Differentiation of Matter and Antimatter by Hand: Internal and external structures of the electron and antielectron

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Abstract

A previous conceptual work, called the Cordus conjecture, has proposed a non-local hidden-variable (NLHV) design for the photon, and thereby proposed a solution to photon entanglement and wave-particle duality. This paper applies a systems design approach to extend the theory to matter, specifically to differentiate between the matter-antimatter species. This concept rests on two premises: that particules have span (physical separation between reactive ends); and that their externally emitted discrete forces have an energisation sequence. Specific hidden-variable models are proposed for the electron, positron, and proton. This concept provides a better explanation of the difference between matter and antimatter in ways that make physical sense. It also provides foundational concepts from which new solutions to other problems, like annihilation and baryogenesis, can be envisaged. The Cordus theory goes beyond conventional NLHV solutions, such as the de Broglie-Bohm model, by offering a solution not only for the inner contents of a particle, the hidden variables, but also predicting how its discrete fields operate. This theory provides a physically natural explanation for spin, handedness, chirality, and related directional attributes of particles, which are otherwise only abstract concepts in quantum mechanics. The theory also explains parity violation, and why the photon does not have an antiparticle. This work makes a conceptual contribution of presenting a new concept of handedness and the matter-antimatter species differentiation. It demonstrates the potential of hidden-variable designs to provide solutions of high explanatory power.

Une étude conceptuelle précédente, appelée conjecture Cordus, a proposé une variable cachée non-locale (VCNL) pour le photon, et ainsi proposé une solution à l'enchevêtrement des photons et la dualité onde-particule. Cet article applique une approche de conception des systèmes afin d'étendre la théorie de la matière, en particulier pour différencier les espèces matière-antimatière. Ce concept repose sur deux piliers: que les particules ont une distance (séparation physique entre les extrémités réactives), et que leurs forces discrètes émises vers l'extérieur ont une séquence de mise sous tension. Des modèles de variables cachées sont proposées spécifiquement pour l'électron, le positron et le proton. Ce concept offre une meilleure explication de la différence entre matière et antimatière dans des termes physiques compréhensibles. Il fournit également des concepts fondamentaux à partir desquels de nouvelles solutions à d'autres problèmes, comme l'anéantissement et la baryogénèse, peuvent être

envisagées. La théorie Cordus va au-delà des solutions VCNL classiques, tels que le modèle de Broglie-Bohm, en offrant une solution non seulement pour les composants internes d'une particule, les variables cachées, mais aussi permet de prévoir comment ses champs distincts opèrent. Cette théorie fournit une explication physique naturelle pour les spin, impartialité, chiralité, et attributs directionnels connexes de particules, qui sont par ailleurs uniquement des concepts abstraits de mécanique quantique. La théorie explique également la violation de la parité, et pourquoi le photon n'a pas une antiparticule. Ce travail apporte une contribution conceptuelle en présentant un nouveau concept d'impartialité et de la différenciation des espèces matière-antimatière. Il démontre le potentiel des conceptions de variables cachées pour fournir des solutions de haute puissance explicative.

Keywords: antimatter, mirror, hand, chirality, parity violation, positron

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1 Introduction

Antimatter is an empirically known species. Yet it is still difficult to give an ontologically satisfactory explanation for differentiates the matter-antimatter species. This is problematic because antimatter is a key component in several other unsolved problems such as how annihilation occurs, and the origins of asymmetrical baryogenesis.

Part of the problem is that matter is poorly understood at the foundational level. We think that matter is made of particles, and we think they are only points with no internal structure (other than assemblies of more points), but we don't know what makes up the *point*, other than expecting it to have *intrinsic* variables like spin. We also think that particles are waves, but other than being able to describe their mathematical behaviour as a wave, we really do not know what that *wave* comprises either. We think that a particle is in two positions at once, i.e. superposition, and can represent that with the wavefunction – indeed we see confirming empirical evidence at the microscopic scale: but not at the macroscopic, which is perplexing. Thus we don't really know what matter *is.* Naturally that also means we don't know antimatter to the level that we would like, nor the *process* of annihilation.

This paper shows how antimatter can be reconceptualised, using a non-local hidden-variable (NLHV) solution, specifically the Cordus conjecture [1]. The previous work identified a proposed structure for the photon, and showed how this could solve wave-particle duality. In the present paper we extend the concept to develop a theory that differentiates between the matter-antimatter species. This theory encompasses the internal structure of the electron, as well as its external structure. By *external structure* we refer to the discrete forces that make up its external fields. These are responsible for its interaction with other particules. The concept of a particule having both an internal and external structure is distinctive of the Cordus theory. In contrast, conventional NLHV solutions, such as the de Broglie-Bohm model [2, 3], only explain the inner structure of the particule. We show that the handedness of this external structure

can explain matter-antimatter species. We also infer the structure of the antielectron (positron) in physical terms. This also provides a conceptual basis for the solution of other problems in physics, such as annihilation and baryogenesis [4].

2 The conventional perspective of antimatter

Antimatter particles are regularly produced by natural phenomena, e.g. cosmic rays striking the atmosphere, and radioactive decay. They are also produced artificially, e.g. in colliders. Whole antimatter atoms have also been produced, currently limited in size to the smaller assemblies: antihydrogen, antideuterium, antihelium (3 & 4). The most abundant type of antimatter is antielectrons (positrons), but antiprotons and antineutrons have also been synthesised. The mass-energy equivalence shows that energy can be converted to and from matter. However antimatter is always created too, and the transformation is always between energy and a particle and its exact antiparticle.

