



ON THE STRUCTURE OF MATTER

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Abstract

A conceptual model for the structure of matter is developed from logical consideration of observations and the proposition that matter derives from the interaction of electromagnetic energy waves.

Introduction

The following represents the development of concepts relating to the nature of matter. The approach taken is to logically connect reliable observations. This involved constructing hypothetical situations that are physically possible and seeing if they accord with observations. All arrangements of matter that could be imagined as being possible were considered to evaluate their consistency with observations. The probability of occurrence was irrelevant.

Evaluation of possible arrangements is constrained by the limited number of reliable observations. Most of the current views of matter represent conjecture, and discriminating between conjecture and observation can be difficult. There are few useful observations.

The situation is similar to investigating native vegetation where abundant observations provide inordinate detail but the underlying chaotic characteristics of vegetation camouflage the underlying mechanisms. The detail serves to hide rather than elucidate the mechanisms.

The constraint of having few reliable observations has been addressed by broadening the scope. The considerations included the structure of the universe as well as matter. However, while this has a pronounced advantage of providing an appropriate context, it introduces uncertainties associated with the assumption that constraints determining the structure of matter also determine the structure of the universe.

The structural development of atoms will likely be subject to the same physical constraints as the universe but the outcomes with the universe will not be the same as with the atom. There should be similarities due to common underlying mechanisms and differences due to scale. The situation should be similar to that illustrated by fractals where patterns recur at different scales but with modifications to the patterns with each step in scale.

The approach represents standard scientific analysis but with greater dependence on logic than is usual. Despite setting the boundary conditions to the universe it suffers the same limitations as all analyses as it cannot be known whether all relevant considerations have been addressed. Indeed, many issues that have been identified have not been resolved. The work is developmental rather than being definitive.

All considerations are within the general context of matter arising through the interaction of electro magnetic (EM) energy waves. The work started with considerations of the expansion of the earth and progressed downward in size to smaller components such as the atom. However, to facilitate comprehension the presentation has been reversed, starting with the structure of the smallest element by way of an EM wave and progressing to molecules. The focus is the structural arrangement of the atom and how this accounts for the solid, liquid and gaseous states of matter and properties such as magnetism and electricity.

Fundamental EM Wave

The fundamental unit of matter appears to be a circular electro magnetic (EM) wave comprising a charged point orbiting at very high angular velocity (frequency) around a point (Fig. 1). The wave is plane polarised (flat). The X in Fig. 1 identifies the point of rotation, where this has location but no dimensions. The circle identifies a trajectory. Only the charged point (green dot) appears to represent a tangible entity.

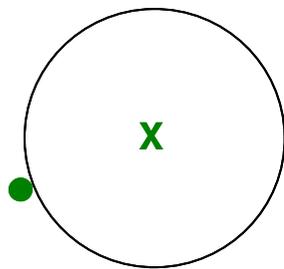


Fig. 1

Planar circular rotation of a charge about a point.

This constitutes a circular EM wave.

Angular movement about a point can be variously expressed as orbit, rotation and spin. Spin is used as representing angular movement about an internal axis, rotation is circular or spherical movement of an object about a point external to it, and orbit is planar rotation about an external point. The earth spins on its axis and rotates around the sun in a planar orbit.

The orbiting charge is termed an Electron and the centre of its rotation is termed the Focus. Capitalisation of terms is used to differentiate their use from the current definitions while retaining the terminology, and this convention is used throughout.

