HOME

The Origins of Particles, Forces and Electromagnetic Radiation Revised

by

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> So then always that knowledge is worthiest … which considereth the simple forms or differences of things, which are few in number, and the degrees and co-ordinations whereof make all this variety.
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> *The Advancement of Learning Book II* Francis Bacon

Summary

A model has been developed which in principle uses the fundamental building block of a single particle to account for all matter in the Universe, and to provide the source of all physical forces and the generation of electromagnetic radiation. This particle is the quantum of matter. It comprises the 'stuff' of electrons and positrons without their electric charge. It has been given the name 'ε-particle' to distinguish it from these two particles and the gamut of other particles. Electric charge is not used in the analysis; the phenomena attributed to the separation of charges are caused by the spinning of the ε-particle on its axis. This is literal rotation, not the notional spins of quantum physics, and the rate is identical and unchanging for all ε-particles, but the direction of spin is determined by interaction with its environment.

The methodology separates the components of Newton's parameter of mass into those related to mechanics and those associated with forces which act at a distance. The 'stuff' of the ε-particle is what appears in 'billiard ball' mechanics. It is 'stuff' which imparts its momentum on collision and continues in a straight line unless deflected by a force. The magnitude of the force is still proportional to the acceleration which it causes, but the term 'mass' is not used because its wider connotations confuse the analysis. In fact it may not be the same as 'mass' determined from other forces. The quantity of 'stuff' used in the definition of mechanical force is therefore a ε-particle or a whole number of ε-particles.

Newton's other use of the term 'mass' relates to forces acting between bodies at a distance from each other, as in his Law of Universal Gravitation. These forces in the model are generated by the spin of the ε-particle on its axis, which causes orientation in the adjacent medium of space by electromagnetic induction. This is transmitted from microgranule to microgranule of the medium of space, also by electromagnetic orientation, until it reaches another ε-particle with which it interacts by the same process. This sets up a two-way resonance between ε-particles along the common axis if the spins of the ε-particles are in the same direction, which results in a force of attraction between

them. If the spins are opposite, the result is dissonance and the force is repulsion. Thus the mechanism communicates both the force and the direction of rotation from one ε-particle to the other. Force is along the axis of spin, and the direction of spin is perpendicular to it. There is a parallel here with electric and magnetic fields.

The same fundamental process operates inside nucleons, between nucleons in the nucleus, at the atomic level and between bodies, where it takes the form of gravity.

The process accounts for the forces between electric charges and between magnetic poles. All originate in the spin of ε-particles, and are transmitted through the medium of space by electromagnetic induction. The differences between gravity, electric charge and magnetism arise from the degree to which ε-particles and their direction of rotation are physically constrained and the environments in which they are measured. Gravitational attraction is ascribed to forces between large bodies at great distances. Distances between electric charges or between magnetic poles may be much less as conventionally observed, even down to atomic dimensions.

It is a variant of this process which is the origin of electromagnetic radiation. Whereas forces acting at a distance are produced by the spinning of ε-particles on their axes, electromagnetic radiation results from the acceleration of ε-particles in translational motion. This linear acceleration generates rotating electromagnetic dipoles (REDs) in the medium of space. These REDs are then transmitted through the medium of space by successive electromagnetic reorientation of the microgranules by induction, which requires no energy and occurs at the speed of light, because REDs are light.

The corollary of all this is that the entire medium of space is composed of microgranules which are susceptible to reorientation by electromagnetic induction.

The analysis allows us to propose a model of the structure of subatomic particles above the fundamental level. According to this, the proton is entirely composed of paired ε-particles rotating in opposite directions, which in effect neutralises their effects, except for one unpaired rotating ε-particle at its centre, that is the source of all external forces. Since there are no particles smaller than ε-particles, and these cannot be created or destroyed, other particles that are detected are short-lived fragments of protons; they have quantum properties because they contain whole numbers of ε-particles.

There is a preponderance of unattached ε-particles with a particular spin in our locality in the Solar System i.e. the electrons. It is proposed that this is caused by the magnetic field of the Earth, which acts as a ubiquitous default state. The implication is that other localities may be different.

The Universe therefore has just two components in this model: ε-particles and the medium of space. Despite being pared down to the absolute minimum, the model contains enough degrees of freedom to account for the phenomena which are observed in the natural world.

A. Introduction

Given the existence of the electron as a fundamental particle, there are two extraordinary aspects of related particles which raise questions about some deeper process linking them. First, why has nature found it necessary to create another particle with exactly the same charge as an electron, but electrically in the opposite sense? This is not simply the absence of the electron's negative charge, which would be neutrality, but a clearly opposite charge of exactly the same magnitude. It does not help to quote the law of the conservation of charge, because that simply restates the phenomenon rather than explaining it. The question still arises, what sort of mechanism produces such a charge, unless it is a mirror image? Then what sort of mirror? In fact what exactly does the term electric charge mean? The practice is to define it in terms of the results which it produces, because there is no alternative.

Secondly, why has this positive charge been incorporated into another particle with about 1836 times the mass of the electron i.e. the proton? Why this number, and why approximately, though that may be a separate argument? We may just take it all as given, but that is hardly an acceptable explanation in the long term.

The present paper develops a model which is consistent with directly observed phenomena by building on previous work but without calling on the concept of electric charges.

I recently proposed from consideration of published data that a free neutron, which is thought to be a 'fairly fundamental' particle, is in fact an association of a proton with an electron in close orbit that exists as a composite only outside the nucleus, and then only for a matter of minutes before decomposing into the two separated particles (1). According to my model, the nucleus, which we consider to be composed of protons and neutrons, is in fact an assembly of protons bound together by electrons orbiting inside the nucleus, one electron for every notional neutron. Thus when a 'neutron' is ejected from a nucleus, it is simply a proton which takes an electron with it in close orbit, until the orbit unwinds under the influence of the environment, and the system degenerates into two separated particles. The clue to this process is that neutrons form at the temperatures and pressures of stars, and apparently survive indefinitely in nuclei, but disintegrate rapidly at normal temperature and pressure. This is not the conventional interpretation, because intranuclear electrons are a new concept, but it has the simplicity of the principle of Occam that 'entities are not to be multiplied beyond necessity'.

As the above analysis implies, the proton is considered to be 'more fundamental' than the neutron, but it too may be unstable in the long term, and it has been suggested that it actually has its own 'half-life', though quite a long one, namely 10^{32} years (allegedly!).

The electron, on the other hand, really is fundamental, but here also there is a debate whether it is really a particle at all, which was the original view, or whether it is some

kind of wave. If it is a particle, it must be very small, even by the standard of fundamental particles. Its diameter must be less than a tenth of that of a proton on the grounds of its relative mass alone, assuming it is made of the same 'stuff'. In fact it is sometimes considered to be more of a point than a particle. In any case it is not clear what the diameter of an electron would actually mean, because electrons could never approach each other to the point of 'touching', and apparently they never 'touch' other particles either.

The modern view is that an electron inside an atom cannot be specified, and so it is best considered as a probability distribution of charge around the nucleus. But whatever its uses, this model cannot be literally true, because the whole distribution represents an integer i.e. one electron, and part of it would be part of an electron, which contradicts the definition of fundamental particle. Perhaps the proper interpretation is that the probability density is a mathematical representation of the chances of an electron being at a particular place at a particular time, because you cannot stop the process to see where the particle is, and you would not be able to see it, even if you could.

B. The methodology

It is essential to set aside preconceptions and start the analysis at the very beginning, which requires a return to the earliest view that an electron is a very small hard sphere, like a billiard ball, but possibly much smaller than we imagine. The methodology is to examine every aspect of phenomena which could be derived from the forces which such a particle could conceivably generate. A clean break with current models requires that we should abandon the concept of the separation of electric charges, and so the phenomenon of electric charge itself. Thus the question becomes, how could particle behaviour give rise to forces which present thinking attributes to electric charge?

However, it goes further than that, because a fundamental consideration of forces must include the question of mass. The term 'mass' is defined in Newtonian mechanics by the forces of gravity and thence the forces of inertia. These forces are ultimately based on variables which Newton could see and measure, namely time and distance, which have therefore become the dimensions of physics. The term 'mass' is the constant of proportionality which he introduces in the first paragraph of his *Principia Mathematica* to enable him to define mechanical forces in algebraic terms. If we rely on mass to explain forces, we are not so much returning to fundamentals as using the conclusions to justify the analysis. A fundamental analysis should explain both electric and the different Newtonian forces, but avoid invoking the properties associated with the term mass in physics.

Of course there is the other everyday meaning of mass as just 'stuff' which is tangible. A fundamental particle must be composed of something, hence the analogy of the billiard ball. In that case all other particles and matter which we consider to be 'stuff', including billiard balls, must be composed of the same fundamental particles of 'stuff' bound together in different arrangements.

We start then with a fundamental particle which is identical to the electron in every way except that it has no charge. It consists of 'stuff', the nature of which is unknown or given. We do not draw on the concept of its mass, but consider that this describes forces to which the particle gives rise. We then develop the analysis by the application of observations which can be made directly.

The population of elementary particles has grown so large that almost all possible names for particles have been assigned, and so I have had to invent a new term. I have chosen to call the new, hypothetical particle the 'ε-particle'.

C. Direct observations

The phenomena on which we draw for the purposes of argument are as follows:

1. Like any sphere, the ε-particle can spin on its axis. This is rotational spin, not the notional spin of quantum mechanics, which is used to denote what are in effect mirror image states without implying mechanical rotation at all. Here it is used definitely to mean rotation at speed about an axis, the sort you can actually see when it occurs on a human scale.