The simplest theory is that matter and antimatter are differentiated solely by charge: e^- and e^+. This view, while ingrained in our notational system, is known to be inadequate due to the inability to explain the antiparticles of neutral particles (most obviously the neutron). The quantum mechanics (QM) perspective is that antimatter is opposite charge *and* opposite quantum numbers. However there is no universal set of quantum numbers, and the quantity of these variables is situationally specific. Furthermore, the main quantum numbers for fermions are charge and spin, but these are common throughout any one generation, e.g. e, μ, τ. Parity, a spatial inversion (mirroring) of physical properties, is another way to differentiate the species, (hence 'mirror matter', as Robert Forward termed it). However it is impossible for QM, with its premise of particles being zero-dimensional points, to provide a physically meaningful interpretation of parity, or the related concepts of chirality, helicity, and spin. These are only mathematical abstractions, like the other intrinsic variables of QM. Thus there is no clear explanation from conventional physics as to what parity corresponds to in a particle, and how it contributes to annihilation. Nor do string theory or M-theory [5] contribute much in this area. What is needed is a concept that makes sense of the matter-antimatter divide and has the potential to explain the deeper problems.

3 Approach

We use a systems engineering design method. This involves taking the *functional requirements* (observed behaviour of matter-antimatter) and inferring the requisite attributes (internal and external mechanics of the particule). The first part of this process was to design a NLHV solution to meet the known physical phenomena of entanglement and wave-particle duality [1]. This is called the Cordus conjecture. It showed that a specific physical structure for particles is able to provide a logically consistent explanation to these effects. We call this structure a 'particule' (as opposed to a point-particle). While such a NLHV solution may seem precluded by the Bell-family of inequalities [6, 7] there is reason to believe those constraints do not exclude absolutely all possibilities [8, 9], though it

has long been expected that if any solution existed it would be counterintuitive [10]. This Cordus solution exploits just such an exception. Importantly, it shows that the appropriate quantitative predictions for entanglement are achievable not only by quantum mechanics but also with this design [11]. It is therefore consistent with empirical observations, in a way that has not previously been achieved with other hidden-variable solutions, and suggests that the Bell-type inequalities can be falsified. This solution has wider efficacy in that it also derives basic optical laws for reflection and refraction [1] and explains a variety of other phenomena.

Second, we developed a model for discrete forces and the corresponding discrete field elements. This explains the electro-magneto-gravitational (EMG) forces, and the strong interaction [12]. These discrete forces are proposed to make up the field elements (Cordus: 'hyperfine fibrils' hence 'hyff') and emitted in one of three orthogonal directions (hence 'hyff emission directions' or HEDs). This provides a competing explanation to quantum chromodynamics. We devised a notation to show the different ways that these discrete fields can be energised. This HED notation identifies the direction (negative/positive charge), hand, and total charge of the discrete field elements for a particule. We find this to be a useful tool in expressing particule interactions.

Third, we then created a coherent model for handedness. Thus emerged a clear proposition for the fundamental difference between matter and antimatter: the hand of their discrete fields. Hand then corresponds to the energisation sequence of three orthogonal discrete field elements. There are only two unique ways this can be done, which we term dexter and sinister for matter and antimatter respectively. The present paper reports on this handed concept.

4 Results: A Design Proposal

The Cordus conjecture postulates that all particles are one dimensional structures of finite length, and emit three-dimensional discrete lines of force at their two ends. This is called a *particule*.

The strength of this model is that it provides a logically consistent set of descriptive explanations for fundamental physics. Consequently it can explain anything quantum mechanics purports to explain. It likewise has explanations for things that general relativity and string theory cannot explain.

The Cordus particule idea may seem to introduce a lot of seemingly extraneous structure: a total of 11 independent geometric variables are required to fully define a particule. However this is more parsimonious than the Standard model (which has intrinsic variables anyway, and requires bosons for each interaction –hence more variables). The Cordus concept is also ontologically superior to string theory (M-theory also requires 11 variables), because it gives physical interpretation to each of its variables, whereas string theories do not.

4.1 Cordus theory for matter

Inner structure of the Cordus particule

The basic idea is that every particule has two reactive ends, which are a small finite distance apart (span), and each behave like a particle in their interaction with the external environment. A fibril joins the reactive ends and is a persistent and dynamic structure but does not interact with matter. It provides instantaneous connectivity and synchronicity between the two reactive ends [1]. Hence it is a non-local solution: the particule is affected by more than the fields at its nominal centre point. Each reactive end of the particule is energised in turn at the frequency of that particule (which is dependent on its energy). The reactive ends are energised together for the photon, and in turn for matter particules. The frequency corresponds to the de Broglie frequency. The span of the particule shortens as the frequency increases, i.e. greater internal energy is associated with faster re-energisation sequence (hence also faster emission of discrete force –see next section- and thus greater mass).

External structure: Cordus discrete field structures

When the reactive end is energised it emits discrete forces in up to three orthogonal directions.[a] The quantity and direction of these are characteristic of the type of particule (photon, electron, proton, etc.), and the differences in these signatures is what differentiates the particules from each other. Although for convenience we use the term discrete *force* for these pulses, the Cordus theory requires them to have specific attributes that are better described as *latent discrete prescribed displacements*. This is because a second particule that subsequently receives one is prescribed to energise its reactive end in a location that is slightly displaced from where it would otherwise position itself. Thus in the Cordus theory, that which we perceive as force is fundamentally the effect of many discrete prescribed displacements acting on the particules.