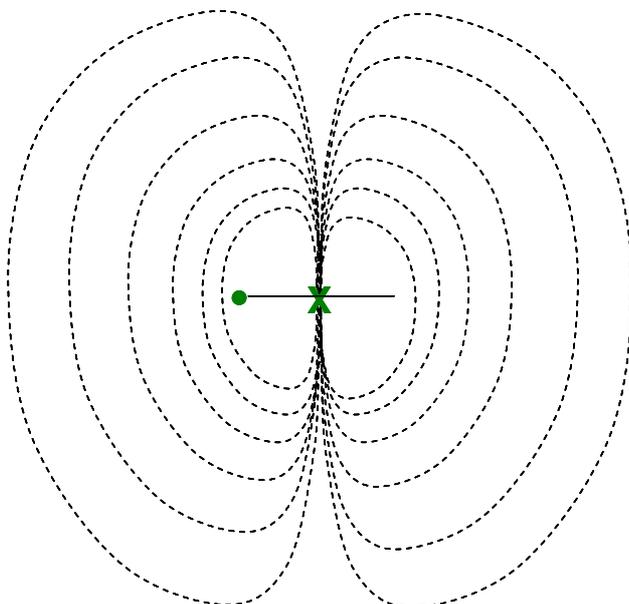


Fig. 2

Magnetic lines of force about the axis of spin of a circular EM wave.

The planar movement of the Electron about a point in a circular EM wave represents an orbit when the instantaneous location of the Electron is taken as reference. However, the trajectory represents spin about an internal point. It is referred to here as spin because the full trajectory of the Electron by way of the full wave is of interest. Also, the spin is about an internal axis orthogonal to the plane of the wave and this Axis is particularly important.

Spin by way of planar rotation of a stable¹ charge about a point generates a magnetic field. The characteristics of the charge on the Electron are unknown but, from realised outcomes, the orientation of the charge is stable and has polarity. This polarity is manifest as the development of a polarised magnetic field centred on the Axis of spin.

The problematical issue when addressing this arrangement relates to the balance of forces needed to maintain the orbit of the Electron. The rapid rotation of the Electron generates a large centrifugal force that has to be countered for the orbit to be stable. The most plausible explanation is that centrifugal force is effectively opposed by the magnetic field, where this has significant consequences for the structure of the wave.

The alignment of the magnetic field is orthogonal to the planar orbit at the Focus, but the lines of force from the North and South poles curve around and join (Fig. 2). The planar orbit arises from the shape of the lines of force with the orbit being in a magnetically neutral plane and located at the maximum distance from the Focus for a given magnetic force. The repulsion of the Electron from the line of force arises from its charge.

The force that is maximally developed at the Focus is magnetic and has polarity. All orbiting Electrons are aligned in the neutral plane orthogonal to the axis (between the + and - fields). All Electrons in an orbit are co-located and hence coalesced into a single unit.

The stability of this arrangement is inherent in its structure. The greater the angular velocity the greater the constraining magnetic field. Similarly, the greater the charge the greater the constraining magnetic field. The rotation of the charge about the axis is naturally constrained to a planar orbit where the charge is located within the lines of force of the field.

THE ATOM

The EM wave described above represents the basic component or unit that variously combines to form matter. It is referred to as a Centroid. Atoms represent assemblages of Centroids.

Hydrogen is the simplest Atom in having a single Centroid orbiting a central Centroid (Fig. 3a). The central Centroid in an Atom is referred to as a Nucleus.

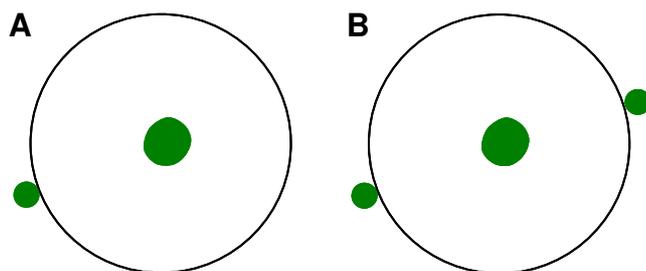


Fig. 3
Structure of the hydrogen and helium Atoms
A Hydrogen
B Helium

¹ The stability relates to the orientation of the charge on the Electron remaining constant relative to the Axis.

Atoms arise through collisions between Centroids. Collisions involving aggregation produce complex nuclei while collision without aggregation can result in orbiting Centroids.

