The Origins of Particles, Forces and Electromagnetic Radiation - A New Analysis (where did all the positrons go?)

by A.C. Sturt

> 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

The ultimate aim of particle physics is to simplify our understanding of the principles which underlie the processes of the Universe. That is not to claim that their manifestations in our world would be any less complicated, but just that the principles themselves should be simple and Universal. In fact what has happened is that the models are becoming more complicated, not less. The evidence of this is that the number of subatomic particles, which are the building blocks, has increased rapidly over the past decades, and they are still not all identified. One attempt at simplification reaches down to the level of quarks, but its physical rationale is not obvious, and it still fails in important respects. For instance it does not comprehend gravity, which is probably the most fundamental of all forces, and so there is a gulf between astrophysics and particle physics.

This paper attempts a completely different approach. It develops a model which uses the fundamental building block of a single particle to account for all matter in the Universe, to provide the source of all physical forces and to generate electromagnetic radiation. This particle is the quantum of matter. It comprises the 'stuff' of electrons and positrons without their electric charge. I have given it the name epsilon-particle or 'ε-particle' to distinguish it from these two particles and the gamut of other particles, because electric charge is not used in the analysis. Phenomena attributed to the separation of charges are caused by the spinning of the ε-particle on its axis. If it seems to us to rotate in one direction, we call it an electron. If it seems to rotate in the other direction, it is a positron. In fact the spins are the same; it is the point of view of the observer or detector which changes.

This is literal rotation, not the notional spins of quantum physics, and the rate is identical and unchanging for all ε-particles; it cannot be transferred from one ε-particle to another i.e. they are frictionless. By contrast, the directions of the axes of spin of ε-particles are randomly distributed in the Universe, and do not change. Their sum must be zero, because the Universe as a whole cannot be biased; there is no yardstick against which a bias of the whole system can occur.

The methodology decomposes Newton's parameter of mass into that which is related to mechanics and that which is 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 a force is proportional to the rate of change which it causes in the velocity of a particle of stuff, 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 one 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 i.e. two-ended forces. In my model these forces 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 induction, until it reaches another ε-particle with which it interacts by the reverse process. This sets up a two-way resonance between ε-particles if their spins are in opposite directions, which results in a force of attraction between them. If their spins are in the same direction, the result is dissonance and the force between them is repulsion. Thus the mechanism communicates both the force and the direction of rotation from one ε-particle to the other. The potential for force is out from the particle along the equator like a planetary disc, except that it does not decrease to zero out of the plane of the disc. It diminishes progressively from a maximum in the direction of the equator to zero in the direction of the axis.

The same fundamental process operates inside nucleons, between nucleons in the nucleus, at the atomic level and between bodies, where we classify it as 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 environments in which they are detected. Gravitational attraction is ascribed to forces between large bodies at great distances, and the detectors which these require, whereas the distances between electric charges or between magnetic poles are usually much less than this in the situations in which they are 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 through the medium of space. 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 reorientations 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 then a symmetrical sphere entirely composed of ε-particles with balanced rotations, except for one ε-particle at its centre. This lone ε-particle is the source of all the external interactions of the proton with other particles. 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. This is a model of the proton which could be tested in proton colliders.

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 describe the phenomena which are observed in the natural world.

There may be a preponderance of unattached ε-particles with a particular spin in our locality in the Solar System i.e. the electrons, perhaps through some form of selection by the magnetic field of the Earth, acting for us as a ubiquitous default state. The implication would be that other localities might be different. Alternatively, it could result from the limitations of our detectors.

A. Introduction

If you had to design a Universe, you would try to make the components as few and simple as possible. You would not devise a host of 'fundamental' particles and forces which act at a distance, such as gravity and electromagnetism. If that is true, the problem for us as subsystems of the Universal system is to find a way to uncover the underlying model, while acknowledging that comprehension of the whole system is of necessity beyond our reach. However, we can formulate better and better models, based on observation and measurement. One opening may be lie in unexpected correlations which have been observed.

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, there is the positron, which is identical to the electron in mass, but has the opposite charge. If an electron is a fundamental particle, so must also be the positron, because it cannot be made of electrons if its mass is equal to that of an electron. One may theorise that this is some sort of mirror image effect, which would not be difficult to accept. In fact this concept is incorporated in the analysis which is developed in this paper.

What is more problematic is that nature has found it necessary to create another particle with exactly the same charge as a positron but a much greater mass, namely the proton. The question is: why does the proton have a charge which is exactly equal and opposite to that of the electron? It is not enough to say that this is just to create balance, or else the Universe itself would be charged, which would be nonsense. What exactly is 'charge' any way? Then why does the proton have about 1836 times the mass of the electron? Why

this number, and why ‘approximately’, though that may be a separate argument? It may just all be taken it as given, but that is hardly a sufficient explanation at the most fundamental level.

