Cordus in extremis: Part 4.3 Gravitation, Mass and Time

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Abstract

Gravitation is conceptually problematic to General Relativity and Quantum mechanics in that the fundamental mechanisms are unknown to both, and the theories have different requirements that are difficult to reconcile into a single model. Cordus gravitation offers a solution to the problem. It provides a mechanism whereby gravitation is not continuous but in discrete force (or displacement) increments similar to quanta (but not uniform increments). Also, the closing force between two masses is transient. In this idea, gravitation, and therefore also mass, is a discontinuous property: i.e. a particuloid emits gravity (has mass) at some moments but not others. Thus gravitation is an effect that a mass does to the whole universe, not to targeted other bodies, and in this regard Cordus is consistent with General relativity. Both QM and Cordus agree that gravitation is quantised. Cordus conceptually integrates the different effects of mass: Gravitation is a particuloid contributing hyff to the fabric; Newtonian mass is resistance of the reactive ends to unexpected displacement; Relativistic mass is decreasing efficacy of hyff engagement with the fabric as velocity of the reactive end increases; Momentum is a frequency mechanism that ensures the reactive end re-energises on-time and in-place; particuloids like nucleons have mass to the extent that they have frequency. Furthermore, Cordus offers an explanation of how time arises at a sub-atomic level by the cordus frequency, and how this aggregates to the sense of time that we perceive biologically. Thus Cordus offers a radically new way of thinking about the problem of gravitation, mass and time that is quite unlike conventional physics, yet includes concepts that might be recognisable to those other physics.

Keywords: cordus; hyff; gravitation; mass,; time; spacetime; sense of time; fundamental physics; Lorentz; fabric; time dilation

1 Introduction

Existing approaches to gravitation are primarily space-time of general relativity, and gravitons of quantum mechanics. However neither explain how the underlying mechanisms work. This paper extends the Cordus principles to gravitation and mass as an *in-extremis* development, i.e. as a conceptual exploration.

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Mass is strange because it is the coupling for effects that otherwise might be independent:

- Gravitation: two masses attract each other. The gravitation force (or interaction) has an unusual set of properties compared to the other forces: (1) it only acts on matter with mass; (2) it always attracts, never repels; (3) it has infinite range; and (4) it cannot be redirected or shielded. Mass is the fundamental strength variable for gravitation.
- Resistance to acceleration (Newtonian mass): the greater the acceleration a or mass m of a body, the greater the force required to change its speed v, F=m.a or more generally F = d(m.v)/dt
- Relativistic mass: as the speed v of a body of rest mass m_o approaches that of light, so the effective mass tends to infinity, or at least the resistance to acceleration does, $m = m_o (1-v^2/C^2)^{0.5}$. This effect applies even if there is no acceleration.
- From the perspective of relativity, momentum is a separate property to mass and the full energy-momentum formula is $E = [(p.c)^2 + (m_o.c^2)^2]^{0.5}$
- In that case, what physical structure carries the momentum, and what carries the mass?
- Mass originates with particles, e.g. protons and neutrons (among others), hence atomic number.

This paper is the third in a set of four that extrapolate cordus ideas to the extremes. The first paper covers the electric and magnetic fields and shows conceptually how they are formed by hyff from cordus particuloids. The second creates a working model for the composition of the vacuum, and shows how this fabric is made of the hyff of all the other particuloids in the universe. It also shows how this fabric limits the speed of light to a finite value that is relativistic but not necessarily invariant. This third paper applies the Cordus concepts *in extremis* to create a conceptual model for gravitation. This model uses the hyff and fabric concepts from the previous papers, and offers an integration between electromagnetism and gravitation. It also provides a working model for mass. Finally, it creates a Cordus model for time, and shows how that integrates with gravitation and the fabric.

2 Cordus Gravitation

We suggest that gravity is a hyff effect, and simply an extension of electromagnetism. There are several variants of this idea. In the first variant, which is not the preferred working model, each massy particle sends out a specialised gravity hyff in addition to any electrostatic hyff. The difficulty with this idea is that it requires extra hyff (is not parsimonious) and it is not immediately apparent why a different mechanism should also be subject to c.[11]

[11] Also, it suggests by analogy with the electrostatic case that there should be another force for movement of the basal generator, like magnetism is for electrostatic. But there is no obvious missing force.