2. As the ε-particle rotates on its axis, it interacts with the medium of space which permeates the entire Universe. In fact by definition the medium of space permeates all the Universe which is not occupied by the stuff of ε-particles This is the same kind of interaction which occurs when particles of mass accelerate in a translational sense through the medium of space so as to generate electromagnetic emissions. It is this shedding of energy in the form of electromagnetic radiation which limits the velocity of mass to the velocity of light (2,3).

3. No energy is consumed in maintaining the transmission of forces through the medium of space, as opposed to their initial generation. Thus no energy is consumed in maintaining the force of gravitational attraction between the Earth and the Sun, or the system would soon have run down. Similarly we do not have to expend energy to maintain the force of gravitational attraction between ourselves and the Earth i.e. our weight, or we would be very tired. This applies to the transmission of gravitational, electric and magnetic forces. It also applies to light, which does not lose energy on transmission *in vacuo*. What these all have in common is the nature of the medium of space with its special characteristics.

4. The movement of electric current through a conductor generates a force acting at a distance and perpendicular to the flow of current, which is the phenomenon of electromagnetism. The direction of this force is designated ultimately in relation to the Earth's magnetic field by analogy with the compass, that is in effect the default position.

D. Basic hypotheses

The acceleration of particles in the medium of space generates characteristic, well defined disturbances in the form of rotating electromagnetic dipoles or REDs by an induction mechanism. These REDs are ejected into the medium of space, and travel at the speed of light until they are intercepted by the bonds of a receptor, or 'seen', and converted back into particle motion. This is the generation, transmission and absorption of light as a particulate phenomenon. The total process depends on resonance between the vibration of a bond in the emitter, the frequency of rotation of the RED which is generated and the vibration of a bond in the receptor. In effect the quanta of light transmit the kinetic energy of particles through space from the emitter to the receptor.

Particles rotating about an axis do not have the translational motion required to launch dipoles into space, at least primarily, but they still interact with the medium of space and act upon its microgranules (4). It is proposed here that rotation of the ε-particle on its axis generates a force which attracts ε-particles rotating in the same sense, but repels ε-particles rotating in the opposite sense. The force acts at a distance i.e. through the medium of space, and decreases in magnitude with the square of the distance between particles. The direction of the force is along the axis of rotation of the ε-particle. The direction of rotation of the particle is retained in the medium of space at a distance by this mechanism of orientation. This is perpendicular to the axis of rotation in the same way that electric and magnetic fields from the same source are conventionally perpendicular.

On this basis we can build up a model.

E. The ε-particle

The ε-particle is represented by a sphere rotating on its axis at a rate which is the same for all ε-particles and never changes i.e. they are 'frictionless' (Figure 1).

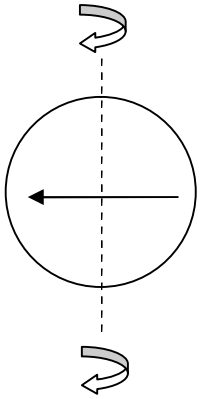

Figure 1. Diagrammatic representation of ε-particle rotating 'east' to 'west'.

Rotation generates a 'disturbance' at the interface with the medium of space, which is the surface of the sphere. The magnitude of the 'disturbance' is a function of the velocity of the surface through the medium of space which ranges from zero at the 'poles' to a maximum at the 'equator' i.e. the properties at the poles are different from those at the equator.

The mechanical spinning of the ε-particle in the medium of space gives rise to a force that attracts other ε-particles with spins which are the same, and repels other ε-particles with spins which are the opposite. This is analogous to the attractive forces between parallel conductors carrying current in the same direction, and the repulsive forces between parallel conductors carrying current in opposite directions, where the flows of current produce electronic orientation which give rise to mechanical effects. There is a connection between this phenomenon of interaction with the medium of space and inertial resistance to acceleration of a body through the medium of space (op. cit.).

The force extends out into space along the axis of rotation as far as infinity, because there is no cut-off point, but its magnitude decreases with the square of the distance from the ε-particle. Force is a maximum when the ε-particles have a common axis of rotation. Particles with axes of rotation which are perpendicular to each other do not interact. If the axes are inclined at an angle of θ to each other, the force between them is reduced by a factor of cos θ. It follows that the force of attraction between a ε-particle and all other particles in the Universe rotating in the same direction is the sum of all these forces making allowance for distance and the relative angles of their axes. By the same reasoning, the force of repulsion between a ε-particle rotating in the opposite direction is the sum of all these forces similarly qualified. In the Universe as a whole the sum of all ε-particle spins must be zero.

It would be equally valid to draw a ε-particle having the same axis of rotation but the opposite direction of rotational spin. In the absence of constraint the axis of either particle could turn through 180º to bring them back to identical configurations again, and such identical configurations could similarly be reversed by rotation of the axis of one particle of a pair through 180º.

A cloud of moving ε-particles with axes which were randomly orientated would act as a perfect gas. Every particle would be attracting all the others as very small masses with forces that depended on the inverse of the square of the distances between them, which would change continuously as the ε-particles moved. The additional effect is that the forces would also change with the orientations of the axes.

To continue the analysis it is enough to depict the direction of rotation by a single arrow at the equator.

F. Pairing of ε-particles

One purpose of the analysis is to find a mechanism which can make a difference of exactly one particle in a structure, by analogy with the electron and the positive charge of the proton. The proposal is that this can be achieved by pairing particles as follows.

Under conditions of extreme pressure, two ε-particles might come into close proximity, such that their axes are in line and constrained, so that their orientation cannot change. Since these associations of pairs of ε-particles are formed statistically under the appropriate conditions, there is no reason why they should not continue to grow, not only in two but in three dimensions to form a lattice. Under these conditions they may have two possible states as in Figure 2.

If the ε-particles spin in the same direction, they are drawn together to form a string or mass with additional and growing attractive force for ε-particles with similar spin. Since it would contain a lot of ‘stuff’, the size of such an agglomeration would eventually be limited by collision with other particles under conditions of extreme pressure and the accompanying temperature. Such a body would exert considerable force of attraction on ε-particles with similar spin. However, it would repel all ε-particles with opposite spin, so that overall in a macroscopic sense its effect would be zero.

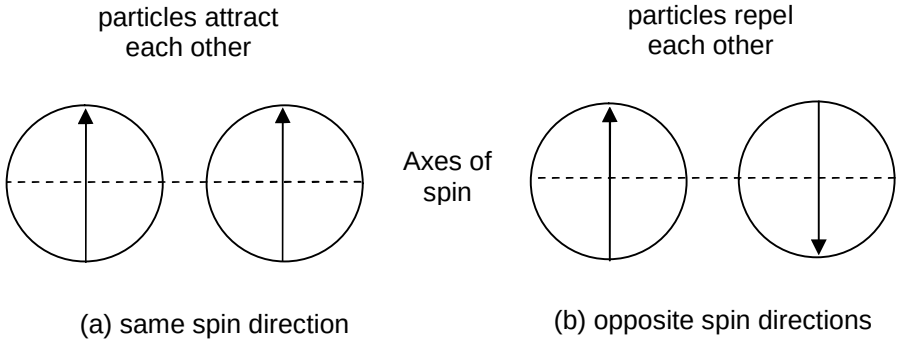

Figure 2. Pairs of ε-particles with (a) identical or
(b) opposite rotational spins

If the ε-particles had opposing spins, they would be pushed apart, but at extreme pressures they would not be able to separate. It is proposed that the structure would grow statistically to form a three-dimensional lattice such as is shown in Figure 3. This structure contains two interlocking lattices in which neighbouring ε-particles repel each other, but the force of repulsion is matched by the forces of attraction of all the adjacent ε-particles for each other. Each ε-particle is physically constrained. The result is that the two lattices repel each other, but cannot separate because they are interlocked.

Any force which a ε-particle in a lattice exerted on another in the space on the outside would be almost exactly balanced by the force emanating from its neighbour. The lattice would therefore be largely immune from forces which originate from the rotational spin of external ε-particles. It would in effect be neutral electromagnetically. The one property that remains is all the ‘stuff’ of which ε-particles are made, which we have excluded as a cause of forces acting at a distance.