The present paper attempts to develop 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 it decomposes into the two separated particles (1). According to my model, the nucleus, which we consider to be composed of protons and neutrons, is really 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 the two separated particles. The clue to this process is that neutrons form at the temperatures and pressures of stars, survive explosion and apparently endure indefinitely in nuclei, but then disintegrate rapidly in the laboratory at normal temperature and pressure.

This new model of the neutron is not the conventional interpretation, which is essentially Rutherford’s, that all the electrons of an atom orbit the nucleus which is therefore composed entirely of protons and neutrons, but no less a physicist than Otto Frisch wrote that the neutrino was invented by Pauli to account for the discrepancy of energy when a fast electron was released from a nucleus i.e. the nucleus contained an electron in some guise. It must contain the electron, because it could hardly manufacture a fundamental particle for the purposes of releasing it.

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 actually 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 like a point than a particle. In any case it is not clear what the diameter of an electron would actually mean, because electrons seem never to 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 taken literally, 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. The question then 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’ was first defined by Newton in terms of the forces of gravity, and he then extended it to 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 *Philosophiae Naturalis Principia Mathematica* to enable him to define mechanical forces in algebraic terms using these dimensions. If we rely on mass to explain forces, we are not so much returning to fundamentals as using the conclusions to justify the argument. A fundamental analysis should explain both the electric and the Newtonian forces without 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 epsilon-particle, or the ‘ε-particle’.

C. Direct inputs

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

1. All stuff in the Universe is composed of ε-particles.

2. 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 about an axis, the sort you can actually see when it occurs on a human scale. All particles spin, and at the same rate. Their axes are unchanging, but all point in different directions so that their total sum is zero, as it must be in the Universe as a whole.

3. The simple property of spin is enough to characterise the spin of all particles in the context of the Universe. In the Universe there is either spin or no spin. This is because a direction of spin seemingly apparent to us depends on which end of a particle's axis we view it from i.e. from north or south. Thus it depends on a detector, a reference point provided by an observer. In the Universe there can be no reference point; there is no fundamental direction, because all postulated directions cancel each other out.

4. 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 of the Universe which is not occupied by the stuff of ε-particles. We are aware that physics has rejected the concept of the medium of space for the past hundred years, but a medium of space with the property of electromagnetic induction explains so many outstanding phenomena that it is reasonable to re-introduce it. In support of this I have proposed astronomical measurements to show not only that it exists, but that it also affects electromagnetic radiation in the form of redshift (2).

5. 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 (3, 4).

6. 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*; there is no 'energy store' into which to lose it. If a particle of light appears to lose energy because of its reduced frequency (according to Planck's equation), it is because it generates a secondary particle of light by electromagnetic induction, so that the total energy which is conveyed remains constant. What these all have in common is the nature of the medium of space with its special characteristics.

7. When change does occur in a force which is transmitted through the medium of space, the new force travels through the medium of space at the speed of light.

8. Interaction of all particles through forces acting at a distance is on a one-to-one basis i.e. such forces are two-ended. If there was no second body, there would be no force. Moreover, the interaction between any two particles depends on the properties of those two alone, however many other bodies there are with which to interact. Thus the gravitational attraction between two bodies is not influenced by the presence of a third, even though both interact separately with that body. This is true even though the influence of every body flows out from it in all directions like ripples on a pond, as described in an example of a system in my book A Degree of Freedom (5). The influence diminishes with the square of distance, but loses no energy in total as it proceeds. This also has a parallel with the emission of light from a source (op. cit.).

9. Electrodynamics may provide the link between the interaction of fundamental particles and the mechanical forces between them. The movement of electric currents through parallel conductors is known to generate forces between them which act at a distance, perpendicular to the flow of current. When the currents are in the same direction, the conductors attract each other. When the currents are in opposite directions, the conductors repel each other. This may suggest a possible connection between the movement, and possibly the orientation, of electrons and the forces of attraction and repulsion between them. This is quoted as an example rather than a solution.

D. Basic hypotheses

The acceleration of subatomic 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 by electromagnetic induction at the speed of light until they are intercepted by the bonds of a receptor, or 'seen', and converted back into subatomic 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 energy of particles through space from the emitter to the receptor.

By contrast, particles rotating about an axis do not have the translational acceleration required to launch dipoles into space. However, they still interact electromagnetically with the medium of space, and in this model they cause reorientation of the microgranules of which it is composed (6). The microgranules themselves contribute no translational movement; they simply re-orientate electromagnetically on the spot. It is proposed here that rotation of the ε-particle on its axis generates a force which attracts ε-particles rotating in the opposite sense, but repels ε-particles rotating in same the 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. 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. In mechanical terms, they are 'frictionless' (Figure 1).