Why is c involved in mass? Variable c is the flight speed of the photon, not an atomic variable. From the Cordus perspective c is the propagation speed of hyff in general. This leads to the second and preferred model: that there is only one type of hyff (E.3.3), and gravitation is therefore carried by the hyff of the fabric. The following lemma sets out the assumptions.

E.4 Gravitation and mass Lemma

E.4.1 All sub-atomic particles, including quarks, are cordi.

E.4.2 All massy cordus particuloids emit hyff.

E.4.2.1 All hyff are the electric field type hyff, but smaller particuloids emit higher frequency hyff (q hyff).

E.4.2.2 The hyff of quarks are much higher frequency than the electric field of the electron, because the cordus frequency is higher for a quark, in turn due to shorter span.

E.4.3 Gravitation is carried by the hyff.

E.4.3.1 The current working model is that the hyffon carries a torsional twist down the fibril.

E.4.3.2 The transmission of gravitation is therefore at the saturated speed of the fabric, c.

E.4.4 Gravitation is attractive.

E.4.4.1 The current working model is that remote particuloids respond in the same way to the hyffon twist, regardless of the particuloid charge and other properties.

E.4.5 Higher cordus frequencies result in more frequent hyffons, and hence greater mass and gravitation effects.

E.4.6 *continued below*

Cordus proposes that the hyff of particuloids, including quarks and any free sub-quark cordi, carry gravitation. More specifically, even when the quark is stationary, it still oscillates at the cordus frequency. The frequency also relates to 'spin'.

In the Cordus gravitation working model hyff do not create gravitation by a direct pull, because that is the electrostatic force itself. Instead the force of gravitation on the remote matter particuloid is caused by the interaction of that particuloid with the hyffon spin: the re-energising reactive end of the particuloid is pulled closer, which is equivalent to saying it is constrained to re-energise in a closer position. This is similar to the magnetism mechanism. The mechanism is elaborated below.

2.1 Mechanism for gravitational interaction force

It is an open question as to how the oscillation of the quark emits the gravitation effect at the basal mass, how that effect is carried on the emitted hyff, and how it interacts with the remote test mass to create gravitational attraction.

It is tempting to say that whatever mechanism is behind the known strong-force phenomenon of quarks always attracting each other, is also that for gravitation. However that will not do, as the later work on quarks identifies the mechanism for the strong force and it is not obviously also a mechanism for gravitation. Thus gravitation does not correspond to what QM might call a gluon field.

The preferred candidate is the Hyff twist idea. This model has the hyffon carrying a torsional twist down the fibril. According to this model, all massy matter comprises charged particuloids, and thus there is electromagnetism to consider. Consider a basal mass of a single particuloid, and the a1 reactive end thereof. Assume a single radial hyff in the <r> direction. As a1 re-energises, it emits a hyffon that carries the electrostatic direct-force fragment, as well as magnetism curvature, and gravitational twist. The process of re-energisation of a reactive end, i.e. the hyffon emission, involves a 3D interaction, driven by the underlying right-hand rule (E.6.11, see part 4.4): the emission of the electrostatic component causes the reactive end to displace radially δr in the <r> direction as per E.7.8 (see part 4.4), there is a linked displacement δa in the <a> direction due to magnetism,[12] and a coupled displacement δt in the orthogonal <t> direction. The combined effect is that the RE describes a localised spiral motion at the moment of re-energisation, and the corresponding hyffon that propagates outwards on the hyff is likewise a spiral pulse.

Assuming such a spiral hyffon, this twist is transmitted out along the hyff, and gravitation is the response of other particles to that twist.[13] Emission of the hyff occurs as part of the frequency cycle for the particuloid. Outward propagation of the hyffon occurs at velocity c, and does not consume energy. The above explanation was for a single hyff. There is reason to think that massy particuloids have three pairs of hyff: one in each of the three orthogonal directions (E.6.2 in part 4.4). Therefore there is always a component of the hyff that is oriented in such a way to interact with another particuloid, *regardless* of the orientation of that particuloid. Thus gravitation is not dependent on the directional alignment of the particuloids, unlike magnetism.

