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The Universe is Shaped by Radiation

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Abstract

Considering the formula of Plank for the spectrum of blackbody radiation as a product of two terms derived from a particle and a wave picture representing the blue and red ends, Einstein studied Wein's equation and concluded in 1905 that light must be composed of independent packets (quanta/wave- particles/soft corpuscles) each of constant energy *h*. That is; the discreteness postulate of Plank was not limited to radiation/light interactions with matter but extends to light itself. This was not intuitive and was not accepted before Compton did his electron-radiation scattering calculations in 1923 using only particles with momentum and energy. In this paper, we adopt Einstein's wave-particle concept and show that it's singly (with the known characteristics of light) and with no added assumptions, can describe all the interactions of physics! We start with the concepts of space, time, mass, charge, force, inertia, discreteness, symmetry, elementary particles, and end with the all-important conservation laws. Radiation spreads from a point symmetrically in all directions, it conserves momentum, has infinite lifetime and moves in empty space at a constant speed *c*. It can also condense to create matter via *E=mc^2*, confirmed by the e-p pair experiments, with matter attributes emerging from this condensation **[1]**. Further interactions with radiation, causes matter to accelerate according to the negative density gradient of energy (radiation) **[4]**. A non-stop energy-matter interaction becomes the basis for building larger matter elements, growing up from elementary particles to elements and compounds to cover all space. The present work suggests that the interactions of physics can all be explained using the Einstein energy quanta together with the known radiation characteristics and we find that this remarkable success of the quanta model (and also that of the weight-function of QM) in representing nature, is basically due to the use of the 'sine' function of mathematics. It is a solution to both the classical and QM wave equations- carrying the characteristics of spacetime symmetry as well as its discreteness and continuity!

Keywords: Light quanta, corpuscles, Radiation-Matter, Energy density, Symmetry, Conservation laws, Doppler-shift, Gravity Shift, Conservation laws, Emergent matter properties, Solitons, Twistors, Knots, Robinson congruence

1. Introduction

Einstein was first on many novels and not intuitive ideas. He proposed in 1905 that light itself and not only its interactions with matter, is discrete- composed of quanta **[6]** of 'constant' electromagnetic energy '*h*'. Einstein did not use the 'photon' for his quanta even when it was later adopted by physics. We think this because his proposed quanta element had a fixed energy *h,* where *h* is the Planck constant- whereas the photon has variable energies given by *E=hf*, and we could have red and blue photons for example. Einstein postulated in the same year that mass is a form of (equivalent to) energy given by *E=mc^2*, increasing in value with increasing speed- a result of the constancy of the speed of light. He proposed in 1915 that gravity is equivalent to/ a form of acceleration via the 'equivalence principle' concept. Subsequent experiments proved the usefulness of Einstein postulates- as in the Compton radiation-electron scattering, the e-p pair creation and annihilation via gamma rays, and before Einstein, we had the tower of Pisa experiment, the undeformed shape of firework ball descending to ground, and the much older observation in Greek Alexandria of falling rocks staying together on their down path, all supporting the equivalence principle **[3]**.
The author previously used Einstein postulates to produce simple and clear mechanisms for many subtle processes in physics **[1-4]**. In the present work, we continue this path and address two more major issues. The first is determining the seat/source of the symmetry of empty space, which is a corner stone to obtain the formulae in our previous work. The second is to find a simple mechanism by which radiation/energy is exchanged with matter. We again find that both results are consequences of two of radiation characteristics- namely, radiation spreads symmetrically in all directions from a point, and behaving like independent, constant energy particles of a gas as given by Einstein quanta. These results, make radiation stand as singly capable of explaining all the known phenomenon, processes and interactions in physics. Here we shall call these particles either 'quanta' or 'corpuscles' to show their constant energy/mass nature and give credit to Newton who was the first to speak of light composed of independent particles. The quanta here are soft corpuscles or one cycle of a wave. We note also that these particles are not the photons, because they have constant energy *h*. The photon has variable energies given by Planck; *E=hf*. That is; the quanta are atoms of one cycle each.

