Counterspace and Atomic Structure

Introduction

The previous article (Reference 3) introduced the idea of counterspace, and how objects existing in both space and counterspace simultaneously suffer strain and stress which explain the forces of physics. In counterspace "infinity" is infinitely *inward* at a point, polar opposite to space. Such a point is referred to as a CSI (counter space infinitude). An essential ingredient is the consciousnesses associated with these spaces. Our ordinary waking consciousness experiences infinity as an unreachable *outwardness*, whereas that inhabiting a counterspace experiences infinity as an unreachable *inwardness* reaching towards the CSI. The developments of quantum physics in the last hundred years increasingly point to the involvement of consciousness, depending upon the interpretation of quantum physics adopted. Non-locality and dependence upon an observer can be so interpreted. The holistic aspect needs, however, to be treated in terms of holistic basic entities, and points are not suitable for that. It is fruitful for physics to embrace the polarity (or duality) inherent in projective geometry so that planes instead of points are basic, themselves having a holistic character. The counterspace approach necessarily involves non-locality and wholeness. The counterspace invariants corresponding to length and angle are called *turn* for planes and *shift* for points. A turn is not an angle, and may be infinite if one plane contains the CSI (Reference 3).

As an engineer I seek thinkable realistic processes to describe a replacement for quantum physics rather than abstract mathematics. I acknowledge fully the power of mathematics and I use it, but what for me is problematic is the Copenhagen Interpretation of quantum physics which declines to explain the results of experiments, because that is too difficult and non-intuitive. It very successfully predicts probabilities of results of experiments, no matter how outlandish those results may be to common sense, based on complex equations which appear to defy physical interpretation. For example the notorious double-slit experiment where single photons appear to go through two distinct slits at once. This approach has been enormously successful as an *instrumental* approach, in the sense discussed by Sir Karl Popper who claimed that after the trial of Galileo instrumentalism won the day without another shot being fired (Reference 4). That appears to be quite true for quantum physics. Much greater minds thine mine have grappled with this problem e.g. David Bohm who sought so hard for "hidden variables" to remove the stochastic basis of physics, not to mention Einstein's dice. In what follows I try to live up to my engineers approach to present my current thinking about a realistic way forward, fully conscious of its limitations and the need for much more articulation by more able minds. It is a "snapshot" of a process I am engaged upon, and will certainly change in the future in the light of deeper insights. But it is a start, an attempt to demonstrate that another way forward is possible even if it is eventually replaced by a better one.

Time was introduced as being inversely proportional to radial turn in counterspace, and that requires the existence of a sphere in the present called the *Valence Sphere* (Σ) as it relates to chemical action which must take place in the present.

Hybrid Resonant Cavities

Point particles and even atoms are not regarded as continuously existing as points, but rather they appear when certain interactions occur. To use a now old example, an electron traversing a bubble chamber has a well defined track, but its location only becomes precise when it interacts with the liquid, producing a bubble. The wave-function then collapses, but since the electron suffers further interactions and collapses, the wave function must somehow reform after an interaction. Thus a lump of copper, for example, need not be regarded as "made of atoms", but atoms may appear during interactions, and may even be held in existence e.g. during ionisation. An exploratory proposal for the structure and functioning of an atom (when manifest) based on counterspace will be described in this article.

Laplace's equation $\nabla^2\psi=0$ is sometimes said to be the most important equation in physics. For a physical system it ensures that ψ is single-valued, finite and continuous. For space this is seen as necessary for fields, so a linkage between space and counterspace needs to respect it. An equation for a spherical surface may be set up between space and counterspace as follows:

$$\frac{\partial^2\psi}{\partial r^2}+\frac{2}{r}\frac{\partial\psi}{\partial r}+\frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial\psi}{\partial\theta}\right)+\frac{1}{r^2\sin^2\theta}\frac{\partial^2\psi}{\partial\varphi^2}=K \qquad (1)$$

which is Laplace's equation in spherical polar coordinates in space, where K is the constant of separation. For counterspace

$$\frac{\partial}{\partial\tau}\left(\tau^2\frac{\partial\psi}{\partial\tau}\right)=L$$

where τ is the turn, ignoring terms involving shift. We now change the variable for counterspace to $t=s/\tau$, taking s as the scaling constant as radial turn measures time, so that $dt/d\tau=-s/\tau^2$ giving the radial Laplace function as

$$\frac{\partial}{\partial\tau}\left(\tau^2\frac{\partial\psi}{\partial\tau}\right)=\frac{\partial}{\partial t}\left(\tau^2\frac{\partial\psi}{\partial t}\frac{(-s)}{\tau^2}\right)\frac{-s}{\tau^2}=\frac{s^2}{\tau^2}\frac{\partial^2\psi}{\partial t^2}=t^2\frac{\partial^2\psi}{\partial t^2}$$

Finally we must ensure K and L are the same, and as (1) has been divided by r^2, we must do the same for (2), giving us

$$\frac{1}{v^2}\frac{\partial^2\psi}{\partial t^2}=K$$

where $v^2=r^2/t^2$, yielding finally

$$\frac{\partial^2\psi}{\partial r^2}+\frac{2}{r}\frac{\partial\psi}{\partial r}+\frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial\psi}{\partial\theta}\right)+\frac{1}{r^2\sin^2\theta}\frac{\partial^2\psi}{\partial\varphi^2}=\frac{1}{v^2}\frac{\partial^2\psi}{\partial t^2} \qquad (2)$$

