3 Dimensional Time in a Nutshell

By Peter J Carroll

www.specularium.org

Introduction.

The hypothesis of three dimensional time arises from a consideration of the following two principles: -

'If quantum gravity fails, try geometricating the quanta.'

'Probability lies at right angles to time.'

Part 1. Geometricating the Quanta.

Gravity resists quantisation because of the equivalence principle. Any particles gravitational/inertial mass depends on its energy; and mass and energy appear as continuously variable rather than as quantised.

Force carrying (boson) particles can transfer accelerations between matter (fermion) particles, and accelerated masses may indeed emit gravitons/gravitational waves. Such accelerations always indicate repulsive and recoil type effects at emission and absorbtion.

However gravitational 'forces' seem best understood as spacetime curvatures as in General Relativity.

Static electromagnetic/electroweak and nuclear 'forces' or 'fields', currently conventionally vaguely modelled as mediated by un-quantised 'virtual' bosons, may instead arise from special forms of spacetime curvature with which only electrically or colour charged particles interact, and they can have attractive or repulsive effects.

If a particle exhibits multiple properties these properties must arise from as yet more fundamental constituents, ***or from the dynamic spacetime geometry of the particle.***

If fundamental particles consist of vorticitating hyperspheres (3-spheres or 4-balls) then a number of degrees of freedom exist for their hyperspherical 'rotations'.

The fourth spatial dimension W*, which arises when an object assumes a hypersphere configuration, lays orthogonal to all the other three spatial dimensions and represents the space-curvature. Relative to this, the hypersphere can spin through the planes XY,XZ,YZ,W*X,W*Y, and W*Z.

Hyperspheres spin through planes rather than through axes. One rotation through one plane (or all three planes) converts a hypersphere into its mirror image; a second rotation through the same plane(s) restores the hypersphere to its original orientation. These rotations can take place in one of two directions for which we have no words but they correspond to something like ‘outside-in’ and’ inside-out’ as they invert/evert the hypersphere with respect to the fourth dimension. In conventional physics notation they correspond to the various conventions of ‘plus’ or ‘minus’ characteristics, and charges. Part two of this paper will set out the case for a spacetime metric composed of 3 dimensions of space and also 3 dimensions of time, with both 3D space and 3D time curved by the geometry of gravity to give hyperspherical space and time. Hyperspheres composed of such spacetime can also rotate about temporal planes BC,BD,CD,A*B,A*C, and A*D.

The Four Dimensional Rotation of Fundamental particles and the entire Universe arises from a consideration of certain symmetries.

Firstly see this elegant display of objects rotated through various dimensions: -

http://eusebeia.dyndns.org/4d/vis/10-rot-1

If we use a line of limited length to represent a ‘one’ dimensional object and then rotate it in a plane and observe it only in that plane, it will appear to shrink to a point and then expand back to its original length but the other way round. (Imagine rotating a thin needle and looking at it in the plane of rotation, it appears to shorten and shrink to a dot as either the point or the blunt end becomes directly orientated towards the observer.

Something similar happens with a ‘two’ dimensional object like a sheet of card rotated towards or away from the observer, when viewed end on it appears to have shrunk into a one dimensional line, which then becomes restored to a sheet as rotation continues.

Of course neither the needle not the sheet of card have actually expanded or contacted if viewed from a wider perspective.

If we could observe a cube rotating in one plane through a fourth dimension and observe it from right angles to that plane then it would appear to shrink down to a line before expanding back to a mirror image of itself.

If we could observe a cube rotating simultaneously in all three planes through a fourth dimension it would appear to shrink to a point before expanding again into a mirror image of itself, assuming that we viewed it from less than a full perspective in four dimensions.

Well the universe appears to have expanded from a point (a big bang) and in some models appears headed for an eventual re-contraction to another point (a big crunch), and perhaps an endless series of such expansions and contractions, only because of a failure to model it in its full dimensionality and with vorticitatory motion.

The universe itself appears to undergo just the inversion rotations of a hypersphere, turning itself 'inside out' and back again in space and time over a period of about 22 billion years.