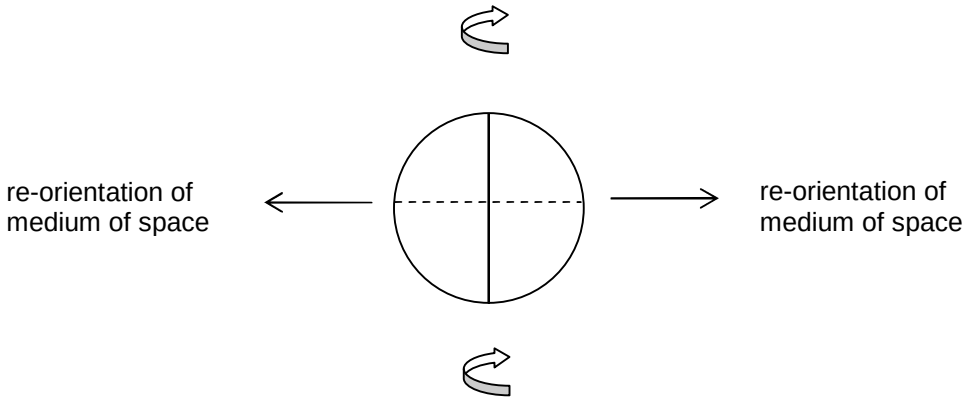

Figure 1. Representation of a ε-particle rotating on a north-south axis

Rotation generates re-orientation of the medium of space by electromagnetic induction, extending out into space from its equator in all directions as far as infinity, because there is no cut-off point. The relative magnitude of re-orientation is greatest in the direction of the equator and decreases to zero at the particle's axis of rotation (Figure 2).

The magnitude in each direction then decreases by the inverse of the square of the distance from the particle, because it spreads out in the same way that the intensity of a beam of light decreases, the further away it travels from its source.

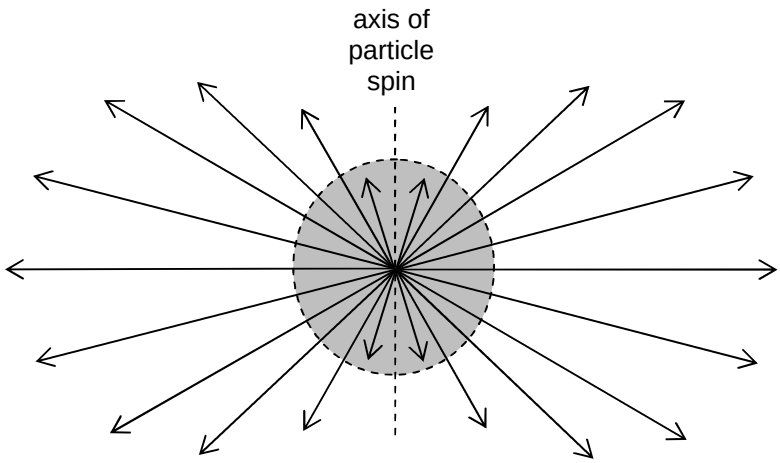

Figure 2. Directions and relative strengths of electromagnetic re-orientation of the medium of space around a ε-particle

Another ε-particle spinning in the medium of space would produce the same equatorial re-orientation of the medium of space. If the ε-particle was spinning in the opposite direction, a resonance in the medium of space between the ε-particles would be produced, giving rise to a force that attracts them to each other. However, if the second particle is spinning in the same sense, the result would be dissonance, which would cause the particles to repel each other.

Thus the interaction produced by electromagnetic induction in the medium of space would be translated into mechanical forces acting on the particles (Figure 3).

As shown in the above figure, the force between the two ε-particles would be at a maximum when their equators are in line. If the equators are inclined at an angle of θ to each other, the force between them would be 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 opposite direction is the sum of all these forces, making allowance for distance and the relative orientations of their equators. By the same reasoning, the force of repulsion between a ε-particle and all other ε-particles rotating in the same direction is the sum of all these forces similarly qualified. In the Universe as a whole the sum of all the forces of attraction and repulsion and ε-particle spins must be zero, because it cannot have a bias.

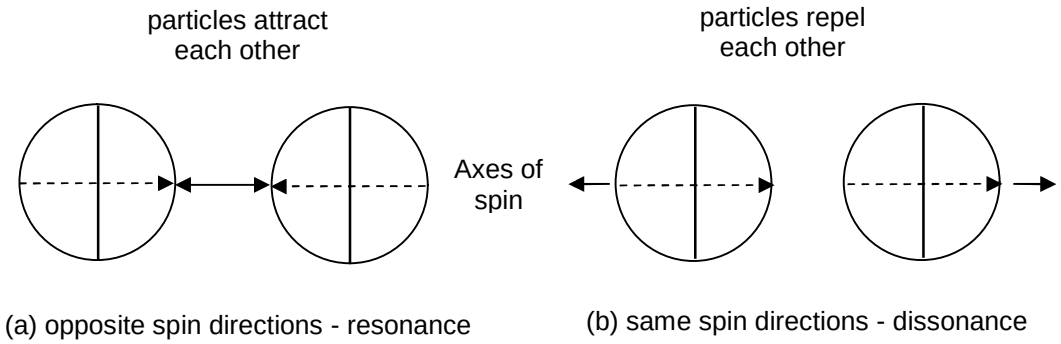

Figure 3. Pairs of ε-particles with (a) opposite or (b) identical spins

The corollary is that ε-particles with axes of rotation, and so equators, which are perpendicular to each other do not interact, and no force between them results from their rotation. In the composition of the medium of space, the microgranules between them remain in their normal orientation, which is random, neither pushing nor pulling.