When this torsional pulse reaches a remote test mass comprising cordus b, with reactive end b1, the handedness of matter ensures similar reactive forces along the hyff of b1. These forces correspond to lengthening the span of the b cordus. Since there three pairs of hyff, the net effect is a motion of the b1 reactive end directly towards that of a1. Note also that the emission process at a1 also moved that reaqctive end outward. So the

[12] The magnetic curvature effect, which exists even for a nominally stationary particuloid because it still has spin angular momentum, causes and is caused by a displacement δa in the <a> direction (which is tangential to the spin).

[13] If this is true, then remote particuloids might also be able to affect each other's spin, though it would only be evident when both bodies were in (separate) full body-coherence (see 'Cordus matter'). The usual massy bodies of the universe do not have such a degree of coherence.

overall effect is that the two reactive ends move closer together, if these are the only two masses operating.

The hyffon twist-pulse moves on further outwards and encounters the second reactive end b2. However the hand is conserved across the span (E.6.7, part 4.4) and the hyffon is approaching from the opposite direction so the force also moves this reactive end closer. The net result is that the whole of cordus b shuffles one increment closer to that of a. Thus gravitation is attractive.[14] In the meantime, cordus b also exerts a similar gravitational effect on cordus a.

We also speculate that the work that can be extracted from gravitational interaction arises from the changed spans of the cordi involved. Recall that the gravitational twist hyffon first encountered reactive end b1, and moved it outwards, i.e. increased the span. The pulse then moved outward and moved reactive end b2 towards a1, i.e. shortened the span again. However in the intervening distance the overall gravitational field, which is made up of many such hyffons, is diluted because it propagates across the surface of an expanding sphere. Thus on average reactive end b2 will not be moved quite as much as b1, i.e. the span will be increased. This corresponds to lower frequency and lower energy stored in the fibril. Thus there is more energy in the hyff field component. So as two bodies move closer together under gravitational attraction, so they release energy for other purposes, and their frequency and mass decrease slightly, according to this model.

The concepts of force and displacement are complementary in this model. This is similar to the magnetism model. Thus force is the high-level effect, whereas the effect at the deeper level is constrained displacement of reactive ends.

We acknowledge that the mechanics of all this at the next level down are indistinct, so the mechanism should be considered simply speculative.

2.2 Features of cordus gravitation

Why can gravity not be shielded?

The above lemmas explain why gravity cannot be shielded: the hyff penetrate everything, and there is no mobile particuloid that can set up a counter field, as the electron does in the Faraday cage for the electric field. Quarks are locked into atoms and are consequently not mobile enough to create such a cage, and even a quark plasma would be insufficient (unless quarks can repel). Only the electric field can be apparently shielded (more accurately neutralised), because the electron is the smallest particuloid that is freely mobile: anything smaller is only available in higher levels of assembly (see part 4.4).

[14] If this explanation is correct then the handedness of matter is responsible for gravitation being only attractive. Therefore the logical implication is that if one particuloid was left handed then gravitation would be repulsive.

Operation of Cordus gravitation

Cordus suggests that gravitation is not continuous but in discrete force (or displacement) increments (quanta). Also, the closing force between two masses is transient. The hyff is not consumed in the process, but momentarily exerts the closing force, then relinquishes it as the particuloid phases back into the de-energised state, and the hyffon moves on outwards. It passes through like a wave to react with other particuloids and even bodies beyond the first. A following renewal pulse along the hyff renews the force. What is perceived as gravitational attraction is the sum of many repeated interactions from different hyff.

Thus gravity propagates outwards in a granular manner from sub-atomic particles. The gravitational field of a particuloid therefore consists of a series of discrete forces. The hyff have infinite range, and are not retracted as in the case of the hyff of the photon. They maintain a connection thread to their base particuloid even at large range. As the particuloid moves, even spins on-the-spot, the subsequent hyff of the next frequency cycle may be released in a different direction. This frequency is very high, and there is an en-masse effect of multiple asynchronised particles, so the overall effect is what we perceive as a smooth field.[15]

In this idea, gravitation, and therefore also mass, is a discontinuous property: i.e. a particuloid emits gravity (has mass) at some moments but not others.

