Introduction

'Fundus' in English is 'ground' from 'bottom' in Latin. Yet nothing, certainly no planet, has any absolute bottom. The concept 'fundamental' in physics seems just as relative and as recursive as fractals, like Russell's piled up 'turtles', infinite space and mathematics after Godel. 'Fundamental' is often used with implicit qualifiers 'more' or 'less'. Should 'fundamental' always be considered as qualified? We suggest 'Yes' but we want most fundamental. so how do we then avoid the infinite recursion of reductionism? 'Ordering' phenomena may also employ relative 'causes' & 'effects' which usually seem clear. Derived properties may be less so. For instance 'frequency' often considered fundamental is really a derivation, mostly of wavelength (also variable) or of trains (unreliable!) and 'time'. Yet time is also ill defined. The convenience of calling time fundamental or 'absolute' fails with Special Relativity (SR). Beliefs also play a part, ten physicists might place things in ten different orders. Before events on the 'Foundations of Quantum Mechanics' (QM) straw poles have shown no majority support for any one interpretation. Copenhagen usually leads. QM has become ever more complex but no rationale has emerged.

Many now advise 'Nature is weird, live with it!'. We suggest John Bell was right that we shouldn't stop looking. Einstein also stressed the need to keep searching for a 'heuristically' logical rationale for SR and unification, in 'Science' in 1940 and in a 1944 letter to Max Born¹ saying; "I hope that someone will discover a more realistic way, or rather a more tangible basis than it has been my lot to find." Karl Popper² likened physics foundations to those with boggy ground as deep as we can go. That view may be valid, yet our greatest buildings, towers and bridges are often not built on rock, their foundation 'piles' working only by small local friction forces and inertia in poor ground. Some parts may have no more traction than others. Only adding the small local resistances hold the structure in place. Rare shock loads may cause it to slide, but find better slightly deeper traction. Time increases local bonds and resistance to motion. Theory, like piles, gains traction over time to establish itself and be harder to move. We explore how deep we need go to find sound ground.

Reductionism

Reductionism tends to 'order' causal chains from 'small' to 'larger',³ even the 'Big Bang' started by the tiniest event, yet problems of infinite recursion and the 'reductionist fallacy' are unresolved. Counter examples i.e. celestial bodies propagating fermion bow shocks. Jerry Fodor (1974)⁴ then Hilary Putnam (1975)⁵ in 'Multiple Realization' argued that no "true identity" statement valid for 'special sciences' could exist to support reductionism. Ever greater complexity from combining

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¹ Karl Popper, "The Logic of Scientific Discovery" (1935).
³ Reducing a phenomenon to its underlying causes.
⁵ Hilary Putnam, "The Many Worlds Interpretation of Quantum Mechanics" (1975).
simple components does seem to imply increasing physical dimensions but we'll test the *more simple* aspect of reductionism, taken down to perhaps it's most ridiculous extreme, to find a *most* fundamental cause.

Common Nagalian models assume that reduction can unify dis-unified theories and entities seen as distinct. Nagal couldn't reduce mental to physical, ontologically simplify or explain many areas so was putatively problematic. ‘Reduction by functionalization’ overcomes this philosophically. We employ an equivalent practical physical approach using Von Neuman's functional view that 'the 'meter' is part of the system' * When considered as simple actions in a propositional dynamic logic (PDL) Baltag & Smets (2010) found a quantum logic compatible with classical logic. The simple logic approach to functional hierarchies has also been shown to follow the rules of brackets in arithmetic. We then ask; Can we nominate and justify the simplest and *most* fundamental action or law in the universe?

A *most fundamental* effect should perhaps be the one with potentially the most profound effect on the most influential theories and all observed nature but via the simplest action possible. The concept 'relative motion' may be so simple as to require no falsification, but we find it worthy of closer examination. Using un-obscure English we first consider; 'motion of what? what 'forms' of motion, (linear, orbital, rotation, oscillation) and what 'most profound' theories should we choose as the most rigorous test.