As pointed out above, it would have been equally valid to draw the ε-particle on the same axis of rotation but with the opposite direction of rotational spin. In the absence of a degree of freedom the axis of either particle could be turned through 180º to bring them back to apparently identical configurations again, and such identical configurations could similarly be reversed by rotation of the axis of one particle of a pair through 180º. They are not absolute; they are relative to each other.

Thus a cloud of moving ε-particles with axes which are randomly orientated would act much as a perfect gas. Every particle would be attracting or repelling all the others as very small ‘masses’ with forces that depended on their orientation and the inverse of the square of the distances between them, which would change continuously as the ε-particles moved. However, by chance it may happen that a number of ε-particles are attracted to each other. They would then form a ‘nucleus’ of particles which could grow through the random movement of other particles. Successive particles with opposite spins would be selectively attracted, and those of similar spins would be selectively repelled. The result would be a clumping of ε-particles.

F. The proton

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 equal but opposite charges of the electron and the proton. The proton as a structure must be composed of ε-particles. The

basic hypothesis is that when an electron and a positron collide, their influence on electromagnetic induction is in effect neutralised, so that they act as a pair of uncharged particles of stuff. This is different from the conventional view that collision of the two particles would lead to their mutual annihilation, with the emission of a photon to conserve the energy. In my analysis, stuff can neither be created nor destroyed.

On this basis the proposal is that the formation of a proton can be achieved as follows. In a population of independent ε-particles, purely as a result of statistical variation, a number of ε-particles may by chance gather around a common particle in the form of a spherical cluster. This would depend on their having the appropriate axes and relative directions of spin. This is an arrangement in space, and the particles do not necessarily touch each other, but it provides a template on which to grow. Other ε-particles add to the structure, again on a statistical basis, which means that they have the spin and axis of rotation appropriate to the location. This sort of arrangement minimises the mutual interference of the ε-particles, and gives the state of maximum stability and lowest energy. Such a structure is shown in two dimensions in Figure 4, where the two colours represent the two species of particles. Each is associated with an opposite partner to the extent that this is possible.

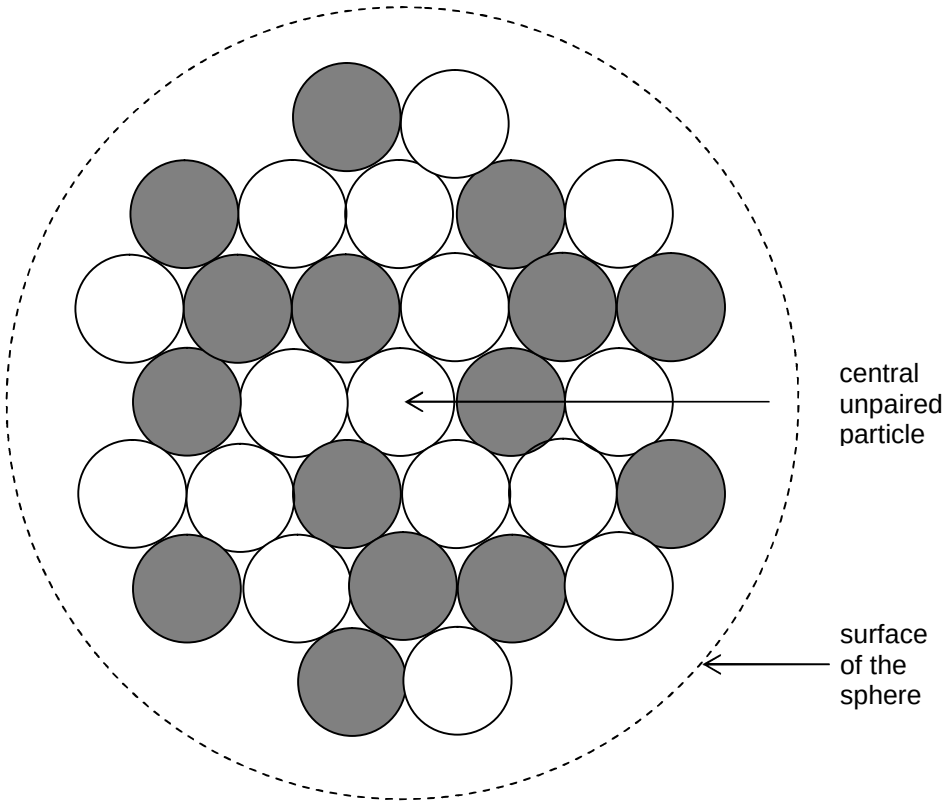

Figure 4. A spherical structure of ε-particles formed statistically by the interaction of their spins around a single particle at the centre

There is one point of asymmetry in the structure, and that is at the centre, which is what we were seeking to produce. Apart from that, the structure would in effect be neutral 'electromagnetically'. The one property of classical analysis that remains is all the 'stuff' of which ε-particles are made, and which we have excluded as a cause of forces acting at a distance. The directional forces of the component ε-particles would ensure that the result would be an array, not a jelly. It would resonate under external forces, not wobble.