Comparison

The Cordus perspective of gravitation emerges as being similar but also different to General relativity (GR). In that other perspective gravitation arises from the curvature of spacetime, and is not so much a force as a geometric interaction of the moving body with that curvature. GR does not explain what makes up spacetime. By comparison Cordus also includes a concept that there is *something* in the vacuum (fabric), and is more specific about *what* is in there (hyff). Cordus uses a quantised force (hyffons) as the mechanism rather than geometric curvature. Both perspectives agree that gravitation is an effect that a mass does to the whole universe, not to targeted other bodies.

Plain Quantum mechanics does not have much of an explanation for gravitation, but Loop quantum gravity does: it proposes the mathematical concept that the fabric consists of spin networks. A region of Cordus fabric contains multiple hyff, and conceptually these momentarily define small dynamic domains: perhaps these correspond to spin networks? However from the Cordus perspective the underlying mechanism is force lines and force pulses, and loops in the fabric are likely to be only transient, and artefacts rather than the mechanism itself. Both QM and Cordus agree that gravitation is quantised.

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[15] To even measure the hyffons will require having an 'instrument' particuloid with smaller span (higher frequency) than the particuloid that generates them. A free quark could be a good start, though not without practical difficulties.

3 Mass

The Cordus explanation for gravitation involves hyff: the same hyff as transmit electrostaticism and magnetism. This gravitation force only acts on matter with mass, always attracts, has infinite range, and cannot be shielded. We now need to show how mass arises, and why it is affected by motion.

The difficulty is integrating mass and gravitation. If an object is just stationary in space, then it is impossible to determine its mass, other than through measuring its gravity. What we perceive as mass only becomes apparent when we try to move the body. So mass is resistance to acceleration, or force required to accelerate the body. Yet the same body just sitting there, also creates gravity, and mass is the common variable. Another complication is that mass increases as velocity approaches the speed of light. How can we integrate all these disjoint concepts?

Cordus model for mass

Additional lemmas are required to integrate mass and gravitation:

E.4 Additional lemmas continued

E.4.6 The mass effect is created at the level of the cordus particuloid by acceleration of energised reactive ends.

E.4.6.1 The reactive ends do not energise and de-energise instantly, so 'energised' above includes partially energised states.

E.4.7 Momentum provides the cordus with the ability to accommodate translational velocity in the position at which the reactive ends re-energise, i.e. there is an interaction between momentum and the frequency process.

Why is mass a motion effect? From an *in-extremis* perspective, the reason velocity and acceleration are linked to mass, is because what we perceive as 'mass' is the resistance to acceleration of the basal reactive end while it is energised (E.4.6). The hyff are force threads into the external environment, all attached to the reactive end. They maintain that force connection even when they are extended far, and they never expire: they just keep propagating outwards, and the force quanta are periodically renewed by new hyffons travelling down the hyff.

Velocity can be accommodated

The hyff are able to accommodate velocity of the basal mass (E.4.7). Velocity generates curvature of the hyff, and thus magnetic fields. At constant velocity the hyffons propagate the new curvature out towards the extremities, i.e. a combing effect. Thus for a stationary particuloid the curvature will eventually be combed out: there will be no magnetic field, and the hyff lines will simply travel radially outwards. The magnetism process does not consume energy per se. So once a velocity is established for the mass or charge, then it can continue moving indefinitely if there is

no external resistance: the velocity does not expire. This property is what is called momentum.

Thus the reactive ends resist a *change* in velocity. The greater the acceleration a or mass m of a body, the greater the force F required to constrain the reactive ends of its particuloids into positions they would not naturally take. Thus F = d(m.v)/dt or F = m.a.
Thus a Cordus model offers explanations for the resistance to acceleration (Newtonian mass).