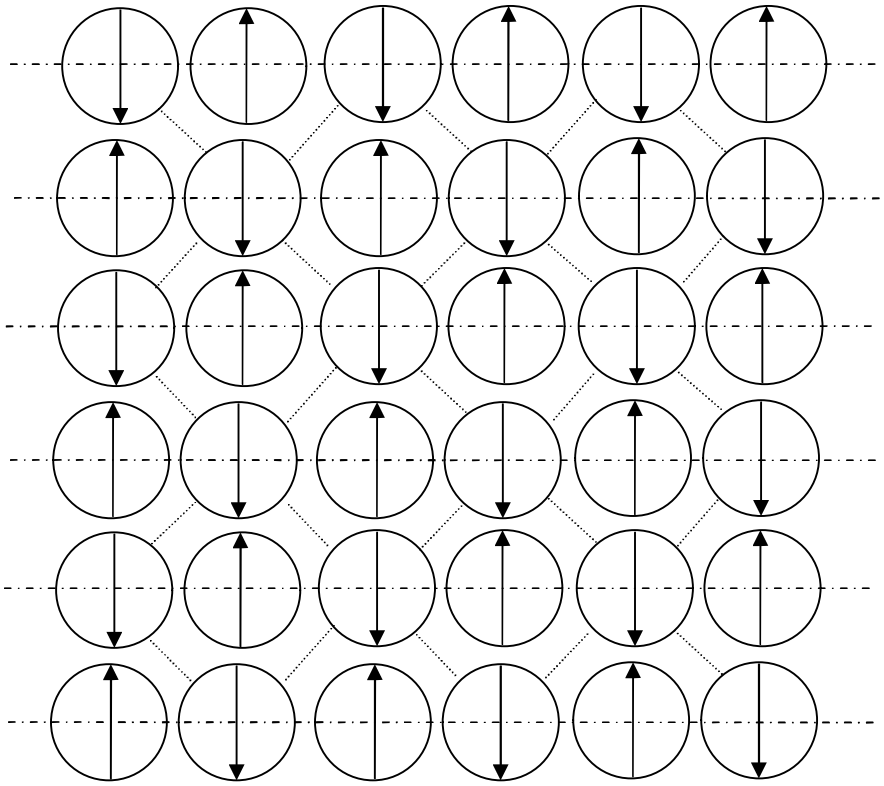

Figure 3. Lattice of paired ε-particles with axes of rotational spin aligned and alternate directions of particle spin forming two interlocking networks in 3D (links of one shown)

Such an array provides a working model for building protons, atoms and bodies, and forms a basis for the generation of gravitational, electric and magnetic forces.

G. The proton

A three-dimensional lattice built on statistical coincidences could in principle grow indefinitely, but at some point the extremities of the cube become more difficult to sustain in any environment with the available interactions, and the structure adopts the usual 'ergonomic' form, which is a sphere. All the problems of fitting a cube into spherical form come into play, and because the ε-particles remain coupled in pairs, the structure is always under even greater strain. Moreover, the centre of the sphere can never be forced into paired configuration, so that it must contain a single, unpaired ε-particle. The properties of this ε-particle are exactly the same as those of any other ε-particle, and its spinning on its axis attracts any other uncoupled ε-particles of the same spin, which is

what the analysis was seeking. However, it is constrained physically by its neighbouring ε-particles in the array.

A proton constructed along these lines would be more complicated than a sphere with an active centre. The opposite spins of the ε-particles surrounding the central ε-particle would differentiate its various clock orientations as follows.

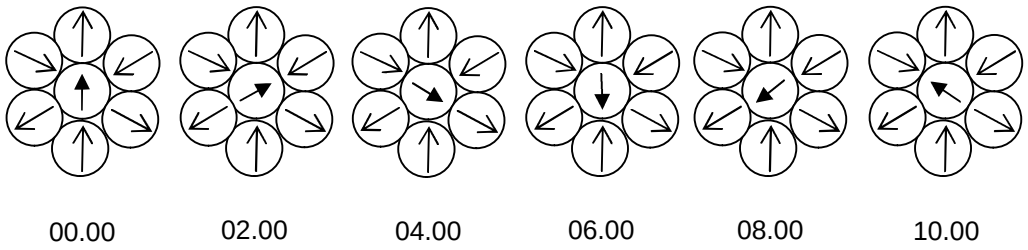

Figure 4 Two dimensional representation of possible spins of the central ε-particle with respect to its immediate neighbours

In three positions, 00.00, 04.00 and 08.00, the spin of the central ε-particle is in the same direction as that of two of its neighbours. In the other three positions it has opposing ε-particle spins ahead and behind it, and the other ε-particles would have spins balanced on either side (Figure 4).

In three dimensions it would be still more complicated. There would be six positions in line and six non-aligned on a spherical surface. This would give a spatially differentiated response to forces arising from an external unpaired ε-particle, but there would always be components of three of the six points available to interact. In addition the differentiation of structure might lead to relative physical weaknesses in the structure of the proton e.g. on impact.

The growth process provides a rational basis for the proton's mass of 1836 times that of the ε-particle; it would comprise the appropriate number of pairs of ε-particles plus one, the unpaired one at the centre. If we use the quoted relative masses of the electron and the proton, integral numbers of ε-particles could not account for the entire mass of the proton, which they must, because the ε-particle is indivisible by definition. However, the discrepancy could be accounted for by the method of measuring particle masses, which is very precise but relative since it is ultimately electromagnetic.

The generation of forces depends on orientations of directions of spin, but as stated above, these differences would disappear if the axes of the particles were free to rotate. The above analysis shows that the ε-particle at the centre of the proton is physically constrained by the matrix in which it is embedded, and that its axis of rotation and its direction of spin are set by the matrix in the absence of external forces. This, however, still allows effective rotation of the axis if the whole matrix rotates. Rotation of a proton is much slower than that of a ε-particle because there is relatively much more 'stuff' in the proton. Newtonian angular momentum still applies to the proton.

H. The extranuclear neutron

It would not be possible for another ε-particle to enter the proton, even though the structure must contain 'cracks and spaces' where the spherical trigonometry stretches the interactions between ε-particles inside the proton. In fact the further from the centre of the proton, the more the cracks would show. However, even if the extra ε-particle could not find a permanent position within the structure, it would still be attracted by the spin of the unpaired ε-particle at the centre of the proton, and it could still enter into close association with it to provide a sort of pairing by orbiting around the surface. It would orbit much faster than a proton could rotate because it contains much less 'stuff' than a proton.

The coupled particles would in effect form a neutron that has been liberated from the constraints of a nucleus, which would enable it to be 'seen' rather than deduced. The free neutron would decompose after a few minutes in space at low pressures into a proton and a ε-particle, as the lone ε-particle lost its attachment and separated completely. The half-life of a free neutron at NTP has been quoted at about 10 minutes.

This model of the interaction of the extranuclear electron with the proton is part way to the formation of an atomic nucleus.

I. Inside the nucleus

The analysis suggests a form for the nucleus which is different from that normally envisaged, because the introduction of intranuclear electrons invalidates the concept that it is composed of protons and neutrons. The nucleus is now seen as an assembly of protons which are bound together by electrons equal in number to the number of 'neutrons' which the nucleus is currently supposed to contain. These intranuclear electrons orbit at great speed around and between the protons in close proximity. They pull the protons together faster than they can fly apart under the influence of their mutual repulsion, so that they remain at equilibrium distances from each other (op. cit.).

This is directly consistent with the concept of the ε-particle. The protons are spherical structures containing an unpaired ε-particle with its axis and direction of rotational spin constrained. The ε-particles are drawn to the protons because they seek, but are unable to attain pairing with their lone, central ε-particles, which is the description of the neutron given above. Protons spin, and ε-particles orbit around them. They move much faster than

protons, because they do not contain as much 'stuff' as protons. Newtonian mechanics applies even though we have stripped mass of its associated forces acting at a distance.

Building up nuclei is a statistical process of forcing together protons and ε-particles under pressure in much the same way as it is suggested protons are formed. Larger nuclei are made by additions to smaller nuclei. This is statistically less and less likely to occur, and so the proportion of larger nuclei is smaller.

J. The atom

The next stage in building up materials is the atom. The nucleus forms an entity which is stable with a smaller number of intranuclear ε-particles than there are protons to match them. The processes at work within the nucleus prevent additional ε-particles from entering the nucleus, because they would be surplus to the stable number. However, ε-particles are still attracted by the nucleus, and so they orbit at a distance i.e. they are the equivalent of orbital electrons. The order in which this happens has been discussed in a previous paper (5).

The nucleus itself spins at high velocity, which causes continual and rapid reorientation of the ε-particles which it contains. The interaction of nuclear ε-particles with the orbital ε-particles keeps them in orbits as far apart from each other as possible, while being drawn to the nucleus.

K. Transmission of forces through space

It is the convention to accept without comment that forces are transmitted through space. The phenomenon is quantified by describing them as fields, a term invented by Faraday to help analysis, but with no explanation of how forces actually reach from one place to another. So we have electric fields, magnetic fields and gravitational fields, but no mechanism for transferring forces from electric charges, magnetic poles or masses to other electric charges, magnetic poles or masses respectively. It just happens. Faraday did not believe this; he thought that the electric field put the space between the plates of a capacitor under tension. Newton too thought that it would be nonsense to believe that there was nothing between the Sun and the planets to keep them in orbit; he just said that he did not know what it was.

The model of ε-particles spinning on their axes offers an explanation. The above analysis shows why particles with spins in the same direction attract each other and particles with spins in opposite directions repel. The same concept can be extended to the medium of space. A previous paper proposes that the medium of space is composed of microgranules which are much smaller than the smallest particle of matter, in this case ε-particles, because they permeate freely between these particles in nuclei without inherent bias (op. cit.). If there is any kind of orientation in the structures, it is because of the influence of the properties of particles of matter, not the inability of the microgranules to penetrate into confined spaces because they are too big.

It follows that the space between spinning ε-particles is filled totally with microgranules which are also capable of rotation on their axes. It is proposed that interaction of a spinning ε-particle with microgranules causes these too to spin in the same direction. Successive adjacent microgranules would adopt similar directions of spin with their axes in line with that of the ε-particle. Such an arrangement allows induction between spinning microgranules, in the same way that electromagnetic induction is observed between conductors.

If the second ε-particle is rotating in the same sense as the first, the process of induction is reinforced and a force of attraction is set up along the chain which pulls the two ε-particles together. This would be a kind of resonance, as the second ε-particle returned the induction by the same mechanism. It is a two-way effect (Figure 5).

