Cordus in extremis: Part 4.2 Fabric of the universe

Pons, D.J. ,[6] Pons, A.D., Pons, A.M., Pons, A.J.

Abstract

The concept of the vacuum is problematic for conventional physics. Electromagnetic wave theory models it as consisting of nothing at all, but yet paradoxically having finite electric and magnetic constants. Quantum mechanics models it as consisting of temporary particles, but no average substance. General Relativity theory includes a spacetime medium, without describing the composition. In all cases the underlying physical mechanisms are obscure. Furthermore, these existing perspectives conflict in their expectations, so the integration is poor. The treatment is not always logical either: conventional theories find the idea of the matter-based aether thoroughly unacceptable, yet ironically all include something that looks conceptually much like a medium. The Cordus conjecture provides a conceptual solution for the composition of the vacuum: it provides a fabric that is granular (similar to quantised) at the smallest scale, scales up to a continuum, provides a medium for propagation of disturbances and waves, provides a medium for electromagnetism and gravitation, is relativistic, is not a matter aether, and includes a time signal. In the cordus solution the vacuum is made of tangled hyff (force lines) from all the surrounding matter particuloids. This cordus fabric concept also provides a descriptive explanation as to why the speed of light is a finite value. The fine structure constant is given a physical interpretation, as a measure of the transmission efficacy of the fabric. Cordus also distinguishes between the fabric that makes up the vacuum of space, as opposed to the void which has neither fabric nor time as we perceive it. This model is radically unorthodox in suggesting that the speed of light is relativistic but not invariant; that it depends fundamentally on the fabric density and hence the accessible mass density of the universe at that locality.

Keywords: cordus; vacuum; void; quantum fluctuations; magnetic constant; aether; relativity; spacetime; speed of light; fine structure constant

1 Introduction

There is a finite limit to the speed of light in a vacuum, but it is not known what determines the value. Wave theory defines light as a self-propagating field disturbance. From that perspective the speed of light is determined by the electric constant and magnetic constant. This of course begs the question of what determines those constants. Why should a

[6] Please address correspondence to Dr Dirk Pons, University of Canterbury, Christchurch, New Zealand.

region of space, with nothing in it, have a resistance to the growth of electric and magnetic fields?

Answers to these questions are not needed to explain the double-slit and other quantum effects. Nonetheless the Cordus conjecture offers some suggestions for thinking about the questions, though these should be considered *in extremis,* i.e. a thoughtful-experiment rather than a necessary core concept.

This paper is the second in a set of four. The first extended the Cordus conjecture to create a conceptual model for electromagnetic fields. The resulting model showed how a cordus particuloid could generate small transient units of force at the sub-atomic level, thereby creating the apparently smooth and continuous electric field that we more commonly perceive. That paper also reconceptualised how magnetism is generated at the sub-atomic level, and likewise explained how the granularity arises. It showed that the electric field is not shielded, only neutralised.

The present paper builds the concept further by creating a working model for how the vacuum operates. This is termed the 'fabric'. The concept is used to explain why light has a finite speed in the vacuum. This has interesting implications for distinguishing between the 'vacuum' of space and what we call the 'void' beyond the vacuum, and it also suggests a physical interpretation for the fine structure constant. The concept of fabric is important in the parts that follow, in that the fabric is proposed to be a core element in the unification of gravitation with electromagnetism, and it provides an explanation for time.

2 Temporal capacitance

The photon is unusual in that it emits and then withdraws its hyff, unlike the electron and proton (E.1.2). Therefore it is more self-contained than other particuloids. Light slows down in denser media because the cordus, through its hyff, exerts forces on nearby charged particles (particularly electrons). This takes time because the electrons have to move, hence plasmons, and their mass resists that. The photon *has* to delay while this happens - it cannot race ahead – because the hyff of the photon and electron are momentarily joined. This is the same as saying that the reactive-ends have to increase their lateral deviation zig-zag through the material and thus take a longer path. Note that the whole process is elastic and there are no losses: even though the photon slows down, it does not lose energy. (This counter-intuitive fact is useful in what follows.) For example, when it leaves a glass medium and goes back into air, it speeds up again. The glass does not provide *resistance* per se, instead it simply wastes the photon's time, and we call this *temporal capacitance*.

That explanation is fine for light passing through matter, but what about a vacuum, where there is no matter or charged particles? What provides the temporal capacitance? Saying it is the electric and magnetic constant is simply circular reasoning. The logical explanation is that there is some kind

of invisible medium, perhaps matter-based, that provides temporal capacitance and keeps the photon's speed down. What could that substance be made of?