'Of What'
'Condensed matter' may be an arbitrary state in a sequence with no known smallest scale, but it at least provides a nominal 'bottom' in the Planck length. Any smaller scale condensate, continuum, Quantum foam (10^-35), Coulomb/Casimir force field, 'zero point' or 'dark' energy, 'universe filling medium' of Wilczec or 'New Ether' of Dirac is beyond observability. We then recognize that the Higgs process or fermion pair production 'popping up' from nowhere' implies a smaller perhaps more fundamental 'sub quantum' scale of rotations as a 'sub-ether'. but we principally constrain ourselves to the testable realm and scale of condensed matter. This domain limit is also the lower end of electromagnetic (EM) coupling. Electromagnetism (EM) permeates, lights and connects the universe, interacts with matter and allows communication. The Quark/Fermion scale (10^-15) as a lower size limit also coincides with John Bells identification of energy density and lattice "fermion number density." as likely founding a classical derivation of QM. As to 'what' is moving we can only designate ever smaller 'states of motion', forming 'matter' at the fermion/'quark' scale.

'Most Profound'.
A valid answer shouldn't avoid the mismatched so called 'pillars' of physics, QM and Special Relativity (SR). Often dismissed as a matter of scale other issues including different concepts of time maintain the gap called a 'chasm' by Roger Penrose. Such incomplete understanding pervades physics and cosmology. Some suggest Paul Dirac's 'relativistic' electron effected some unification though he didn't claim so, and his New Ether was to to help address remaining issues. John Bell commented on Bohr et al's assumption that no classical QM derivation could exist;

“...in my opinion the founding fathers were in fact wrong on this point. The quantum phenomena do not exclude a uniform description of micro and macro worlds...systems and apparatus.” p171. & p172;
"a real synthesis of quantum and relativity theories requires not just technical developments but radical conceptual renewal." and suggested a 'lack of imagination' was the problem, that we should keep looking, and; "...the new way of seeing things will involve an imaginative leap that will astonish us. In any case it seems that the quantum mechanical description will be superseded."

A credible test of the most fundamental action in physics would be to find the simplest action possible to resolve probably the most fundamental consistency problem in physics SR v QM. Any valid modification or replacement should also allow the closely linked pair; General Relativity (GR) and Quantum Gravity (QG) to emerge. A solution should look as simple as most in the past have looked once revealed, probably 'ridiculously' simple as all others have been tried! Occam's razor rules! (And Einstein did say; 'we should be able to explain physics to a barmaid!')

Motion
Relative motion, ostensibly the simplest of concepts is at the heart of SR and all physics at all scales. Consider the simplest form of motion; linear, as a precursor of rotation. No 'particle' could even exist without it's spin motion. Any motion through the continuum may create the vortices we find in all larger scale fluids. The Higgs process can be considered as an additional spin state and Cern's ATLAS experiment finds evidence of Higgs Boson 'decay' producing fermions. However it happens we've long been aware of fermion pairs 'popping up' as the precursors of more complex bound particulate matter, mainly only the inverse kinetic refraction from their motion itself revealing their presence. We stay focussed on the fermion and consider it first in the simplest way; as a rotating sphere, so as Orbital Angular Momentum (OAM).

OAM
We've identified that OAM has two components, linear and rotation ('Curl') identified by Maxwell but little rationalised and interestingly largely not accounted for in Quantum Mechanics spin up/down (1,0) states. Curl is found at poles (S+, N-) reducing to ZERO at the equator (90°). Linear momentum is the inverse, peaking at the equator but zero at the poles. Both invert through 180°. This gives a simple 'quartet' analog of momentum worth dwelling on as it's new physical physics. Or is it? Dirac found the electrons 'antiparticle' of equal mass but opposite charge in 1928 and obtained 4 'spinors' but with no physical explanation. Weyl's popular 1929 electron had 2 states and no mass. The Majorana fermion (1937) is 'it's own antiparticle', with left and right hand (Chiral) momenta states and mass. It has 'helicity', handed rotation or orbitals with translation, analysed in a previous essay. 'Supersymmetry' needs the Majorana but complex interpretations & claims still confound understanding. We offer a 'ridiculously' simple fresh view.