2. Theory

2.1. Space, Time, Matter and Radiation

The discovery of the Brownian motion in 1827 made it clear that nothing is at a standstill in the universe, and the smaller matter particles become, the faster they

move, with the electron moving near the speed of light. A fixed point in space is only a mathematical average of many continuously changing values. Motion should then be taken as the main variable of work and not space or time separately. A position could be an average over many readings for one particle, or of many particles at one time- as in the case of a fast-moving electron in an atom, or a large rock sitting on ground. We also note that a motion variable contains the units of space and time locked in one inseparable *spacetime* unit- the *velocity*. Since we need mass as well to define motion, and this mass could be electrically charged too, we look round and find that EM radiation and its units stand to be the simplest entity that carries the needed information/units above and could thus be taken to describe our 'spacetime'. From experience we know that radiation exists everywhere and possesses electric and magnetic force fields in its *E* and *H* vector fields. It also has a momentum and energy densities, derived from its Poynting vector *S=E^H*, in the form *p=S/c* and *e=p/c*, per unit volume. Armed with these facts we start our quest.
The fact that we can see stars from the edge of the universe, shows that radiation exists everywhere in space- even in the void regions as it crosses them on its way to us and to other regions. Einstein in support of this was quoted to have said; *matter is highly condensed energy and outside it is a region of diluted energy.* That is no region in space is void of radiation. The density of radiation in general, is not constant and could differ from point to point. This could be used to identify different regions of spacetime and construct coordinates accordingly. The microwave background radiation map is a good example. The *negative gradient of energy density* at any point establishes an *acceleration*/force that tends to move matter from high to low density energy regions. That is to say; matter particles tend to move to a lower energy density positions and gain energy by pocketing the difference. Since small particles have no source of energy of their own; *Moving along the negative energy density gradient becomes the 'only' path and a general rule of motion*. This is an intuitive and universal law. A particle moving uphill the gradient, loses its velocity, stops then starts again down the hill. But the acceleration/force is downhill all the time. The same happens to an electron between two potential plates. Fluid particles as an example, move from high to low pressure and electric charges move from high to low electric potential- these are only two of many. Pressure, stress, gravity and electric potentials etc. all have the units of energy density. Heat (fast random motion) as well, moves from hot to cold regions caused by the negative gradient of the (random) kinetic energy density of the vibrating molecules. This is a simple and intuitive statement of *the second law of thermodynamic*s.
If radiation is alone in space, there is no way to define space or time separately- hence the phrase; *Light doesn't see time*. 'Time' however, emerges as radiation condenses to matter and self-trap to move along closed loops with the same vacuum speed forming electromagnetic solitons **[1]**. Penrose arrived at the same equations of a soliton via his twistor model, see **[5]** and **Fig 3.** The appearance of the soliton leads to the emergence of time as the number of rotations radiation makes in the soliton closed paths. Here we get a number that is ever-increasing (arrow of time) and a scalar. This is exactly how time should be. Space/distance can emerge at this stage too- if there was a 'second' matter point to which light can go to and reflects

back while counting the rotations within a soliton. A distance is; *d*=(number of rounds of a certain length) x (the *constant* speed of light). We note that this is also how the international standard of units presently defines time; by counting oscillations in atoms and distance by the number of wavelengths of radiation of a certain frequency.
EM radiation condensate can create solitons with positive or negative rotations (spin) giving rise to an e-p pair with opposite spin, charge, and mass given by *E=mc^2* each with m related to the number of corpuscles involved. Then the rest of matter attributes emerge here too **[1]**. Angular momentum/spin from the rotating momentum vector; *p=S/c*, where; S=E^H, and a magnetic dipole moment from the *H* field along the spin. The electric field vector is normal to the two and becomes radial. The 'electric charge' is the *divergence* of this radial field as per Gauss divergence theorem. This construction gives a discrete time and matter units. The smallest time can be calculated from; *E=mc^2=hf*, giving *T=1/f=h/mc^2*=8.1e-21 seconds (compare with the zitter frequency of Dirac), with *m*=9.1e-31kg for the electron as the smallest unit of (stable) mass. Larger units of time or of (rest) mass are integer multiples of these minimum quantities. A relativistic mass would be this rest mass added to the (kinetic) energy in multiples of *h* units of energy/mass. This is additional to the fixed and stable structure and of the electron. Since the rest mass of the electron is a constant and time can be related to this with the fixed speed of light, we see that there exists a *universal local time that is ticking the same rate everywhere*- even though it can't be interrogated simultaneously from different places due to the limited speed of propagation of radiation.
We thus conclude that*; matter is a state of condensed radiation and radiation is the evaporated state of matter*. The e-p pair creation and annihilation events fit this perfectly. Like a true vapour, radiation carries many of the attributes of the condensate, and the process of evaporation condensation itself is infinitely repeatable and fully reversible via this process. As usual, condensation of radiation into matter requires a nucleus/catalyst. It can't happen in empty space- very much like water vapour requiring nucleation centres to condense. This is a result of two opposite gamma rays (to get net zero momentum) needing to 'veer' away from each other in the creation process, so as not to annihilate again. This requires an external support- e.g. momentum input. The reverse processes of evaporation or of annihilation clearly doesn't need a catalyst to happen, and the resulting radiation leaves in pairs in opposite directions with zero net momentum. This is, by the way, is the source of the factor 0.5 in the kinetic energy of a matter particles condensed from radiation.