These discrete forces are connected in a flux line that is emitted into the external environment. (In the Cordus theory this is called a hyperfine-fibril, or hyff). We acknowledge that we have not described what comprises these discrete forces, or the flux lines. Instead, the Cordus conjecture simply shows that having such elements is a logical necessity for this solution. Each reactive end of the particule emits three such orthogonal hyff, at least in the near-field. The exception is the photon, which only emits radially. These directions are relative to the orientation of the span, and the velocity of the particule, and termed hyperfine-fibril emission directions (HEDs). The axes are named [r] radial outwards co-linear with

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[a] *Discrete forces:* Within our theory we refer to these discrete force pulses as *vires.* Earlier papers used the term *hyffon* for the discrete force. We have changed the terminology to avoid the implication that these elements are 0-D particles. The terms *vis* (singular) and *vires* (plural) are Latin for *force*.

the span, [a] and [t] perpendicular to the span and to each other. These are so-named for consistency with our previous nomenclature for the photon, but when applied to massy particules do not necessarily imply motion. It is proposed that the quarks and other leptons follow the same pattern, though in the case of the quarks not all the hyff emission directions [r,a,t] are filled (hence their fractional charge). These general principles are shown in Figure 1, and their application to the photon in Figure 2.

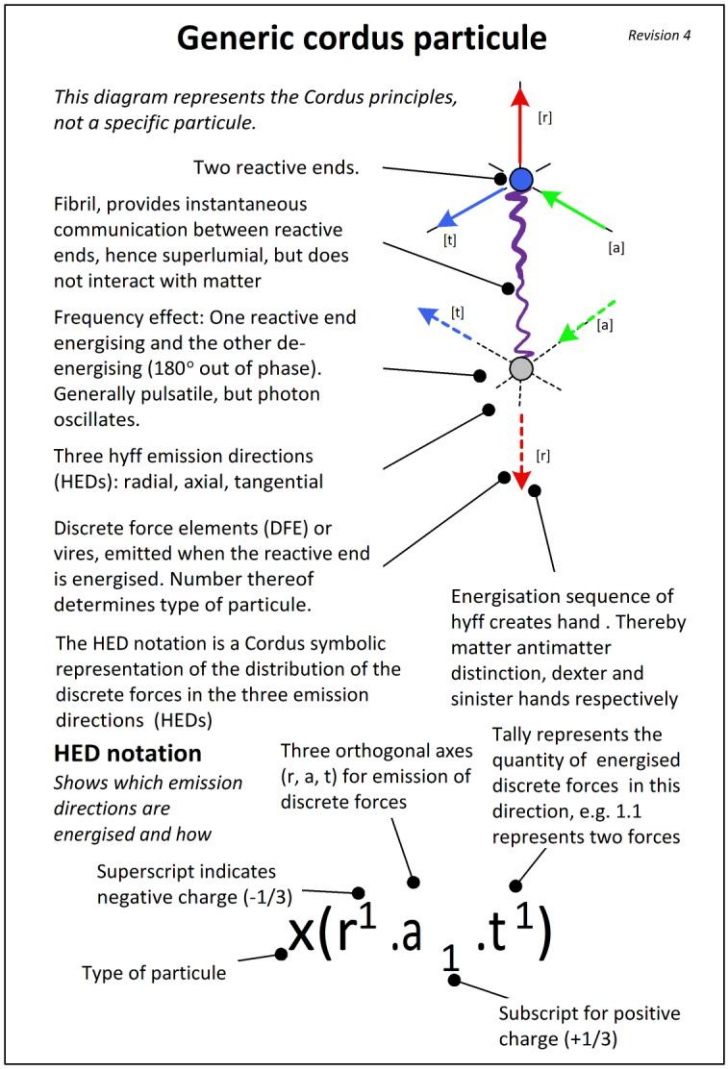

Figure 1: The Cordus theory proposes that particules have an internal structure and emit a signature of discrete external forces. This diagram shows the generic principles.