One candidate might be quantum vacuum fluctuations: particles and antiparticles that pop into existence and almost immediately interact and then disappear. If so, this suggests that the speed of light would be determined by the rate density at which electron quantum fluctuations occur. For that to be a workable solution would require a uniform distribution of electron energies, so that the speed was the same for all energies of photons. Nor is that the only limitation. Why should the vacuum need to fluctuate in the first place? The conventional explanation is that it is an outcome of the probabilistic nature of the wave-function. However Cordus does not accept the wave-function as the reality (see 'Cordus matter'), so cannot accept that explanation either.

What about the concept of aether: that there is a fluid of otherwise undetectable particles through which light travels? That is an ancient concept, first disproved by the Michelson-Morley experiment, and now thoroughly discredited by modern physics. Yet the Michelson-Morley experiment merely disproved the concept of a static or moving-matter aether through which the Earth was moving – the wind. Is it possible to conceive of a different type of aether that is invariant to velocity, a *relativistic aether*? After all, c is invariant to Observer speed. This leads us to the fabric conjecture.

3 Cordus Fabric-of-the-universe conjecture

The fabric conjecture is based on the following assumptions.

E.3 Fabric hyff Lemma

E.3.1 The fabric of the universe is made of the hyff of all the other massy particuloids in the universe.

E.3.2 All 'virtual particles' are actually hyffons.

E.3.3 There is only one type of hyff, which is electrical, and is created by charged particuloids, but the frequency varies. The low frequency hyff generated by electrons are termed e-hyff, whereas high frequency hyff from quarks are termed q hyff, but they are otherwise all the same.

E.3.4 The frequency of basal generator determines the spacing of the hyffons. Therefore the frequency of the hyff varies for different types of cordus particuloids. There is a spectrum.

E.3.5 The density of the hyff in the vacuum determines the temporal capacitance and therefore the propagation speed through the vacuum. We term this the *saturated* speed of the fabric. This is the speed of light in the vacuum.

E.3.6 Propagation of light through matter, e.g. glass, involves additional hyff generated by the matter of the medium. This increases the hyff density and lowers the speed of light.

While we use the term 'fabric', this should not be taken to mean a 2D structure, nor a regular lattice like cloth. Instead the fabric weave a complex and disorderly mesh of 3D force lines, more like a bowl of spaghetti.

Speed of light explanation

Cordus suggests that light has a finite speed in a vacuum because the cordus has to interact with the *fabric* of the vacuum. According to this conjecture, the fabric is made of the hyff of all the other massy particuloids in the universe. Whether the hyff are electrostatic or some other type is not specified here. We proceed on the former assumption, which is effectively the same as saying all hyff are of the same type, hence E.3.3.

Origins of the fabric hyff

All the positive and negative charged particuloids in the universe, even those in neutral matter, contribute to the fabric hyff. The relatively low frequency hyff (e-hyff) from unit charges (electrons and protons) create electric fields which travel through everything. These low frequency hyff exert the electrostatic force on other charged particuloids of *comparable* frequency, i.e. on other protons and electrons. The e-hyff are also compatible with some energies of photons, and therefore electron mobility is important in many optical phenomena: it is no coincidence that polished metal reflects light. These e-hyff can *apparently* be shielded, by electrons in a Faraday cage setting up a counter field that balances the electrostatic force. However the original hyff are still there.

Deeper particuloids, e.g. quarks, also emit hyff. These particuloids have short span and high frequency, and their hyff have corresponding high frequency (q hyff). These hyff penetrate everything, but do not react with nominally charged particuloids like the electron and proton. These q hyff correspond to the gluons in QM. It is important to note that these q hyff are the same effect as the electrostatic hyff: just different frequency.

The hyff are weak at vast distances, but still finite. And they never expire, unlike those of the photon. All the positive and negative charges in the universe contribute to the hyff fabric. The electromagnetic force may seem to be zero at any one point, but this is merely because the hyff fields balance: the underlying hyff still exist.

These fabric hyff are themselves propagating outwards. These fabric hyff interact weakly with each other in passing, providing temporal capacitance. The interactions mean that the whole fabric operates at a certain saturated speed, c, and this also applies to the temporary hyff of any photons trying to move through. Since the whole hyff fabric operates at c, this provides the invariance to the observer's speed. It is not an 'aether' because it is not made up of particles, [7] but it is relativistic. So

[7] However if one wished to use the nomenclature of QM, one could say that the fabric was composed of virtual bosons.

everything that travels in the fabric of the universe is limited to a finite saturated speed, which is the speed of light in the vacuum.