2.2. The Quanta/Soft Corpuscles Model

The Einstein quanta model is clearly explained and justified in Klein **[6]**. This quote sums up the idea: *Quoting Einstein: "One sees that the temperature dependence of the (radiation wavelength) as well as its order of magnitude can be correctly determined by means of the general molecular theory of heat, and I believe that because of the great generality of our assumptions, this agreement ought not be ascribed to chance"*. The model was intended to reproduce Wein's law for the

spectrum of high frequency radiation, which solves the so called 'ultra-violet catastrophe' that plagued the wave theory of radiation at the high frequency end **Fig 2.** Combining Weins law with the wave theory resulted in a perfect fit to the measured spectrum from a blackbody. This caused Einstein to conclude that radiation can be taken as the result of many *independent quanta particles of constant energy h*. The term 'photon' was later adopted in physics, but Einstein didn't use it in his work- even after that. We think the reason is because the photon energy can have any value as *f* is changed- resulting in 'red' and 'blue' photons for example **[7]**. Einstein quanta(corpuscles) have energy *e=h=Planck constant each*, which is *fixed*. It is *one cycle (wavelength)* of radiation.

To describe the mechanism by which matter absorbs and loses radiation energy, we refer to Einstein quanta behaving like independent molecules of an ideal gas. Their Independence means they don't interact with each other but only with the surroundings. This is like a gas in a piston-cylinder transferring energy from one mechanical part of an engine to another via expansion and compression cycles. **Fig 1** shows few cycles of 'red' radiation in a cylinder compressed into half the size/length to become 'bluish'. This effectively doubled the frequency and the *energy density* by 'halving' the wavelength. This would be the same if it was a gas and we applied Boyles law for the relation between pressure which is energy density, and volume =length/stroke of constant area piston. One body transferring energy to another via; compressing the radiation between the two, forcing motion/doing work and delivering energy via expansion.

For an example from mechanics, take a billiard ball moving to hit another to make it move. The molecules of the balls never touch- because if they do, they fuse together, and this doesn't happen normally. Instead, the Coulomb repulsion force increases as the two approach each other, till the force is strong enough to push the static ball and move it. Since we have a change in velocity (acceleration and a deceleration) the process would involve radiation too as per Maxwell equations. An Avogadro number of electrons are involved in this process. When radiation hits a 'stationary' object, it reflects back with the same frequency and energy unchanged. But if the relative distance between the balls is reduced, radiation gets compressed, its pressure increases to give the standing ball a push to move and accelerate too causing the relative distance to increase again and radiation gas to expand. We could either use emission of radiation energy and absorbing it to describe this process which doesn't tell much about the mechanics of it. Or, the static field changing to radiation because of acceleration, getting compressed and transferring energy by expansion like in a real piston. To further clarify, we could think of a doppler shift scenario with frequency up and down due to relative motion between source and emitter causing a change in frequency/ energy. The end effect is; radiation being compressed and expanded to transfer work. Another similar picture from fluids is of a Pelton wheel cup hit by a fluid jet, moving it and reflecting back with less velocity/energy. The radiation sail is another application clarifying this. We could even replace radiation by a mechanical spring getting compressed between the balls by impact, compressed then expanded to push the slow ball and transfer energy. The transferred quanta of kinetic energy is kept/saved/absorbed by a moving object

to be used/released in the next encounter. This is also similar to a football hitting a wall, getting compressed slightly and springing back away again by expansion and pushing the mass of the ball back and away from the wall. Potential energy is saved in the compressed radiation/gas. In the virial theorem for a closed system, the kinetic energy is said to be half the potential energy but only on the 'average' but not instantaneously! *This opens the door that energy is not conserved instantaneously, and also for the idea of energy borrowing!* But if the potential energy in the radiation in the 'intervening spaces', is taken into account, the equality becomes instantaneous all the time. The time average of this energy goes to zero if all emitted radiation is absorbed locally and not lost and the virial theorem is correct in the average too.

