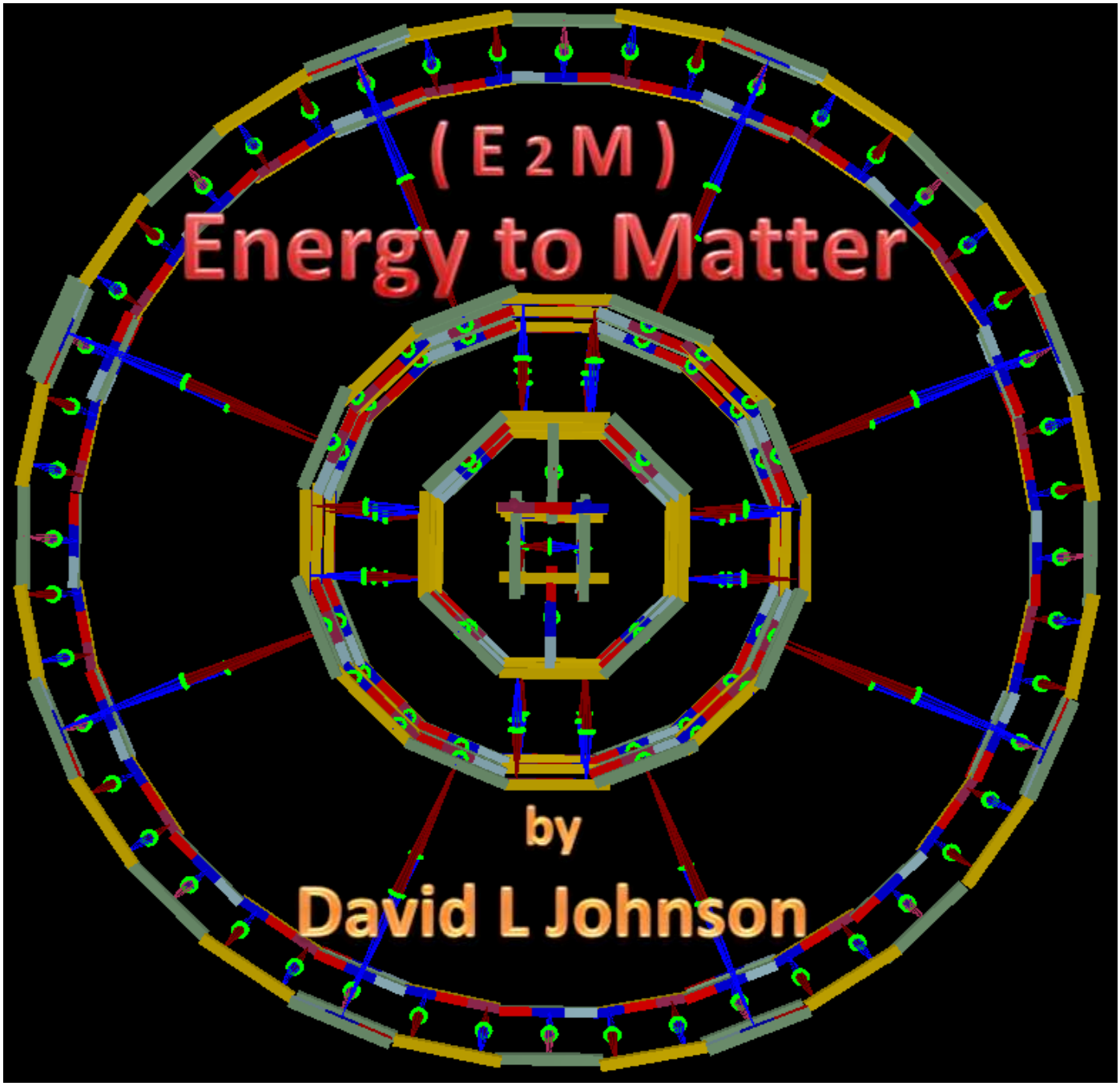

Version 8

February 2018

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Figures

Energy to Matter (E2M) Overview

Energy to Matter (E2M) presents an energy-centric rationalisation of electromagnetism and provides a descriptive explanation of the nature and structure of matter. It proposes a structure for quarks and nucleons, and uses these to generate 3-dimensional models of atomic structure and bonding, and to provide an explanation for Beta Decay, Electron Capture, Positron-Electron annihilation, Electromagnetic Radiation (EMR) and the phenomena of Gravity.

Concentrated Energy Sources and Electromagnetism

E2M considers all matter to be composed of energy and only energy. In concentrated form, energy is considered to have a central **Core Energy** in the form of a dense sphere rotating around a central axis (analogous to a spinning ball bearing or the Earth's central core). E2M considers that there to be a range of different core energy sizes and rotational speeds for these **Concentrated Energy Sources** (CESs), and possibly even a continuum of them. The **electron** is one of the smallest of the CESs, as represented as the yellow sphere of figure 1.