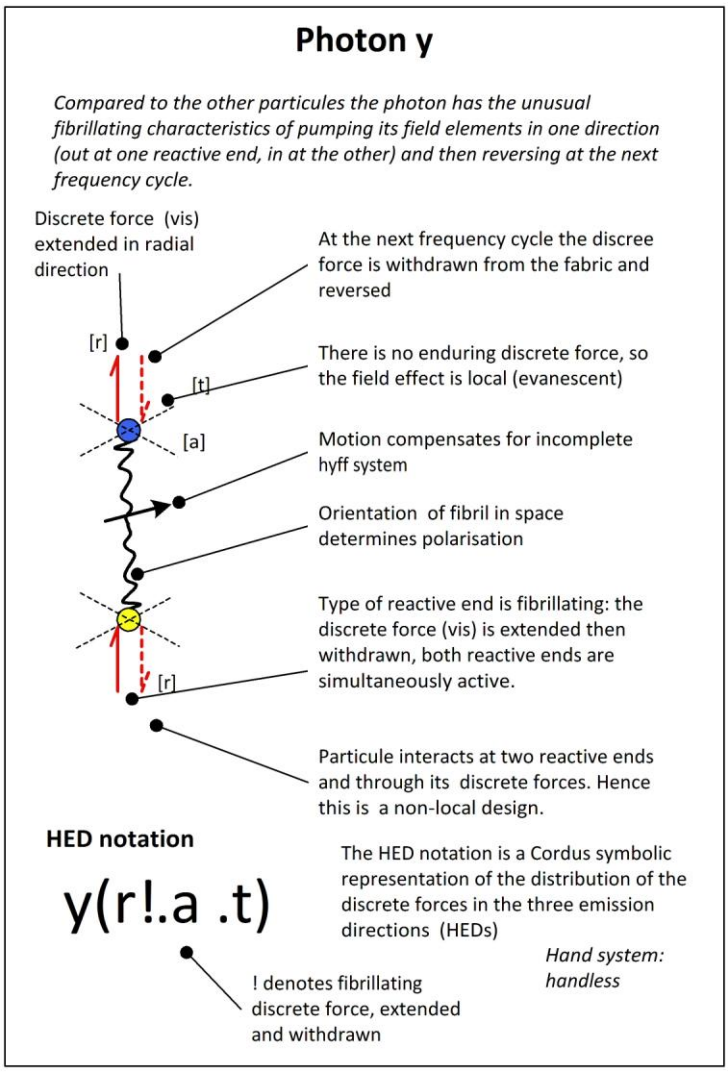

Figure 2: The Cordus theory for the photon structures.

The aggregation of discrete forces from multiple particules creates the EMG fields, which are thus discrete. The combined emission discrete forces makes up a 3-D composite structure. The direct lineal effect of the discrete force provides the electrostatic interaction, the bending of the hyff flux line provides magnetism, the torsion provides gravitation interaction, and the synchronicity between discrete force elements of neighbouring particules provides the strong force. These are all carried simultaneously by the composite discrete force element as it propagates outwards on the hyff flux.

Assembled massy particules compete spatially for emission directions, and may synchronise their emissions to access those spaces. Thus there is mutual negotiation in the near-field between interacting particules, based on shared geometric timing constraints. These particules interact by negotiating complementary HEDs and synchronising the emission frequencies of their discrete force elements. This synchronicity is proposed as the mechanism for the strong force [12] and for coherent assemblies. The same mechanism, acting through coherent assemblies of electrons, explains molecular bonding. Thus the Cordus theory provides force unification by providing a model for electro-magnetic-gravitational-

synchronous (EMGS) interactions as consequences of lineal, bending, torsion, and synchronicity effects respectively. The discrete force element is a 3-D composite structure, with a hand defined by the energisation sequence between the axes. This hand provides the matter/anti-matter species differentiation, as shown here.

4.2 Electron structure

In this theory electric charge is carried at 1/3 charge per discrete force, with the sign of the charge being determined by the direction of the discrete force element. So the number and nature of energised HEDs determines the overall electric charge of the particule. For example, the electron is proposed to have three discrete field elements. Neutral structures are accommodated, but incompletely filled HEDs are proposed as the reason for instability and decay.

In the Cordus theory the photon is required to have a single radial discrete force element which it periodically extends and withdraws. By comparison all massy particules have permanent discrete forces that they continue to generate (at the frequency of the particule) and propagate out into space. This includes neutral particules like the neutron. The difference in field structures between the photon and electron then explains why the photon generates an evanescent field that decays exponentially whereas the electrostatic field of electron decays at $1\backslash r^2$. (This is to do with the nature of the reactive ends: the photon does not release its discrete forces, hence the y(r!a.t) representation, whereas the electron with its pulsatile reactive ends does). We consolidate these concepts by providing the Cordus model of the electron, see Figure 3.

