The Electric Dimension, Quantum Retrocausality and Preons

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Abstract

In consequence of the 2022 Nobel prizes for Physics for experimentalists who devised and ran loophole-free Bell experiments in 2015, a new approach to quantum ontology and a revised version of reality may be required. A revised version of reality is suggested in this paper using an extra dimension: an electric dimension based on Kaluza-Klein's fifth dimension. Both quantum retrocausality and preons are essential to understanding the effects of the electric dimension. Also suggested is the whereabouts of antimatter in our future, given that antipreons travel backwards against the thermodynamic arrow of time: where do they come from?

PART 1 Bell, Quantum Retrocausality and the Electric Dimension

BELL + RETROCAUSALITY -> MALUS

My previous work on simulating Bell's Theorem Experiments has led me to quantum retrocausality. But prior to that, a static scalar value of particle polarisation led me to a CHSH S value of 2 in my Bell simulations. This is equivalent to a mere classical correlation of 0.5 where Alice and Bob's detector polarisation angles differ by an angle of 45 degrees, a correlation which does not imply that the Bell Inequalities are exceeded. (Ref. 4.)

Next I made a toy model of a photon (and an electron) using a gyroscopic effect. This model was reverse engineered using classical physics so as to conform to the results of Malus's Law for photons passing through a detector. (Ref. 8.) This is a dynamic model of particle polarisation. Say a gyroscope spins on a table top. Vertically upwards represents the particle polarisation vector direction. But as the gyroscope precesses, its axis points in other directions, though never points downwards. The variable direction is vitally important in determining the variable outcome of a measurement on an individual photon. This variable direction is the hidden variable.

Armed with this new dynamic model for generating simulated particle polarisations I tried another Bell's Theorem experiment simulation. Unfortunately, I was so disappointed with the negative outcome that I did not write up the results in a paper. I found a correlation of approximately 0.375 which is even worse than the classical value of 0.5 for detector polarisation angles different by an angle of 45 degrees. (No reference, not written up.)

I eventually realised why the correlation was so low: the static vector obtaining the classical correlation of 0.5 was better than the dynamic model (using locality and classical reality) as the dynamism was making the outcomes more variable. No model using locality and classical reality would improve on the classical correlation.

That failed simulation led me to try quantum retrocausality in a final Bell's Theorem experiment simulation. And that simulation worked to give the quantum correlation of 0.707 where Alice and Bob's detector polarisation angles differ by an angle of 45 degrees. This method did not break the Bell Inequalities but instead bypassed them because of the use of retrocausality. This method also was in agreement with Malus's Law and was therefore taken by me to imply agreement with the use of my dynamic model of the photon [or electron]. That led to me coining a slogan: Retrocausality + Bell –> Malus. (Refs. 9, 10 and 11.)

In the quantum retrocausal Malus scenario, Alice measures particles with polarisation angles +**a** or -**a** or +**b** or -**b**. Ditto for Bob. Every particle has one of these polarisation angles in the Bell experiment. This is pure Malus and it is hard to see it any other way though it has implications for our view of reality, whilst preserving special relativity and locality in a new reality. Angles **a** and **b** are the polarisation settings of Alice and Bob's detectors.

RETROCAUSALITY AND THE ELECTRIC DIMENSION

My 2017 paper, in Ref. 2, shows my model to have at least sixteen dimensions, four of which are time dimensions. This is not inconsistent in general with string theory dimensions. Kaluza in 1919 postulated a fifth, spatial, dimension which is sometimes referred to as an electric dimension. Yablon (Ref. 5) calculated a variant of this fifth dimension which was a temporal dimension but also an electric dimension. Yablon's dimension calculation used Dirac's equations in a covariant form. My interpretation of extra dimensions is that they come in blocks of four (3, 1) dimensions just like our spacetime so the electric dimension is actually four dimensions in my model. It is even more complicated as my paper shows that twelve QCD colour dimensions aggregate to form the four electric QED dimensions (Ref. 12). Each set of four dimensions has its own arrow of time correlated to its own trivector representing the torsion in its spatial dimensions and direction of inflation. That electric arrow of time could correspond to say the direction of motion of negative charge within that 4D electric block. The electric dimension of time will be independent of our universal arrow of time but will sometimes travel with and sometimes against it. The equal amounts of positive and negative electric charge in our universe shows that the two sets of four dimensions intertwine thoroughly and negative (say) charge always travels in the same temporal direction as does our universe's arrow of time.