This is the well-known spherical wave equation used to describe sound waves, explosions etc. where r is the instantaneous radius, θ the 'latitude' and φ the 'longitude'. We are spared having to solve it as the solution is well known:

$$\psi=Y_{k,l}(\theta,\varphi)J_{\pm(l+\frac{1}{2})}(\omega r/v)e^{i\omega t} \qquad (3)$$

where Y is a surface spherical harmonic, $\omega = 2\pi f$ and J is a spherical Bessel function which has equally spaced zeros due to the $\frac{1}{2}$ term in its subscript. It will be recalled that Y gives the pattern of oscillation magnitudes determined by θ and φ on a given instantaneous sphere, J gives the radial variation in magnitude as the wave expands and f is the frequency. Finally v is the radial velocity determined by the medium.

In the present context (3) describes a wave between space and counterspace, and so the standing wave interpretation is appropriate, and we imagine a linked bounding sphere of a resonant cavity in which the standing spherical wave exists. The potential ψ is that of the "ether" in counterspace. Thus there <u>is</u> an ether, but not the 19th Century variety as it is not an idealised physical quantity but exists in counterspace. We will learn more about it later. The frequency f is comparable to the Zitterbewegung.

<u>Linkages Based on Cavities</u>

Such a hybrid cavity provides a means for seeing a linkage between space and counterspace as a process rather than as a mathematical abstraction. It could simply have been postulated, but it is better to see its possibility verified mathematically. A possible example of such a cavity in Nature is the Sun, which could be a warmth/heat cavity transforming etheric warmth into physical heat. A "point linkage" is now replaced by a hybrid heat cavity in which ψ relates to heat. This is the first example of an "ether". Equation (3) governs this, so let us start with hydrogen. Assuming a hydrogen atom, when manifest, is such a cavity with a node of J on the valence sphere Σ i.e. for r equal to the radius of Σ, $J_{\frac{1}{2}}(\omega r/v)=0$. If l=0 in (3) we have a simple uniform distribution in 'longitude' round Σ which is zero for l=0, but has a uniform oscillating magnitude at other radii. The other bound of the cavity is the Euclidean plane at infinity Ω. Thus for a linkage between the spaces we require both Ω and the counterspace infinity (CSI) at the centre of Σ. J is zero at infinity, satisfying the boundary condition for the cavity on Ω. Note that in counterspace the radius of Σ is ρ which is a finite turn between Ω and Σ, so the wavelength in counterspace is finite. The radii of the nodes are <u>counterspatially</u> equally spaced, which for a Euclidean consciousness means the spheres would appear to have radii seperated by increasing Δr outwards, but that does not apply to space, noting that (3) is the spatial side of the cavity equation. In space r decreases inwards towards the CSI with equal spatial steps between the nodes. That means the transformation between space and counterspace implied is a projective polarity, and the counterspace spheres do not coincide with the spatial ones.

If any of r, v or ω change or are perturbed in (3) the valence sphere will no longer be at a node and other modes of (3) may be stimulated. An increased energy in the l=0 mode is then transferred to another mode so that the fundamental oscillation retains its node on Σ. The mode is governed by k in 'latitude', and I now take k=2Z (where Z is the atomic number, see rationale for this below) so that l may be -2, -1, 0, 1 or 2 for hydrogen, giving two modes for positive l corresponding to the possibility of one electron appearing for l=1 as we will see, l=0 relating to the non-ionised pure cavity state. l=2 will be seen to have another significance. We note that $l<0$ will be a further possibility requiring interpretation, if it arises. For other chemical elements Z is greater and more modes and electrons are possible. I am assuming, contrary to the Standard Model, that *there are no electrons* in a non-ionised atom, and also *no protons or neutrons*. The greater is the atomic mass number A the greater the frequency i.e. the mass of the atom relates to the frequency. If υ is taken to be the frequency of hydrogen then other isotopes have resonant cavity frequencies Aυ. As there are no protons there is no 15 ton force between protons as in the conventional nucleus and thus no need for the strong force, or hypothetical quarks or gluons. Quite a simplification! Thus (3) is now

$$\psi=Y_{2Z,l}(\theta,\varphi)J_{\pm(l+\frac{1}{2})}(A\upsilon r/V)e^{iA\upsilon t} \qquad (4)$$

replacing v with V to avoid confusion with υ. Since the valence sphere must have the same radius for all elements, and $J_{\frac{1}{2}}(A\upsilon r/V)=0$ for that radius for all elements, $V \sim A$, which makes sense. However since V may vary from that during ionisation (see below) we do not replace it with, say, kA.

The complexity of the Standard Model arises principally from the attempt to retain aspects of classical physics at the quantum level, and so tries to explain everything in terms of particles with mass, momentum, spin and orbital angular momentum. Yet the Standard Model cannot account for mass without importing the Higgs mechanism! Without mass only spin remains. The New Quantum Physics discarded the idea of orbits of electrons, for example, in favour of orbitals which are not even in a plane. Yet the underlying thinking still tries to bring in quantities like orbital angular momentum. What is essential are the quantum numbers and the quantum laws which they obey. Given those, all else follows. However, particles (other than atoms) do arise as we know, but they may be regarded mostly as transitory modes which decay, the proton and electron being the exceptions. In line with the above counterspace considerations, the proton is regarded as an ionised hydrogen atom when it is created, but not as part of the cavity. It also arises from the radioactive decay of ^{5}Li, which again we may regard as ionised hydrogen. More on the electron later.