In this model, the fabric itself provides the temporal capacitance: it uses up the time of photons and other particuloids that travel through it. The mechanism for using up time becomes apparent later in the gravitation and time paper (part 4.3), as interference by the fabric with the re-energisation of reactive ends. Thus the vacuum is not empty, but contains a tangle of moving hyff lines, each propagating hyffon pulses down its length at high refresh frequencies, so that the overall effect is a busy congested and dynamic network. The photon has to fight its way, albeit elastically, through this fabric, and this slows it down to the speed that we know as the speed of light in the vacuum.

Cordus also suggests that, by contrast, there is something emptier than the vacuum: something where the tangle of hyff has never been, and time perhaps has not yet existed. We term this the void. Conventional theories, including wave theory and quantum mechanics, do not have this concept. Instead they perceive of the vacuum as containing either nothing at all, or a sea of transitory particles (which is effectively also nothing).

The electric and magnetic constants of the vacuum become much easier to comprehend when the concept of the fabric is included.

As a lemma in the previous paper noted (E.2.4), the electric field is the fundamental effect, and the magnetic field is a derivative. The fabric model derived here is consistent, in that it proposes that the fabric is fundamentally constructed of plain electric hyff. That does not need to stop it also transmitting magnetism, and as we shall see, gravitation too, but the fabric itself is electric. This is also consistent with the known fact that the vacuum has an 'impedance of free space', which is in units of electrical resistance (approx. 376Ω). Those units are unfortunate, because from the cordus perspective it is better to think about the fabric in terms of 3E-09 sec time lost per metre travelled, because that emphasises that the impedance is not loss of *energy* in drag or resistance, but rather the loss of *time* in transit.[8]

The fabric as a whole is charge-neutral, because it consists of hyff from positive and negative charges. Thus the electromagnetic force on a stationary test charge seems to be zero at any one point, and it does not get moved by the fabric. This is merely because the hyff fabric-forces balance: the underlying fabric hyff still exist. In addition, the electromagnetic force only looks like a photon-effect, hence QM's 'virtual photon', because the hyffons create transient disturbances in the fabric hyff and these have a similar signature to a photon.

[8] Both electrical capacitance and inductance are time effects, and lossless regarding energy.

Quantum vacuum fluctuations

The fabric is granular at sufficiently small scales. It will also appear as noise, since there are q+ and q- hyffons to the fabric. Thus it can look like short-lived particles of electrons and positrons suddenly appearing and then disappearing. Thus Cordus suggests that what QM perceives as quantum vacuum fluctuations are the passage, past the Observer, of disorderly hyffons, not real particuloids of matter.

Gravitational bending of light

If the above conjecture were true, then it has some other implications. The first concerns nearby masses. What happens when light goes close to a big lump of matter – won't that change the strength of the fabric hyff? Yes, and that is what we interpret as gravitational bending of light. In this idea, it's not so much the mass that the photon is responding to, but the charges within that mass. The bending of the locus would be caused by more fabric-hyff leading towards the mass. Note that hyff are force lines, and while the general background fabric-hyff apply a balanced force on any particuloid, the hyff from the local mass are strongly directional. Therefore the fabric in the vicinity of a mass will have a preferred direction, i.e. it is a vector field not a scalar field.

Fine structure constant

One implication of the hyff fabric concept is that the density of the universe affects the speed of light. The fine structure constant α appears in several places in physics, and thus can be explained in various ways.

From the Cordus perspective α is a measure of the transmission efficacy of the hyff-fabric, i.e. it determines the relationship between the electric constant of the vacuum fabric, and the speed of propagation c through the fabric. To explain this another way, the fabric is made of electrical hyff, and the saturation thereof crates the temporal capacitance, which in turn results in the electric constant and limits the speed of light to a certain finite value. Thus Cordus suggests that the dependent variable in the equation is the velocity of light c. Thus:

$$c = \frac{e^2}{(4\pi\hbar\alpha)\varepsilon_o}$$

where e is electric charge; ħ is reduced Planck's constant; α fine structure constant; ε_o electrical constant of the vacuum. Assuming all of these are constant bar the last, then the speed of light depends on ε_o, the electrical constant of the vacuum. Cordus suggests that ε_o represents the density of the fabric hyff, and thus depends on the mass density of the universe. Thus the speed of light in the vacuum depends on the mass of the universe and the local density of the fabric hyff.