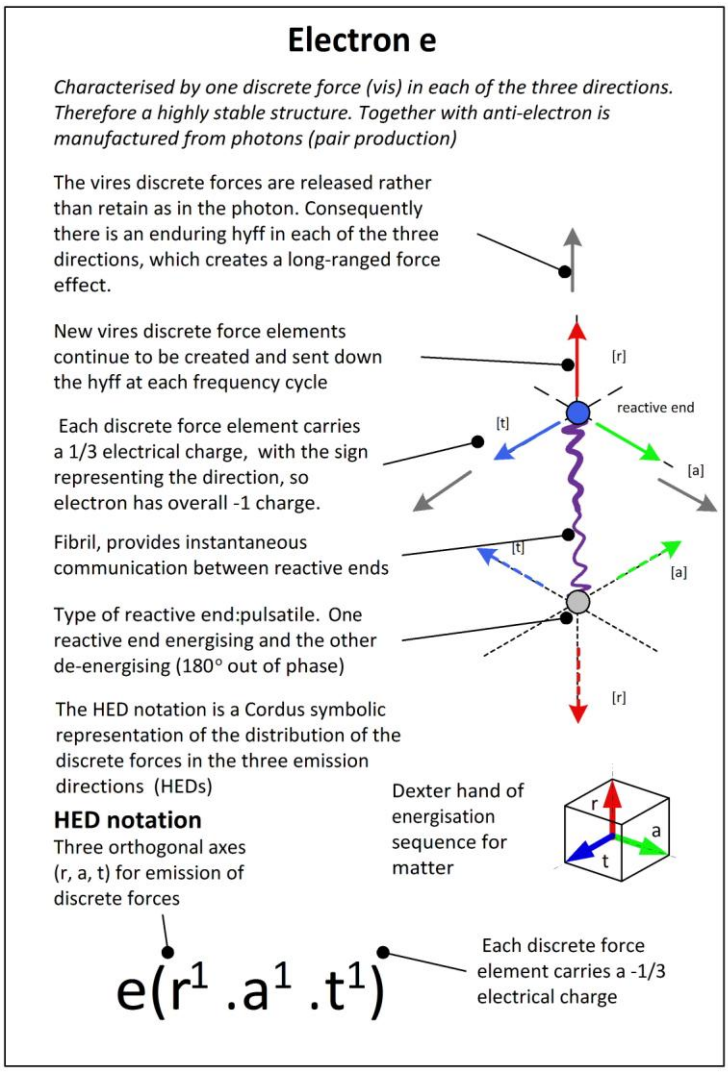

Figure 3: Cordus theory of the electron. It is proposed that the particule has three orthogonal discrete forces, energised in turn at each reactive end.

4.3 Cordus hand model for matter and antimatter

Handedness arising from energisation sequence

We propose that the energisation *sequence* of the discrete forces in the three axes [r, a, t] introduces a handedness to composite discrete force as a whole. This creates a handedness (parity/chirality) for matter, e.g. the right-hand rule of the Lorentz magnetic force. Further, it is proposed that this handedness is set at the point in time when the particule is created and cannot be subsequently changed while that specific assembly remains.

It is important to note that this Cordus concept for handedness is different to the quantum mechanics concepts of 'hand' and 'chirality'. Handedness in QM refers to the direction of spin of the particle relative to its linear motion [13]. When the spin is in the same direction as the momentum, then it is termed right-handed. The particles of QM may have either right or left spin-hand, and this spin-hand inverts for antiparticles. The concept of chirality is known in QM, but in a different theoretical formulation, e.g.

chiral perturbation theory in quantum chromodynamics. Here we reconceptualise it, and therefore use different terms to distinguish the Cordus concept.

We have two candidates for the origin of the handedness. One is that it is built into the structure of the fabric [14], and is thus a deeper level of mechanics than the Cordus structure. The other, and the current preferred design model, is that the handedness arises because of the *sequence* of activation of the hyff, e.g. [r], then [a], then [t] at the first reactive end, followed by r-a-t at the other, as the particule re-energises at its frequency.

This handedness requirement might seem artificial, but is not unreasonable because something similar already exists in other theories: classical physics already has the right-hand-rule for electromagnetism, and quantum theory has spin and chirality. Even the basic QM concept of spin suggests that there is some directionality to a zero-dimensional stationary particle. None of these are well explained: Why does the right-hand-rule exist? How can a zero-dimensional (0D) point (or a wave) have spin and directionality? The Cordus theory provides a more physically substantive concept for handedness.

Differentiating between matter and antimatter

Having created a new concept for hand, we now apply it to differentiate matter from antimatter. From the Cordus perspective all stable *matter* particles, including the electron and the proton, have three orthogonal hyff at each reactive end (each with an appropriate number and direction of discrete forces), and these are all of the same hand, for convenience called dexter. Furthermore it is proposed that the hand is the same for all matter particule, whatever their charge. The difference made by charge is simply the direction of propagation of the discrete forces within the hyff.

Inversion of hand

It follows that antiparticules have opposite hand, i.e. the sequence of energisation of the discrete forces is spatially inverted (mirrored). We propose that the inversion is about the long axis of the fibril, so the [r] axis is preserved – though it changes sign, see Figure 4. We term the inverted hand sinister.[b] Importantly, note that inversion of the hand also changes the direction of the discrete forces, hence the sign of the charge. Thus the [r] axis is conserved in both hands, though the sign changes. We use the underscore to denote antimatter, rather than the over bar, since this is a new construct.

[b] Sinister for left-hand - since this hand was left-behind in the asymmetrical genesis of the universe.