Nuclei are complex circular waves comprising aggregations of single waves in Centroids. They retain all characteristics of EM waves in being plane polarised and having an associated magnetic field. However, the strength of the magnetic field is usually increased compared to a single EM wave due to the greater charge.

The strength of the magnetic field produced by the Nucleus must be commensurate with the number and strength of the orbiting Centroids. The situation with Helium is simple whereby the additional charge derives through a composite (complex) wave with dual polarisations. However, as only four polarisations appear possible the main means of increasing the charge is through compound Electrons. The main apparent means of increasing the magnetic field of the Nucleus is increasing the charge on the Electron(s).

The Electrons in the orbiting Centroids have the base or nominal charge where this can be increased incrementally. The incremental increase is likely the threshold for voltage measurement, which is around one hundredth of a microvolt.

Centroids orbiting Nuclei are arranged similarly to Electrons in Centroids in being aligned on the null magnetic plane. However, there can be multiple orbits at different distances from the Focus of the Nucleus, where each step in the size of orbits is likely associated with magnetic lines of force.

While the lines of force of the magnetic field provide a means of constraining the orbits of centroids about the Nucleus there is at least one additional force involved. The rotation of Centroids about a Nucleus likely arises from drag. The force associated with the spin of the Nucleus is transmitted to the Centroid, as arises with planets orbiting a sun. As the orbits and spin are in the same direction the force is one of attraction.

The magnetic lines of force provide the basis for the stepwise basis for the increase in diameter of orbits of Centroids about the Nucleus. However, they do not appear to provide a basis for the limited numbers of Centroids that can occur within orbits. The arrangement is such that the separation of Centroids within orbits is greater than that between orbits. This sets limits to the numbers of Centroids within each orbit.

The basic arrangement of a complex Atom is planar with Centroids arranged in set orbits about a Nucleus (Fig. 4). The main difference between this and prevailing representations of the atom relate to the planar structure. With matter deriving from EM waves a planar arrangement is logically essential. Moreover, the random, circular, 3 dimensional movement of electrons currently proscribed is logically difficult because of the inevitable collisions between electrons. As electrons are viewed as being matter the inevitability of collisions poses insurmountable issues as to how continuity of motion could arise.

Molecules

Molecules are assemblages of Atoms. The planar arrangement of Atoms places constraints as to their structural combination to form molecules. Figure 5 provides a two dimensional representation whereby Centroids are shared between Atoms. The main conclusion from Fig. 5 is that, when combined in molecules, the Centroids in outer orbits of Atoms are positionally stationary. The Centroids spin but do not orbit.

A great diversity of arrangements of Atoms can arise in three dimensional molecules, and this limits most discussion to specific molecular arrangements. However, some generalisations arise, as with some key properties of matter depending on the orientations of the Axes of the Nuclei. These can range from being effectively random to being strongly aligned where this determines the magnetic and electrical properties of the materials.

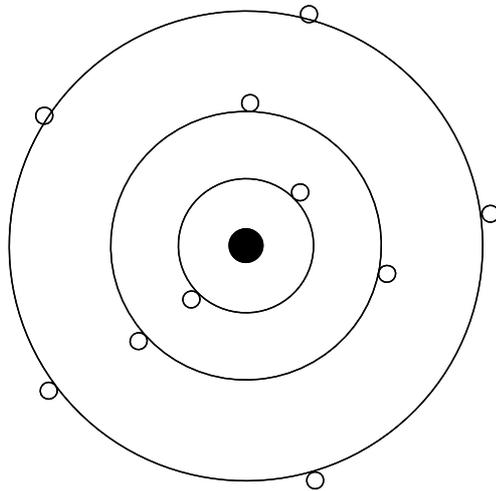


Fig. 4
Complex atom with 3 orbits and maximum numbers of Centroids within orbits.