The RATE of change of all 4 momenta though 90°, well known in geophysics as surface orbital velocity, is non-linear, by the Cosine of the angle of Latitude $\theta$; So curl; -1 at 0° (north pole) changes non-linearly to zero at the equator then inverts to become +1 at the south pole (180°).

Linear
Linear momentum amplitude at any interaction with spherical rotation is inversely proportional to curl. QM's 'complementarity' emerges through the non-linearly reduction to zero at 90° and reversal back to 180° for any one orientation. (If the equator your side goes right or down the opposite side is going left or up). There are then two simple and REAL inverse pairs of physical
momentum distributions, 'superposed' in a way equivalent to 'quantum spin' which has not before been thought possible as simple rotations.

So, even if in an absorption and re-emission model, we define 'position' by Latitude of the intersection tangent point with respect to the polar axis, which then specifies amplitude of energy or momentum transfer. John Bell identified this as a key step to a classical solution; "What is essential is to be able to define the position of things, including the positions of instrument pointers... In making precise the notion of position of things the energy density comes immediately to mind." (but) We would have to devise a new way of specifying a joint probability distribution.¹⁰ (p.175).

We now predicate 10 Axioms, some known, most feasible, and use them to solve the puzzle.
1. Polariser fermions rotate polar axes on absorption & re-emission to their own (angle setting).
2. Fermion re-emissions are at local 'c' with respect to centre of mass rest frame of the fermion.
3. Rotating sphere surface momentum distributions with latitude modulate momentum transfer.
4. Field depth squares amplitude (known in QCD) & applies in photomultiplier/diode channels.
5. Photomultiplier 'click' rate ('density') is a function of amplitude & channel setting angle.
6. Fermion pairs DO 'pop up' from a sub-quantum condensate (motion induces pressure changes).
7. EM does not couple with 'sub-ether' but does with fermions, all with similar spherical rotation.
8. Fermions have plasma refractive co-efficient ~1 so are not detectable by EM without 'motion'.¹⁰
9. Majorana fermion; north hemisphere = electron, S = positron, (equator is Up, or Down at 180°)
10. The Dirac electrons 4 spinors are equivalent to Maxwell's linear & curl states handed, inverse with each other over 90° and reversing over 180°.

**Transition Zone (TZ)**
We've found far more space plasma than assumed, at densities up to 10¹⁴/cm³ around celestial bodies including Earth. At smaller scales free 'surface charge' electrons are equivalent as density increases with motion. Maxwell identified TZ's between the 'near field' (local speed 'c') and 'far field' (un-rationalised) domains.

Antenna engineers know 'where' TZ's are as wavelength (λ) (so frequency) is changed. But TZ distance changes with λ, from ~1 micron for short waves < Parsecs for long waves in low density space plasma & gas. The effects would be 'Lorentz Transformations' (LT). Dayton Millers progressive change (& multi state 'birefringence') at different heights up Mount Wilson²⁰ then corresponds to the iono/atmo- spheric refraction²¹ well known to NASA and to Diracs 'Lorentz co-variant' electron. No lens could then ever find anything but 'c' as EM speed is localized on meeting the 'near field' identified as discrete ⁹ in line with Einstein's final conceptions. The TZ process, also termed 'Continuous Spontaneous Localization',* has a max. 'optical breakdown' plasma density²², the strong local ionization of the medium with plasma densities beyond critical value (10²⁰ - 10²² electrons/cm³). EM can't then couple, so no LT or spacecraft communications possible on re-entry. Excess heat does damage but at least the 'ultra-violet catastrophe' is avoided.

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The simplest provision; re-emission of light in each fermion centre of mass frame, seems then able to remove all apparent paradox from Special Relativity, and simplify much 'interpretation'. Dilation and 'length contraction' become simply Doppler effects and apparent superluminal motion (as found by NASA at up to 46c in quasar jets)\textsuperscript{23} is allowed with no violation of local propagation $<c$. Fields move within fields moving relative to observers. The light pulse within the passing train CAN do apparent $c+v$ with no violation of $c$. But there's a greater test; to use that simplest of 'relative motion' mechanisms to solve the 'EPR paradox'\textsuperscript{10} and allow a classical reproduction of the predictions of QM.