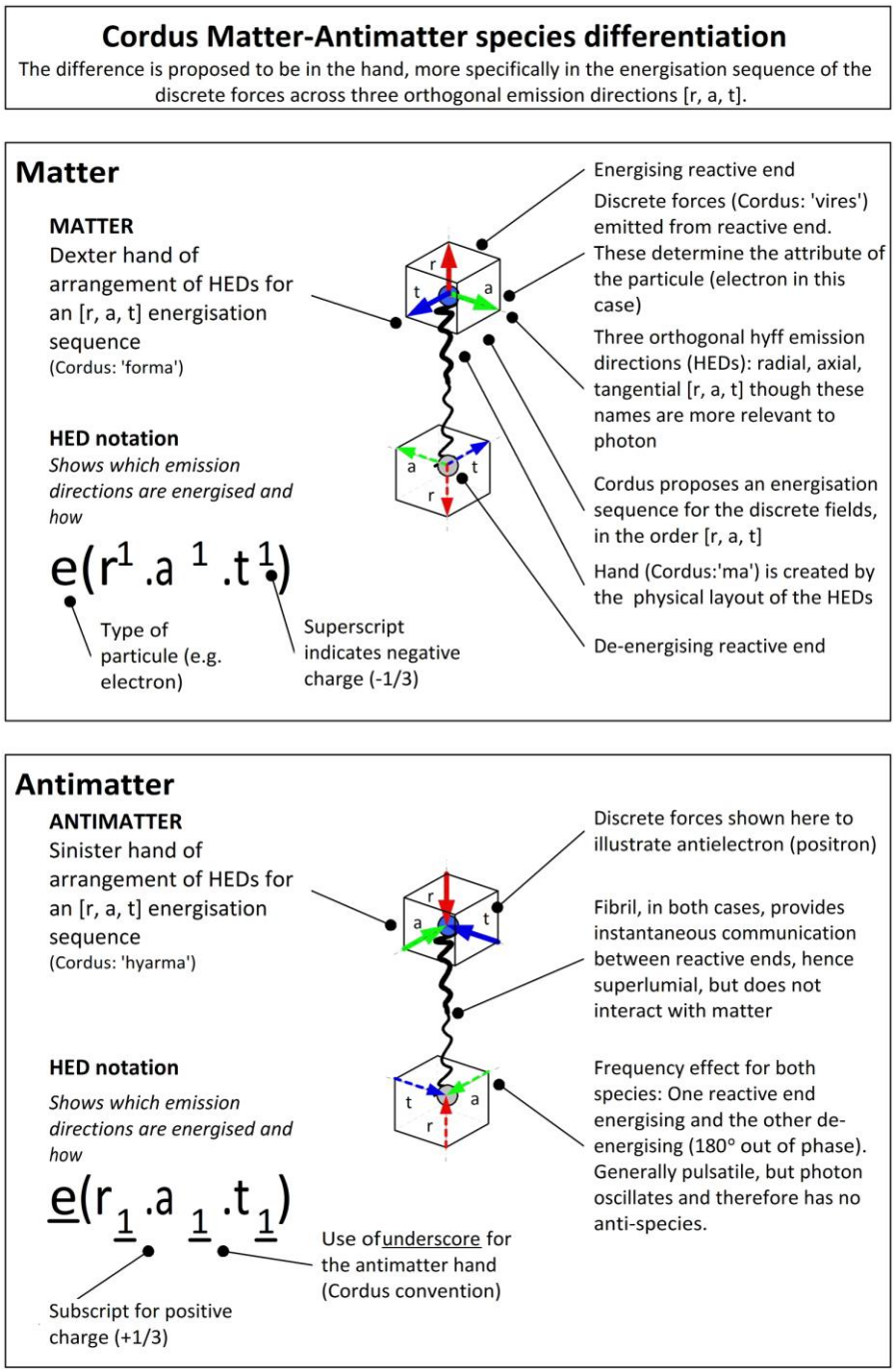

Figure 4: Definitions of handedness in the Cordus theory. Within this theory the term 'ma' is sometimes used to differentiate this particular definition of handedness from other concepts.

The Cordus theory therefore conceptualises the inversion of hand in terms of the functional geometry of the particule structure. Thus it provides a physically natural interpretation for antimatter. There is a subtle, but important distinction between this definition and that of quantum mechanics. First, the Cordus theory creates an operational definition out of handedness, which QM with its premise of zero-dimensional points (alternatively waves) does not, and cannot. Second, the Cordus theory states that that the difference between matter and antimatter is primarily in the hand, and the changed sign of the charge is a secondary effect and

dependent on the first. By comparison QM conceptualises antimatter in terms of opposite charge and opposite spin, as independent variables, and does not define the relationship between the two. Obviously there must be a relationship between the two, since there are not four species of matter, but QM does not address this problem.

Thus it is hand AND charge that is important in the Cordus theory, but they have a common cause. Incidentally, this definition also makes it easier to understand why a neutral particule like the neutron does have an antineutron. In the Cordus model the neutron has discrete forces but these neutralise so that there is no net external charge: but nonetheless discrete forces are propagated in the flux lines on the dexter hand, hence the neutron has mass. An antineutron is explained as having inverted hand and therefore charge, i.e. is still charge-neutral externally, but has the sinister hand of activation of its discrete forces. The same explanation applies to any other neutral particule such as the pions and deltas: these can have antiparticules, where the hands are different, even if the changed sign of the charges is still neutral. By comparison, it is not intuitive in other theories why neutral particles should have antiparticles.

Antielectron structure

Applying the above theory results in a prediction for the structure of the antielectron, where we invert the hand (energisation sequence of discrete forces) and the charge (direction of discrete forces), see Figure 5.