The whole process would be driven by interactions of forces between particles on a statistical basis. It consists of self-selection of the appropriate ε-particles for building the sphere from the population of available ε-particles. This does not mean that the other ε-particles are 'failures', because their spins and alignments would all be suitable for other spheres forming elsewhere. In fact any order in any part of the Universe must be balanced by the opposite order in another part, because there can be no overall bias. It would all take much time, and many other interactions would undoubtedly occur which did not survive. But the lowest energy solution would persist, and the one thing which the Universe has is plenty of time.

To bring the argument from the general down to the particular, let one of the ε-particles be an electron. It is known that the particle of stuff which is identical in size but has the opposite charge is the positron. Let the opposite charges be opposite spins on their axes, in accordance with the arguments of this analysis. The result would be a spherical structure which is exactly balanced, and so neutral, except for the unpaired particle at the centre. In our scheme of things this would be a positron, to give the positive charge which exactly balances the charge of an electron. Thus more than half of the ε-particles in a proton would be positrons.

It is much easier to describe this in terms of positives and negatives, but the point of setting out the argument in general terms is that the central particle could equally well be an electron, in effect the anti-positron. In this case the 'proton' in the structure would have a negative charge, which would be an anti-proton. The general term for such structures might be 'protospheres'.

Spherical structures of ε-particles, which are formed statistically by such interactions over time, could grow to the size of a proton. There would be a limiting size, because of the constraint of the directions of the forces, which could account for the actual size reached i.e. 1836 ε-particles. At this size the surface of the sphere would be large enough to appear almost planar compared with an ε-particle, and so there would be no way into it. As a structure, the sphere itself would be able to spin on its axis, but the ε-particles would maintain their directions in space. The definite directions of the forces which link each ε-particle to the others would remain in force, so as to give a structure that retained its integrity, while allowing enough flexibility to vibrate or resonate.

The ε-particles which find themselves at the centres occur at random in the population of ε-particles. Their characteristic is that their axes of rotation are also random, and they are unchanging in this analysis. The result will be a distribution of proton structures with differently oriented axes, just as electrons and positrons in this analysis have random axes

of spin. This may be detectable by distributions of their deflections in magnetic fields, provided these are homogeneous enough to resolve the differences. That may depend on the apparatus which is used to generate the magnetic fields. The only unambiguous detection system may be one-on-one particles.

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

There is one further twist to the formation of protons. There is no reason to think that ε-particles cease to enter the proton structure when it is complete. In a cloud of protospheres, there would be ε-particles which are attracted to its surface to pair with the positron at the centre. When one succeeded, the ε-particle at the centre would in effect be neutralised by the lone ε-particle on the outside. The result would be a neutron. This is because the directions and magnitudes in which the spins of the two particles re-oriented the microgranules of the medium of space would be exactly equal and opposite at any distance. Since this would apply to all the forces acting at a distance which they generated, the neutron particle would exert no gravitational force. In terms of Newton's equation, a neutron would appear to have no mass, which is rather counterintuitive. It would, however, still be composed of two particles of stuff, and obey his laws of mechanics on collision.

Such a composite particle would last indefinitely in empty space, because there is no reason why the additional ε-particle should be shaken off. However, sooner or later it would be struck by another particle, either floating freely at random or perhaps the wall of a vessel, and it would separate to give a proton and an electron. As these separated and perhaps clustered into separate species, the effects of their spins would decouple, and the forces acting at a distance which they generated would become evident again.

This may be the process of neutron decay with a half-life of about 10 minutes in the laboratory. Neutrons are useful missiles, but they are certainly not fundamental particles.

G. Metallic nuclei

All heavier nuclei are composed of protons. Just as protons are made from random ε-particles in stars, so heavier nuclei are also made in stars by a stochastic process. This is the next state of aggregation of particles of stuff. The neutron effect may prevent protospheres coming together directly so that their unpaired central ε-particles can attain their full attractive force. So a positron at the centre of a proton is prevented from pairing up with an electron at the centre of an anti-proton by a spare electron which is sitting on the proton's surface. This is the 'neutron' effect described above.

However, under suitable conditions which arise by chance, the protospheres in this position come together through their momentum as particles of stuff, displace the interfering ε-particle and form the bond between them. The ε-particle does not retreat completely, but continues to associate with the pair of protospheres in the most stable

orientation, which may be lodged or possibly circling in the crevice between them, just off-centre. In conventional terminology, this would be a nucleus composed of a proton and a neutron, otherwise known as a deuteron. My proposal is that it is composed of two protons with one intranuclear electron, which Rutherford interpreted as a proton and a neutron.