If a fundamental particle hypersphere has a finite hyperspherical displacement in three dimensional time as well as space, then four classes of degrees of freedom become available, and these correspond to the four main particle properties of chiral spin, colour charge, electro(weak) charge, and generation, as shown below: -

Particle Property.	Inversion.	'Force.'	Notes.
Spin (Chiral)	Spatial.	G.	±Parallel or transverse modes.
Colour Charge	Temporal.	G & C.	± 1, 2, or 3. (R, G, B, -R, -B, -G) *1
Electo(weak) Charge	Temporal.	G & E.	± 1, 2, or 3. *2
Generation	Spatial*3.	G.	± 1, 2, or 3.

*1 Quarks have ± 1, Baryons have ± 3. Mesons have +1 and -1.

*2 The total of E & C charges always equals ± 3 or 0 for any particle, if we consider the 'fundamental' charge on the electron as 3 rather than 1, as implied by the fractional charges on quarks.

*3 Particles and antiparticles can perhaps have Generation character of either sign, as with Spin.

Fig 2. Spin Planes in 4D Space (W*,X,Y,Z), and 4D Time (A*,B,C,D).

Where W* and A* represent the 'fourth' dimensions of space and time arising from the hyperspherical geometry of fundamental particles.

Rotations in 3d

Spatial rotations

XY

XZ Ordinary chiral spins?

YZ

Temporal rotations

BC

BD Colour spins?

CD

Inversion rotations involving the fourth dimensions

Spatial Inversions

W*X

W*Y Generational spins?

W*Z

Temporal Inversions

A*B
A*C Electro-weak spins?
A*D

Now just which of these classes of rotational freedoms gives rise to each of the four phenomena of particle Spin S, Colour Charge C, Electro(weak) charge E, and Generation G, remains currently unclear, but some tantalising hints exist: -

1) All fundamental particles must exhibit both S and G, this seems to indicate some basic spacetime displacement requirement for existence. (Bosons in this model appear as composed of particle-antiparticle components which do not manifest separately if such manifestation violates condition 5 below).

2) S and G do not give rise to 'forces' other than gravity/mass, i.e. simple spacetime curvature.

3) S and (probably G) undergoes spatial reversal, reflect the particle and it undergoes a reversal of Chiral Spin and probably also of Generation, (this explains the apparent non-conservation of particle Generation in some reactions.)

4) C and E undergo temporal reversal in the sense that antiparticles have the opposite signs of C and E to particles.

5) The numerical total of C and E spins always equals 0 or ±3 for any fundamental particle, never ±1 or ±2, this suggests that some form of complete rotation in all 3 planes only, or none, can occur. This effect seems to manifest in a secondary manner as well by allowing only quark-antiquark mesons or baryon quark triplets.

6) Gravitational and Electrostatic 'fields' have unlimited range. C 'fields' have only atomic range effects.

Before examining how all fundamental particles accommodate themselves within this scheme it seems worth considering what 'fields' and 'forces' actually do and what they may consist of.

Static Gravitational and Electric fields have non-local effect, lightspeed does not limit them. Black Holes still have Gravitational and Electric ‘fields’, even though the spacetime curvature prevents photons from leaving. Gravitational and Electrostatic effects act on bodies instantaneously from their absolute simultaneous positions. The non-local effects of gravitational fields rules out multiverse hypotheses.

Thus Gravitational and Electrostatic fields and probably Nuclear fields seem best modelled as forms of spacetime curvature rather than as forces or fields mediated by so called virtual boson particles. Accelerating mass or charge nevertheless produces real boson particles, such as gravitons, photons, and gluons.

All particles consist of quanta of spacetime rotating through various planes; all of these rotations subtend some sort of spacetime curvature. Some combinations of spins require more energy to create than others and hence create more massive particles; however the spin combinations do not add up in any simple way, some just seem to represent more energetic and hence massive distortions of spacetime than others.

For a simple analogy, of much reduced dimensionality, consider a kinked elastic band, any two kinks in opposite directions will tend to cancel out if they approach, but kinks in the same direction will start to repel if they come closer. This models nuclear and electroweak field effects. However any kinks at all, of either kind, in an elastic band increase the general tension, and this represents a gravitational field which always has an attractive effect.

Fig 3. Fermion and Boson Particles described by their hyperspherical spins

Key: Fermion spin defined as 1 unit. ╪ means plus AND minus.

∓ means minus or plus with respect to <u>associated</u> ± plus or minus.