Mass is an important quantity, which must now be considered. In Reference 2 it was shown that frequency is proportional to momentum. What was not explained there was that the frequency involved is radial, as in a spherical cavity. That in turn implies a new concept: *radial momentum*. Since momentum may be related to mass I take radial momentum to relate to rest mass, noting that being radial it involves no translatory movement. Thus the frequency of our hybrid resonant cavity now gives us the mass of the atom in terms of the implied radial momentum, and so the relation of the resonant frequency to the atomic mass number A makes sense.

Spinor Linkage

We now need to relate the metric linkage between space and counterspace to the cavity. Recall that the null vector

$$x^2+ y^2+ z^2=0$$

is related by Cartan (Reference 1) to the two components of a 2-spinor. It is a mysterious beast, as Cartan discovered the existence of an entity with invariant magnitude under the *three*-dimensional orthogonal group which has only *two* components. That is a 2-spinor. A four spinor arises similarly from a null plane. Now the equation of the absolute imaginary circle which determines the metric properties of Euclidean space was shown by Arthur Cayley to be

$$x^2+ y^2+ z^2=0=w$$

in homogeneous coordinates, where w is the coordinate relating to the plane at infinity, which is zero to place the circle there. In reality it is a degenerate quadric as Cayley's metric proposes an invariant quadric. For counterspace the same formal equation describes the absolute imaginary cone (c.f. Reference 3), where now {x y z w} are plane coordinates and w=0 places the real vertex of the cone at the CSI (origin of coordinates). This formal identity suggests using the equation for the linkage between the two spaces, and the formal identity with the null vector of a 2-spinor suggests that a spinor is suitable for the linkage tensor between space and counterspace. Now every quadric may be interpreted as a projective polarity transformation, so the polarity encountered earlier may be taken as that of the spinor, with imaginary radius (see below). A projective polarity is a special case of a projective *correlation* which transforms points into planes and *vice versa*. The more general correlation may include a rotation (which is zero for a polarity). I further propose that there is such a rotation between the space and counterspace absolutes which is therefore included in the spinor transformation, amounting to a permanent 'spin'. This amounts to an *azimuthal strain* so I relate it to the atomic number Z since conventionally k in (3) is the *azimuthal quantum number*, which has been replaced by 2Z in (4). That was the rationale for introducing Z into (4). Thus this spinor relates to the electrical properties of the atom governed by Z. Then $Z=n\theta$ for some constant θ.

Now the linkage properties require a special scaling tensor, distinct from the linkage tensor (see Appendix A), which may be decomposed into two components: one is radially conservative and relates to the above spinor, while the other has curl and is suitable to describe magnetic properties. The tensor was derived for light with a scaling constant c, which decomposes into ε_0 and μ_0, the permittivity and permeability of free space which are scaling constants. Hence instead of the linkage tensor being a 2-spinor, a 4-spinor is proposed which consists of the above geometrical/electric 2-spinor together with a second 2-spinor related to the magnetic moment of the atom. Both relate to an imaginary unit sphere, see (A2) in Appendix A. Note that Dirac used a 4-spinor for his famous description of the electron.

The process that makes the spinor linkage real rather than abstract is the above correlation. This is identified with the oscillation of the cavity, so corresponding to e.g. oscillation of air in a sound wave we have a continous correlation between points and planes of space on their polar spheres (inside and outside Σ), including the rotation given by $\boldsymbol{N}$ in Appendix A. This well illustrates the nature of the intensive linkage involved, for the linked points and planes are not incident, and it is the rates of change of position and counterspace location which are linked, according well with an oscillation.

Ionisation

The electron is envisaged as an imaginary cone in line with the imaginary unit sphere associated with the linkage spinor and transformation above. An imaginary 45° cone is identical to an imaginary sphere, having a real vertex and a real but negative polar area. That makes its charge negative. Ionisation occurs when such a cone is emitted from a mode of (4) (see the next paragraph). All interactions with the electron take place at its real vertex. In affine geometry areas are only comparable for figures in parallel planes, or in the same plane. In counterspace, polar areas for polar-affine linkages are only comparable in polar-parallel points or in the same point. For the electron that means at its vertex e.g. two interacting electrons must share the same vertex (or their vertices must lie on a line through a counterspace infinity). The vertex is referred to as the *Affine Interaction Location* (AIL). For this reason the electron appears to be point-like in space as it only has one real point of contact, but neither the charge nor the mass are concentrated in that as conventionally. The AIL is analogous to the post box of a house, all correspondence entering the house through it; the house is not the post box, however. This neatly solves the problem of infinities in the Standard Model, where the electron has to be a point particle as otherwise is would blow itself apart due to the Coulomb force, and so the charge-density and mass-density have to be infinite (N.B. it is not 'smeared out' conventionally by the wave function; the latter describes the probabilities for its point location in accordance with the Born Interpretation of the wave function). The Coulomb force does not operate pointwise for our counterspace model, and only acts between atoms and electrons as a whole, but not within either. The mass of the electron is given by its radial momentum. An electron counterspace (ECS) is postulated in which all electrons exist. Their CSIs are at their AILs. Thus ionisation involves a coupling between the parent cavity and the ECS so that the energy is transferred to the latter via the coupling (see the paragraphs below on coupled oscillators). Electrons are created by ionisation; they do not exist in a non-ionised atom.