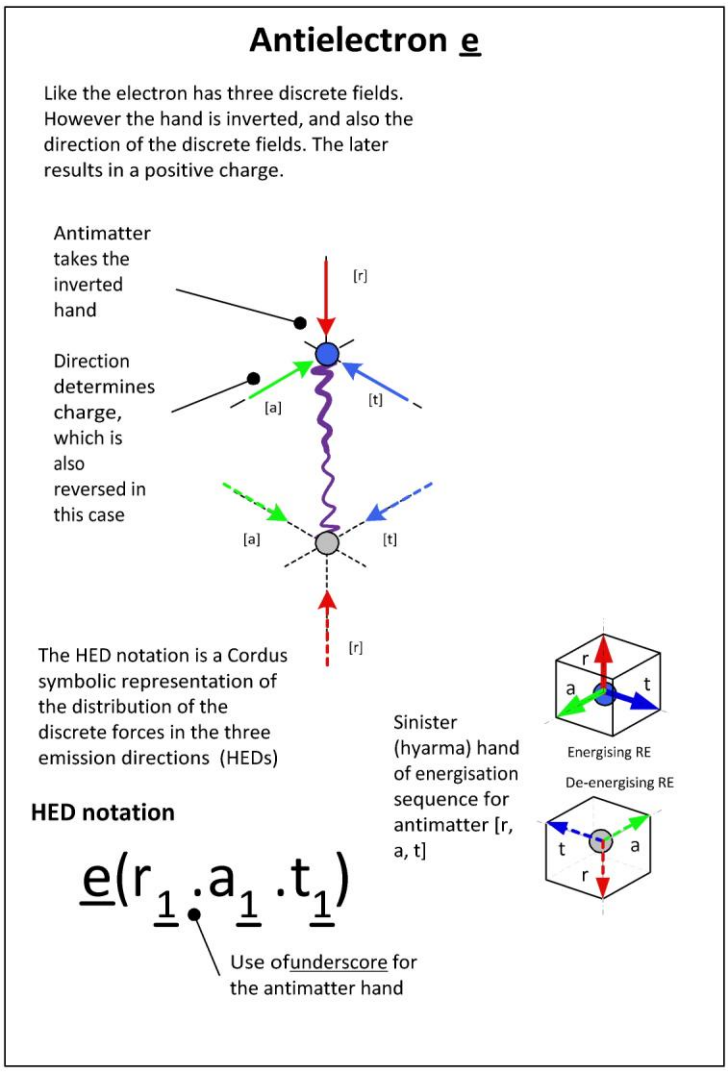

Figure 5: Cordus theory for the antielectron. The difference, compared to the electron, is the inversion of the hand of the axes, and that of the direction of discrete forces (hence also charge).

Note that we prefer the term 'antielectron' and avoid 'positron': this is because *antielectron* is truer to the present representation of the structure, if we accept that the word 'anti-' refers to inverted hand. We suggest this feature is much more important in understanding what is happening than the charge perspective.

5 Discussion

Implications

The Cordus theory is built on a conjecture: a specific proposition for the structure of particules. This implications of this theory are that the matter-antimatter differentiation is not simply by charge, but by hand. Also, that handedness arises from the way that discrete forces are emitted by the particule, as opposed to any other feature in the particule. Thus three independent variables emerge from this theory: charge, hand, and number of discrete forces, i.e. the *external* structures. The implication is that

different particules (electron, proton, etc.) are entirely differentiated by their external characteristics.

Thus from the Cordus perspective, positive and negative discrete forces (charges) of particules of like hand do not destroy each other but instead bond by synchronising their emissions (i.e. the strong force). In subsequent work we show that annihilation occurs where particles have exactly complementary discrete forces of opposite charge, and inverted hand.

Handless photon

The Cordus model also explains why the photon does not have an antiparticle: it does not have a hand. The photon is a single hyff, and a fibrillating one too.

Parity violation

The reason parity is not conserved by weak interactions is explained by the Cordus theory as a geometric consequence of the particule having both a span and a hand. The arrangement of the discrete forces is conserved across the span (the hand is the same at both ends), but the span is a finite length of separation. Therefore a mirror image of a Cordus particule is not identical to itself about every mirror plane. If fundamental particles were points, which is the QM position, then they would look identical for any mirror operation. This is not the case, which is evidence for a deep conceptual flaw in QM.

The Cordus theory not only explains why parity violation occurs, but also explains why it only occurs at small scales. This is because at a coarse enough level of view, the span becomes negligible and the Cordus particule can be considered a zero-dimensional point for practical purposes. Neither of these explanations is accessible to quantum mechanics, because of its fixed premise of particles being zero-dimensional points.

Comparison of electron, antielectron, and proton

One of the paradoxes of conventional theories of antimatter is that it is not immediately clear what the difference is between the proton and the positron. After all, they both have charge +1. Why then does the electron not annihilate with the proton, but does with the positron? Why do the proton and positron have such difference masses, given that their charge is the same? With the Cordus concept of hand, an explanation is possible. The proposed structure for the proton is shown in Figure 6. This is derived from consideration of the known quark content and their charges.