This raises the question of the orientation of bonds between protons. Their centres would certainly be on a straight line because there is no alternative between two particles, but the interference of the intranuclear electron would force them apart by trying to muscle in. It would just be a slightly longer straight line. This effect will be even more apparent in larger nuclear structures.

Similarly, it may by chance happen that the deuteron comes together with a third proton which displaces the intranuclear electron, so that it can adhere to both of the existing protons. This forms a triangle of protons, but the electron does not go away and is joined by a second intranuclear electron for stability. This also circles around and between the three protons to make the nucleus tritium. The triangular form is more likely on the grounds of stability than a straight line. The force between any pair of the protons is less than that which bound the deuteron, because the angles are no longer orthogonal.
If two deuterons or a tritium nucleus and a proton then combined by the same stochastic process, they would form a tetrahedron. This would be an α-particle, which is the nucleus of the helium atom. This is no longer a planar structure, but its symmetry would make it very stable.

In this way all the nuclei of the Periodic Table are built up. All the metallic nuclei have structures in three dimensions. They can rotate around nuclear axes and vibrate as complete structures, but the orientations of their component ε-particles would remain fixed in space with respect to each other. All this process is driven by chance at the pressure of stars, which brings the particles into close proximity, and it occurs by definition with increasing rarity as the structures increase in size, since each synthesis uses a selection of those previously formed.

However, it may not be all synthesis, because nuclei are composed of stuff, and so they are susceptible to the laws of mechanics. Under the extreme conditions of stars they may collide and disintegrate, which provides a feedback system to maintain the composition of the Universe stable. In the absence of such feedback, all the stuff in the Universe would by now be in the form of heavy nuclei, whereas observation shows that only a very small proportion has been converted. It is still nearly all hydrogen.

As pointed out above, different orientations of ε-particles may be difficult to distinguish because of the limitations of detectors. The consequence is that they appear to have only two states: electron and positron. The same will be true of protospheres, because the only features which distinguish them from each other in their particular environment are the orientations of the ε-particle at their centres. These will be fixed during their synthesis to form the structure of maximum stability, which is lowest energy. In any nucleus heavier than tritium the structure will be in three dimensions, and so the forces between particles

cannot be at their greatest magnitude. There will be the same problem of the resolution of detectors.

The corollary of this analysis is that the Sun could well be making protons, or more generally protospheres. It cannot make ε-particles, of course, because it is composed of ε-particles and the structures to which they give rise.

H. Atomic structure

The thesis is that atomic nuclei are formed at the pressures of stars by a process that involves displacing ε-particles from the protospheres to which they are closely attracted. However, there may be 'surplus' ε-particles, or more specifically electrons, over and above those which prevent nuclei even coming into contact. These 'extra' electrons still remain attracted to the positrons at the centres of protons, but there is insufficient room on energy grounds and so they orbit at a distance, the orbital electrons, whose access to the nucleus is blocked by the intranuclear electrons. These orbital electrons also interact with each other.

The resultant atomic structure is therefore likely to be:

- a nucleus composed of a sphere of protons which are trying to associate composed of equal numbers of electrons and protons (because the whole structure is neutral),
- unpaired positrons at the centre of each proton,
- electrons close to the protons (intranuclear), but fewer in number than the protons, (which leaves the nucleus positively charged),
- and electrons orbiting at a distance, equal in number to the difference between the number of protons and the number of intranuclear electrons.

This is the electrodynamic structure of the atom described in a previous paper (7).

It is orbital electrons which are responsible for combining atoms together to form molecules. This is how we experience directly the process of building up the world in which we live, what we know as chemistry.

The protospheres of which nuclei are formed are all asymmetric, because of the single particles at their centres. The process of building nuclear structures requires that specific orientations are maintained between the component protospheres. Since these are derived from the orientations of the bricks from which they were built i.e. the ε-particles, the asymmetries also survive in the nuclear structures, and affect the next stage of particle building, which is the atom. This suggests that the ε-particles which orbit the nuclei at a distance also adopt an orientation and an orbit which is determined by the asymmetry of the nucleus. The orientations in nuclei may play a much bigger part in chemical reactions than conventionally recognised.

I. Gravity

The phenomenon of gravity is applied to the world which we experience directly, the world of bodies rather than particles. Gravitational attraction operates between two bodies in a straight line from centre to centre, whatever the direction this line may take, and whatever the shape of the bodies. It is unlikely, therefore, that the source of gravitational attraction lies in the form of the bodies as such. It must result from the stuff of which bodies are composed.