Relativistic mass and the Lorentz

It is known that as the speed v of a body of rest mass m_o approaches that of light c, so the effective mass tends to infinity, or at least the resistance to acceleration does, $m = m_o (1-v^2/c^2)^{0.5}$. Thus the mass of a body appears heavier when it travels at higher velocity. This effect does not slow the velocity, so the body can continue at this speed indefinitely, but it does mean that disproportionately more force will be required to further accelerate it.

The Cordus explanation is that process of the hyff engaging with the fabric becomes progressively less effective as the velocity of the mass also approaches c. Thus from the Cordus perspective the concept of 'relativistic mass' is incorrect: the mass does not increase as the velocity approaches the speed of light, nor does the mass grow more hyff. Instead the mechanism of communicating with the distal regions of the hyff becomes compromised. Another perspective is that the fabric cannot be informed as easily of the changes, so the moving mass clashes more with the fabric. But the fabric is immense, being backed by the rest of the universe, and resists. To an observer it looks like the mass is increasing.

A partial quantitative explanation is also available, see Figure 1. In one unit of time, as the mass moves forward at v, so the hyff length has to maintain range c. The range contracts to B whereas usually it would be A. Then $\gamma = c/b$ is the ratio of contraction of the hyff in the direction perpendicular to the motion, and is the degree to which the hyff are compromised in their interaction with the fabric. By simple trigonometry $b = (c^2-v^2)^{1/2}$ and hence after rearrangement $\gamma = (1 - v^2/c^2)^{0.5}$, which is the Lorentz.

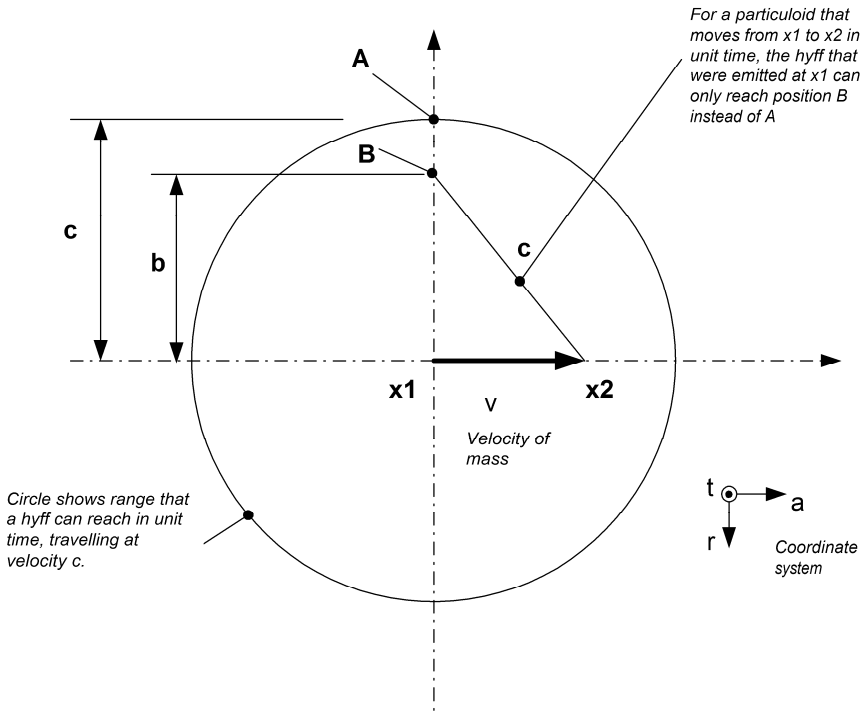

Figure 1: Degree to which hyff engagement with fabric is compromised as velocity of particuloid increases.

Thus greater force is required to accelerate a mass that is already at higher velocity, than slower. As the velocity approaches c, so the efficacy of the hyff compensatory mechanism tends to zero, and therefore the inertial resistance to further acceleration becomes infinite. From the Cordus perspective, mass is invariant: it is the number of hyff a body emits and the frequency thereof. From this perspective the mass only *appears* to increase at relativistic speeds because another force is acting that happens to look like mass.