**QM**

Lets return to our simple rotating sphere, propagated as vortices by motion. Particle pairs were attributed just 2 'superposed states' Up & Down. We've known since Maxwell there are four, confirmed by Dirac. 'Curl'; left & right hand rotation or +/- polarity, (zero at the equator), and also 'Linear' (Equatorial rotational direction which reverses at 180° but is zero at the poles). So back to 'motion', the amplitude as 'surface rotational velocity' of each momentum pair changes inversely over 90° by the cosine of the angle of latitude (0 - 90°). 'Quantum 'Complementarity, is previously unexplained but has that exact set of 4 inversely proportional attributes changing by the Cosine of 0 to 0 at 90° and inverting at 180°! The non-linear momentum transfer then repeats in photomultiplier fields, so giving Cos\textsuperscript{2}, though properly written (Cos x)\textsuperscript{2} not Cos(x\textsuperscript{2}).

But QM has other weird effects. Surely 'entanglement' can't be explained so ridiculously simply, when stats show Bob MUST be able to change Alice's finding instantly from light years away!

We'll send money to Alice & Bob far apart. Stick 2 pound coins together (heads to tails) & spin on the polar (x) axis. Clockwise sides (say 'south') will face at some angle 50:50 to A or B. Stern-Gerlach (etc) then 'splits' each pair & send one to each maintaining parallel spin axes. if Alice gets heads, even if angled so elliptical, she knows Bob has tails. So when facing each other with all else equal they get 100% opposite findings, BUT; A or B can use a rotatable polariser (or a 'half wave plate' etc.) to 'reverse' their finding, or 'spin flip\textsuperscript{24} the coin on arrival. So either A or B flips theirs 180°, they get 100% the SAME findings! Even without flipping the coin their polariser field reverses on the y or z axis so a finding of 'opposite' changes to a finding of 'same'.

**Heisenberg's Uncertainty Theorem**

But now if one just turns theirs 90° (to the other) as there's a stream of 50:50 random heads/tails, there's no bias to either 'same' or 'opposite' correlation so just 50:50 results. 50:50 (maximum uncertainty) is precisely as QM predicts at relative 90°! If polar and propagating axis vary we find ellipticity on the y or z axis. At 90° again the ellipse goes to 0 so uncertainty peaks. Uncertainty then is still as uncertain but is at least classically explainable. Of course it's ridiculous to expect to 'hit' A & B's detectors in free space with a photon or electron. We must consider the surface of the expanding (at 'c') Schrödinger sphere of an emission and Optics convention of local lateral motions to give helicity and elliptical polarity. Signals are requantized at polariser fermions but light expands again if not in a fibre optic cable, so always enters both channels of 2 channel photomultipliers. Orthogonal channel settings then measure different (curl/linear) momenta in inverse proportions. The non-linear 'cosine' curve ('probability') amplitude distribution are a result of the spherical surface momentum distributions on each 90° segment. Nearing the equator 'curl' amplitude is very low (consider as the pound rotated to a thin ellipse on the y or z axis).
Photo-multiplier (or 'Cascade photodiode') channels are also charged fermion fields, so give a second cosine relationship subject to $\theta$, squaring cos values. **Heisenberg's uncertainty** relation of "momentum & position" is reproduced as Maxwell & Dirac's orthogonal paired inverse momenta.

Channel field cascades should have 3 *not* 2 *dimensional* expansions so the conical expansion by the square found in Quantum Chromodynamics (QCD). But below a tuning threshold no 'click' will be triggered, so data 'bin' contents are inversely distorted. An experiment with a touch or optical tachometer and rotating sphere simply reproduces the basic inverse Cosine curves (Fig 1).

![Image](image.png)

*Fig 1. Experimental confirmation. QM's inverse (offset) Cosine curves reproduced using simple orbital surface velocity distribution with latitude as equivalent to momentum transfer on absorption & re-emission interaction. PJ.*

The Tax man decides Alice & Bob's cash is taxable so sets up automatic photomultiplier cameras. Some coins leaving the polarisers were so extremely elliptical they didn't trigger a camera click (= a 'non-detect'). He knew Alice & Bob got half each so he collated detections. Sure enough they tallied, but he didn't know he was collating 'click intensity' not all the money!