The tangential speed at the core energy's equatorial line is close to the speed of light, and the tremendously strong centrifugal force at the equatorial extreme of the core energy causes its outer energy to behave fluid-like and to spread out along the equatorial plane (the green plane in figures 1(a) and (b)). The stretchy viscous fluid-like nature of the escaping energy causes it to spiral upwards and downwards (as drawn) rather than just flying off tangentially like sparks from a Catherine Wheel. The escaping energy creates a mirrored swirling hemisphere around the core energy called the **Magnesphere**. Vortices form in the axial regions of the magnesphere that, at both ends, serve to pull most of the escaped energy back, returning it to the core energy with minimal loss.

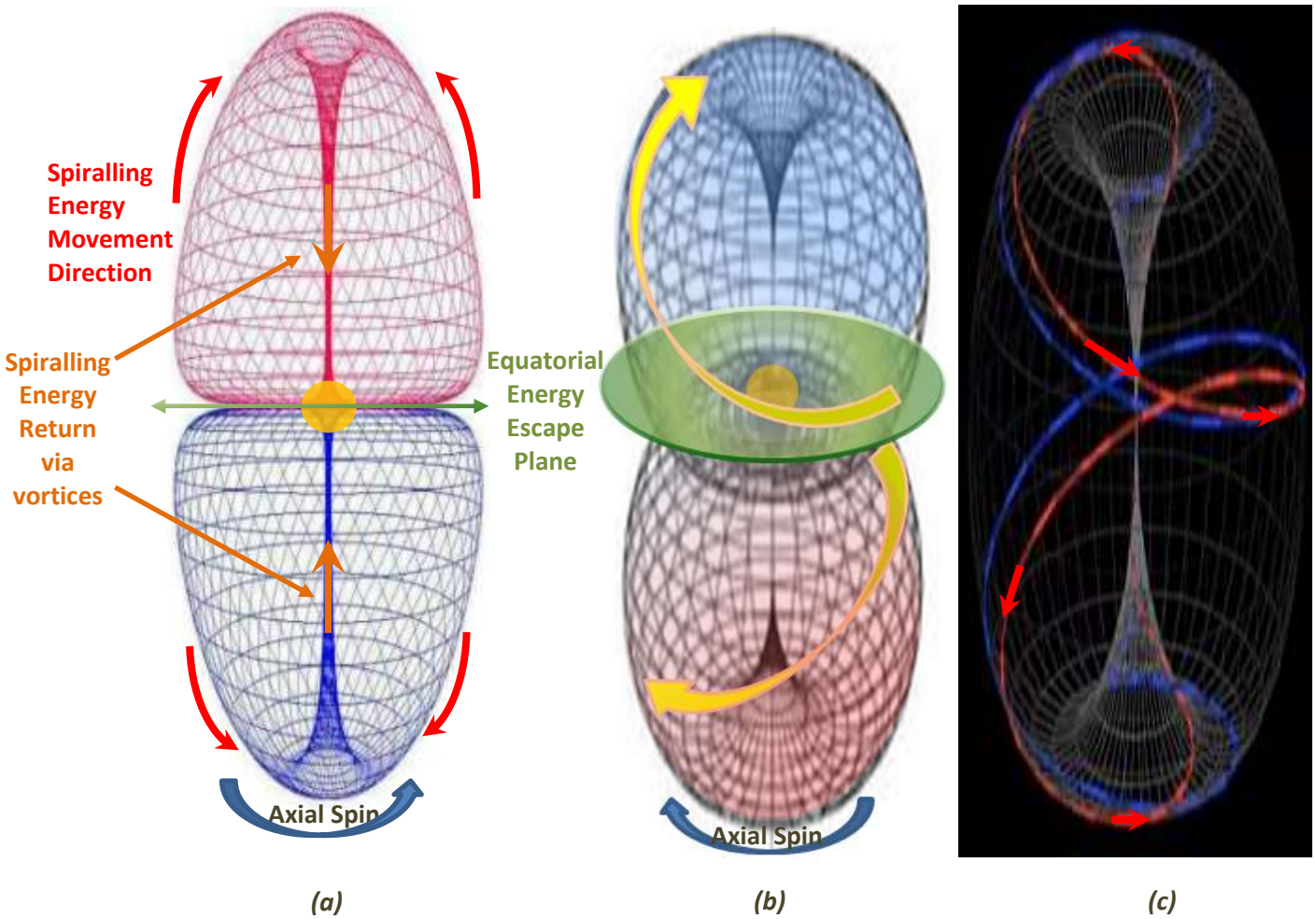


Figure 1: Models of Energy Flows around the Core Energy of an Electron

The swirling magnesphere surrounding core energy is a form of magnetic energy. Note that:

- The circles parallel to the equatorial plane in figure 1 are not flowlines - they are purely to define the geometry of one envelope within the 3D hemispherical of the magnesphere. The energy flow is spirals in circles of diminishing radius towards the vortex area as shown by yellow arrows of figure 1(b).
- David Lapoint's 'Primer Fields' (www.youtube.com/watch?v=lpI6ikj1G-s), involving plasma field flows around dome-shaped magnets, demonstrates flow patterns similar to those proposed for magnespheres.
- Magnesphere energy flow should not be confused with the toroidal representation of magnetic energy that flows from one vortex, spiralling down to be returned via the other vortex (see figure 1(c)), as promoted by some non-mainstream groups (e.g. life-force spiritualist).