At this small scale the dimensions travel at the speed of light. Measurement on such entities have binary outcomes which differentiate between the directions of inflation of the spaces and that is equivalent to the difference between the temporal directions of the spaces. This explains the underlying quantisation of all measurements. These multiple dimensions form the essential core of points of space. Matter is empty space at all levels, even at the level of preons, even at the level of hexarks or of Calibau-Yao manifolds at the heart of all matter. My preon model places these multiple dimensions at the centres of hexarks. Aggregates of hexarks make up the preons. (Ref. 12.)

The temporal direction of the electric dimension is at a small scale and the antipreons are aggregates which do not wholly travel against the electric temporal dimension. Likewise, antiparticles cannot wholly travel against the electric temporal dimension. What is important for the Bell experiment is that the spin components of a positron or a photon can travel backwards against the universal arrow of time.

PART 2 Questions and Answers

Can there be time travellers: as in H G Wells' story?

No. Macroscopic objects contain both forwards- and backwards-in-time preons and the forwards-in-time preons can never be sent backwards-in-time, and vice versa. So there is no grandfather paradox with this model. There is no mechanism to send matter into the past or into the future, quantum retrocausality is natural and is already occurring. Macroscopic retrocausality cannot be compelled to happen in my model; even microscopic retrocausality cannot be forced against its natural direction.

Why is quantum retrocausality needed?

The loophole free Bell experiments of 2015 forced me to accept that quantum nature has either non-local, instantaneous connections or else some other form of reality is instead occurring. Quantum retrocausality represents another form of reality.

Is my quantum retrocausality compatible with wormholes on a microchip?

Although wormholes on a microchip are credible to me, I baulk at them being traversable and usable as a means of instant non-local travel for particles. If the wormholes were traversable, it would be more acceptable particularly if 't Hooft's idea that black holes had no internal content were true as passage would then be instantaneous. It seems more likely that falling into a black hole would take positive time within the wormhole but to escape would require travelling through negative time to fall out of the wormhole. The transit time of zero in our universe would be composed of an infinite amount of positive time in the wormhole's metric

followed by an infinite amount of negative time in the wormhole's metric. Cancelling two infinities of time does not seem desirable to me. These times in the wormhole are not of our universe's arrow of time which is separate from the wormhole times, so the effect is possible even if not desirable. I preferred to look for an alternative reality to explain the results of the bell experiments.

My version of quantum retrocausality is not unlike the wormhole explanation. Retrocausality requires cancellation of a positive time by a negative time to allow an instantaneous non-local effect. But these times are within our own spacetime and are not infinite in time duration though it does require a belief that the time paths are traversable in both time directions. This is generally not believed as the negative time path is opposite to the universal thermodynamic arrow of time. However, I already had the belief that antipreons travelled backwards in time and so was already prepared to accept the notion of quantum retrocausality.

Is quantum retrocausality preferable to superdeterminism?

Retrocausality does not require special effects set in train from the beginning of time. All the retrocausal effects are within the time frame of the Bell experiment. It is a truism that determinism has direct influences from the beginning of time but that is not required to explain the Bell experiment results. That is why I never used a superdeterminism explanation of the Bell experiment results.

My retrocausality requires an absolute time frame for particles. Is there a problem with special relativity?