Momentum mechanism

Everyday experience, and classical mechanics, suggests that a body needs to have mass to have momentum, and therefore if the photon has momentum it should have mass. However, relativity states that mass and momentum are separate properties, related to energy through the energy-momentum formula:

$E = [(p.c)^2 + (m_o.c^2)^2]^{0.5}$

In that case, what physical structure carries the momentum, and what carries the mass? Cordus suggests that a frequency effect at the fibril level drives both mass and momentum. The working model is that a moving cordus has a persistent gait for its reactive ends: at constant velocity the momentum gives the cordus frequency mechanism the required position of the RE that will energise next (E.4.7). Change in velocity interferes with the location, determined by momentum, where the reactive end was due to re-energise. Thus the reactive end re-energises later or sooner than it should have, which affects the frequency of the whole cordus including the hyffons. The engagement of hyff with the fabric becomes less effective.

We cannot answer that as clearly as we would like, and it looks to be an interestingly open question for future research. The place to start looking for a better understanding is probably the photon.

Relativity has no issue with a particle having momentum but no mass, and the photon is usually considered such an example. The photon is conventionally thought to be massless at rest, and in flight to be massless but with momentum. Several effects are known: its trajectory is affected by gravity, as is the frequency. Compton scattering, whereby an incident photon is deflected by an electron and changes energy, is explainable assuming conservation of energy and momentum, with the photon having momentum p=hf/c.

Cordus suggests the issue may need reconsideration, for several reasons. The first is that it is not sensible to speak of a stationary photon (see Cordus conjecture), so what it appears to be at rest is totally irrelevant to flight, since they are different forms. Furthermore, Cordus suggests that mass is a transient phenomenon, not the enduringly stable property conventionally assumed. Specifically, the Cordus construct is that mass is created by acceleration of energised reactive ends (E.4.7). Since the photon meets that criterion, and there is no other lemma preventing it, we have to logically assume that there is a possibility that the photon has dynamically transient mass during flight. If this were to be true, then the conventional partition of mass and momentum might need to be reconsidered too.

Integration of gravitation and mass

Cordus conceptually integrates the different effects of mass: Gravitation is a particuloid contributing hyff to the fabric; Newtonian mass is resistance of the reactive ends to unexpected displacement; Relativistic mass is decreasing efficacy of hyff engagement with the fabric as velocity of the reactive end increases; Momentum is a frequency mechanism (as yet incompletely described) that ensures the reactive end re-energises on-time and in-place; particuloids have mass to the extent that they have frequency; mass arises from particuloids like the proton and neutron.

Thus a stationary object floating in space contains particuloids that are oscillating cordi, and these engage with the fabric. They contribute to the fabric and thus gravitation, and are constrained by the fabric hence the mass effects. The Cordus mass model is therefore consistent with that for gravitation, and both depend on the concept of cordus frequency. What the model has not yet explained is gravitational time dilation. That comes at the end of the next section on time.

4 Cordus Time

The following is a Cordus model for time. Cordus offers an explanation whereby time is determined at a sub-atomic level by the cordus frequency, and this aggregates to the sense of time that we perceive biologically.

E.5 Time Lemma

E.5.1 The cordus frequency for a particuloid determines its time unit (tick). Time is determined at the sub-atomic level by the re-energisation of the reactive ends at the cordus frequency. The cordus frequency is therefore the minimum time unit for that particuloid. Each particuloid has its own tick, which is determined by its span (E.5.6).

E.5.2 Anything that delays or interferes with re-energisation of a reactive end, changes time for that cordus particuloid.

E.5.3 The fabric, to which every matter particuloid contributes, transmits information about the phase of other particuloids, and provides an opportunity for a degree of disorderly synchronisation between particuloids and atoms. (Not necessarily full body coherence).

E.5.4 Interactions between atoms are not temporally continuous but occur when the particuloids are energised.

E.5.5 Biological sense of time is a neurological perception overlaid on the molecular time units.

E.5.6 The smaller the span of the cordus particuloid the higher the frequency.

E.5.7 The higher the cordus frequency the greater the contribution to the fabric, and the greater the mass of the particuloid.