Electron, Neutron\textsuperscript{25} & 'photon' experiments all give equivalent results. 'Squared' Cos amplitudes give click 'Intensity' (for the Born Rule, & Malus' Law; Intensity [$I$] $\propto \cos^2\theta$). The required 'Clau-\textit{ser-Horne-Shimony-Holt}\textsuperscript{26} >2 ('Bells theorem proof') inequality is $\approx 2.16$. A Steering inequality of 'non-detects'\textsuperscript{27} at $>1$(to close the 'detection loophole') is $\approx 1.62$. **Entanglement** need only entail shared parallel spin axes to be maintained for each 'particle' or signal. All arises from the most ridiculously simple motions, linear, and spherical rotation. A 100 second video\textsuperscript{28} helps explain.
Non-Integer Spin.
The video also reproduces 'spin half' & 'spin 2' particles (take only half a turn, or two to do 360°). For rigour we'd need to explain; Spheres have 3 degrees of rotational freedom (x,y,z axes). Polar x axis spin defines south (clockwise) & north. Rotating 180° on the y or z axis reverses them. So a 180° rotation simultaneously on y & z gives 'spin half'. If y axis rotation is at half the y axis rate then a 360° rotation on z only switches the poles, so, simple in 3D; z rotates 720° in spin 2.

Quantum 3 Filter Problem
Conclusive evidence that polarisers rotate not just 'block' light is in the 'bizarre' effect where 2 orthogonal 'filters' block all light but a 3rd inserted between them at 45° 'releases' around 25%. We identify the first polarises and 'rotates' amplitude peak by phase shift leaving near zero at 90°. The 2nd can only then transmit zero amplitudes. Adding the third (middle) filter rotates the light from the first 45° by phase shift to also impact the last filter at 45° so now allowing a proportion through. The final intensity transmitted is then Malus' Law applied twice, in a state dictated by the last filter (polarised media absorbs more light if not an 'optically active' type). Anton Zeilinger's leading Vienna team found; "light always has the polarisation state given by the last polariser and has no memory of it's earlier history." Final but it seems the amplitude of that light will also depend on past states. Other assumptions led to strange results in 'delayed choice/quantum eraser' experiments. Emissions use all paths. Rotational and reflective femtosecond delays explain the decoherent fringe shifts found on recombination. See Fig. 2.

Gravity (QG/GR)
We briefly expand on the hypothesis that reductionism & physics may extend to sub-quantum states increasingly implied by vacuum evidence. Fermions as the soliton 'peaks' of Quantum Optics in a sub-ether scale energy 'sink' with an equivalent 'energy density depression' maintained around each. 'Annihilation' will then flatten 'sink' energy level. The effect would extend to all matter so equivalent to Einstein's heavy ball on a trampoline, equivalent to a maintained 3D 'pressure density distribution'. The more matter 'binds' the larger & greater this sub-matter energy density differential. A seemingly natural tendency of each combined 'matter/sub matter region' to equalise sub-matter density would then simply reproduce what we call gravity. An apparently 'alien' concept is the maintenance of the 'depression' around matter, yet weather systems have some similar pressure distribution characteristics while in rotation, perhaps merit further study.
Any requirement for 'curved space-time' to be a physically real entity rather than derived from a physical mechanism in matter would be lifted by a sub-quantum medium without direct EM coupling. The gradual refractive effects we now know from ionospheric refraction\(^1\) (see p.4) the diffuse but far denser than assumed halo's increasingly found and kinetic effects of moving plasma halo's and fields need to be better quantified. Increasingly surveys such as Atlas 3D/ Sauron\(^2\) suggest a significantly greater identity may exist for real Brans-Dicke type scalar fields\(^3\) than anticipated when first formulated. The simplest suggestion would be that 'gravitational' lensing could be simple refractive lensing in diffuse matter. Again further study is merited.

**The Barmaid Effect**

We've shown there's a prima fascia case for exploring reductionism to it's smallest and most ridiculously simple level. We've covered the most fundamental theories, where analyses of the simplest rotational mechanism allows a unified description in ambient rest frames *not* coupling directly with EM. The Special Theory of Relativity *and* Quantum Physics would be simplified to employ the concepts anticipated in Einstein's 1952 addendum (see p.4) as "*spaces in motion within spaces not thought of as bounded*" and also by John Bell's "fermion number density."