No, but, because of special relativity, there is no absolute time ordering for an observer. This issue provides a limited scope for some retrocausal models to accept an uncertainty for an observer of the direction of time transited by a particle. If the observer is removed, however, the particle's own internal clock does provide an absolute time direction for the particle itself independent of an observer. Although the notion of absolute time has been removed for observers, particles themselves do obey their own absolute time which van be deduced as they are believed to never travel backwards in their own time, assuming they had their own personal clocks. My model relies on this property of travelling absolutely back in time in a Bell experiment rather than relying on non-absolute times for observers.

Various retrocausal models rely on influences which travel backwards in time, though fall short of explicitly using antiparticles which travel backwards in absolute time. In my preon model, preons travel forwards while antipreons travel backwards in the universe's arrow of time. This statement is not wholly correct as my preons are composed of hexarks some of which are travelling forwards in time while others travel backwards. The hexarks of my model are multi-dimensional entities comprising of multiple extra spatial dimensions and also fewer but multiple time dimensions. (Refs. 2 and 12.)

Space and time are orthogonal, yet spacetime has a virement as seen in special relativity where travelling through space diminishes the amount of travelling through time and vice versa. So space is related to time despite the orthogonality. In geometric algebra there are two opposite orientations or torsions of a 3D space. These are described by the sign of the trivector of a volume of space. I maintain that the sign of the trivector determines the direction of the thermodynamic arrow of time in that spatial volume. Time is increasing in line with the direction (not a vector, but a trivector) of spatial inflation of the universe.

Does my quantum retrocausal model work with photons?

Yes. One reader's earlier comment on my retrocausal model which had used positrons travelling backwards in time was that modern Bell experiments used photons not electrons. This useful comment is best answered using my preon model and in fact I had previously been conflating some ideas about preons versus particles: antiparticles do not 'wholly' travel backwards in time; neither do preons, but hexarks do and therefore parts of an antiparticle travel backwards in time.

In my preon model, the right-handed positron is composed of one preon (B) and three antipreons (A', C', B'), so the positron is partly travelling forwards but mostly travelling backwards in time. The Bell experiment is concerned with the spin of the particle and spin is only carried in the A and B preons not in the C preon. So the r.h. positron is net travelling backwards in time with a measured spin of +0.5 (derived by 0.5{A'} -0.5{B'} +0.0{C'} + 0.5{B}).

The spin and direction of photons travelling through time is also explainable using preons. The photon is its own antiparticle as it is a boson without net electric charge: typically an antiparticle has the reverse sign of electric charge to the particle so the photon has no net charge to be reversed. The photon does have two possible spin states: +1 and -1 and these two forms of photon, in my preon model, carry the spin states in opposite time directions. The spin +1 photon has two preons BB and two antipreons C'C' where only the B preons contribute spin to the photon: spin 0.5 for each preon B. Spin +1 could travel either along or against the universe's arrow of time but preon B has net negative electric charge of -0.5 and it is the sign of that QED charge that determines 'along or against' the universe's arrow of time. The spin is a passenger carried along in the direction of motion of the electric charge in the preon that carries that spin. The spin -1 photon has its spin travelling in the opposite absolute time direction to the spin +1 photon. This feature allows absolute time reversal models of retrocausality to account for retrocausal explanations of Bell experiments using photons. I have made an arbitrary decision at some point in the past in developing my preon model that negative electric charge is associated with being 'along' the same time direction as our universal arrow of time. This means that all negative charge in the universe is travelling along with the universal arrow of time and all the positive charge is travelling in the opposite time direction. I have assumed that negative charge is positively correlated with the universal arrow of time but it could be vice versa similar to the uncertainty in the nineteenth century when positive charge was assumed to be flowing along electric wires.

Is quantum mechanics complete?

No, because quantum mechanics is a statistical theory. If you think you understand quantum mechanics then you are mistaken. So spoke Richard Feynman in illustrating a foundational problem in physics that no-one really understands the 'why' of quantum mechanics and therefore a 'shut up and calculate' policy is prevalent. Gamow's 1940 book: Mr Tompkins in Wonderland has long given accessible and simple analogies of what quantum effects would look like if they could be applied to macroscopic objects. For example, you may find your car has mysteriously reappeared outside your garage in the morning whereas it had been locked in the garage the previous night … corresponding to the quantum tunnelling effect.