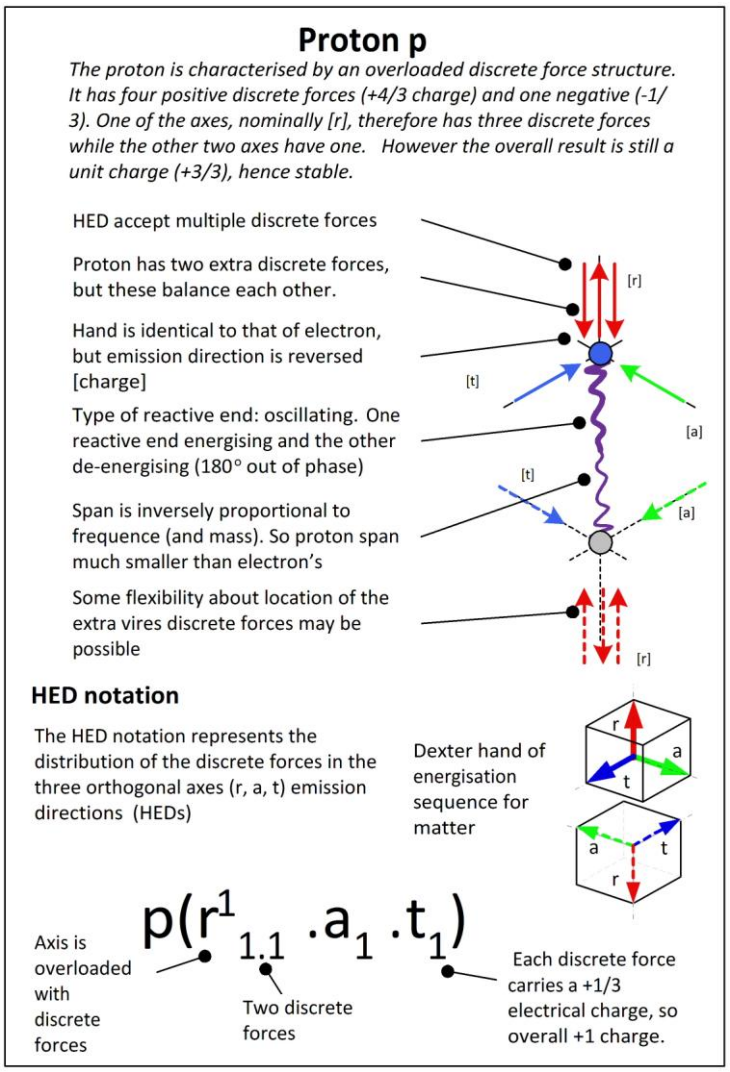

Figure 6: Cordus model of the proton. The distinguishing feature of this particule is the overloaded discrete forces. The higher mass of the particule, compared to say the electron, is proposed to arise from the higher frequency of re-energisation for this particule, in turn driven by internal fibril dynamics not apparent here. Compared to the antielectron (positron) note the direction of propagation of discrete forces is inwards in both cases (hence both have positive charge), but the hand or activation sequence is different.

Comparison of the electron, proton and antielectron models shows that all these particules have different external structures, either in the hand, direction of discrete forces, or number of discrete forces. The only thing that is common between the antielectron and proton is that they both show positive-charge behaviour. The Cordus theory explains why the electron and proton do not annihilate despite their opposite charges: the hands are the same.

Outcomes

This work makes several novel intellectual contributions. The first is a conceptual contribution of presenting a new concept of handedness and the matter-antimatter species differentiation. This has been used to create

models of the electron and positron, as representatives of the two species. This concept, which is unique to the Cordus theory, rests on two premises: that particules have span (physical separation between reactive ends); and that the externally emitted discrete forces have an energisation sequence. Neither of these concepts is accessible to quantum mechanics or other physical theories, and therefore this proposed matter-antimatter differentiation is novel and radical.

A second contribution of this work is ontological, in that it demonstrates the potential of hidden-variable designs to provide solutions of high explanatory power. The hidden variable approach is commonly considered non-viable, whereas we have shown that it can be a feasible approach. We have previously shown that this particular hidden-variable design is able to explain entanglement and wave-particle duality for the photon [1]. Now we have shown that the same design can extended to matter. True, as a NLHV solution the proposed structure of the Cordus particule is unusual, but no more so than the conventional idea of a 0-D point having spin and other intrinsic properties.

A third contribution of this work is methodological, in that it demonstrates the usefulness of a systems design approach. It is a qualitative approach and provides explanations that are logically consistent across a wide range of phenomena. The method has weaknesses (see below), but so do other methods: strategies based on mathematical hypotheses have generally not delivered interpretations that make physical sense [15]. Likewise other hidden-variable solutions, of which the most prominent is the de Broglie-Bohm, have been limited in the extent of their applicability and have not delivered detailed concepts for anything but their focus area. This Cordus solution is also able to explain a wide variety of other effects, using a single logically consistent framework, i.e. it generalises well to other situations.

A fourth contribution is the provision of a novel concept that provides a physically natural explanation for spin, handedness, chirality, and related directional attributes of particles. These are otherwise only abstract concepts in QM. The Cordus theory also explains parity violation, whereas QM does not.

Validity and Limitations

We acknowledge the conjectural nature of our starting premise (that particules have two reactive ends), and that the conceptual theory requires several layers of assumptions. Also, we have not been specific about the composition of key elements in the theory, such as the discrete forces and the energisation sequence. We also acknowledge that the design method is unable to prove that this is a uniquely valid solution. All we can claim is that the particule structure identified here is *sufficient* to explain certain phenomena.

Implications for further research

At this point we are not too concerned about the mechanisms that sustain the reactive ends, discrete forces, or hyff: we acknowledge those as the

next deeper level in the mechanics. Furthermore, the Cordus theory does not yet have a mathematical formulism, since that is a consequence of the method. It would be interesting to see further development in that direction.

The differentiation by hand is an interesting conceptual breakthrough that opens up new possibilities, both for the interpretation of the structure of matter, and further conceptual advance. We subsequently show how it provides explanations for annihilation, decay, neutrino behaviour, pair-production, and eventually asymmetrical genesis.

6 Conclusions

The main difference between matter and antimatter, according to the Cordus theory, is that the hand is inverted. Each reactive end for a stable matter particule, e.g. the electron, has three sets of discrete forces, orthogonally arranged. It is proposed that the hand arises from the energisation sequence of the discrete forces, and that only two sequences are available, hence the two species, matter and antimatter. The hand is the same throughout a species. For all antimatter particules the hand is inverted, and this also changes the direction of the discrete forces, and thus reverses the charge. Thus from the Cordus perspective, positive and negative charges of like hand do not destroy each other but instead bond through complementary frequency synchronisation. This Cordus concept permits models to be created differentiating between the electron, proton, and antielectron (positron).

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