It seems Einstein's view that; *"we should be able to be explain physics to a barmaid"* may then be valid but, if so, may pose issues for many of us. Do most in physics really want it's mysteries to be simplified so all can understand at will? Some may perceive it as not in their best interests! Kuhn and others also showed that analysis is biased by past theoretical beliefs. We know this as 'confirmation bias', and it may be more common than we hope. The entanglement experiments of Aspect\(^4\) and Weihs et al\(^5\) reported unexplained 'rotational inconsistencies' but results followed predictions when ignored, so they were. They are now explained. Deep familiarity with complex (if incomplete or flawed) theory may then dissuade many from adopting new unfamiliar concepts, even, or particularly, if ridiculously simple! We may need to show we can do so before it's too late. A revolution may be overdue and revolutions are least damaging for the revolutionaries. Hopefully, ridiculously simple hypotheses that look possible but unfamiliar on first examination may be given the same exposure as the deeply obscure to allow wide testing and falsification.

**Conclusions**

We find that the word *'fundamental' should be qualified with 'more' or 'less'. But at the lower reductionist limit of 'condensed matter' the apparently most *ridiculously simple of concepts* can resolve & unite incomplete and incompatible theories. That simple concept is *relative motion*, linear and rotational, so orbital & helical. All bound & ever more complex molecular matter and physics then evolves. As for *'foundational interpretations' of Quantum Physics; Little support emerges for 'Many Worlds' or 'Pilot Waves' with electrons passing through just one of two slits. The Copenhagen interpretation looks like Von Neumann's 'meter' as detector EM fields strongly influence findings, but the moon *could* be there when we stop looking! Simply adding re-emissions at *local 'c' may have stopped all SR/QM argument at the 5th Solvay conference of 1927.*
EXPERIMENTAL PROTOCOL (see essay Fig 1.)
Rotating Sphere; Inverse Complementarity of Paired Momenta States.

Equipment.
1. Rotating Sphere. 2. Optical or contact Tachometer i.e. ATP DT6236B
Spin sphere at a constant rate, apply tip & press 'record' at equal angles of latitude $\theta$.

Linear
Apply meter at a tangent to the equator, parallel to the polar axis.
Move the tip towards either pole maintaining tangential contact.
Touching lightly at poles (if friction tip) continue tangentially to equator 180° from start point.
Continue on (inc. recording) tangentially, to the opposing pole then on to return to start position.

Curl
Apply meter tip orthogonal to surface, firmly at a pole (or as close as possible) on the spin axis.
Move the tip towards the equator maintaining orthogonal (radial) attitude, continuing recording.
Touching lightly at equator (if friction tip used) continue radially to (opposing pole).
Continue and complete the 360° circuit as above to return to the original pole.

Analysis
Plot recorded linear values at equator each side of poles as opposite (i.e. up/down) and similarly at poles, max as -1 to +1; clockwise to 'southern' hemisphere, reverse to north. Share x axis for $\theta$.
Notes; Friction tip option gives high uncertainty tangentially near poles & radially near equator.
If alternate direction /pole is first chosen all results are simply inverted. There is no 'up' in space!
On absorption & re-mission each states momentum transfer must relate to surface momenta at $\theta$.

REFLECTION & TRANSMISSION LIGHT DELAYS Fringe shifts vary subject to incidence $\theta$, lambda, polarity etc. i.e. [1307.7163](http://arxiv.org/abs/1307.7163) or Wiki, Down to a few femtosecond transmission delays. Also; [https://www.sciencemag.org/](https://www.sciencemag.org/article/how-do-mirrors-reflect-ph)


SIZES The top quark is about $10\times10^{17}$ times the planck length. 0.0000000000162 ym (1.62×10$^{-35}$ m).
In string theory smaller lengths 'make no physical sense',[1] Quantum foam is thought to exist at this level
[Electron, quark, string, $10^{-15}$ Classical electron radius] = 2.81794 fm.

References