That quantum mechanics is a statistical process can be seen by such as the Born rule which describes the outcome of a quantum measurement in probabilistic terms. This probabilistic treatment can lead to a confusion between ontological interpretations and non-ontological interpretations of quantum mechanical objects. The antagonism between ontology and non-ontology is perhaps best seen in the quantum property of superposition combined with the notion that elementary particles of the Standard Model are indivisible point particles.

Is superposition a problem for my quantum retrocausal model?

No. My preon model helps resolve the antagonism mentioned above for superpositions as there are multiple (hypothetical) preons within each elementary particle. An example of how preons help understanding is in the ***superposition*** status of gluons. A red-antigreen gluon contains the red property in some of its preons and the antigreen property in some of its other preons. This gluon has an overall superposition status but the individual preons within it do not exist in separate superposed states. More-complex arrangements of superpositions can be built by adding more components to the particles.

Is entanglement a problem for my quantum retrocausal model?

Entanglement is very important as it is the reason that we need quantum retrocausality. The quantum property of entanglement is an extra tweak on superposition. In entanglement a quantum property is shared between two different particles, such as two photons. The common macroscopic analogy is of Bertlmann's socks. If one sock is seen to be red we instantly know that the other sock is green. The colour information for both socks is available instantly to an observer when only one sock is measured and that information transfer is not limited by the speed of light. This is a feature of statistical information and it may not be surprising to arise when using a statistical process such as quantum mechanics. Entanglement is a very serious thorn in the ontological expectation that non-local effects do not exist for quantum particles in the same way that nonlocal effects do not appear to exist for everyday macroscopic objects. Quantum entanglement is more complex than Bertlmann's socks as a sock has a definite colour before observation whereas quantum properties when entangled are shared properties until measurement. This is not surprising when the definition of an

entangled singlet of a pair of socks uses (say) (sock1=red AND sock2=green) OR (sock1=green AND sock2=red). This function enforces a non-local relationship between the colours of socks observed. Quantum retrocausality removes the need for non-locality by using hidden variables (of the form of a specific sock colour). When sock1 is measured in a Bell-like experiment, the (retro)causality after that measurement of its colour follows sock1 back to the moment when the two socks were put on Bertlmann's feet, and that is the origin or source (or Hadamard gate) of the experiment which ensures that the other colour goes on to the other foot as sock2. When the socks are measured, they always have opposite colours.

Entanglement is an extremely unusual feature of the quantum world. The EPR paper of 1937 drew attention to this feature: was quantum mechanics a complete description of quantum nature or not? The issue festered until Bell in the 1950s and 1960s produced a theorem which allowed an experimental test of this issue. Early experimentalists found it difficult to make a fool proof experiment and it took up to 2015 to design and run a sound experiment to prove that quantum experiments did not obey Bell's Theorem. My solution to this issue is that locality is preserved but that a new description of reality is needed which shows that the Bell experiment does not actually involve a contravention of the Bell Inequalities. This is because nothing can break the Bell Inequalities and the reality of the Bell experiments is different from what is traditionally believed. A revised reality is an alternative to believing in instantaneous action at a distance.

The strangeness of entanglement is seen in the current drive towards achieving quantum computers which will depend upon entanglement to provide their hyper-speed of processing. Even the lesser strangeness of superposition, and the measurement problem, has led to changed ideas of reality such as the 'many worlds' view. My preon model allows superposition to exist for Standard Model elementary particles within the current reality, and therefore does not need a many worlds view, whereas entanglement is a step too far to lie within current reality. Yet the 2015 Bell experiments show that entanglement exists and therefore a new view of reality would be helpful while maintaining relatively, locality, and the speed limit of light.

Is quantum retrocausality a new idea?