2.3. Space Symmetry and Conservation Laws

Radiation spreads symmetrically and equally in radial directions when emanating from a point source. This is normally taken as a property of empty space. But equally valid, is to attribute it to radiation itself. Empty space is difficult to define, whereas radiation is a tangible item. We could thus conclude that if light goes to one direction, an equal and opposite of the same light must go the opposite direction to satisfy this symmetry. The reason we see a laser beam go in only one narrow direction is the effect of the reflecting mirrors that provide the opposite momentum. Since matter is condensed radiation, it follows that the same principle applies to matter and also to its interactions with radiation. Thus, if one matter point m moves to one side dx, another equivalent matter must move equally to the opposite side. We then have; $\Sigma(m.dx)=0$, along any line. Differentiating the two sides once and twice keeping m constant and dx variable, gives expressions for velocity and acceleration(force), and give the conservation laws: $\Sigma(m.v)= \Sigma p=0,$ and $\Sigma m.a= \Sigma f=0$ along any line. This shows that the basic symmetry in radiation is the source of the conservation of momentum p and the action and reaction force equality of Newton **[1]**. Moreover, as energy is the scalar integral of momentum, we get conservation of energy too; $e= \int p.dp=0.5\ p\hat{}2$, for unit mass, leading to $E=.5\ m\ v\hat{}2$ with $p=m.v$. for any mas. The conservation of *angular momentum* follows suit if we multiplied linear momentum by a constant radius of rotation.

2.4. Equations of Motion

The conservation laws above become a basis for deriving the laws of motion. If momentum is conserved, any two bodies in one plane in isolation from other masses and trapping each other in a closed orbit, will remain in that plane for ever. This is simply because any departure requires an external momentum input in the normal direction (to the plane) for it to happen. This was first pointed out by Newton, then Bertrand theorem used it and showed that the forces between orbital masses, must be those of the inverse square or those of the space spring (Hook's law). The inverse square of Newton's gravity and Coulomb's electrostatic forces will thus follow from this. Further application leads to the derivation of *Maxwell type equations* for electromagnetism and those for gravito-magnetism (linear GR), if we used the

retarded potential integral and the constancy of the speed of propagation of forces (of radiation) being all limited to that of light **[2]**.
Next, we find that the inverse square *f=k/r^2* for two masses in isolation can be modified by the presence of neighbouring masses, as in the case of crowding and confinement. When displacement is small, it is easy to show that the inverse square asymptotically changes to Hook's law; *f=kr* because we now have a *multibody problem* not just that of a pair and the inertial effect of the crowd becomes significant. Hook's forces are the source of *all* vibrations in matter **[1].** Vibratory motion is a result of an exchange of energy between kinetic and potential energy reservoirs within confined spaces. For medium crowd degrees we can have all the intervening powers of the separating distance *r,* and we write; *f=k r^n*, with *n*=-2, -1, 0, 1 to fit various degrees of crowding. The case *n*=0 gives the case of *asymptotic freedom*- reported in particle physics in connection with the strong force. One can also represent the general case by a continuous rather than a discrete function in the form; *f=a*exp(b/r)/r^2*, where *a,b* are chosen so that the formula changes smoothly with particle crowdedness- normally referred to as *the range of forces*- 'the distance particles travel before hitting others'. This is the Yukawa formula in particle physics, and also that of MOND of astronomical physics- that modify Newton's gravity to explain astronomical anomalies at the galaxy scales **[3]**. We also note that the Yukawa formula is derived in the literature from a solution of Laplace equation for a continuous medium. This can represent crowding as high densities. Note also that Laplace equation itself is derivable from the inverse square formula via the concept of 'potential'. These results connect quite few processes together as all coming from a single inverse square origin- derived in turn from momentum conservation as given above.