After loss of an electron a cavity has reduced radial momentum due to the loss of mass. That means the frequency is slightly reduced, so V decreases in (4) to maintain a node on Σ i.e. r is not changed as it is that of Σ. A change in V is consistent with the change in frequency, as neither A nor υ can change in (4). Due to its coupling with other like atoms (see Coupled Oscillators below) there is a different kind of energy exchange with other atoms than in the non-ionsed state, which is what makes it an ion.

Coulomb Force

In Reference 2 the chord law is described which generates a repulsive force between disinct affinely-related CSIs, due to affine strain. This accounts for the Coulomb force. Thus it does not act within a cavity but between cavities, emphasising again that no strong force is needed as conventionally. The force between electrons and between atoms is repulsive, but since the polar area of electrons is negative that between electrons and atoms is an attraction. Since electrons always experience repulsion, there is a permanent strain within the ECS. However between atoms there is only a strain if they are ionised, giving the positive-charge repulsion.

Farewell Ferrer

Returning to the spherical harmonic $\boldsymbol{Y}$ in (3), Ferrer's function $T_k^l(\cos\theta)$ describes the 'latitude' variation of $\boldsymbol{Y}$. Now this has a bit of a history, as the function actually derived for the solution of Laplace's equation is the associated Legendre function

$$P_k^l(\mu)=\left(\mu^2-1\right)^{l/2}\frac{d^l P_k(\mu)}{d\mu^l}$$

where μ is the independent variable and $P_k(\mu)$ is a Legendre function. For spherical polars $\mu=\cos\theta$, which makes P_k^l imaginary for odd l. Rather embarrassing! So Ferrer proposed replacing μ^2-1 with 1- μ^2, resulting in $T_k^l(\cos\theta)$ which also satisfies equation (2). However I have retained P_k^l, or P_{2Z}^l, which results in imaginary odd l modes and real even-l ones. The reason for this is that the electron is related to an imaginary cone (see above) which may be realised by this use of P_{2Z}^l. The potential involved for the odd modes is distinct and is called the 'light ether' as it may give rise to ionisation or emission when a mode is rendered unstable i.e. (4) is no longer obeyed. It is rather satisfying to revert to the true mathematical solution to meet our requirements.

If a node is no longer on the valence sphere there are oscillations in magnitude on its surface with a pattern given by Y in (4) and an amplitude given by J. They are in counterspace as they are physically timeless, being confined to the present as they remain always in Σ, and so are oscillations in planar intensity, the magnitudes being represented by that of Y at the tangent points. This applies to the even-l modes which are real. These oscillations concern a third kind of "ether" as they are not radial oscillations, and being confined to the valence sphere they concern what was called the "chemical ether" in Reference 2 (after Rudolf Steiner). A philosophical issue is encountered here as we end up with oscillations independent of time. This is resolved by noting that if they are purely in counterspace no physical time contradictions arise as counterspace determines 'time' for the physical world.

Thus it is the intensity of this ether which is oscillating in the planes, and for that to happen there needs to be a coupling of the warmth and chemical ethers so that an actual activity occurs in Σ which can lead to physical processes. Since time elapses in physical processes, such action involves a transfer of some kind from or between those oscillations, which takes time.

The conclusion is that the odd modes allow for up to Z electron modes (not necessarily electrons), and the even modes allow for up to Z chemical modes. Chemistry has been divorced from electrons within the atom, unlike in the Standard Model, but not necessarily between atoms.

Absorption and Emission

One process for absorption has already been described: a change in frequency of the cavity oscillation due to absorption of energy results in Σ not being at a node in (4), and to restore that the absorbed energy is transferred into a mode of (4) with $l>0$.

Photons have real polar area and must be emitted from even modes. Conventionally the radii of the electron orbitals are determined by Laguerre polynomials, and the inter-orbital energy differences explain the Balmer Series. The counterspace approach does not so far postulate orbitals, and all action is related to the valence sphere Σ. The Balmer and Lyman etc. series arise from polar areas of cones tangential to Σ as in Reference 2, the expression being

$$\text{polar area} = k^2\pi\left(\frac{1}{r^2}-\frac{1}{h^2}\right)$$

where h is the radial distance of the vertex of the cone from the CSI, r is the radius of Σ and k is the scaling factor between space and counterspace. h is the radius of the vertex of the photon cone when it detaches from Σ and is thus emitted. Since it must detach when h is at a node of J in (4) so that none of its energy remains in the cavity, and since the nodes are equally spaced for a *spherical* Bessel Function, it follows that there is an integral relation between r and h, as required for those series. The reason for this integral relationship was not apparent in Reference 2.