Fermion and Boson Particles described by their hyperspherical spins					
Particle Type.	**S**	**C**	**E**	**G**	**Remarks**
Neutrinos	±1	$?*^{n}$		∓1,2,3	
Graviton	±2			╪1	**Awaiting detection**
(‘Photon halves’	±1		±1	±1	**No independent existence)**
Photons	±2		╪1	╪1	
Electrons	±2		±3	$\pm1,2,3$	**± electron, muon, tauonF**
W+ boson	-2		$+3$	╪1	***positron-neutrino***
W- boson	$+2$		-3	╪1	***electron-antineutrino***
Z boson	±2		╪3	╪1	***electron-positron***
(‘Gluon halves’	±1	±1		±1	**No independent existence)**
Gluons	±2	╪1		╪1	
Type 1 quarks	±2	±1	∓1	$\pm1,2,3$	**± down, strange, bottom**
Type 2 quarks	±2	±1	±2	$\pm1,2,3$	**± up, charm, top**
Mesons	**any quark-antiquark pair**				
Higgs	**Z/Z or W+/W- composite particle?**				**Non existent**$*^{B}$

$*^{B}$Despite the much trumpeted detection of a boson particle at around 125GeV at CERN, the above model does not require a Higg’s boson to confer some component of mass to some particles. In place of the Higg’s mechanism, mass arises in this model from spacetime curvature as in General Relativity. The weak and fleeting signal at 125GeV may well arise from a composite particle such as a ZZ or a W+W-, into which it almost instantly decays anyway. We may well observe other even more energetic artefacts of such experiments, but at such high energies particles have only the most fleeting existence as their component spins rearrange themselves into other particle configurations and then cascade down the energy scale until they reach more stable forms which we can observe in nature.

The quest for ever higher energy experiments seems unlikely to yield any fundamental surprises if this 6D spin model accurately describes reality. Only three generations of fermion particle exist as a consequence of the structure of the underlying 6D spacetime, bosons consist of particle-antiparticle components. At very high energies more or less any particle can mutate into any other as the spins rearrange themselves, some exotic and barely stable particles not forbidden by the model may appear very fleetingly before they decay, but they will consist of just the possible spins rearranged into very strained configurations.

$*^{n}$Whether Neutrinos exhibit some sort of Chiral Spin to Generation linkage remains unclear, the observed Chirality of W bosons suggests that they do. Neutrinos probably behave as Marjorama rather than as Dirac fermions, i.e. as their own antiparticles, thus ensuring matter-antimatter symmetry at the most fundamental level.

This model treats bosons as having a particle-antiparticle configuration and hence avoids supersymmetry hypotheses.

Part 2. Three Dimensional Time and Observed Reality.

A consideration of the mechanisms underlying indeterminacy, entanglement and superposition.

On a macroscopic level the idea that time might have the same three dimensional geometry as space seems at first absurd, the past seems to have happened in one particular way, even if it has become a bit hazy in places, time seems to have a singular moment of the present, even if different observers cannot entirely agree about it, and we expect only one future to manifest, although we can never remain totally confident about which one.

Some physics theories attempt to explain particle behaviours as arising from their activities in extra dimensions of space, however, so as not to upset the rest of macroscopic physics these extra dimensions of space have to have an extreme compactification down to incredibly small sizes and the theories which use them call for an embarrassingly large number of them.

Three dimensional time however can potentially describe particle behaviour and provide a reason for the mysterious existence of the two extra generations of fermions some of which occasionally occur naturally and the rest of which nature allows us to manufacture.

The two additional dimensions of time do not require ‘compactification’. We cannot really ‘see’ the size of one dimensional time, the present seems vanishingly short but the past and future appear potentially quite huge. The present moment doesn’t seem to have a readily discernable ‘length’; although $\sqrt[3]{U}\, t_p$ may represent the smallest meaningful or measurable interval, but does it also have a ‘width’?

If time has three dimensions that we cannot see, then perhaps the linear time that we imagine merely consists of an imagined line joining a series of points that need not form a straight line from another perspective. Blindfolded persons wandering across a surface might well insist that they had walked in straight lines, but though those that can see might well disagree.

The existence of three phenomena in particular seems highly suggestive that time may have ‘full size’ orthogonal components, a domain through which probability, superposition and entanglement work.

The apparent indeterminacy that we observe in many physical processes can only arise from some sort of underlying mechanism which has a probability component that yields the still statistically reliable outcomes that we observe in nature. If a plane of time lies orthogonal to the ‘ordinary’ linear timeline which we construct or abstract by memory and expectation then it could conceal a plethora of possible alternatives which wave equations attempt to represent without precise specification. Indeed the relative angles or orientations of events in orthogonal time seem inaccessible to us and perhaps randomly chosen anyway.