The only component which is capable of doing this is the proton, specifically because of the lone ε-particle at the centre of its structure, as in Figure 4. Nuclei are built up from protons which are always attracting each other in orientations which are specific with respect to each other, because of their asymmetry. Atoms formed around nuclei also preserve these orientations. Bodies which are formed from atoms must also preserve such orientations resulting from the original proton structures, because these are unchanging. The result is that all bodies attract all other bodies because their protons are also oriented to attract each other.

Thus every proton in a body attracts every proton in another body. If Body A contains *m* protons and Body B contained *n* protons, the force of attraction between them would be proportional to their product *mn* as in Newton's Law of Universal Gravitation. His equation is not only tried and tested on the scale of the solar system, but it is also the basis of all the mathematics on which his physics is constructed, because it gives rise to the parameter which he called 'mass'. Mass appears to be proportional to the number of protons in a body.

To summarise, if protons attract each other in the nucleus, they ought also to attract each other in bodies, which we detect as gravitational forces. This is completely at odds with the concept that nuclear protons repel each other because of their positive charges, and have to be bound together by the 'strong force'. The attraction proposed for gravitational forces may in fact also be the source of the strong force, differing in magnitude only because of the much smaller distances in the nucleus than between bodies. It may also explain why such forces do not become infinite at apparently zero distance, as predicted by the inverse square law. The reason is that the central ε-particles, which are the source of the forces, cannot approach each other more closely than the diameter of a proton, because of its structure. They also account for the electroweak force, which is the weak nuclear force and the electromagnetism which gives rise to atomic orbits. Thus there is no need to postulate different forces for different distances between particles. The ε-particle model unifies all four.

The force of gravity cannot be avoided in the way that bodies can be shielded from magnetic and electric forces. The force of gravitational attraction between two bodies depends on the numbers of protons in their structures, which is essentially the number of unpaired positrons at their centres, as described above. This does not change if another body is interposed between them. The microgranules of the medium of space permeate this third body, as it permeates every body, and the orientation which is caused by

electromagnetic induction between the first two bodies persists. However, the third body of course adds its gravitational attraction to both.

A shield is a plate of conductive material placed between a body which is generating fluctuating electric currents and another body which would be affected by them. The conductive material has labile electrons that are attached to the plate but free to move on it. The fluctuating currents attract labile electrons to the side of the shield nearest to them. This causes an equivalent positive charge on the side nearer to the second body, but one which does not fluctuate because it is rooted in the fixed structure of the material. The result is a force between the shield and the body that is being shielded which also does not fluctuate. This force is in addition to gravitational attraction, which is also constant. This is the sort of force which is observed in a capacitor between the plates of a capacitor.

J. 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.

Distance between ε-particles	Distance (metres)	Square of distance $(\text{metres})^2$	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}

Table. Relative strengths of forces at different distances using the ε-particle model.

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.

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.

K. Our local environment

The fundamental particles with which we are familiar on Earth are almost exclusively electrons, the particles to which we attribute a negative charge. In the ε-particle model these are the same particle of stuff, but with opposite relative spins. In conventional terms, electrons have a negative charge and positrons an equal but opposite charge. If the observations are correct, either there is an imbalance of fundamental particles on Earth, or our detectors are biased towards negatively charged stuff.

Electrons flowing in conductors generate magnetic fields, or at least that is how they are detected, but this implies that they are randomly arranged or they are in some balanced order which cancels out any effect, until they are caused to flow. The flow of electricity in parallel conductors is known to produce forces of attraction or repulsion between them depending on the directions of current. It may be that the electromotive force causes the flow of electrons with a certain alignment of spins. The fact that these alignments are reproducible in the same conductor and in other conductors suggests the influence of some blanket external factor, like gravity and water flowing downhill.

There is in fact an overarching effect in the form of the Earth's magnetic field, which may provide a default position. For ε-particles this may favour a predominant direction of axis of spin. If this is so, other celestial environments may be different, and on the largest scale of all it might even be speculated that co-ordinated axes of spin holds galaxies together. In the unified scheme of forces proposed above, this might just be another way of describing gravitational attraction, but potentially different from galaxy to galaxy.

In a Universe without bias, there must be localities where there is a matching preponderance of positrons. Not that you would know, if you were there, because the terminology of physics would be adjusted accordingly, and all the fundamental relationships would be the same. You would only notice if you had a foot in both systems.

L. Conclusions

The model has enough degrees of freedom to represent the phenomena of the cosmos, even though it has only two components, a fundamental species of particle interacting with a medium of space. There is no electric charge or parameter of mass in this model, which makes it much simpler, but more difficult to envisage than positive and negative charges. However, confining ourselves to electric analysis may mean missing out on half of the Universe. Effects which would conventionally be attributed to them are provided by decomposing the gravitational and inertial forces of Newton's initial definitions.

Particles are the stuff of the Universe which obeys his laws of mechanics of momentum. Every particle spins at the same rate, and is distinguished from the rest by the direction of its axis of spin relative to all the others, which never changes. Stuff is not interchangeable with energy.