It is important to recall (Reference 3) that a photon cone has no frequency or wavelength. However solution of the differential equation for absorption shows that at the moment of absorption a frequency arises related to the polar area of the cone. Since light can only be studied experimentally by observing its interaction with matter, it is generally assumed that photons always have a wavelength, leading to all manner of conclusions including cosmological ones. The current work solves the particle/wave duality as neither exist except during interactions, and all macroscopic conclusions based on wavelength are thus suspect. Furthermore, as shown in Reference 2, light does not have a velocity, the number c being the scaling constant between space and counterspace. This also affects cosmological conclusions based on the velocity of light.

Coupled Oscillators

If two pendulums of equal length (period) are suspended at separate points from a horizontally supported length of string, and one is set oscillating, the oscillation of the first gradually decreases in amplitude while the other increases until the first stops altogether. The process continues cyclically, each pendulum stopping in turn. This is an example of *loosely coupled oscillators* (LCOs), the tension in the string determining the looseness of the coupling. What happens in more detail is that the pendulum that is transferring energy to the other lags it in phase by 90°. It has to stop completely before the reverse process can occur as then it must lead by 90°. If the pendulums are of different periods then the one that starts at rest goes through the above cycle but the other increases and decreases in amplitude without ever stopping. A more detailed study based on a computer simulation of two coupled simple harmonic oscillators shows that the periods are not constant but vary slighly, typically by a few percent, during the cycle. This finding is of importance for the possible coupling of cavities.

Two cavities could be coupled in which case a cyclic energy exchange could occur as above. The variation in amplitude of the cavity oscillation is now important, as two coupled cavities could exchange energy and thus their amplitudes would vary. So far the amplitude has tacitly been assumed to be fixed, on the grounds that the radial momentum and thus mass is fixed for a given frequency. A change in energy may either lead to stimulation of a mode of (4) for $l>0$ to accept excess energy, or to a rise in temperature or to a change in A. A small variation could not lead to a change in A, and the most likely outcome is a change of temperature. Noting that temperature affects the scaling between space and counterspace, that change would allow the amplitude to change slightly. Thus temperature is raised by this means, and the implication is that above absolute zero small cyclic variations of amplitude always exist. Absorption is quantised by (4) so absorption of an incident photon cone of the right energy stimulates an even mode of (4) rather than affecting the temperature.

The cavities are linked by their *Primary Counter Space* (PCS) i.e. the assumption is made that each element has its own counterspace and CSIs, and therefore cavities, exist in it. This provides the coupling for the oscillators.

Heat energy is stochastic in nature, which is exemplified above by the random phases of the cavity oscillators. If a cavity increases in temperature above the mean for the material the other cavities will generally take it back again. It depends upon the effective phase of the rest of the population and if it lags, the temperature of the single cavity could rise, but on average as the phases vary it will reduce again. Interesting practical possibilities arise if the phases could be influenced.

If a sufficiently large amount of energy is absorbed A could be increased, leading to another isotope of the element. This would require a (relatively) large change of the order of the energy of a hydrogen atom ($1.5\text{x}10^{-10}$ Joules). A very large temperature increase could effect this, as is well known. It is clear why such large temperatures are required for most nuclear reactions. The reverse process is more interesting. If the cavity could be compelled by some means to lose a small amount of

energy it could react by emitting energy and reducing *A*. The loss could arise from another kind of coupling. Only radioactive ^{5}Li emits protons, so it would be a candidate for such a change, but *Z* would have to change too. Otherwise α and β decay are most likely from experience. The above mentioned frequency variation experienced by coupled oscillators can represent appreciable energy for large *A*, and the simulation suggests that for *A* around 200 and above there is sufficient energy for α decay. That is exactly what occurs in practice, the only α emitters with *A* less than 200 being ^{8}Be ^{8}B ^{12}B ^{20}Na ^{24}Al and ^{32}Cl. A very large variation in frequency is required for such low-*A* oscillators to reach the required energy, consistent with a phase difference of 90°, which may be attained at the moment of phase reversal when one oscillator has the excess energy required at the expense of the other. This has been demonstrated by the simulation. In practice many oscillators are linked so this would occur for a single cavity having the excess energy at the expense of the rest of the population, which is why it suffers the decay. The probability of this happening determines the half-life. It is necessary now to turn to large assemblages of oscillators.

If a very large number of cavities are linked, and the linkage is loose, then energy exchange is possible. A single cavity 'sees' many phases which will sum to a single resultant phase with which it may interact. Heat energy is one result as seen earlier, involving small frequency variation. As a result phase-locking of the whole population is unlikely as that would imply a temperature of absolute zero. It could apply, though, to a Bose-Einstein condensate where the temperature has been reduced to near absolute zero, and the phase-lock will cause the whole population involved to behave like a single cavity.

Different elements are less likely to interact via modes of (4) as the patterns of the surface spherical harmonics *Y* are different as *Z* is different for each element. Now *Y* is zero round the 'equator' for all modes with $l \neq 0$ but paralled planes at another 'latitude' tangential to a group of cavities, arranged in a simple lattice, could yield planar couplings. Thus if a set of planes of the lattice are coincident then the distinct intensive oscillations at tangent points to members of the lattice could become coupled oscillators. The strength of the coupling would depend upon the overlap of the two associated Legendre functions - given by the two values of θ in (4) - while *l* determines the number of possible coupled lattice orientations. There is appreciable overlap if an enveloping cylinder is taken (i.e. tangent planes for all θ), which for given *Z* and *l* is fairly constant for other *Z*'s and the same *l*, but gradually increasing with *Z*. The modes have to be energised, and the chemical even-*l* modes are envisaged. A cylinder is sensible as all its tangent planes anyway exist, so a crystal lattice affords this kind of coupling, in all applicable directions. The coupling (overlap) is much less for distinct values of *l,* which would apply to a heterogeneous crystal.