2.5. Particle Acceleration and the Gradient of Energy density
The simplest and most general law of motion is; *acceleration = negative gradient of the energy density*. This is an intuitive rule since elementary particles don't have a power source of their own and rely on moving from high to low energy densities to gain motion and kinetic energy **[4]**. This is readily seen by checking the units of energy per unit mass (*.5v^2)* being (m^2/s^2) and on dividing by length to get a gradient, we get; m/s^2 which is acceleration. But also, by direct derivation along a line; *∂/∂s(.5v^2)= v∂v/∂s=(v ∂v/∂t)(∂t/∂s)=∂v/∂t=a* , which is acceleration- after putting; *∂t/∂v=1/(∂v/∂t) =1/v,* and cancelling. Since all energies can contribute to acceleration, and with energy being a scalar function (additive), it becomes possible to gather all energy densities at a point to find the total acceleration. That is; $\boldsymbol{a} = -\nabla \sum$ (kinetic + potential + stress/pressure + heat _ electromagnetic, etc) energies. Note that both $\boldsymbol{a}$ and ∇, are vectors, leading to different values for the acceleration depending on the direction of change of the energy density. In **[4]** it is shown that taking the gradient of Einstein field equations lead to a simpler relation in the form of acceleration= - energy density as given by the energy momentum tensor, thus offering an intuitive interpretation to the idea of; *energy bending of spacetime.*
We next look at the seat of inertia. As it stands, (magically) *objects are said to move in a straight line if not affected by others*. We can have an intuitive and simple

reason for this behaviour using the above findings. A mass needs momentum and energy to change speed and direction. Without such input, mass can't change its state of motion. More force/power is needed to produce a larger acceleration. This is like requiring a higher voltage for the fast building of an electric current- a case that doesn't involve any masses. Mass doesn't resist motion, rather mass requires energy/power to move faster. Give it momentum/energy and it will change motion. Give it more power and it will accelerate faster- as in the case of a race car. Clearly this phenomenon is a function of the mass too.

Next we examine why inertial mass equates a gravitational mass. It is because we need the same force/power to do a certain accelerate to mass whether it goes horizontally (parallel to earth surface) or vertically normal to earth. Both cases follow the negative gradient of energy density to happen. In one case we had potential (energy density) from gravity, and in the other we had compression or pressure energy densities.

We next consider the centrifugal acceleration/force. This force is normally derived and explained via a *vector velocity* changing direction. Equally, we can think of it in terms of energy density. A centrifugal force on a uniformly rotating mass is a result of the kinetic energy *v^2* being constant along the circumference. Then *v^2/r* is the gradient along the radius of rotation and normal to the constant energy direction. The energy density is high at the circumference and zero at the centre. The negative gradient is directed outwards. A similar case can be seen in the structure of Einstein geodesic equation of motion, where in the acceleration on the left side is equated to the negative gradient of a generalized form of the kinetic energy in 4D- see **[4]**.

2.6. About Non-Classical Interpretations

Many claim that small atomic scale physics is not amenable to classical rules. Discreteness, unpredictability/randomness, multiplicity/entanglement, and tunnelling are some of the cases. This can't be true in the present case on principle- since the quanta/soft corpuscles idea is a pillar in modern physics. As the quanta behave like the atoms of an ideal gas, we get classical physics on board too. Further, since matter is created from condensed energy/ radiation quanta, *the behaviour of small and large matter should be governed by the same rules*. Discreteness and a wave-particle duality must be a universal theme in physics whether classical or modern.

As described above, the quanta model is fully deterministic. The same can said about the wave equation governing it- whether classical or not. Nevertheless, and because of the near infinite number of quanta entities within even a minute system, a full deterministic treatment becomes impossible. The number of quanta within a neutron (mass energy divided by *h*) for example, is of the order of an Avogadro number! This is huge to follow individually- thus requiring the use of group treating concepts like energy, probability and the continuum (non-discreteness). A 'continuous' matter is a simplifying model and not real, while a probabilistic system is an idealized state and not real too.

Non-locality is another of the concepts that is frequently mentioned and is readily amenable for a simple classical explanation. The source of acceleration- the gradient of energy density, is a local operator. But energy/radiation on which it operates is not. It is governed by an integral equation requiring integration over the whole space for its evaluation. This gives rise to a conservation of entangled quantities for a short time before interacting with other particles (decoherence). The reason why spin is mostly used for studying this phenomenon is because rotation/spinning offers a much smaller chance of interaction with another spin than two linear momentum interactions. This leads to entangled pairs by rotation lasting longer before losing their pairing. The long stability of swirls in fluids is a good example. Gravity being caused by the distant masses at the very edge of our universe is an excellent example of nonlocality effecting local processes.