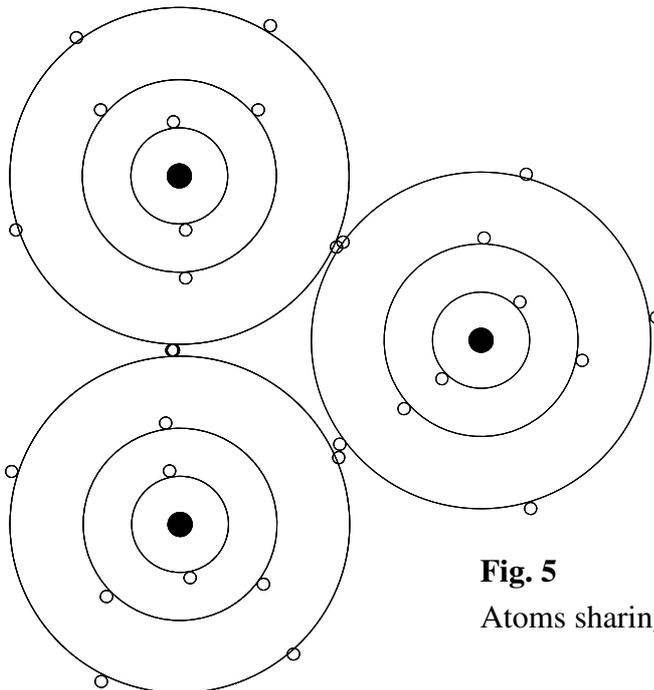


Fig. 5
Atoms sharing Centroids in outer orbits.

States of Matter

Gasses arise where Atoms are separate or dissociated. Solids arise where atoms lock together by sharing Centroids. The issue is how liquids arise, where this relates to the force attracting matter to matter

Electrons are held in orbit by the lines of force of the magnetic field generated by their spin. Centroids are held within the force lines of the magnetic field generated by the Nucleus.

Centroids in the outer orbits of different atoms can be shared, where this locks the atoms into a rigid lattice (solid). The rigid lattice does not represent maximal density, as with water being densest as a liquid at 4C.

The activity of atoms increases with temperature through the temperature dependence of frequency. The increase in frequency with increase in temperature increases the strength of the magnetic field.

A temperature increase decreases the size of the Centroids and Nucleus by decreasing the wavelength but increases the effective size of the Atom (thermal expansion). This outcome likely represents a balance between the decrease in size of the wave and the increase in magnetic field through the higher frequency. The net result is that the lines of force of the magnetic field expand slightly with temperature.

Transfer of sensible heat by way of thermal conductivity likely represents the transfer of magnetic force between atoms. It therefore depends strongly on proximity and connectivity of the magnetic fields. Good thermal conductors are usually good electrical conductors.

Gases

- Atoms bounce off the magnetic fields of other atoms. This gives a low packing density.
- The saturated concentration of gases increases with temperature.
- A gas condensing into liquid releases energy. The frequency therefore decreases.

Liquids

- Atoms maximally pack but do not lock (liquids are fluid but incompressible).
- It takes thermal energy to convert a liquid to a gas where this increases the frequency
- Thermal energy is released with conversion from a liquid to a solid. The frequency decreases.
- The magnetic fields of Atoms likely lock but the arrangement is random. That is, the level of attraction between atoms differs greatly.

Solids

- Atoms lock together in a lattice. The magnetic fields therefore also lock with the alignment determined by the structure of the lattice.
- Conversion from solid to liquid requires thermal energy where this increases the frequency.

The frequency effect in solid-liquid-gas conversions indicates that the transitions are related to the strength of the magnetic field. With gases the collisions between atoms do not penetrate the field. With solids the collisions give penetration with subsequent locking.

With liquids the fields would be maximally proximal but randomly aligned. The binding of Atoms to form liquids derives from coupling of magnetic fields. The issue is why no locking. The question is likely linked with the increase in saturation concentration of gases with temperature. The strength of the magnetic field has to be reduced to achieve locking

Magnetism

The planar rotation of the Electron in a Centroid produces a magnetic field at the Axis of spin. With random orientation of atoms the magnetic fields counteract so the material has no magnetic field. Materials have a magnetic field where the axes of nuclei are aligned. The orientation of their axes gives the N-S poles.