E.5.8 Assembly of particuloids into structures may cause the spans of some to change to accommodate the others. This changes the frequency of the particuloid and also its mass.

Tick of time for the particuloid

The Cordus perspective is that time, or at least the tick (time unit) thereof if not the flow, is determined at the sub-atomic level by the re-energisation of the reactive ends at the cordus frequency (E.5.1). Each half cycle of frequency is the tick of that particular particuloid. It eventually becomes the time unit for the rest of the local environment: that particuloid interacts with the rest of the atom, and in turn is influenced by the other particuloids in the atom. That atom is linked to others to form molecules (E.5.3).The maximum speed that an effect can occur within that molecule, e.g. the making or breaking of a bond, is one tick of the involved particuloids.

Therefore the frequency of the cordus *becomes* time for the particuloid: if for any reason the cordus was prevented or delayed in its re-energisation of a reactive end, then time for that cordus is likewise stopped or delayed (E.5.2).

The degree of synchronisation of re-energisation (CoFS) is very strong within one electron orbital (see 'Cordus matter'), and between the quarks. It can be strong between atoms, as superfluidity shows, but is not always dominant like that. In everyday materials the CoFS is not strong, but we assume that some degree of loose co-ordination exists between the matter particuloids (E.5.3). We conceptualise it as radiating out from each particuloid in the form of the hyffons in the fabric, that *encourage* but not prescribe other particuloids to synchronisation. So the fabric provides a

relativistic, dynamic and flexible partly-synchronised fuzzy-tick for the universe.

Irreversibility of time

Thus 'spacetime' is an apt descriptive term for the fabric: it encapsulates space, and it includes a universal (if disorderly) time synchronisation signal. The fabric guides reactive ends to reform in accessible locations, by interacting with the hyff emerging from the RE as it phases into existence. The fabric is a mechanism for all matter in the universe to influence all other matter. The one-way irreversibility arrow of time is then the internal continuity of the cordus that ensures that the opposite reactive end *will* re-energise, but *where* it does is influenced by the fabric hyff (E.5.3). Given the fine and disorderly nature of the fabric, and that every particuloid (including the one under consideration) contributes to that fabric, no cordus will necessarily re-energise in exactly the same place as previously. So there is an irreversibility of geometric position, and that contributes to the irreversibility of time too. The actual mechanism for controlling the frequency is then time itself, from this perspective, the cordus provides the tick or quantisation of time, and the fabric of the universe provides the irreversibility.

It is important to note that the span of the cordus particuloid is a fundamental driver of the irreversibility. If matter was a 1D point particle, then there would be no irreversibility in time, because the second reactive event would be exactly where the first was located. The fact that the REs are in different places provides a small increment of time in which the universe can partially re-arrange itself in response to the what the first RE did in the previous time unit. Larger particuloids like the proton are buffeted by the higher-frequency of the fabric hyff. Thus the fabric, with its higher frequency, has plenty of time to respond to the first RE. Thus the irreversibility of time becomes stronger as the level of assembly of the system becomes higher, i.e. tending towards larger bodies. There is also entropy in those bodies (see Cordus Matter). The corollary is that the observed CP violation is also due to cordus span. As Cordus Matter concluded, the 1D point paradigm of conventional physics is an unreliable premise and the cause of many unnecessary problems.

Sense of time

Our biological perception of time is apparently smooth and continuous. We think, and move our hand; our fingers touch the paper; we feel the sensation of touch; we pull the book towards us; the book does actually move; we see the letters on the page; we comprehend. The whole of the physical reality is apparently consistent. We do not perceive the underlying individual atomic interactions, the agitation of the electrons throughout both bodies, the chemical bonds being changed. But they are there, happening faster than our senses can detect.

Our perception of time is at that higher level of squishy biology. We see physical cause and effect around us, and we can participate in moving objects and interacting with the rest of the world – and enjoy the world interacting with ourself, like the touch of another or the simple pleasure

of the fresh air on our face. Each quark has a unique personal time determined by the fabric of the universe in its location. But that frequency is so high that it really does not matter at our level of perception, since the effects are averaged out. The brain constructs a personal sense of time out of the neurological events, which in turn are based on physiology, which in turn is based on chemistry, which in turn is based on atomic physics, which in turn is based on the frequency of a cordus. That biological sense of time is subjective and sufficient rather than necessarily accurate.

