagating waves. Whether CTF constitutes its own substrate, or whether something even more fundamental gives rise to, and sustains it, remains as of yet unknown and requires further exploration. For now, we will assume the former possibility, i.e. that CTF exists independently.

We have already discussed EM waves, and in the remainder of the paper, we will show how particles, forces and even time represent emergent properties of one single, fundamental, complex physical entity: CTF.

2. PARTICLES

In 2010, Greulich observed, that one can calculate the masses of long-lived elementary particles as certain integer multiples of the quantity $m_e/2\alpha$ (see FIG.1), where m_e corresponds to the mass of the electron, and $\alpha = \frac{e^2}{2h}\left(\frac{\mu_0}{\epsilon_0}\right)^{\frac{1}{2}} \approx \frac{1}{137}$ represents the fine-structure constant.[4] This provides a further hint to the idea that particles most likely emerge as some sort of resonant oscillations of CTF under strong non-linear perturbation of its quiescent state. We hypothesize that stable elementary particles, such as electrons and the protons, correspond to complex, non-linear, localized, non-decaying, self-looped resonances of the tension field, while unstable particles correspond to almost-resonances that decay into more stable ones. Particle decay continues invariably until it results in one of the only two known stable elementary particles: the proton or the electron. Their stability may, arguably, have its root in some variational or action principle involving general primary and emergent secondary properties of CTF.

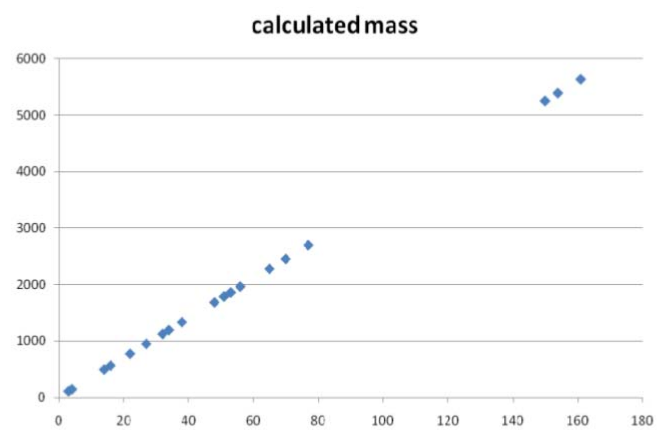
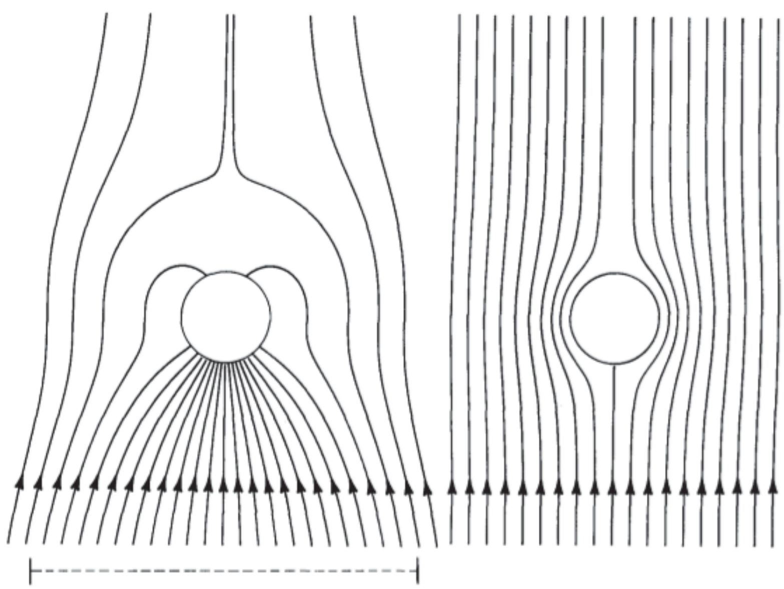