If, however, the second ε-particle is rotating in the opposite sense to the first, the induction effect is repulsed in a form of dissonance, and the ε-particles are pushed apart (Figure 6).

If the ε-particles were rotating in directions perpendicular to each other, there would be no interaction and so no force between them (Figure 7).

The result is a direct analogy of the forces of attraction and repulsion between electric charges. The force decreases with increasing distance between particles because the orientations become diffuse and spread out. Since this spreading occurs across an area at any particular distance, the force decreases according to an inverse square law with the distance between ε-particles.

However, there is another piece of information which is transmitted by this mechanism: the direction of spin. The second ε-particle would recognise the direction of spin of the first particle, which is perpendicular to the axis of spin and therefore perpendicular to the force of attraction between the two ε-particles. This is the analogue of the magnetic field

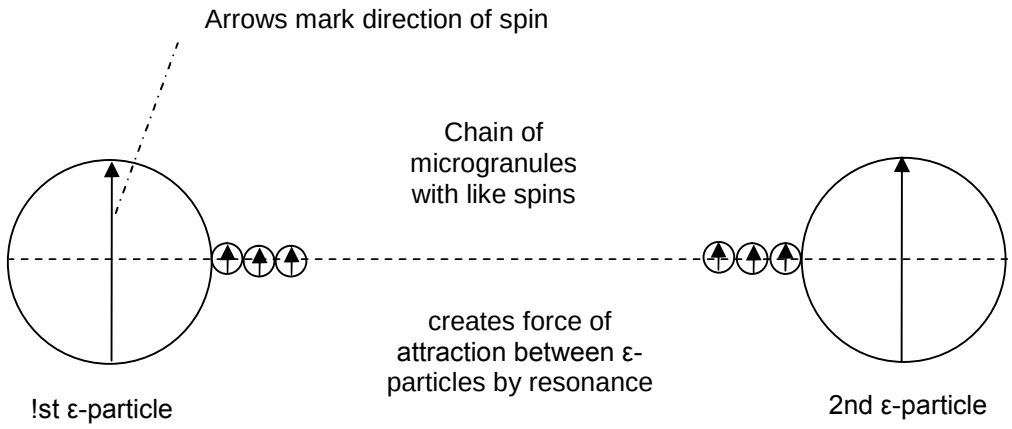

Figure 5. Force of attraction through the medium of space created by ε-particles rotating in the same direction

which is perpendicular to the electric field in conventional analysis in the process of magnetic induction.

The direction of spin induced in microgranules must be the same as that of the ε-particle which initiates the induction because there is no energy involved, and there is no mechanism for the storage of energy in space. This is unlike induction in transformers, which involves a build up of energy in a material structure.

This analysis is consistent with the RED model proposed for electromagnetic radiation (op. cit.). In the RED model microgranules become oriented not by the spin of a ε-particle but by its linear acceleration through the medium of space, which results in the orientation of microgranules in a circle. This rotation is ejected into space and travels away at the speed of light. There is no suggestion that microgranules themselves actually travel through space, but rather that their orientation is transmitted to successive microgranules by a process of electromagnetic induction. Since the ε-particle may be travelling through the medium of space in either of two directions when it accelerates along a bond, the orientation which it generates may be of two sorts: clockwise or anticlockwise. If REDs decrease in frequency on travelling through the medium of space, it is not because they are losing energy into some kind of sink, but because they are generating a secondary RED by electromagnetic induction. By the arguments given above this secondary RED must then rotate in the same direction as the primary RED.

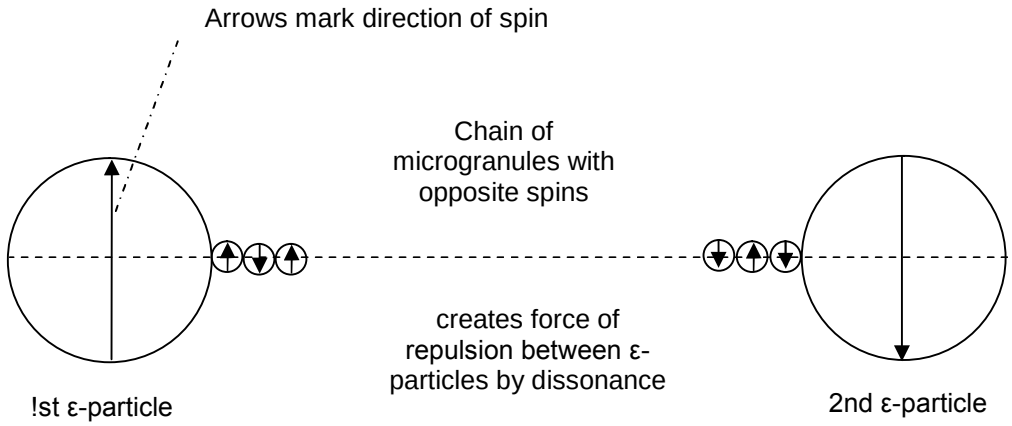

Figure 6. Force of repulsion through the medium of space created by ε-particles rotating in opposite directions

One caution is that the diagrammatic representations of microgranules should not be taken literally, or the result would in effect depend on their 'diameter'. The interpretation should be that the rotational axes of the ε-particles find pathways. In addition, since the orientations of microgranules are caused by ε-particles that are continuously spinning, any changes in the forces which they transmit because of changing location of ε-particles

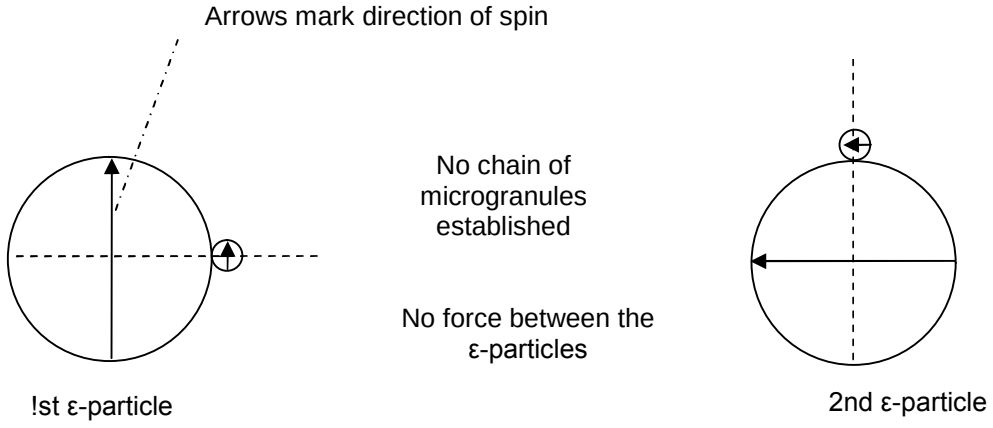

Figure 7. ε-particles rotating on axes perpendicular to each other do not interact

would also travel through the medium of space at the speed of light. Anything else would cause anomalies.

L. Gravity

The Universe must be isotropic. There is no external yardstick against which to measure its deviation from the norm i.e. the Universe can have no degree of freedom, because it is the whole system. Any heterogeneity which develops is local and must be compensated for elsewhere. The spin of ε-particles is therefore the same in any direction, and since all ε-particles spin at the same rate, the number of ε-particles spinning in any direction is the same as the number spinning in the opposite direction. The average spin of ε-particles must therefore be zero, taking account of opposite spins.

In this model the forces between bodies depend on the spin of ε-particles, and so it might be expected that the distribution of bodies would be even. However, matter is clumped together in space as far as the 'eye' can see, which today is very far indeed. The explanation is gravitational attraction. Thus if all forces are caused by the rotation of ε-particles, there is an apparent inconsistency between an isotropic Universe and the aggregation of matter into galaxies and stars.

Gravity is the observed force of attraction between bodies. It is not normally used to describe forces between particles because these are observed by electric or magnetic detectors. It cannot be a property of bodies as such in this model, or gravitational attraction with this mechanism of spin could be reversible by inverting a body, which is nonsense. Gravity must be a property of the components of which bodies are made.

Gravitational attraction has a structural cause if the model is valid, because there is nothing else. This structure must therefore be located in atoms, nuclei or nucleons, which in this model are all protons. It stops at that level because ε-particles cannot be differentiated in structure by definition; they are identical. At the first of these levels, it is difficult to see how atoms as such could be biased on a large scale, because there is enough mobility in orbital electrons to rectify any irregularity.

This narrows the focus to nuclei and protons. Nuclei are sintered together, and so there is a possibility of bias there, but the obvious source of bias is the proton. The previous analysis suggested that there are certainly asymmetries in protons, if they are composed from ε-particles under pressure.

Any differentiation of structure must in some way present a surplus of like ε-particle spins to other bodies with like ε-particles spins if they are to form a permanent attraction to each other. This surplus must operate even when bodies are rotating and moving. The 'surplus' must therefore provide some kind of gravitational skin. Not much bias is necessary, because only one part in 1837 is sufficient i.e. the ratio of ε-particle to proton.

It is proposed that in fact the structure of the proton is sufficient to provide the origin of gravitational attraction. It has been shown that there are six points or directions in which ε-particle spins are in line in the proton. These might be called lines of reinforcement. There are another six directions in which spins are not in line, and in which there is no reinforcement. Any external ε-particle with the same spin will form an alignment with the three of lines of reinforcement facing it to form a force of attraction by adding the vectors. This applies whatever the orientation of the bodies and whether or not they rotate. The other three lines of reinforcement on the other side of the sphere will give the opposite effect i.e. repulsion, but they are further away from the external ε-particle by definition (by the diameter of the proton!), and so they will have less effect. The net force is attraction.