A similar argument applies to odd-*l* modes which are envisaged as the electrical "conduction band" when energised, and are involved in the metallic bond. As conventionally, this is quantised by *l* in (4).

Beta Decay

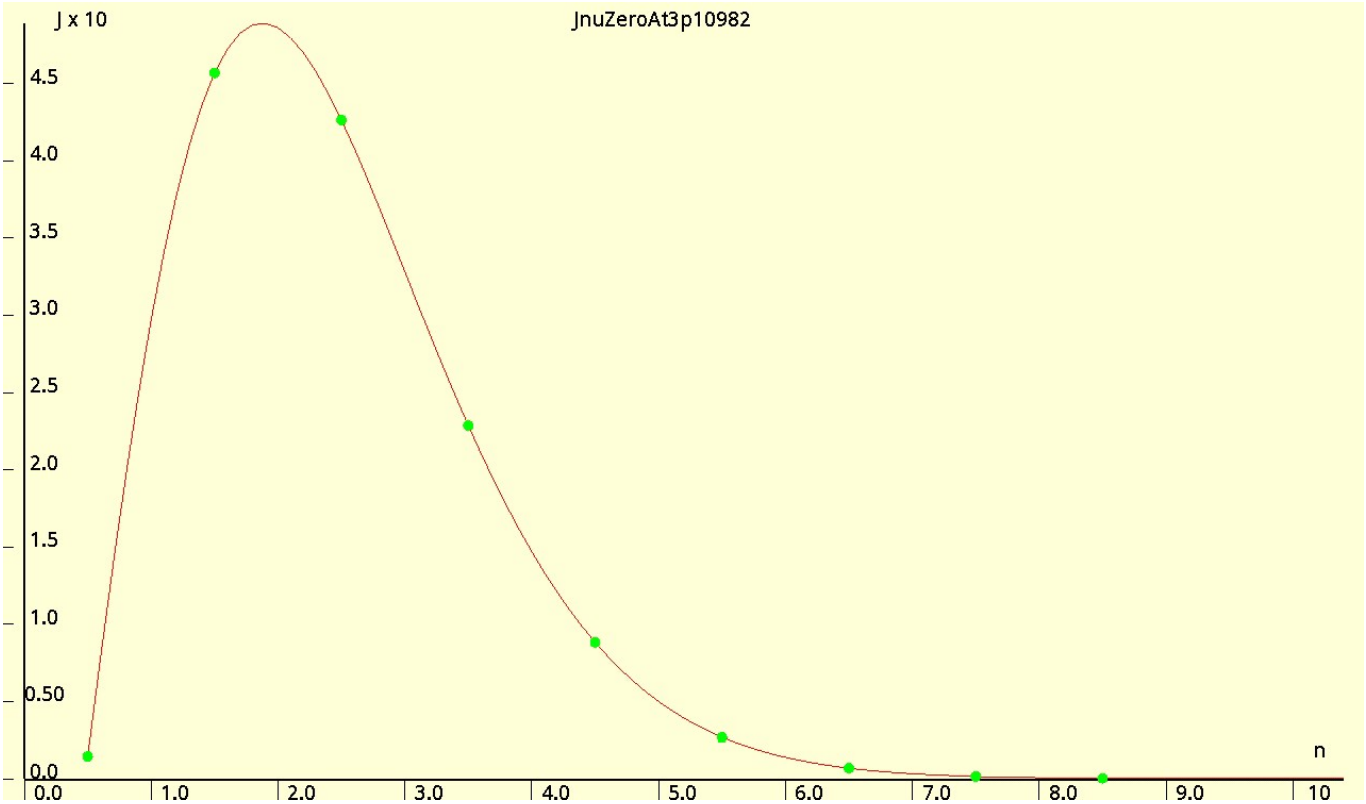
If *Z* changes, normally β decay results. If an odd mode of (4) is energised, then a change in *Z* will render the mode invalid and may cause emission of an electron, resulting in β^- decay if *Z* increases or else β^+ decay. A change in *Z* implies a change in the azimuthal strain of the rotation ***N*** associated with the spinor coupling. Separate spatial and counterspatial couplings of the oscillations between atoms would lead to strain which could not endure, so a change in *Z* could be caused by that. Again this would be between an atom and the rest of the population, so that atom would suffer the decay.

Chemical Bonds and Compounds

A cavity could contain several standing waves with distinct frequencies. This is seen as the basis of chemical compounds. In the case, for example, of CH_4 the four instances of hydrogen will have distinct phases in the cavity. This approach does not explain compounds based on the ionic (electrovalent) bond which does involve electrical activity, so it is the basis of the covalent bond which conventionally requires sharing of electrons. It is very strong as the bonding is the most intimate possible. It is 'covalent' because the valency determines which atoms can share a cavity, and how. A linkage between the cavities must be established for this interaction to take place, and for a coupling the energy would have to be totally transferred to the parent CSI e.g. carbon above.