Figure 1: Plot of particle mass m (in MeV/c^2) vs. integer N, calculated using the equation $m = \frac{m_e}{2\alpha}N$, where m_e corresponds to the mass of the electron, and α represents the fine structure constant. Source: Greulich, 2010[4]

In our paradigm, the formation of such a resonance undulation seems, under certain circumstances, to provide a channel for "disposing" of perturbation energy more efficient than simply "pushing it away". Under suitable resonance conditions, the details of which still remain largely unknown, CTF can convert linear EM energy into such meta-stable or stable self-looped resonances. This effectively enables CTF to confine energy locally, as opposed to pushing it away continually, thus increasing its overall state of quiescence. Experimental observations of this effect (for example *pair production*) date back to the 1930s[5] and have become common place in particle colliders around the world. It appears very hard to observe this effect in the absence of matter, i.e. without the presence of already existing self-looped resonances. In most practical experimental situations, as far as we know, energetic bundles of EM radiation (photons) have to *interact* with a *catalyst* (some material particle) in order to form new material particles.

Feynman diagrams of this process[6] and other symbolic relations, such as $\gamma + \gamma \longrightarrow e^+ + e^-$,[7] often mislead us by not explicitly including the mediation by particles actually present in the process. Symbolically, we should represent such a process more faithfully by $\gamma + \gamma + N \longrightarrow e^+ + e^- + N$, where N represents the facilitating (catalyzing) material particle / self-looped resonance (note that the number of photons involved in these processes may actually vary). Through this process, a previously linear perturbation of CTF can become part of a *stationary* resonance, as opposed to continually propagating with constant velocity c. In this new state of existence, as a non-linear, probably self-looped, resonance, this particle can now acquire other velocities - smaller than that at which CTF pushes away linear disturbances. With all this as a backdrop, the CTF hypothesis can explain the mystery of the upper limit on velocities ($c = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$) more intuitively: since all material particles ultimately represent some kind of (non-linear) undulation of this same tension field, we can't push (move) particles (i.e. more complex disturbances) faster than CTF itself could push away the simplest disturbances of itself (EM waves).

A further avenue for disposing of perturbation energy within the linear restoration capabilities of CTF presents itself when we consider composite systems, made up of a number of fundamental particle resonances (elementary particles): nuclei, atoms, molecules etc. Absorption experiments done at low energy density indicate a *suction* (by the particle), or *pushing* (by CTF) effect: the amount of energy absorbed from the propagating EM waves appears to exceed that intercepted by the geometric cross section of the absorbing atom or molecule (FIG.2). Classical and semi-classical theoretical investigations find this effect due to the detector's interaction with the superposition of the fields incident on and those (re-)emitted by the detector.[8,9] The semi-classical treatment additionally finds the intensity dependence of this behavior: with increasing energy density, the effective cross section decreases,[8] due to saturation.



(a) (b)

Figure 2: Pointing vector flow (field lines) in the vicinity of a particle at resonance (a), and not at resonance (b) with the impinging EM field. The particle at resonance has an effective cross section 18 times larger than its geometric cross section. Source: Bohren, 1982[9]

A quick back-of-the-envelope calculation for free atoms in a gaseous state will illustrate this enhanced absorption effect. For instance, electronic transitions happen nearly instantaneously, and for a resonant atom to absorb a red photon from a $1mW$, $1mm$ diameter laser beam,[10] it would have to have a radius of about $55\mu m$. For comparison, an excited hydrogen atom in its $n = 137$ state has an atomic radius of about $1\mu m$, while 'regular' atoms have radii on the order of angstroms. This implies that, frequency-resonant atoms have the ability to increase their interactive volume by at least 17 orders of magnitude!

Hence, a resonantly excited (free) atom presents a very large effective cross-section for harnessing EM energy from its surroundings. This can probably not happen when the atom finds itself confined within the restricted solid state environment. Thus, optical solid state detectors need higher EM energy flux as they become smaller, while *nuclei* in such detectors can offer large cross sections to resonant γ-rays, due to the enormous amount of space between nuclei even in such environments.