Superposition consists of a particle or ensemble of particles apparently occupying two or more mutually exclusive states simultaneously. We cannot observe particles in superposed multiple states but we can infer that they must have come from superposed states immediately before measurement or interaction to account for their actual behaviour. For example an electron does not seem to have a single definable position at any instant as it orbits the nuclei of an atom, but rather it seems to act as though it occupies all points of a wider distribution that we identify as its ‘orbit’ which can extend over several atoms. This means that entire molecules behave as though they exist in two or more different states at the ‘same’ time. Indeed the whole of physical reality seems to exist in superposed states except for the brief instants when particles interact using just one of their superposed states chosen seemingly at random.

Entanglement occurs when two or more particles can remain in some sort of linked quantum state even if separated to arbitrarily large distances. If one then falls out of the quantum state the other(s) then seem instantaneously predisposed to fall out of it in a correlated matter even if no ordinary lightspeed signal could possibly have passed between them.

Whereas superposition consists of multiple events in the same space separated by sideways time, entanglement consists of multiple events at the same time separated by space.

Now the Minkowski formalism usefully allows us to work out spacetime separations by describing ‘ordinary’ time as an ‘imaginary’ form of space using an extension of Pythagoras’ theorem to four dimensions: -

$$d = \sqrt[2]{x^2 + y^2 + z^2 + (ict)^2}$$

Where $(ict)^2$ means the imaginary number ‘i’, the square root of minus one, multiplied by lightspeed multiplied by the time. This has the effect of turning the temporal part of the spacetime separation or distance into a negative contribution to the separation.

Thus if we consider the spatial distance as just a one dimensional ‘s’ and square out the square root of minus one we obtain: -

$$d = \sqrt{s^2 - (ct)^2}$$

This means that something travelling at lightspeed, for example a photon, experiences a zero spacetime separation between its point of emission and its point of absorption. Onboard flight time shrinks towards zero at lightspeed as predicted by Special Relativity and confirmed by experiment.

Now by taking the radical step of designating the orthogonal components of time as 'imaginary' or 'unobservable' forms of time, i.e. as: -

i^2ct, then its Pythagorean component comes out as $(i^2ct)^2$ or simply $(ct_I)^2$ so sideways time can act as type of space which we could regard as some sort of pseudo-space in which superposed states can reside.

Thus we can represent the full spacetime and sideways time separation between two events as: -

$$d = \sqrt{x^2 + y^2 + z^2 + (ict)^2 + (i^2ct_2)^2 + (i^2ct_3)^2}$$

where t_2 and t_3 represent the axes of the plane of orthogonal, 'sideways', time.

Or more simply by squaring out and omitting some dimensions for convenience: -

$d = \sqrt{s^2 - (ct)^2 + (ct_i)^2}$ (compact form, one spatial, ordinary temporal and one sideways temporal dimension.)

Now two cases of zero separation become immediately apparent: -

$0 = \sqrt{s^2 - (ct)^2}$ (Entanglement) $0 = \sqrt{(ct_i)^2 - (ct)^2}$ (Superposition)

In superposition multiple linked events can occupy the same place but remain distinct because they occupy different positions in orthogonal time.

In entanglement multiple linked events can occur at the same time despite any degree of spatial separation.

(Note that this implies that we must not ignore the negative roots, the advanced wave solutions, and that entanglement works by advanced signals travelling backwards in time from the point of quantum state collapse to specify the correlation at the point of emission, as in Cramer's Transactional Interpretation.)

Superposition implies that the perceived reality of 3D or 4D spacetime and the illusion of 'substance' and 'stuff' and material reality, with its attendant phenomena of indeterminacy, entanglement and superposition, arises from an interference pattern from quantum wave functions in a much more extensive 6D spacetime.

Moreover, 6D spacetime perhaps provides the skeleton for a ‘unified field theory’ which can accommodate all fundamental ‘forces’ or ‘fields’ as curvatures in spacetime and all fundamental particles as various arrangements of spin of the underlying spacetime quanta.

The questions of how hypersphere antipode length and vorticitation rate give rise to such phenomena as Compton wavelength and frequency and the existence of apparently massless exchange particles receive attention in the following Quantum Hyperspheres paper.