Valency

The valency of an element relates to the way an atom manifests i.e. the even-l mode of (4) involved, its magnitude being determined by J. If an interaction occurs then modes of oscillation of (1) with $l>0$ are added to that of the heat cavity. $J_{\pm(l+\frac{1}{2})}(Avr/V)$ differs from $J_{\pm\frac{1}{2}}(Avr/V)$ for the heat oscillation at r, so the hybrid oscillation manifests in space on the VS. The following graph shows the variation of J (ordinate) with l (abscissa) for fixed Avr/V such that $J_{\frac{1}{2}}(Avr/V)=0$



The small-l modes have the greatest amplitude, the magnitude for l=8 already being down to 0.000276 while that for l=10 is less than 8.5×10^{-6}. Because the modes are on the VS they are real even-order ones rather than radial odd-order ones. Thus a large increase of energy will mostly lie in the l=2, 4 and 6 modes, which accords with the valency which is associated mostly with l=2 and l=6 corresponding to the conventional s and p shells. The larger l modes will anyway be filled by heat energy as they are of such small amplitude. This investigation remains incomplete.

Transient Atomism

Atoms and molecules as characterised above are postulated to exist only during interactions. Otherwise there is a node of J in (4) on the valence sphere which means the cavity is not manifesting atomistically in space. Most if not all interactions result in the manifestation of atoms for the duration of the interaction. But a lump of, say, copper is certainly manifest as a whole. In Reference 2 the treatment of gravity postulated "CSI pooling" so that each crystalline domain has such a "pooled" CSI. That is well represented here by the cavities remaining essentially in counterspace with their nodes on Σ. The extent or size of a crystal depends upon the number of pooled cavities, with their common CSI at the centre of gravity.

When an atom manifests then surface planar oscillations appear on the surface of Σ as described earlier, which means that its chemical properties become apparent during the interaction. They will depend upon the magnitude of J on Σ. Coupling of the planar oscillations with other manifest atoms allows the interaction to proceed. Odd order modes of (4) determine the electrical properties of the atom, while the magnetic ones depend upon the second 2-spinor. Thus when an atom manifests it does so in a well defined manner with consistent chemical and electrical modes which are the same whenever it manifests, but are then subject to change during the interaction.

The nature of the valence sphere has not been explained. That is, how does it act as a cavity "wall"? After all, it is not made of anything! Interactions can only take place in the present (Relativity aside for the moment for local action), and the "wall" is the necessity to interact with other manifest atoms in the present, which is avoided by keeping a node of J on Σ.

Heisenberg's Uncertainty Relation

As mentioned in Reference 2, many quantities exist for affine rather than metric linkages, and become metric during an interaction. This notably applies to light, which is probably the most developed area there. Quantities may co-exist at the affine level, causing no strain, but which become incompatible at the metric level during an interaction. This is seen as the source of the uncertainty relationship. No reason for bifurcation of the world seems necessary on this view.

Many Worlds

In current physics the many-worlds model seems to have won the day. The quantum bifurcation basis for that, as mentioned above, is not accepted here. The monumental contravention of the law of conservation of energy seems quite implausible. Where does the energy come from to create a new universe? Not just one or two, either, but uncountably many when the number of interactions occurring all the time is taken into account. William of Occam must be turning in his grave!

Conclusion

This is a report on work that is ongoing, and considerable further work is not included as it is "in the melting pot". That a non-materialistic approach to modern physics is possible is demonstrated, but this report is based on the fourth of a series of ongoing proposals as the ideas develop. So it is far from the last word on the subject. The essential idea that a non-material "ether" world interacts with the physical through strain and stress is the main thrust.

References

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Appendix A

Intensive Scaling Tensor

The work with light (Reference 2) scaled the perpendicular distance r of a plane from the CSI to its turn τ in from Euclidean infinity in an extensive manner as $r=ct=c^2/\tau$ where $t=c/\tau$. This is associated with a diagonal scaling Jacobean $\boldsymbol{J}$ relating turn to length. As intensive scaling is more suitable (e.g. at a point), it is better to scale rates of change, but such that the results from the extensive approach are not lost. A new scaling Jacobean $\boldsymbol{J}$ will now be derived for this. Taking spherical polar coordinates for the spatial coordinates $\{x_1\, x_2\, x_3\}$ and counterspatial coordinates $\{\xi_1\, \xi_2\, \xi_3\}$:

$$x_1=r.\cos\theta.\cos\varphi,\ x_2=r.\cos\theta.\sin\varphi,\ x_3=r.\sin\theta$$

$$\xi_1=\tau.\cos\theta.\cos\varphi,\ \xi_2=\tau.\cos\theta.\sin\varphi,\ \xi_3=\tau.\sin\theta$$

then e.g. $\partial x_1/\partial\xi_2=(\partial x_1/\partial r)(\partial r/\partial\tau)(\partial\tau/\partial\xi_1)=(\cos\theta.\cos\varphi)(dr/d\tau)/(\cos\theta.\sin\varphi)=\cot\varphi.dr/d\tau$ etc. assuming θ and φ are constant and angles scale directly to shifts. Thus as $\cot\varphi=\xi_1/\xi_2$ and similarly for the other $\partial x_i/\partial\xi_j$, and as $dr/d\tau=-c^2/\tau^2$ (assuming velocity=c for light), we have