Thus the Cordus perspective is that the fine structure constant α refers to the relationship between electrical hyff and the speed of propagation of hyffons. Thus it is to be expected that α will appear wherever electrical

hyff and propagation of fields occur, and this includes the cases covered by CoFS such as electron bonding.

If this is correct then the speed of light in the vacuum may be locally but not temporally invariant, even if it is always relativistic. Light may have been faster in the very first moments of the universe when there was not much matter about (inflation), then slower when matter formed and the universe was much denser than now. Finally it could be increasingly faster as the universe expanded and the mass density dropped. The speed of light may not even be directionally invariant. These are unorthodox predictions of cordus *in extremis*, and there may be other factors to consider. But if true then the structural implications would be large: it would imply that many of the supposedly fundamental physical constants may not be as exact as thought. On the bright side, the differences are likely to be negligibly small, at least for engineers who need to make things work in this present epoch and local region of space.

Vacuum vs. void

In conventional electromagnetic wave theory there is no aether and EM waves can propagate through nothingness. However Cordus *in extremis* differentiates between the vacuum of space and the void. The vacuum is that region of space in which the hyff-fabric has become established, but where there is not-yet any matter. As later extensions of the idea show, the fabric is also where time, as we perceive it, exists. By contrast the void is beyond the universe and has neither fabric nor time as we perceive it. The fabric expands into the void and colonises it.

The fabric concept is that the hyff expand space into the void, and that gravitational attraction is carried by the fabric. The expansion might not occur at the outer edge of a spherical universe, but *throughout* the space of the universe, in which case space is also expanded, and matter accelerates outwards (the expanding universe). It is also possible that the fabric simultaneously carries the hyffon pulses that create specific gravitational *attraction* between bodies, while the fabric itself exerts a *repulsive* force on space (‘dark energy’).

If matter continues to accelerate outwards, and were to approach relativistic speeds, then parts of the fabric might become disconnected from each other and the hyff Lorentz-compromised (see part 4.3) in the radial direction. In this speculative model, the eventual physical fate of the universe could be a 2D shell, or rather a set of disconnected shells like an onion, where the only possible interaction was laterally.

4 Conclusions

Conventional theories of physics model the vacuum in one of two ways. Electromagnetic wave theory models it as consisting of nothing at all but yet paradoxically having finite electric and magnetic constants. Quantum

mechanics models it as consisting of particles that randomly pop in and out of existence, though the underlying physical mechanisms are obscure. General Relativity theory also has a fabric, in this case of spacetime, but likewise is not specific as to what that contains, though by implication it is smooth rather than granular. Even more problematic, the existing perspectives do not integrate together, and thus are part of the wider discontinuity that is 'wave-particle duality'. Gravitation has been particularly difficult to integrate into the particle paradigm of conventional quantum mechanics. This is because relativity has a smooth spacetime, whereas QM expects gravitation to be quantised to particles.

Existing theories implicitly require that there is something in the vacuum: something that is a medium for the propagation of waves, or provides the random fluctuations required by QM, or carries the spacetime curvature for relativity. While conventional theories find the idea of the matter-based aether thoroughly unacceptable, they ironically all include something that looks conceptually much like a medium, though none are specific about its composition.

Cordus provides a solution that *does* provide an integrated solution for the composition of the vacuum: it provides a fabric that is granular[9] at the smallest scale, scales up to a continuum, provides a medium for propagation of disturbances and waves, provides a medium for electromagnetism and gravitation, is relativistic, is not a matter aether, and includes a time signal. Cordus is a radically different theory to the conventional physics of wave theory, quantum mechanics, and general relativity, and was not derived from any of them. Yet the fabric that it predicts still includes features that are recognisable, even if subtly different, to those other theories.

In the cordus solution the vacuum is made of tangled hyff (force lines) from all the surrounding matter particuloids. This cordus fabric concept also provides a descriptive explanation as to why the speed of light is a finite value. The fine structure constant is given a physical interpretation, as a measure of the transmission efficacy of the fabric. Cordus also distinguishes between the fabric that makes up the vacuum of space, as opposed to the void which has neither fabric nor time as we perceive it. This model is radically unorthodox in suggesting that the speed of light is relativistic but not invariant; that it depends fundamentally on the fabric density and hence the accessible mass density of the universe at that locality.

The Cordus fabric concept is a useful component in the next level of exploration, which is the creation of a model for mass and gravitation, and for time, see Part 4.3.

[9] Granular, not quantised, as the fabric is not composed of uniform increments as the term 'quantum' suggests.