The result is that all protons will always attract all other protons in all bodies, which is what we need to describe gravitational attraction. In fact the force generated between ε-particles of like spin is perpendicular to the direction of spin, so that the interaction is between lines of ε-particles with like spin formed up in line abreast. It might even be planes of ε-particles facing each other in a three dimensional analysis. However, that only serves to complicate the analysis at this stage, and the overall result is the same. There is no reason, therefore, to look further than this mechanism for the source of the Universal force of gravitational attraction.

Gravitational attraction between bodies is a one way effect which obeys an inverse square law and has no cut-off distance. This is unsustainable in an isotropic Universe; there must be feedback to keep the system in operation. In fact there are two feedback systems. The first reduces the structure of bodies, atoms and nuclei to the ε-particles from which they originated by collision in the environment of stars. This would result in a form of perfect gas with stochastically oriented axes, which removes the order formed in the process of synthesis. The second redistributes the ε-particles of the gas through space by explosion, so that the processes of aggregation, star formation and nuclear synthesis can begin again. This is the repulsive force which balances the agglomeration caused by gravitational attraction. The overall result is then a Universe in dynamic equilibrium with a small, constant proportion of metallic nuclei amid a lot of hydrogen, punctuated by explosions which throw material into space. This is a process of stochastic regeneration and distribution at the most fundamental level.

Astronomy may provide the test by observation of the clouds of gases which fill large volumes of space. There are two possible mechanisms which could be the origin of such clouds: either there is some engine which is pumping out the gas, and we see what remains locally, like steam pouring out of a chimney; or gas gathers because of gravitational attraction. If gravitational attraction can be proved for molecular hydrogen, the source of attraction must be contained within the molecular hydrogen structure. If it can also be proved for atomic hydrogen, the source of attraction must be contained within the atomic hydrogen structure, but if not, it would be a feature of the molecule. If however clouds of hydrogen ions could be detected, and if it were shown that these were formed by gravitational attraction, this would confirm that the source of gravity lay with the hydrogen ion i.e. the proton.

This is difficult to simulate in the laboratory, because the generation of protons, their control and their observation with detectors all introduce external factors which introduce order where there would otherwise be none.

In the model of this paper, bodies are built up from successive layers of ε-particles around the centre of a proton. The first level of aggregation is the proton itself, which is stable enough to survive in its own right and has its own asymmetries because it is a composite. The second level is the nucleus in which a number of protons are bound together by free ε-particles which try to pair with the ε-particle at the centres of protons, while avoiding each other. The neutron, which tries to add a further ε-particle to a proton, is merely a short term, extranuclear association in free space. The third level is therefore the atom where more free ε-particles are attracted to pair with the protons in the nucleus but find no room and are driven apart by each other, so that they remain in orbit. Molecules are combinations of atoms which are bound together by sharing of ε-particles in orbits. The final level is the combination of many billions of atoms and molecules into bodies, which is where we directly observe the force of gravitational attraction.

Each proton in a body interacts with protons in another body, so as to form two-way links. The corollary is that if the number of protons in the one is *m* and the number of protons in the other is *n*, then the force between the bodies is proportional to *mn* i.e. their product. The result is that all bodies are always gravitationally attracted to all others, but the attraction between any two bodies is proportional to their proton content i.e. one body to one body. Furthermore, this one-to-one attraction is not influenced by other bodies. These are all consistent with Newton's equation for gravitational attraction.

M. Mass

Newton used the term mass as a constant of proportionality to derive his definitions of force, starting with gravity and extending the concept to inertia. The one led to his Law of Universal Gravitation and the other to his Second Law of Motion. We decided at the beginning of this analysis not to invoke mass as a parameter but treat it as 'stuff', in order to unravel the basic assumptions. This means abandoning the term 'mass' to separate out the different effects.

A ε-particle of stuff would travel in a straight line at a constant velocity unless a force deflected it. Since all ε-particles are identical, the force required to accelerate a body composed of ε-particles of stuff would be proportional to the number of ε-particles which it contained, and the momentum of ε-particles would be conserved if they collided. This is the mechanics side of the Newtonian definitions. One might go further and say that the amount of 'stuff' in the Universe is the number of ε-particles which it contained multiplied by the amount of 'stuff' which a single ε-particle represents.

Forces which act between two particles at a distance from each other are different in kind. All ε-particles are always spinning on their axes, and at the same rate, which is what generates forces between them. These forces, therefore, cannot be turned off. The result is

that no ε-particle is ever immune from the forces generated by its interactions with other ε-particles in different locations. When it changes location itself, all these forces have to realign, and so it never travels in a straight line.

If two approaching ε-particles have opposite spins, they repel each other. The closer they get, the greater the force of repulsion, and so they never collide. The effect may seem to be like the collision of billiard balls, because they move off in opposite directions, but they never touch and no energy is lost. In fact their trajectories are probably hyperbolas, much as Rutherford seems to have found in the experiment which first proved the existence of the nucleus.

If two approaching ε-particles have the same spin, they attract and accelerate towards each other, but they do not collide in the sense of touching, which is another way of saying that they have no friction. If their momentum is sufficient, they simply deflect each other's trajectories, so that they swing around each other and go their separate ways. If their trajectories bring them close enough, and if their momentum is not sufficient for them to separate, they go into orbit around each other to form a binary pair. This pair would be undetectable by gravitational, electric or magnetic means because their opposite spins in effect neutralise their effects.

All the forces associated with ε-particles which are separated by distance are derived from their spin. The forces which affect the larger particles which are composed of them are derived from the ε-particles which they contain. It is their spin which gives rise to the analogues of electric, magnetic and gravitational forces. If a ε-particle did not spin, it would be unable to influence other ε-particles at a distance, whether they were spinning or not, because it would not stimulate the microgranules of the medium of space by induction.

Conflicts between the Newtonian definitions of gravitational and inertial forces were there from the beginning. It was reasonable to characterise the phenomenon of gravitational forces by observation of falling weights, and it was equally reasonable to define force by the rate of change of momentum. The link between the two was the concept of mass which he invented. But Newton's analysis did not account for the force of attraction of one body to another body on which it rests i.e. its weight when there is no movement at all, and it did not explain the fact that the force of gravitational attraction between masses was obviously not infinite when the distance which separated them was zero.

The model of rotating ε-particles developed in this analysis suggests answers to both questions. The force of attraction of one body to another body, say the Earth, depends in this analysis on all the protons in each body trying to pair with all the protons in the other body, as well as all those within itself. This force is the same whether the body is just out of contact with the Earth or whether it is resting on the Earth. If it rests on the Earth it will be just that much closer, but negligibly so. It comes to rest because all the orbital ε-particles at the surface of the body repel all the orbital ε-particles at the surface of the Earth with a force that increases as distance decreases when the body sinks to Earth, until

eventually they balance, just like bedsprings. This is the force of restitution, that is determined by the ε-particle structure of the body. The result is an apparently zero distance of separation, which accounts for the value of inertial mass at rest.

The product *mn* in the previous section then translates directly from the new model into Newton's Law of Universal Gravitation which states that the force of gravitational attraction between two bodies is the product of their masses. By the previous analysis of proton structure, the gravitational attraction between two bodies is the product of the number of protons in each. Protons represent virtually all of what is considered to be mass in classical physics, because by previous analysis neutrons are also in fact protons, and the mass of electrons is negligible by comparison. Thus the number of protons in a body represents almost all the 'stuff' which constitutes its 'mass'. The product of the numbers of protons is almost equivalent to the product of their masses, as in Newton's equation.

In similar vein the new model explains the mechanism by which force equates to the rate of change of momentum by the following reasoning. The Second Law of Motion states that force is proportional to mass and acceleration, or alternatively that mass is proportional to the acceleration of a body which a force produces. You cannot detect a force, except by producing it with another force which you already know (action and reaction), and you cannot detect an inertial mass except by applying a force and observing acceleration. This circularity is inherent in the definitions. However, you can detect the momentum of a body, and so its rate of change, by catching it or firing it at a target etc. When the body hits the target, it rapidly comes to rest because the ε-particles at its surface are repelled by the ε-particles at the surface of the target. This is just like bedsprings again, except that the purpose is to see how good the springs are in compression.

Thus the ε-particle model suggests a fundamental difference between inertial forces and gravity. It is the amount of 'stuff' in a body which obeys Newton's Laws of Motion. The amount of 'stuff' is simply the number of ε-particles which the body contains. The gravitational force between two bodies is proportional to the number of protons which they contain. Protons are composed of ε-particles, but there are also intranuclear and orbital ε-particles in atoms and molecules, and so protons do not contain all the 'stuff' in a body. Thus Newton's term 'mass' has two meanings, one gravitational and one inertial. These have identical values for bodies, which are aggregates of very large numbers of complete atoms and molecules, but there are differences for smaller particles when some of the ε-particles which normally accompany protons are removed. There may be a link here with discrepancies in the summation of mass, such as in 'mass defects'.

It usually works in practice because:

- The two values are not very different, say 1 in 1000 (ε-particle to proton).
- Gravitational forces are not easily measured with that kind of precision.
- Gravity is usually discounted as a force for small particles, where electric and magnetic forces are thought to apply. This is because electric and magnetic forces can be controlled.