This extends our hypothesis of CTF's inability to absorb perturbation energy (EM waves) further, and in light of the CTF hypothesis, we can interpret the above results as follows. Stable or metastable compositions of self-looped resonances of CTF may have multiple stable or metastable configurations (i.e. nuclear, atomic and molecular energy levels), transitions between which will require (or release) energy in form of EM radiation. A possible transition from a lower to a higher internal energy state of such a complex resonance provides a potential *sink* for "free" EM energy. The resulting state of higher internal energy of our composite particle may present a more favorable overall state, and could thus result in a preferential "pushing" action by CTF to guide free EM energy such as to effect the absorption of the linear perturbation by the self-looped resonance composite. This process would then explain the apparently much larger cross section for such energy absorption processes.

3. FORCES

In addition to disposing of some of the problems that plague current theories,[1,11] the existence of CTF also provides a natural reason for *why* some particles should at all interact with electromagnetic waves, or with each other, and hence explain the existence of forces. We argue that CTF can support many secondary gradients, for example that created by massive and/or charged particles, which can influence the state of motion of other particles in the vicinity. Since all particles emerge as localized, self-looped resonances from the same fundamental tension field, their ability to interact with one another in *some* way seems natural and a logical consequence of our hypothesis.

With CTF and the self-looped resonance picture of the elementary particles in mind, we can see what this would imply for what we currently regard as the four fundamental forces of nature: electromagnetism, the weak and strong nuclear force, and gravity. Electromagnetism, as we have already indicated, represents the simplest of the four in our proposal. Traveling electromagnetic waves represent simple, linear perturbations, i.e. traveling gradients within CTF. We know that both of the fundamental particles (electron, proton) feel this gradient in the way mathematically well described by the Hamiltonian for charged particles in such a field. The neutron corresponds to a composite-resonance of the two fundamental particles, and since the interaction depends on the emergent property of *electric charge*, the neutron does not appear to "feel" the electromagnetic gradient. Due to its composite nature, it may have a very small dipole moment by which it *can* interact with the field, but so far experiments have only put upper limits on its size, but not conclusively confirmed its existence.[12]

Our theory appears compatible with either possibility, and would require more detailed knowledge of the nature of the self-looped resonances to make predictions with regard to either of the two possibilities. However, an incomplete cancellation of charge, i.e. a minute interaction, could arguably provide the reason for the instability of the neutron, and its eventual decay due to the perpetual presence of background fluctuations. This hypothesis presents us with the possibility of experimental confirmation (or refutation), since the neutron's decay time should show a dependence on the amount of electromagnetic background fluctuations, as well as the presence and influence of other high energy and low energy particles.

Different types of internal undulations may give rise to different kinds of potential gradients around, into which different particles can "fall", or from which they get "repelled". What we call forces actually results from various gradients of CTF. The successful mathematical modeling of forces as potential gradients thus far corroborates this postulate.

Thus, in our theory, the weak and strong nuclear forces would likely find an explanation in (possibly non-linear) interactions of elementary self-looped resonances of CTF. Quantitative, and more detailed qualitative understanding of this will, of course, require a suitable mathematical model. As it stands, gravity will probably pose the largest problem to incorporate into our theory. A very weak, long-range secondary gradient within CTF, set up by any self-looped resonance, may provide one possibility. As evident from Newton's law of gravity, this gradient would have to have a very long range, and add up linearly with the contributions from all other particles as they form a macroscopic material object. This gravitational potential gradient has only one sign (attractive), unlike the long-range electro-static potential gradient, which we observe as either attractive or repulsive depending upon complementary internal undulations.

Most importantly, our CTF model does not rely on any quantized exchange particles to facilitate interactions between particles with "material" properties.