When we look at atomic clocks then we see closer to the sub-atomic level of time. The electrons in that clock change energy levels at a higher frequency than we can perceive biologically. That clock frequency in turn depends on the cordus frequency for the electron (E.5.4). The atoms in our own body likewise react at a cordus frequency to create bodily functions, so our sense of time is a neurological phenomenon overlaid on a physical foundation.

Matter, fabric, and time

The above interpretation of time is at the level of particuloid physics, and thus closer to the quantum mechanics perspective. Conventionally the QM and general relativity perspectives of time do not integrate well. With Cordus the integration is conceptually straightforward: cordus frequency determines local time for matter particuloids, and simultaneously all the matter particuloids in the universe contribute hyffons to the fabric and thereby affect local time everywhere: a causal arrow.

So all of the universe, including the vacuum, has a time signature. At any one point in space these hyffons might conflict with each other, so the signature might not be clear, but it exists nonetheless and it is relativistic. Thus spacetime does have a time signature, though Cordus does not conceptualise time as a fourth dimension.

If this is correct, then the fabric itself carries the time signature for the whole universe. If we accept that the unit of time exists at the sub-atomic level, and that sub-atomic mechanisms create the irreversibility, then philosophically the next deeper question to ask is, 'Why does the cordus fibril have a frequency?' Even so, if accept that time is fundamentally an effect whereby cordi interact with the fabric, then it suggests that time only exists where the fabric exists.[16]

The Cordus concept of time therefore explains time at the 'particle' level, biological level, and for general relativity.

Time dilation

Time dilation (slowing of clocks) is known to occur for bodies that are accelerating or in higher gravity. Cordus explains this as the reactive ends of the particuloids in the body encounter the fabric at a greater rate or

[16] Thus the void is timeless. A universe of fabric and time expands into the void. The universe is granular and therefore the void is also within the universe. A time-full universe is overlaid on a time-less void.

density (respectively). This compromises the hyff emission process (see the Lorentz above) and the re-energisation of the reactive ends, which then slows the frequency of the cordus. This applies also to a body travelling at relativistic velocity.

5 Conclusions

Gravitation is conceptually problematic to conventional theories of physics in that the fundamental mechanisms are unknown, and the theories have different requirements that are difficult to reconcile.

Cordus gravitation offers a solution to the problem. It provides a mechanism whereby gravitation is not continuous but in discrete force (or displacement) increments (quanta). Also, the closing force between two masses is transient. In this idea, gravitation, and therefore also mass, is a discontinuous property: i.e. a particuloid emits gravity (has mass) at some moments but not others. Thus gravitation is an effect that a mass does to the whole universe, not to targeted other bodies, and in this regard Cordus is consistent with General relativity. Both QM and Cordus agree that gravitation is quantised, though Cordus diverges in suggesting that the effect is granulation rather than uniform indivisible increments.

From the Cordus perspective 'mass' is the resistance to acceleration of the basal reactive end while it is energised. Cordus conceptually integrates the different effects of mass: Gravitation is a particuloid contributing hyff to the fabric; Newtonian mass is resistance of the reactive ends to unexpected displacement; Relativistic mass is decreasing efficacy of hyff engagement with the fabric as velocity of the reactive end increases; Momentum is a frequency mechanism (as yet incompletely described) that ensures the reactive end re-energises on-time and in-place; particuloids have mass to the extent that they have frequency.

Furthermore, Cordus offers an explanation of how time arises. It is proposed that time is determined at a sub-atomic level by the cordus frequency, and this aggregates to the sense of time that we perceive biologically. The fabric therefore carries an elemental time signature, though it is not a fixed quantised system. The concept of time is conceptually consistent with General relativity's spacetime, and with the QM expectation that time is quantised. Thus Cordus offers a solution to reconcile those competing perspectives into a new way of thinking.