The interference pattern of the double slit experiment is another of the famous non-classical cases. The common interpretation of it is that particles go through the two slits at the same time in the case of electrons and dimmed light (single photons). This mystery immediately goes away if we considered the slit material role in the process. This must be important input since there is a known relation connecting the slit and the wavelength, for the interference to happen. There also exists a condition of coherence, as two independent sources of light feeding the two slits won't produce fringes. In reality, the slit narrow region becomes a confining space for the passing electrons causing the inverse square to change to its space spring asymptote. This then creates a *harmonic force field that guides every single electron to its correct fringe position*. For the single photon case, the explanation is also simple. A photon is a wave whether dimmed or not, and would go through the two slits as per the wave theory. The reason the fringes are built from the time accumulation of dots giving the impression of single particles, is due to the *quantised interaction of light quanta with the screen* and not because the single photon is point like substance. The quanta is not a point in geometry. The interference is also said to disappear if one slit is sampled to find out which slit is passed at every event, which adds another mystery. This is caused by disturbing the original random distribution of the variable via inappropriate sampling method. A good example is the disturbance introduced if we sampled/interfered with the balls falling to form the normal distribution in the Galton board experiment. Only pure random fall can produce a Gaussian curve.

Simple explanations exist for mysteries involving polarizers- the 'eraser' problem is one. Here again people overlook that a polarizer *doesn't act as a 'go-no go' gate*. Rather it interacts with the incoming beam of light then produces a new beam in the output. This in fact is also stated in QM. A vertical polarizer for example, doesn't erase the horizontally polarized part in an unpolarised light. It interacts with the incoming light and produces a 'new' vertically polarized light. This way it is not necessary to ask why an image disappeared after a succession of a vertical and horizontal polarizers, then appearing again after putting a third diagonal polarizer in between the two. The new light appearance is caused by the diagonal filter taking the vertical part and produced a diagonal light that has a 'new' horizontal as well as a vertical component. The newly created horizontal component is what is showing

by the next horizontal filter from the middle one not the first. Of course, QM can give what it likes within its modelling theory, but this shouldn't be taken to mean there aren't any other and even more intuitive explanations.
Tunnelling is particularly simple to explain. A molecule on the surface of a liquid for example, needs excess energy to escape the surface tension and become a vapour molecule. It gets this at random times because the fluid molecule are in reality not all at the same kinetic energy but on a spectrum of it- the Brownian distribution. Thus, between time and time one molecule can randomly gain an excess energy and jump out. This is tunnelling with a classical explanation without invoking the need for the spread of the wave function over all space crossing barriers on the way.
The weight function collapse is yet one more of the widely mentioned non-classical issues. Systems are said to exist in a superposition of many different states. Then a definite state is achieved only on doing a measurement. How this happens is a matter of continuing debate. We get a simple classical explanation if we remembered that a measurement act in QM involves doing an integration over frequencies (weight functions). But we know that the weight function itself is a sinusoid that can be part of a *Fourier transform of the path of particles*. This means that the system is effectively being analysed in the complex spatial (not temporal) frequency domain, and the act of measurement is simply doing a transform back to the particle spatial domain. This is very much like transforming a time signal to the frequency domain, doing a process on it like filtering then integrating back over all frequencies to go to the time domain again. This also explains how can the weight function for a single particle exists everywhere in space before the act of measurement /integration/back transformation. This also gives the meaning of the many-world interpretation of the measurement problem. So far, we saw that there is no inherent randomness in physics- as Einstein always insisted on. *The unpredictability which is real, comes from our ignorance due to the huge number of atoms involved in every minute interaction.*

3. Conclusions

We showed that the laws of nature are logically connected in a chain very much like the theorems of Euclidean geometry. The starting postulate is Einstein quanta together with the known properties of EM radiation. The quanta/corpuscles are wavelike entities, have constant energy and behave like independent gas molecules/corpuscles. The properties of radiation include spreading out symmetrically from a point, moving at a constant speed and is conserved. The consequences that follow from this are numbered below:
1- Empty space is symmetric because it is filled with a symmetric radiation, its condensate (matter) and its interactions with matter. Conservation laws then follow from this symmetry- (**sec 2.3**).
2- Trapped masses (that could be charged) in closed orbits experience a force of the inverse square type, and is a direct consequence of the conservation laws- (**sec 2.4**).
3- Inertia of crowded particles modifies the inverse square to the spring force, which is responsible for all vibration in matter. The crowd also modifies the inverse square

to produce the Yukawa and the MOD force formulae. The limited speed of propagation of forces/acceleration on the other hand modifies the inverse square further to give Maxwell type equations for electricity and gravity- (**sec 2.4**).

4- Radiation can self-trap and create matter e-p pairs as EM solitons (or knots). It further interacts with matter via normal thermodynamic relations (Boyles law and others). The resulting e-p pairs create neutral positronium atoms which in turn create all the unstable (charged and neutral/dipole) elementary particles like the neutron. Highly stable protons are created when a neutron loses an electron and captures it in an orbit to form a stable hydrogen atom. Many hydrogen atoms can create the elements and compounds of chemistry. Stability is determined by the lost formation energy and also the particular configuration of the structure of a particle- (**sec 2.1**).