The idea of retrocausality has been around for decades and many proponents seem to disbelieve that an elementary particle can actually travel backwards in time. What is generally agreed is that Special Relativity removes the existence of absolute time for observers. In general, there is no ability to always be able to say which of two events absolutely occurred first as the time ordering of events depends on the position and speed of the observer in relation to the positions of the two events. In this limited context, retrocausality can be modelled by advanced and retarded waves where the temporal ordering is relative. (Wheeler and Feynman, and Ref. 1.) More recently Aharonov introduced weak measurements with waves which have forwards and backwards-in-time components. I maintain in this paper that

there are also circumstances where antimatter (or components thereof) can actually travel backwards in time above and beyond the limited scope allowed within Special Relativity.

Do delayed choice quantum eraser experiments show evidence of retrocausality?

Nothing is erased. My version of quantum retrocausality does not involve revising or re-visiting existing spacetime events.

Do Bell experiments demonstrate the breaking of the Bell Inequalities?

The effects of the reversed-time direction of antiparticles is to restore locality to interpretations of Bell experiments by circumventing, rather than breaking, Bell's Inequalities. It is shown (Ref. 8) that if antiparticles have a reversed time direction, and reversed-time causality, then a Bell Experiment is no longer carried out on pairs of entangled particles. The particles are certainly entangled at one stage, and that entanglement is important, but the measurement of the time-reversed antiparticles is carried out **before** the entanglement occurs. The Bell Experiment then defaults to measurement on polarised beams of electrons. Alice first measures a beam of positrons and the subsequent entanglement enforces the beam of electrons measured by Bob to be polarised in the direction of Alice's detector setting; and, similarly, Alice measures electrons polarised in the direction of Bob's detector setting. The measurements of polarised of beams give results compliant with Malus's Law, and Malus's Law is compliant with correlations which give an apparent but false impression of breaking the Bell Inequalities because the constraint of measurement of entangled pairs is removed from a central role in the experiment. The antiparticles are not entangled at their time of measurement as their entanglement lay in *their* futures after their measurement. In their own time experienced, the antiparticles (including antiphotons) had not even reached the Oven (or Source or Hadamard gate) at the time they were measured. Time reversed antiparticles remove the need for nonlocality in the explanation of a Bell experiment.

Where is all the antimatter?

A combination of reversed time direction for antiparticles and the nature of dark energy explains why the macroscopic arrow of time points in the same time direction as the microscopic time direction of matter particles. Antimatter gravitationally repels itself so that it (and dark energy and dark matter) cannot form macroscopic structures such as animals, planets, stars or galaxies as repulsive gravity would pull structures apart or not allow them to form. Matter can form such macroscopic structures and hence the macroscopic time direction, that is the arrow of time, points in the same direction as the microscopic direction of time for matter which comprises the macroscopic world.

End of inflation/expansion is the end of time?

I accept the breakdown of space and time at nodes in Penrose's CCC model as it agrees with my use of the Rasch model to create spaces with metrics (Ref. 3). That Rasch paper was

written prior to my work on quantum retrocausality, however, so I now wish to understand CCC using Standard Model particles composed of preons which move forwards in time and antipreons which move backwards in time. So how to explain backwardness in time of antipreons at the CCC node where time has ceased or nearly ceased to exist? This isn't a problem for Penrose as only photons remain in existence at the nodes; and photons exist with a zero duration of time in their own frame.

In my multidimensional model (Ref. 2) there are a number of different time dimensions which align with or against the thermodynamic arrow of time. The antipreons exist in their own dimensions and are travelling backwards in our thermodynamic time. Antipreons do not necessarily exist in ***our*** future time but they exist in their own dimensions which have a correlation between their time direction and our thermodynamic time direction.

A very low-tech analogy (with my apologies) is with knitting where the wool on the knitting needles represents current spacetime. The strand of wool being added to the knitting comes from a ball of wool on the floor. That strand, which represents incoming antipreons, is only integrated into spacetime in the present moment. The strand on the floor exists in its own space and time but not within our space time, yet correlated to it. This imagery also affects and maybe contradicts the idea of spacetime being always existent in its full extent of time and space, or in a block universe.