- In the Laws of Motion forces are in effect defined by the parameter of mass in a circular argument, so there is no problem.
- The two values for a species of particle which has a well-defined number of ε-particles are not only close but always in the same proportion.

The 'bedspring' argument does not work for deflection by fields because there are no impacts, or at least what is measured is the deflection, not the damage. Newtonian mechanics is still in operation because the particles which are deflected are composed of 'stuff', whatever the origin of the forces acting on them. It is possible that deflections of an electron by a positron may yield information about the effect of spin on the basic particle of 'stuff', assuming that the relationship which connects deflection and mass are valid. However, nuclei may be more complicated, because NMR shows that protons may react differently according to their magnetic environment.

Nevertheless, both gravitational and inertial forces are accommodated in the same model. The same fundamental mechanism of attraction and repulsion of spinning ε-particles applies to gravity as to electric and magnetic forces, which is just as well for Newtonian mechanics, or alternatively, for electromagnetism. The corollary is that all the forces of nature, the strong nuclear, the electroweak, the electromagnetic and gravity, are caused by the same mechanism at the level of fundamental particles, which also suggests that there is only one basic particle, the one which is made of 'stuff' and has electromagnetic spin properties, the ε-particle.

There is one final twist to the argument. When an electron and a positron collide, they are said to disappear in a puff of electromagnetic radiation. Their mass is said to be converted into two high-energy photons, which disappear off in opposite directions. This is a mechanism for destroying matter, because electrons and positrons are particles of 'stuff' which are identical except for their opposite electric charges or spins. Destruction of matter is not a problem for adherents of the theory of relativity, because it can always be recreated from energy elsewhere, but explanation is required if energy and mass are not considered to be interchangeable, and if the Universe is infinite in time and space, which is the model proposed here.

The present analysis suggests a different outcome from the collision. Two ε-particles of opposite spins on a collision course would accelerate together because of their mutual attraction, and produce two equal and opposite particles of light as a result, which would dissipate the acceleration. But there is no question of their 'stuff' disappearing, or that the particles would somehow evaporate. They would stick close together as ε-particles in close orbit to form a binary system, so that the forces to which they give rise as individuals would be neutralised, much as the effects of the paired ε-particles in a proton are neutralised. They would retain their Newtonian mechanical properties, but they would simply be invisible because of their proximity and their opposing spins i.e. they would not interact gravitationally, electrically or magnetically with external detectors.

Of course it could be argued that ε-particles locked together in this way are no longer capable of producing some of the interactions which are attributed to mass, and so the

property of mass has indeed been converted to energy in the form of particles of light, but that is not how Einstein's equation is interpreted. Conventional physics states that the actual 'stuff' has disappeared, which has quite different implications.

A mechanism for locking together ε-particles in this way throughout the Universe would in the infinity of time reduce it all to particles of essentially non-interacting or inert 'stuff'. Since this has not happened, there must be a compensating process at work which breaks up the pairing, or perhaps uses it to make protons. This would presumably happen through physical collision, perhaps in a star somewhere i.e. a process of redistribution and regeneration.

N. Energy

The spin of bodies having the property of mass requires energy in Newtonian mechanics. However, this property has been qualified in the present analysis, and so some explanation is needed of how it relates to the concept of ε-particles and the transmission of forces through space. There are two components in the model: microgranules and ε-particles.

Microgranules interact with each other by a process of perfect electromagnetic induction. The sum of all the spins of microgranules in the Universe is zero i.e. the medium of space is isotropic, because spin which is induced in one microgranule is exactly and simultaneously matched by the opposite spin in those that performed the induction. The process is perfect because nothing is lost. Alternatively you might say in conventional physics that microgranules have no mass.

The argument for ε-particles is different because they are made of 'stuff', and so obey Newton's laws of mechanics i.e. momentum, impact force, kinetic energy etc. However, maintaining the spin of a ε-particle requires no energy, and its direction can be changed only by the spins of other ε-particles in equal and opposite interactions, which means again that nothing is lost. The reasoning is as follows.

- All ε-particles in the Universe are spinning on their axes.
- They all spin at the same constant rate which cannot be increased or reduced.
- Spin cannot be mechanically transferred from one ε-particle to another because they have no friction.
- The axis of spin can assume any orientation.
- Actual orientation is determined by interacting with all other ε-particles.
- The effect of any single ε-particle on another diminishes with the square of the distance between them.

- Spins of ε-particles in the same direction tend to attract, spins in opposite tend to repel.

- Spins of ε-particles on axes which are perpendicular to each other do not interact.

- Spinning ε-particles may be considered to have rotational energy because they are made of 'stuff', but this would not be meaningful because this energy cannot be detected or exchanged; energy is measured only by difference.

- The sum of all spins of ε-particles in the Universe is zero, because the spin of every ε-particle is cancelled out by the opposite spins of others. So the Universe of ε-particle spin is isotropic.

- Thus the entire Universe is isotropic.

- The corollary is that the number of ε-particles in the Universe is fixed.

- There is no consumption of energy in these phenomena because they result from perfect electromagnetic induction without losses.

The properties of microgranules and ε-particles are listed in the Appendix.

The attraction of spins which are the same tends to be self-reinforcing because it diminishes the distance between particles, which increases the force of attraction. If particles move apart, the force of repulsion decreases. The overall result is that everything tends to gravitate together, which is what is observed. The absence of friction explains why fundamental particles never seem to stick to one another; they slide into orbit and form binary pairs, because they have nothing to which they could adhere.

The absence of energy from ε-particle rotation and its transmission through the microgranules of the medium of space are consistent with observation. No energy is required for one body to experience gravitational attraction to every other body in the Universe, as Newton's equation requires. Thus no expenditure of energy is required for the Earth to orbit the Sun. Gravitational attraction changes from potential energy to actual energy only when the body falls. Similarly an electric charge repels every other like charge without the expenditure of energy, and a compass needle does not require an input of energy to maintain its force of magnetic attraction.

The fact that microgranular reorientation requires no energy is also substantiated by the transmission of electromagnetic radiation *in vacuo*. Light loses no energy in the processes of successive orientation of microgranules during its travel through the medium of space. Energy was required to accelerate particles enough to form REDs in the first place, but not to maintain them thereafter. If a RED appears to lose energy as it travels through

space, it is because it is generating a secondary RED by the process of electromagnetic induction. The total energy of the pair is unchanged.

In a wider context, it is the same process which allows electrons perpetually to orbit the nucleus of an atom without the loss of energy predicted by classical physics. The electrons and the nucleus interact by perfect electromagnetic induction, as each movement of one is exactly compensated for by a movement in the other, so that nothing is lost and the electron can orbit for ever. Energy is not involved until an electron accelerates out of its orbit and leads to emission of a RED. It was this misconception about the loss of energy that led physicists to reject a solar-system model for the atom, and diverted attention into the mysteries of Bohr orbits, quantum levels etc.

O. Orders of magnitude of forces

A very rough comparison of the relative strengths of forces can be made by comparison of distances using the force of attraction between ε-particles as the yardstick. The diameters of the atom and the nucleus are of the order of 10^{-10}m and 10^{-15}m respectively. The diameter of a proton in, say, the carbon atom is not likely to be more than a tenth of that of the nucleus, say 10^{-16}m.

The diameter of a ε-particle is likely to be much less than a tenth of that of a proton, say. 10^{-17}m from the ratio of the mass of the electron to that of the proton by conventional measurement, assuming they are made of the same 'stuff'. It may even be considered to be a 'point' according to some estimates. Thus the distance between two ε-particles spinning in close proximity may be, say, 10^{-18}m. The force between them can then be assumed to be inversely proportional to the square of the distance between them, which is 10^{-36}m^2.

Distance between ε-particles	Distance (metres)	Square of distance (metres)^2	Force proportional to inverse of square of distance	Ratio of forces
in the same proton	10^{-18}	10^{-36}	10^{36}	1
in an adjacent proton in the same nucleus	10^{-15}	10^{-30}	10^{30}	10^{-6}
in a proton and an atomic orbit	10^{-10}	10^{-20}	10^{20}	10^{-16}
in a proton and in another body	1	1	1	10^{-36}

The relative forces for this specific interaction at greater distances can then be estimated from the inverse of the squares of these distances in the same way. This approximation ignores any interactions which may be taking place. For the weakest force the distance

between ε-particles may be taken as one metre, as an order of magnitude. The relative forces are then as in the table.

These ratios seem to give the right order of magnitudes for decrease of force from the nucleus to the much smaller forces involving orbital electrons in the atom and the weakest of all between macroscopic bodies, which we know as gravity.

Comparison of these results with the four fundamental forces i.e. nuclear strong, electroweak, electromagnetic and gravity is difficult because they describe different things. Moreover, the standard model does not deal with gravity.

P. Our local environment

The model presented here depends on the orientations of particle axes, their resistance to change and the interaction of their spins. Particle axes do not have to be perfectly aligned to have an effect, but this will be diminished in proportion to the decrease of overlapping areas, which can be calculated trigonometrically. However, there ought to be exactly equal amounts of opposing spin, so that the Universe itself does not have an inherent bias. Or alternatively, there ought to be as many positrons as electrons if the Universe is neutral in terms of electric charge. But every atom in the Universe is surrounded by a cloud of electrons not positrons, at least as far as we can determine. So the question is: where have all the positrons gone? According to the above analysis most of them are in fact bound up in protons and what we still call neutrons, in equal number to the electrons with which they are paired. However, there remains the fact that the free particles with which we are familiar are almost exclusively electrons, the particles to which we attribute a negative charge.