5- Matter is discrete and the e-p pair represent the smallest units of mass and charge- a result of the unique construction of the mass soliton/knot. Time is discrete because it is determined by rotation counts of radiation inside the soliton- the Zitter frequency of Dirac. Larger vibration states causes further larger levels of discreteness resulting from Hook's law. This law is an asymptotic behaviour of the inverse square. Our world looks fractal as a result of the inverse square having a power law form, which is scale invariant with no true mean or standard deviation. This explains the butterfly and the black swan phenomena in nature. As the inertia of a crowded system modifies the inverse square and change the dependence on the separating distance change from -2 to +1, with lowest crowding corresponding gives the empty space form of the law- the massless state - (**sec 2.4**).

6- The radiation density gradient comes out as the single source of particle acceleration/force. This is true for gravity, electromagnetism and other fields. The gradient of energy of the distant masses (mass multiplied by c^2) is the cause of gravity as suggested by Mach, which explains its being weak and relatively constant in the observable space. The rise of a water surface in a rotating bucket is not caused by the same as in some literature. Rather, rotation of the Newton bucket induces by friction, rotation in the water and geometrically created radial kinetic energy gradient to the centre. The gradient of this kinetic energy causes the (centrifugal) acceleration/force. The quantity v^2/r is a gradient of the energy v^2 along r, pushing the water out to form the observed parabolic surface shape.

The equivalence (principle) between acceleration and gravity finds it's explanation here too. Inertia in this case is explained by the need to supply energy/power to produce a change in motion- rather than the unintuitive concept of matter resisting change or continuing to be in the same state of motion or rest - (**sec 2.5**)

7- Radiation going down a gravity well is blue shifted. By the gas analogy it is compressed due to acceleration going downward. Thus, we see that gravity compresses not only mass but radiation too. Chemical compounds, elements and elementary particles remain stable in general, because their constituents lost large energy in formation and need the same large energy back to disintegrate. We observe this in our daily life- in the supplying energy to melt ice for example. At extreme conditions, disintegration can reach even the e-p pair structure. In this case we arrive at radiation-lepton soup at the central regions of extremely heavy astro-

nomical objects/blackholes. If one such object explodes, it will spread matter in the various states of composition. By abundance, we should get radiation, leptons, hydrogen, then the heavier elements and compounds**[3]**-**(sec 2.1)** .

8- Gravity and *all forces* come out to be both local and non-local. This is because the gradient of energy density is a local operator, whereas the energy/radiation itself, on which the gradient operates, is non-local- governed by an 'integral' equation requiring integration over all space- (**sec 2.5**).

9- The quanta/soft corpuscle/wave particles (taken as a one cycles) of constant energy *h* together with the known characteristics of radiation comes out to act as *the building block or the atom of the world*. The '*sine'* function of the quanta carries the symmetry of spacetime as being a solution of the wave-equation. It is a constant quantity of energy behaving like a gas molecule. It can be used to describe radiation, condensed radiation (matter) together with their interactions. This sine wave is also the *weight-function* of QM and as claimed, can represent anything. It also carries 'both' the continuity and discreteness characters of spacetime. We also note that the sine wave itself can be generated by motion on a circle- which was one of the earliest attempts to unify astronomy by explaining the motion of planets via epicycles principle- (**sec 2.6**).

4. Figures

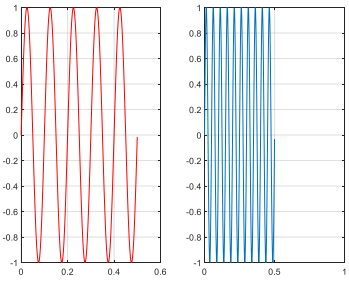

Figure 1: Few cycles of EM waves(red) compressed into half the volume(blue) leading to an effective doubling in frequency(halving wavelength) and energy density/pressure – similar to the case of pressure (energy density) in an ideal gas when isothermally experiencing the same space reduction (Boyle's law).