Forces which act a distance are by electromagnetic induction, generated by the spinning of the particles and transmitted from particle to particle by orientation of the microgranules of which the medium of space is composed. Particles which have opposite spins form resonance in the microgranules between them and attract each other. Particles with similar spins cause dissonance, and they repel each other.

All larger particles and bodies are composed of assemblages of the fundamental particle of stuff. They form clumps and grow on a statistical basis by self-selection of particles with spins which happen to produce the greatest stability. The great majority form pairs with opposing spin, so that the electromagnetic influence from each cancels out that emanating from the other, and the result is neutral. However, they retain an unpaired particle at their centre, and this is the source of all the external influence of the assemblage through space.

The first larger particle formed in this way is a sphere the size of a proton. The next stage is the nucleus, and the third is the atom. The bodies of which the world is composed are assemblages of atoms, which we call molecules. In the Universal system all spins are the same, because there are no co-ordinates. But when there is a degree of freedom provided by a detector or observer, assemblages of particles are seen as having opposite forms in equal proportions. Thus for every electron there is a positron, and for every proton an anti-proton. When these are associated, the anti-particles are not detectable. In our locality there may be a bias towards detection as electrons.

When particles combine in three dimensional structures, the forces between them can no longer be orthogonal relative to their axes of spin, which were set by the original fundamental particles from which they were formed. The effects of these angles persist in nuclei, because of the process by which protons and anti-protons grow, in the electrons orbiting close to them and the electrons orbiting at a distance. They may also persist in the chemical reactions of atoms, in which these electrons combine orbits.

Analysis at this abstract level suggests some unexpected results. The fundamental forces of physics, which are the strong nuclear force, the electroweak force and gravity, all result from the same electromagnetic induction at different distances. The strong nuclear forces are attractive, as proton-type particles seek each other like positrons and electrons, not repulsive as between positive charges. Every assemblage of fundamental particles matches the distribution of particle axes of the original particles at their centres. The limit on the force of 'gravitational' attraction is set by the diameter of the 'proton'. It can never reach infinity, which is implied by the inverse square law at zero distance.

Another surprising result is that there may be particles of stuff in the form of free neutrons which have no mass, because their interactions with the rest of the Universe are exactly equal and opposite, and so negate each other. This is not what Newton had in mind, when he brought together momentum and gravity!

Electromagnetic induction through space consumes no energy. Thus the forces which result from it are timeless; they have no time-dimension. It is changes of these forces resulting from changes in the distribution of particles of stuff which require energy. The rate at which change of force travels through space is the speed of light, whether it is gravitational or electromagnetic force. This is consistent with my theory of light as rotating electromagnetic dipoles, which also travel through the medium of space by induction, and lose no energy in transit.

All 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 make order where there would otherwise be none.

Astronomy may provide a clue 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 it can be shown that clouds of molecular hydrogen are caused by gravitational attraction of the molecules themselves, the source of attraction must be contained within the molecular hydrogen structure. If the same can also be proved for atomic hydrogen, the source of attraction must be contained within the atomic hydrogen structure. However, if clouds of hydrogen ions could be detected and shown to be formed by their gravitational attraction to themselves, this would confirm that the source of gravity lay with the hydrogen ion, which is the proton.

Astronomical measurements may also confirm the existence of the medium of space and its properties of electromagnetic induction, as in the paper in the reference. The medium of space has not appeared in the analyses of physics for the past hundred years, but it simplifies explanation of so many natural phenomena that it is vital to establish its existence.

If the 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 the most fundamental particles. It is also relevant to collapsed stars, such as the neutron stars that have intense magnetic fields, which may imply free, mobile electrons. It could also throw some light on how some stars apparently change fundamental properties at extraordinarily fast rates.

The implications for particle physics would be no less profound. Complete destruction of protons and other particles by collision would result only in fundamental particles spinning one way or the other on their axes i.e. detected as 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. The results of this process of destruction might be determined by the differentiated forces of cohesion of the proton developed in the analysis.

There are implications for the Standard Model. The analysis shows that the four fundamental forces, gravitation, electromagnetism, the strong nuclear force and the weak nuclear force, may derive from the same cause, which is 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. In that case there would be no need to postulate any species of smaller particle.

This is a Universe which is self-ordering and self-destroying of that order. Opposing processes maintain a dynamic equilibrium, in what is a process of stochastic regeneration and distribution. The whole model is driven by chance. The assumption is of ceaseless translational motion of all particles in space. Particles from this population are tried in each position to see what fits. The concept is simplicity itself, but it may be very complex in its application. It is much simpler to fall back on positive and negative 'charges', even though these may differentiated, because they are not necessarily equal units in the particular circumstances concerned. The illusion of identical units may arise from studying populations of particles, because this is the only practical possibility, but things may look different at the particle level. As in chemistry, the stoichiometry of equations and the constants may summarise the final result but mask the fundamental actions of individual particles.

This model may offer a new approach to understanding the complexities of the cosmos.

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