4. TIME

Our hypothesis also helps explain a contentious issue most other theories do not address from a fundamental point of view, if at all - namely that of time. From our perspective, no "running time" exists in the universe. Instead, all that we have to work with, and the only thing we ever measure, corresponds to a time *interval*. Even these intervals do not come from direct measurements of *time* as a physical parameter. All clocks, even the most sophisticated atomic clocks, at the most fundamental level measure oscillation *frequency*.[13,14] This quantity, when inverted, gives the period of oscillation, which, in turn, we can stack up to make any time *interval* we like. Time, then, really counts/measures the number of periods of *some* physical oscillator, i.e.

$$\Delta t \equiv n \frac{1}{\nu} \tag{1}$$

where $n \in \mathbb{R}_{\geq 0}$ corresponds to the, possibly fractional, number of periods, and ν to the frequency of the particular oscillator chosen.

With this, we can regard the popular and somewhat circular "definition" of time as "time is what clocks measure" as almost right: as a black-box like machine, a clock shows us a quantity we call time, but it *creates* this quantity by *measuring* the more fundamental parameter of frequency, deriving the period from this measurement and then stringing these together. Clock designs keep getting more and more complicated and intricate. The most accurate clocks today use the transition frequency of certain atoms or ions. However, we cannot use these frequencies directly for our clocks - the actual measurement comes from locking an external oscillator, like a microwave cavity or a laser, to the transition frequency using feedback mechanisms.[13,15] Even with the *simplest* time measurement devices, we cannot measure time intervals *directly*. In comparison, we *can* measure spatial distances simply, although we can make these measurements arbitrarily complicated as well. One of the simplest devices, the meter stick, provides a direct measurement of a space interval. Equally simple devices for (direct) time interval measurements do not exist.

Furthermore, considering time on an equal footing with space results in what we'll call the Current-Instant-Problem (CIP). If time exists as a dimension comparable with space, why do we perceive this dimension in a "slice by slice" fashion, while we can move through space at will? Clearly, the *current instant* in time has some kind of special place, compared to other instants, or points, in time. This also includes the problem of the "arrow of time" (a.k.a. the Humpty Dumpty problem).[16] We commonly see explanation of the latter referred to the second law of thermodynamics.[17,18] This, however, only really applies to (large) ensembles of particles, while time and the associated direction applies just as well to single particles, as well as to EM waves, which do not involve particles at all. Thus, the second law mostly represents a convenient carpet under which to sweep this important problem.

None of these, nor other associated problems, occur with the CTF hypothesis. The *physical properties* of CTF completely determine the oscillatory behavior, and with it things like transition frequencies, of emergent entities like electrons, protons, atoms etc. Thus, time just emerges as a *secondary* or *derived* quantity from the oscillatory processes occurring within CTF. The "arrow" of time naturally finds an explanation in the above mentioned tendency of CTF to "push away" perturbations from their current location. This property of CTF also causes EM radiation to diffract, or spread out. From this vantage point, the spreading of light and the arrow of time have the same cause, and represent similar physical effects. Without independently existing time, CIP does not even come up. CTF's physical state, and thus that of physical entities emerging from CTF, evolves at a rate based on its physical properties.

Evidently, our current (time-based) language (and thinking) lacks the proper terminology to discuss this situation adequately. Talking about the "current state" of CTF conjures up the notion of time automatically and seems to require it. However, our proposed CTF universe, existing in an overall non-equilibrium state, really does not require the notion of time at all. Its intrinsic physical properties just keep CTF evolving, not in time, but *away* from its current state, and *toward* a new state.

5. CONCLUSION

We have introduced our hypothesis of a fundamental, complex tension field, and demonstrated how this postulate can provide a basis for essentially all observable phenomena, including electromagnetic waves, the existence of material particles, their forces of interaction, and even time. In this sense, CTF may provide a starting point for a unified field theory. If nothing else, it provides us with a more visualizable, process-driven and integrated way of thinking about the physical universe, in contrast to most current, very mathematical and abstract theories.

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