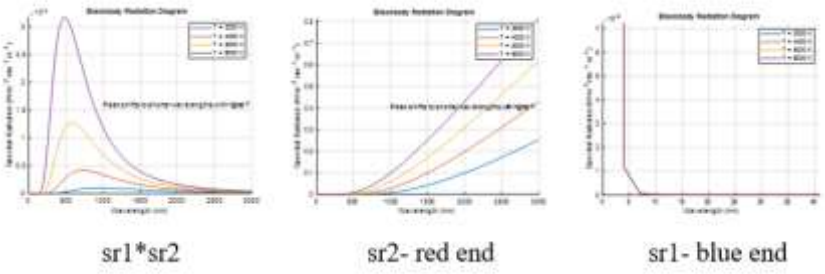

Fig 2 a,b,c: Black body spectrum and algorithm for separate blue-end and red-end factors (sr1,sr2- in algorithm).

[Spectral radiance= (2 * h * c^2) / (λ.^5)/(exp((h * c) / (λ * k * Ti)) - 1)]

% Algorithm: To Plot a blackbody radiation spectrum (*AI assisted*).

```
clear all; close all; h = 6.626e-34; c = 3.0e8; k = 1.38e-23;
lambda = linspace(1e-9, 3e-6, 1000); % Wavelength from 1 nm to 3 µm
% Define temperatures (in Kelvin)
T = [3000, 4000, 5000, 6000]; % Example temperatures
figure(1);hold on;colors = lines(length(T));
for i = 1:length(T);Ti = T(i);
sr1 = (2 * h * c^2) ./ (lambda.^5);
sr2 =1./(exp((h * c) ./ (lambda * k * Ti)) - 1);sr=sr1.*sr2;
plot(lambda * 1e9, sr, 'Color', colors(i,:) ;end;
'DisplayName', sprintf('T = %d K', Ti)); % Plot with legend
% Convert spectral radiance sr to(Watts per square meter per meter per steradian)
xlabel('Wavelength (nm)');
ylabel('Spectral Radiance (W·m^{-2}·nm^{-1}·sr^{-1})');
title('Blackbody Radiation Diagram');legend('show');grid on;
xlim([0, 3000]); ylim([0, inf]);
text(1000, max(sr)/2, 'Peak shifts to shorter wavelengths with higher T', ...
'FontSize', 10);hold off;
```

.

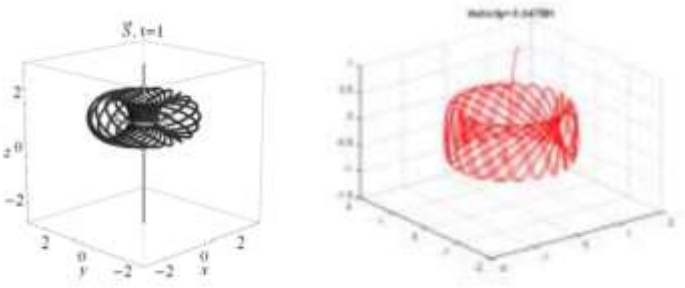

Fig 3 A ‘Knot’ from the twistor model of **[5]** and a ‘Soliton’ algorithm and output from **[1]**, to model EM radiation condensing to create matter (e-p pairs), and resulting in the emergence of matter specific attributes; mass, spin, charge, and magnetic dipole moment.

%Algorithm to Generate a soliton [1].

```
clear all;close all;
n=1e3;dt=1;x=1;y=1;z=1;X=[];Y=[];Z=[];
for kk=1:n; r2=x^2+y^2+z^2;
u0=(1/2)/(1+r2)^2; u=u0*(-y+x*z); v=u0*(x+y*z);
w=(1/2)*(2*z^2+1-r2);f2=u^2+v^2+w^2;f=sqrt(f2);
```

```
Ik=4*f2./(1+r2); %HelicityL=Intg(I.rot(I))d^3(x);He=rot(I)=4I2/(1+r^2).
x=x+dt*u;y=y+dt*v;z=z+dt*w;X(kk)=x;Y(kk)=y;Z(kk)=z;
I(kk)=Ik;end;'kk';Im=mean(I);
figure(1);plot3(X,Y,Z,'r');grid on;title(['Helicity= ' num2str(Im)]);
```

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***Quoting Einstein**: "One sees that the temperature dependence of the (radiation wavelength) as well as its order of magnitude can be correctly determined by means of the general molecular theory of heat, and I believe that because of the great generality of our assumptions, this agreement ought not be ascribed to chance",*

"And at the end of this decade he(Einstein) is quoted as often saying, "For the rest of my life I want to reflect on what light is""

[7] Wikipedia, Planck Constant, Retrieved Aug, 2025, https://en.wikipedia.org/wiki/Planck_constant

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