There are a number of questions along the same lines. For example, it is not difficult to see how electrons flowing in a conductor could have co-ordinated spins which result in magnetic fields, but why do different conductors on different occasions always produce the same direction of magnetic field? Why do they always apparently choose the same one of two options? In terms of spinning ε-particles, the particles must on average have their axes aligned perpendicular to the direction of flow, or else the forces which they produce at a distance would be self-cancelling. (Incidentally, the other implication of this model is that the dimensions of conductors may change when they carry electricity because of the force which the spinning of ε-particles generates.)

But to return to the point, why do they always spin in the same direction? They do not simply travel from end to end of the conductor; their overall effect might travel straight and fast, but the particles themselves in spite of being ‘free’, move much more slowly because they become involved in entanglements along the way with the orbital electrons of the atoms which maintain the structure. Does that mean that these too have a similar orientation and direction of spin under the influence of electromotive force? This would be compatible with the phenomenon of magnetising an iron rod with a coil carrying

electric current, and with demagnetisation by physically striking it. The Universe may be much more ordered at the fundamental level than we thought.

There is, of course, an overarching magnetic orientation within which we all live on Earth: namely, the Earth's magnetic field. In the scheme developed here, this is also a predominant direction of spin, the opposite of what we on the surface of the Earth experience, according to the principle that opposite magnetic poles attract. The Earth's magnetic field determines a sort of default position against which all other matter aligns itself. This would account for the predominance of a particular direction of spin, and it would also provide a mechanism by which the Earth's magnetic field occasionally reverses. There is no reason to think that such reversals, which have occurred frequently over geological time, have involved large scale bulk movement of magnetic material. However, changes of spin once initiated could occur very rapidly and would involve no expenditure of energy, as described above. On the other hand energy would certainly be required to start the process.

This only leads to further questions: how do atoms transmit spin on this scale, and what caused spin in the first place? What on Earth happened, quite literally, and when? Was it caused by the Sun, and if so, why do not all planets show the same effect? Geologists suggest that reversal of the magnetic field is likely to happen again quite soon.

The corollary of this would be that you should take your own magnetic orientation with you, if you are thinking of leaving the Earth's magnetic influence and venturing out into deep space. This might extend much further than you think, because it can really be detected only by difference, which might account for some of the hazards of space travel. On the largest scale of all, could it be ε-particle spin that holds galaxies together in a coherent state?

Q. Conclusions.

It is certainly a particulate Universe; bodies are composed of particles which are themselves composed of particles, and so on down to the ultimate particle. There must be an ultimate particle by definition, but the question is: at what level? There is no place for a continuum either physically or by mathematical implication. Of what would the continuum be composed?

The analysis of this paper has reduced the number of fundamental particulate entities to just two species: ε-particles, which are made of 'stuff', whatever that may be, and microgranules, which are infinitely smaller and comprise the medium of space that fills the rest of the Universe. Microgranules are not usually considered to be 'particles' at all since, as far as we are concerned, they lack substance. Nevertheless the arguments for a 'particulate' medium of space are compelling, because it is the only mechanism of change. More tangible are particles of 'stuff'. It is 'stuff' which obeys Newton's laws of mechanics for momentum etc. According to this analysis, the interaction between 'particles' of the same species, and between particles of the two different species, is electromagnetic induction.

All the forces which hold ε-particles together, impinge on them and cause them to separate are generated by their spins on their axes and transmitted through the microgranules of the medium of space by electromagnetic induction. Since there is no limit to the distance over which these forces are transmitted, and they are always in operation and cannot be switched off, their maintenance requires no input of energy and so they are timeless. It is their changes which require energy, but this energy is associated with changes in the location of the ε-particles from which they emanate i.e. Newtonian forces, not with the realignment of the microgranules in the medium of space. However, realignment of microgranules by electromagnetic induction takes time to propagate from the point of a disturbance throughout the infinity of space. The rate of propagation is a property of the medium of space. Propagation is probably the right term, because it may imply a continuing connection between source and receptor; the forces are two-sided.

The generation of electromagnetic radiation is a different form of electromagnetic induction. Forces between ε-particles arise from their spin on their axes and proceed directly from particle to particle via microgranules. However, when ε-particles accelerate in a translational sense through space, this generates disturbances in the medium of space in the form of little 'whirlpools' of polarised microgranules, or rotating electromagnetic dipoles (REDs). The rate of rotation represents the energy associated with the conditions which generated the RED. When a RED is ejected into space, the 'whirlpool' progresses in a straight line at the speed of light because the polarisation of microgranules requires no energy, as described above. In this case the orientation is in a circle or in fact a helix, since it is progressing.

Microgranules themselves do not progress with the RED, but simply transmit their polarity to adjacent microgranules by electromagnetic induction, after which they return to the previous unorientated state of microgranules as determined by their environment, again by electromagnetic induction. This disconnects REDs from their source, and so they are free to travel as 'quanta' until they interact with receptors. If the microgranular environment through which they travel has some kind of orientation which is the result of the transmission of forces between other bodies e.g. gravity, it is possible to see how their paths might be deflected. As in the case of changes in forces described above, the rate at which these realignments occur is determined by the nature of the medium of space, and so they all travel through space at the same speed i.e. the speed of light.

No energy is lost by REDs as they travel through space, because the process of electromagnetic induction is perfect. If their frequency of rotation decreases in transit, it is because they generate secondary REDs in their turn by the same process of electromagnetic induction as they progress. Light 'particles' are not so much propagated as disseminated, because like seeds they lose contact with their source as soon as they are emitted. It is a one-sided process. A RED travels through the medium of space in a straight line until it engages in resonance with a structure of ε-particles and is absorbed, thus transferring the energy which it acquired at the source which created it. There is no other fundamental source of electromagnetic radiation in the model, because there are no particles of matter smaller than ε-particles.

Thus all forces acting at a distance travel through space at the speed of light, and are caused by electromagnetic induction between ε-particles with a like spin, a phenomenon which in nature consumes no energy. All ε-particles have the same amount of spin which is constant, but its direction is changed by electromagnetic induction, as described above. The corollary is that the number of ε-particles and the amount of spin in the Universe must be constant. They can neither be destroyed nor created, and so the amount of 'stuff' in the Universe is also constant. Since all bodies in the Universe are in ceaseless motion because of collisions and explosions, and no energy is lost in the interactions of the ε-particles of which they are composed, it follows that the sum of their momentum over the Universe as a whole must also be constant.

The mechanism of attraction of ε-particles with similar spins is consistent with the tendency of matter to agglomerate under the force of gravity. Like spins tend to pull the ε-particles together, and the closer they become, the greater the force. Opposite spins have the opposite result. They repel, and the further apart the ε-particles move, the less the effect. Thus the results of like spins are dominant in the model, as well as in the physical world which it represents; matter tends to agglomerate, hence stars.

The source of the constant attractive force of gravity between bodies is traced to the asymmetric structure of the proton, if its formation from paired ε-particles is valid. The model exploits the fact that the exact and opposite electric charges of the electron and the proton are most unlikely to be a coincidence. Much is already known about the responses of protons which may confirm the analysis. More still will be discovered from the high powered proton accelerator.

The conditions for forming the paired particles of opposite spin, and the protons and nuclei which are composed of them, are just those which exist in stars because the principal requirement is that the particles should be in extremely close proximity to one another, so that they become statistically more likely to combine by the mechanism described above. This is mainly a question of pressure, which is in effect another way of describing the density of moving particles in a perfect gas.

The other condition which accompanies high pressure in a star is high temperature, but this may not be helpful to forming ε-particle arrays. First, it is not obvious what high temperature means under these circumstances, because temperature is a thermodynamic parameter. It depends on the motion of atoms which are capable of transmitting movement to each other primarily through the interactions of their orbital electrons. Thus if electrons are not orbiting, there is no meaningful temperature. This argument about the thermodynamic nature of temperature can be understood by considering an element, say helium, at absolute zero thermodynamic temperature. No one expects the orbital electrons to cease to orbit or the atom to lose its form; the orbital electrons continue to separate the nuclei. Moreover, any enhanced movement of particles because of 'high temperature' would appear to work against the formation of structure rather than promote it. Nevertheless stars would still seem to be the most likely loci of this sort of particle-

building. The existence of opposing tendencies suggests that there might be an optimum combination of temperature and pressure for forming ε-particle arrays.

If this model is correct, it sheds a new light on cosmology. It has implications for astronomy in the formation of heavy elements in stars, because it proposes a statistical process of building nuclei from ε-particles. It is also relevant to collapsed stars, such as the neutron stars that have intense magnetic fields, which may imply free electrons. It could also throw some light on how some stars apparently change fundamental properties at extraordinarily fast rates. Particle spins would be one possibility, because in principle their reorientation requires no energy, though what triggered the change certainly would.

The implications for particle physics would be no less profound. Complete destruction of protons and other particles by collision would result only in ε-particles spinning one way or the other on their axes i.e. electrons or positrons. Incomplete destruction would give quantised bits of protons ranging from paired ε-particles and their aggregates to lumps containing odd numbers of ε-particles, which would be 'seen' as having electric charge and mass. However, significant amounts of 'stuff' might be invisible by electromagnetic means of detection until they unravelled, because they would be very short-lived at low pressures. The results of this sort of process of destruction might be determined by the differentiated forces of cohesion of the proton developed in the analysis.