The above does not affect determinism. It may be that the form of spacetime in full is predetermined, but I like to think it is not. The constituents of our future spacetime exist but they do not necessarily exist within our spacetime. In my model, spacetime is 4D, but there are other 4D blocks of which the most important one is the Kaluza-Klein “fifth” dimension which in my model is at least three QCD colour blocks of 4D each. I have resolved my worry about where reverse time antipreons were coming from in our future. They are in a 12D place correlated with but not inside our future space and time.

Can my preon model be used without waves?

Yes, though it is known that particle models are generally deficient in coping with weak isospin because it is not conserved in particle interactions. My preon model conserves all preons in particle interactions so it was necessary to model weak isospin as a particle or aggregate of preons and include weak isospin in preon interactions to make particle interactions conserve all aspects of their interactions. Thus making conservation complete.

The simplest example is when a left-handed electron converts to a right-handed electron whilst emitting a photon. The outgoing right-handed electron and the outgoing photon have no weak isospin but the incoming left-handed electron has weak isospin of -0.5. This weak isospin is lost to the vacuum field and that is covered by Quantum Field Theory but it thwarts a conserved, purely particle approach. To get around this, it is noted that the Higgs boson has only the net property of weak isospin +0.5 or -0.5. My preon model has three generations

of Higgs. The above interaction needs an incoming generation 1 Higgs boson of weak isospin +0.5 to conserve the preons through the interaction. The Higgs discovered by CERN is in Generation 3.

The conservation of preons (but not of particles) is reminiscent of the conservation of atoms (but not of molecules) in chemical reactions.

Is the preon model relevant to Zitterbewegung?

Yes. In my preon model, I identify/assume that matter/antimatter paired preons or components within a fermion particle such as B & B' are responsible for fermion mass. The Z and W and Higgs also contain such pairs, but the photon does not. I did not design my preon model with mass properties in mind. It just worked out this way to enable preon counts to balance going in and out of particle interactions.

Maybe a matter/antimatter matched pair of preons create a friction and drag on motion (and the zitter or trembling condition) between them because they are moving in opposite time directions.

Higher generations of fermions contain more preons such as BB', AA' and CC' and are more massive than lower generations. For example, an electron contains one such pair, a muon has five and a tau has nine such pairs. A Z boson has two such pairs while a photon, which is massless, has none. My first generation Higgs has unknown mass and has no such pairs so despite being a scalar particle it may possibly be massless!

What is the vacuum?

The vacuum appears to be the union of at least four sets of 4D dimensions. Why cannot we see the other three sets of dimensions? String theory is based on particles travelling at or near the speed of light. Special relativity requires that lengths moving near the speed of light with respect to us will appear to be severely foreshortened. Dimensions moving near speed c will therefore be foreshortened or compactified, which is why we do not observe them. Compactification is an observer effect. If we can imagine living in, and co-travelling within, one of these compactified 4D universes, it would not seem compactified to us, whereas our own spacetime would seem compactified and unobservable.

There is no solid matter in any of the dimensions except for knots of intertwined dimensions appearing to be matter. Matter can 'pop' out of the vacuum into our spacetime coming from the other sets of 4D dimensions.

Is the preon model relevant to SUSY (supersymmetry)?

A preon model plays the physical role of a SUSY as one can make both fermions and bosons out of a common pool of preons. The mathematics for fermions and bosons are very different from each other but that is overcome in SUSY by using Grassmann algebra. One difference

between SUSY and a preon model is that using preons does not invoke a need for SUSY superpartners, for example, ‘selectrons’.

An example of preons connecting fermions and bosons is electron/positron annihilation of fermions to produce two photons (bosons):

BCBB’ + B’C’C’C → B’B’CC + BBC’C’

Electron + positron → photon (spin -1) + photon (spin +1).

A common set of BBB’B’CCC’C’ preons can make an electron and a positron or can make two photons (actually in my model, a photon plus an antiphoton).

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