$$\boldsymbol{J}=\frac{-c^2}{\tau^2}\begin{bmatrix} 1 & \frac{\xi_1}{\xi_2} & \frac{\xi_1}{\xi_3} \\ \frac{\xi_2}{\xi_1} & 1 & \frac{\xi_2}{\xi_3} \\ \frac{\xi_3}{\xi_1} & \frac{\xi_3}{\xi_2} & 1 \end{bmatrix}=\frac{-c^2}{\tau^2}\boldsymbol{S} \qquad \text{(A1)}$$

where $\tau^2=\xi_1^2+\xi_2^2+\xi_3^2$. That $|\mathbf{S}d\boldsymbol{\xi}|=d\tau$ is easily verified, which yields $dr=|\mathbf{J}d\boldsymbol{\xi}|=-c^2d\tau/\tau^2$ as required, the integral then giving the same results as for extensive scaling i.e. $r = c^2/\tau$. It is also readily verified that (A1) is a tensor. Now $\boldsymbol{J}$ may be factorised as follows:

$$\boldsymbol{J}=\begin{bmatrix} \frac{i}{\epsilon\tau} & & \\ & \frac{i}{\epsilon\tau} & \\ & & \frac{i}{\epsilon\tau} \end{bmatrix}\begin{bmatrix} \frac{i}{\mu\tau} & \frac{\xi_1}{\mu\tau\xi_2} & \frac{\xi_1}{\mu\tau\xi_3} \\ \frac{\xi_2}{\mu\tau\xi_1} & \frac{i}{\mu\tau} & \frac{\xi_2}{\mu\tau\xi_3} \\ \frac{\xi_3}{\mu\tau\xi_1} & \frac{\xi_3}{\mu\tau\xi_2} & \frac{i}{\mu\tau} \end{bmatrix}=\frac{i\boldsymbol{E}}{\epsilon\tau}\frac{i\boldsymbol{M}}{\mu\tau} \qquad \text{(A2)}$$

since $c^2=1/(\varepsilon\mu)$ where ε is the permittivity and μ the permeability of the medium (ε_0 and μ_0 for free space). These are taken as scaling constants for electricity and magnetism. The first matrix is a tensor suitable for an electric field, being symmetrical giving a conservative radial field. The second tensor is not symmetrical, and $\boldsymbol{M}$ may be partitioned as follows:

$$\frac{1}{2}\begin{bmatrix} 2 & \frac{\xi_1}{\xi_2}+\frac{\xi_2}{\xi_1} & \frac{\xi_1}{\xi_3}+\frac{\xi_3}{\xi_1} \\ \frac{\xi_1}{\xi_2}+\frac{\xi_2}{\xi_1} & 2 & \frac{\xi_2}{\xi_3}+\frac{\xi_3}{\xi_2} \\ \frac{\xi_1}{\xi_3}+\frac{\xi_3}{\xi_1} & \frac{\xi_2}{\xi_3}+\frac{\xi_3}{\xi_2} & 2 \end{bmatrix}+\frac{1}{2}\begin{bmatrix} 0 & \frac{\xi_1}{\xi_2}-\frac{\xi_2}{\xi_1} & \frac{\xi_1}{\xi_3}-\frac{\xi_3}{\xi_1} \\ \frac{\xi_2}{\xi_1}-\frac{\xi_1}{\xi_2} & 0 & \frac{\xi_2}{\xi_3}-\frac{\xi_3}{\xi_2} \\ \frac{\xi_3}{\xi_1}-\frac{\xi_1}{\xi_3} & \frac{\xi_3}{\xi_2}-\frac{\xi_2}{\xi_3} & 0 \end{bmatrix}=\boldsymbol{Q}/2+\boldsymbol{N}/2 \qquad \text{(A3)}$$

$\boldsymbol{Q}$ is a quadric which is of rank 2 consisting of two points determining a dipole with a bundle of planes in their common line (with coordinates ξ_i). $\boldsymbol{N}$ must have a zero determinant since $\boldsymbol{Q}$ does, and represents a null polarity as it is skew-symmetric. In other words $\boldsymbol{N}$ represents a field with curl suitable for a magnetic field. Thus $\boldsymbol{M}$ represents a magnetic dipole combined with a

curl. $\boldsymbol{E}$ is referred to an imaginary unit sphere which is consistent with the polarity transformation associated with the spinor. For if a point {a,b,c,d} is transformed into a plane by means of the imaginary unit sphere, the resulting plane has plane coordinates {a,b,c,d}. This relates to the spinor transformation for the cavity, for which $\boldsymbol{E}/(\varepsilon\tau)$ relates to the first 2-spinor and $\boldsymbol{M}/(\mu\tau)$ to the second magnetic one. It applies as the spheres have imaginary radii in (A2).
Since $\boldsymbol{S}$ is singular the reverse transformation is not possible, which is valuable as it means interactions are not instantaneously reversible.

A similar tensor may separately be derived for the reverse transformation with very similar results but in terms lengths; it is not the inverse of $\boldsymbol{S}$.