The alignment of axes can occur in response to an applied magnetic field, as arises with paramagnetism. However, it can also be 'permanent' wherein the axes remain aligned when the inductive field is removed. Retention of magnetism by material, as in 'permanent' magnets, arises where the orbits align with the aligned axes of the nuclei. This structure of parallel orbits of Atoms makes the material brittle.

Antimagnetism arises where an applied magnetic field induces the same response (like induces like). As with paramagnetism, the applied magnetic field need only align the axes of the nuclei, but the effect is the same if the orbits also align provided current flow is insignificant.

Electricity

Electricity arises where the Axes of the Nuclei are aligned and the material conducts the magnetic charge. It appears that barriers to the propagation of electricity arise through differences in the characteristics of atoms within materials. Good electrical conductors can be poorly conductive when impurities are added. Moreover, changes in the orientations of atoms can alter the conductivity, as in semi-conductive materials.

The occurrence of mixtures of different forms of Atoms represents impurities in 'pure' substances, but it is normal in most materials such as rocks. As a flow of current proportionally reduces the magnetic field, retentive magnets are mixtures of materials, as with carbon and rare earth metals in iron.

At low voltages the effectiveness of barriers in blocking current flow depends linearly on voltage, as in $V = I * R$. All molecules logically can conduct current but materials are almost inevitably mixtures of different Atoms. The realised outcome depends on the degree to which the orientations of the Axes of the Nuclei of different forms of Atoms can be aligned.

Current represents the flow of energy when prevailing representations have current arising from the flow of matter by way of electrons. There is no flow of the Electrons which serve to produce a charged energy field. The flow of electricity is the propagation of a charge through a field.

Current

DC current arises where the orientations of the Axes of the Nuclei are aligned and the material is conductive to the generated charge. The alignment of the axes is parallel to the direction of flow of the current.

AC current arises where the axes of the nuclei are aligned but spin about the plane of alignment. The axes of the Nuclei are orthogonal to the direction of flow of the current. This situation is not natural and must be induced by an external field, as with an applied AC voltage.

Super electrical conductivity arises where all axes and planes in matter are aligned. That is, there are no barriers.

Realised outcomes

The nature of the field within matter depends on the direction of spin of the nucleus, and hence also the rotation of orbits. Material composed of atoms having like spins can produce a cohesive response. The response where atoms have different spins is chaotic and the net outcome is null.

The requirement for compatible rotations applies when linking objects as well as atoms. Material having the same spin can be coupled taking account of polarity. Material with converse spins cannot be coupled regardless of polarity. Paramagnetic material has 'normal' spin. Antimagnetic material has a reverse spin.

Materials having magnetic properties have extremely high resistance to the flow current. Materials with significant electrical conductivity current generally do not have magnetic properties, ferrous materials excepted. The electrically conducting materials are Clect and Dlect where Clect equates with Amag and Dlect with Pmag.

As matter comprises an accumulation of Centroids the mass of matter is given by the number of Centroids and their average charge per unit volume, which is a charge density. The existing definition of matter relating to inertia defines matter by way of an outcome rather than cause.

Discussion

The above representation of the structure of matter is more rational than prevailing views. For example, energy flow by way of electricity is currently 'explained' through the flow of matter by way of electrons. Incongruities that arise with this irrational suggestion include the need to postulate the formation of holes in matter to account for the performance of semiconductors. The current representations of the structure of matter can only be wrong.

While the material presented here is an advance it is based logical extension of propositions and, as such, is unproven. In this regard it is the same as existing constructs of the structure of matter with the only difference relating to testing. Existing views can be shown to be wrong when such errors have yet to be identified for the material presented here. The concepts here have been constructed to accord with existing observations hence the scientific requirement for rejection is to identify any discords.

The considerations here are incomplete, as is usual with any such development. In particular, logical conclusions arise where there is no evidence to substantiate them. The delving into such unknowns represents the basis of science as it is how advances in knowledge are made.