Free or unrestrained ε-particles would respond to forces from bodies with unpaired ε-particles of opposite spin direction by moving away. This is in effect shielding of electric charge, which is a surface phenomenon. But the forces between all parts of bodies would be transmitted unimpeded through the microgranules of which they mainly consist. Thus the dielectrics of capacitors do not shield plates from the electric fields which permeate them, though there is modification, and such fields generate forces between the plates. Most obviously, there would be no shielding from gravitational attraction, because of the scale on which gravitational forces are observed. In fact there may be a case for reconsidering the implications of the macroscopic summation of gravitational effects as 'centres of gravity'.

In summary, the orthogonal model proposed here seems to have enough degrees of freedom to be consistent with a diverse range of physical behaviour. Electric charge and magnetic poles may be convenient shorthand for some very complicated processes as we observe them, but there is a level of analysis at which they do not suffice. In the same way, there is value in unravelling the different meanings of mass which are implied in Newton's equations.

The operation of the proposed system has the potential to account for all the physical complexity of nature without calling on mysterious conversions, but its foundation which is derived from observation and measurement is simplicity itself: a basic particle of 'stuff' spinning on its axis, a microgranular medium of space and their interaction by the well known process of electromagnetic induction.

Needless to say, there are implications for the Standard Model. The four fundamental forces, gravitation, electromagnetism, the strong nuclear force and the weak nuclear force are shown to derive from the same cause, a single species of spinning particle with electromagnetic properties. The different forces are simply observed on different scales with different 'detectors', if you can call a falling apple a detector. There is no need to postulate any species of particles smaller than ε-particles. Larger particles are quantised blocks of the ε-particles of which protons are composed.

The new model requires the reintroduction of the medium of space, what was formerly called the 'ether' until Einstein disposed of it a century ago, but this time in particulate form and with electromagnetic properties. A medium of space in this form is not only necessary to analysis but it simplifies explanation of many natural phenomena.

Finally, the model suggests that it may be appropriate to reappraise the structure of the atom itself. If the proton has the asymmetry described above, its interactions both with other protons and ε-particles orbiting around them inside nuclei become very complex, especially when all are spinning. The model provides a rational basis for the stability of metallic nuclei, but of course the complexity multiplies with each stage of growth. There are also the ε-particles which orbit the nucleus in the atom interacting with the nucleus and each other through the changing orientations of their axes of spin. A veritable field day for computing!

A moment's thought makes it obvious that the simple concept of electric charge represents something more fundamental. Electrons are identical particles of 'stuff' which can be fired like missiles, and they all have the same negative electric charge, so that they repel each other. But when electric currents, which are the movement of electrons, are passed in the same spatial direction through parallel conductors, the conductors experience a force of attraction to each other, not repulsion. Why? And if the direction of current in one conductor is reversed, how to explain why the conductors then repel each other? The electrons flowing in the reverse direction still have their negative charges, and so they ought to attract, judging from the first experiment. This can be described as generation of magnetic fields etc, but that simply restates the observation. Why does the orientation of magnetic fields depend on the direction of current flow?

What has changed relative to the two conductors must be some property of electrons. The only property available to identical spheres is rotational spin about their axes. Even if it is postulated that an electron has some kind of north and south poles, it is not clear why these should reverse with change of current direction or produce lateral forces. The only other property which spheres can have is spin about their axes. The direction of spin would certainly reverse if the axes were perpendicular to the direction of the current. The conclusion is that it is the direction of rotation of electrons about their axes which changes with the direction of current flow, which takes us back to the beginning again.

The experimental results, though not the reasoning, can be found in any textbook. The simplest physical observations can lead to new models if the argument is rigorously pursued. Reappraisal must begin at the most fundamental level, because most analyses

tend to start in the middle of other people's assumptions, derived in environments that may not be entirely apposite. Such a radically different model needs to be tested in the whole range of circumstances from particle accelerators to space, but it has the merit of simplicity as its foundation, and even the process of analysis sheds new light on many things. It also has considerable scope for development.

I recommend it for further evaluation.

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Attachments: References and Appendix

References

1. Neutrons in the Structure of Atomic Nuclei by A.C.Sturt 29 November 2006 www.churingapublishing.com/neutronp1.html.

2. The Nature of Light – A Uniform Theory of Rotating Electromagnetic Dipoles by A.C. Sturt 9 May 2003 www.churingapublishing.com/relite_1.htm.

3. Mass in the Universal Inertial Field – A Revised Version by A.C. Sturt 18 September 2003 www.churingapublishing.com/numass_1.htm.

4. Electric Charge in a Microgranular Medium of Space: Ultimate Components of the Universe? by A.C. Sturt 21 December 2004 www.churingapublishing.com/granul_1.htm.

5. An Electrodynamic Model of Atomic Structure by A.C. Sturt 3 October 2003 www.churingapublishing.com/dynamat_1.htm.

Appendix

Components of the Proposed Model of the Universe: Summary of Properties

The proposed model of the Universe contains two components: ε-particles, which are the single species of matter or 'stuff', and a medium of space consisting of microgranules, which have the property of being polarised electromagnetically. The ε-particles interact with each other through the medium of space. There is nothing else; all the Universe which is not 'stuff' is filled with microgranules. The properties of these particulate entities are as follows.

1. Microgranules of the medium of space (first component)

    - Microgranules are the entities of which the medium of space is composed.
    - They fill the whole Universe except for that occupied by 'stuff'.
    - They are what was formally called the 'ether' until the twentieth century, but with electromagnetic properties.
    - They are identical, so that they cannot introduce bias resulting from variable properties.
    - They are very much smaller than the smallest particle of 'stuff', so that their size is not an impediment to the movement of particles of 'stuff'.
    - Microgranules permeate between fundamental particles of matter, between fundamental particles in nucleons, between nucleons in atomic nuclei, between atoms in bodies and so between bodies.
    - Microgranules have no mass.
    - They do not change location except to slide around particles of 'stuff' which are in motion.
    - They are the medium within which the ε-particles exist.
    - They have an axis about which they rotate i.e. they spin.
    - They are induced electromagnetically to spin in the same direction as the adjacent ε-particle.
    - Their spin induces spin in the same direction in adjacent microgranules along the line of the axes of ε-particles.
    - ε-particles also spin, so that there is a common axis for ε-particles and the line of microgranules which connect them.
    - Forces of attraction and repulsion are transmitted through lines of microgranules between ε-particles along the common axis of spin.
    - The reorientation of the spins of microgranules requires no energy, so that there is no storage of energy in space.
    - A microgranular medium of space provides a mechanism for the reorientation of forces between bodies which are moving relative to each other.
    - Light also travels through space by the successive reorientation of microgranules.

- The rate of reorientation of microgranules therefore provides a cause of the constant velocity of light *in vacuo*.
- The corollary is that this must also be the rate at which changes in forces between ε-particles proceed: gravitational, electric and magnetic.

2. Particles of matter (second component)

The fundamental particle of matter is the ε-particle, which has two sets of properties, first as 'stuff' which obeys Newton's Laws of mechanics, and secondly as particles which interact with each other electromagnetically through the medium of space as a result of their spinning on their axes. All other particles and bodies are composed of ε-particles in different combinations.

a. Mechanical 'stuff'

- The ε-particle is the fundamental particle in the Universe.
- There are no other fundamental particles. The ε-particle is the quantum of 'stuff'.
- The number of ε-particles in the Universe is fixed. Matter and energy are not interchangeable.
- ε-particles are spheres.
- All ε-particles in the Universe are always rotating, each on its own axis.
- All ε-particles rotate at the same rate.
- The direction of each ε-particle's axis at any time depends on its environment i.e. it is not fixed for all time.
- ε-particles have the Newtonian properties of linear momentum, collision angular momentum etc.
- Particles which are composed of ε-particles e.g. protons also have Newtonian properties.
- The momentum of a body is proportional to the number of ε-particles of which it is composed.
- ε-particles have no mechanical friction.
- The axes change direction in response only to those of other ε-particles.
- Such changes occur without expenditure of energy, because each change of direction of the axis is balance simultaneously by opposite changes in the ε-particles which caused it.
- Nothing is lost as heat.
- The forces between bodies in motion therefore realign through space without expenditure of energy as the bodies move.
- Thus the phenomena of gravitational, electric and magnetic forces consume no energy to sustain them between their point of origin and infinity.

b. Electromagnetic properties

- The spinning of a ε-particle causes an electromagnetic interaction with all other ε-particles.
- ε-particles rotate on their axes without the consumption of energy.
- Force exists between all ε-particles with axes of rotation which are not perpendicular to each other.
- Maximum force is along the line of axes.
- Force between ε-particles decreases trigonometrically with increasing angle between the direction of axes, and becomes zero when the angle is 90° so that the axes are perpendicular to each other.
- The force between particles is the same for all ε-particles, other things being equal.
- ε-particles cause adjacent microgranules to spin in the same direction as themselves by electromagnetic induction.
- Like spins of ε-particles cause a force of attraction between them by setting up resonance through chains of microgranules in space.
- Opposite spins cause a force of repulsion by setting up dissonance.
- No energy is consumed in maintaining these forces.
- Changes in these forces travel through the medium of space at the speed of light.
- The direction of spin of a ε-particle may be changed only by the spin of other ε-particles.
- The direction of spin of a ε-particle may be fixed by interaction with others in close array.
- Spin is effectively reoriented in space when a whole array rotates, as in spinning protons, nuclei, bodies etc.

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