The core energy of the electron and its magnesphere spin together in either a clockwise or an anticlockwise direction. Due to symmetry, a clockwise spin electron becomes an anticlockwise spin when it is rotated 180° around an equatorial axis and your point of view remains unchanged.

E2M defines magnetic North Pole via is a right hand convention (analogous to Maxwell's Right Hand Grip Rule to determine the direction of the magnetic field induced by a current passing through a wire conductor). When the fingers of the right hand are wrapped in the direction of rotation of the electron, the thumb will point to the nominal magnetic North Pole as shown in figure 2. Alternatively the left hand can be similarly used to identify an electron's magnetic South Pole.

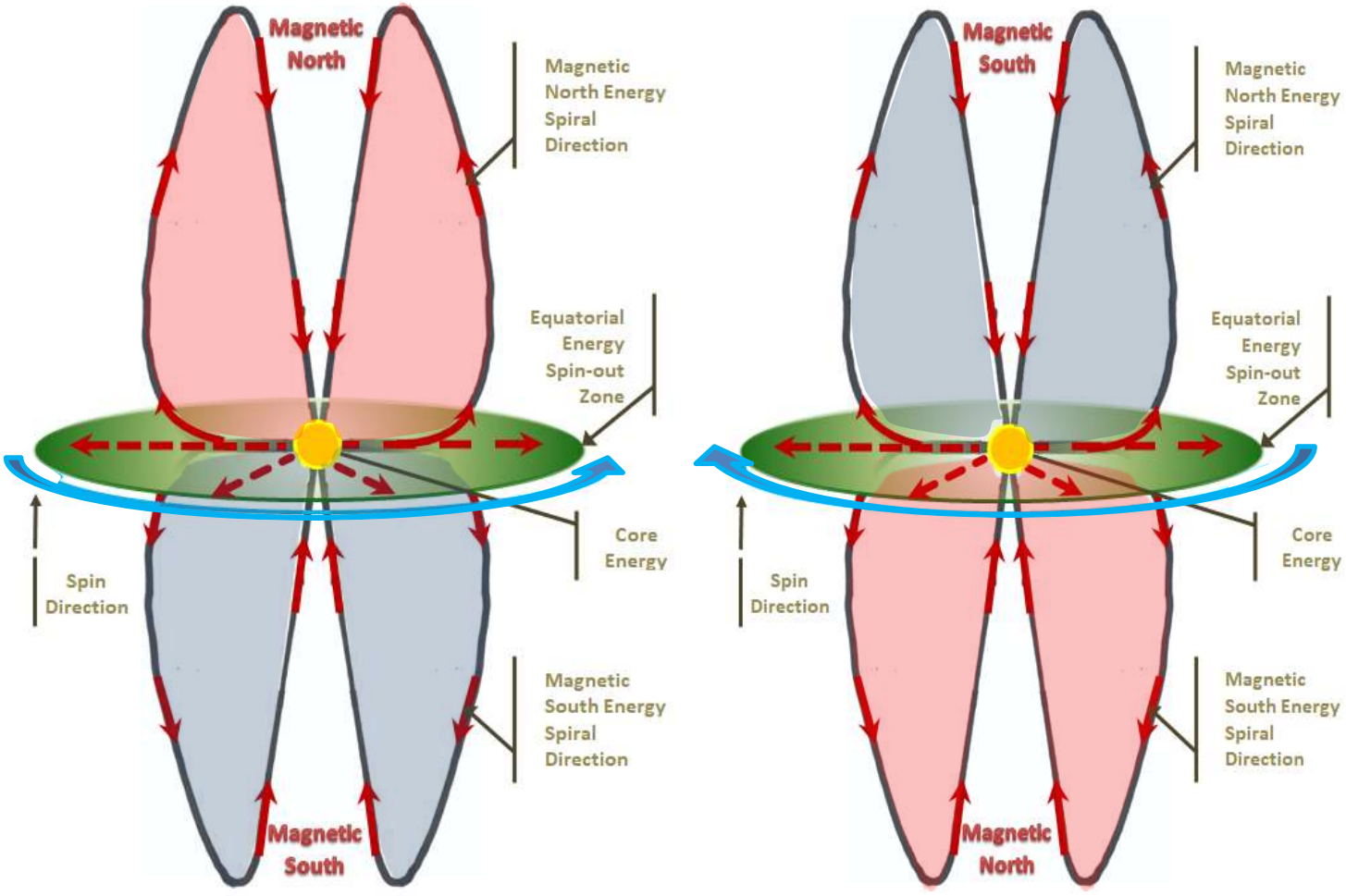
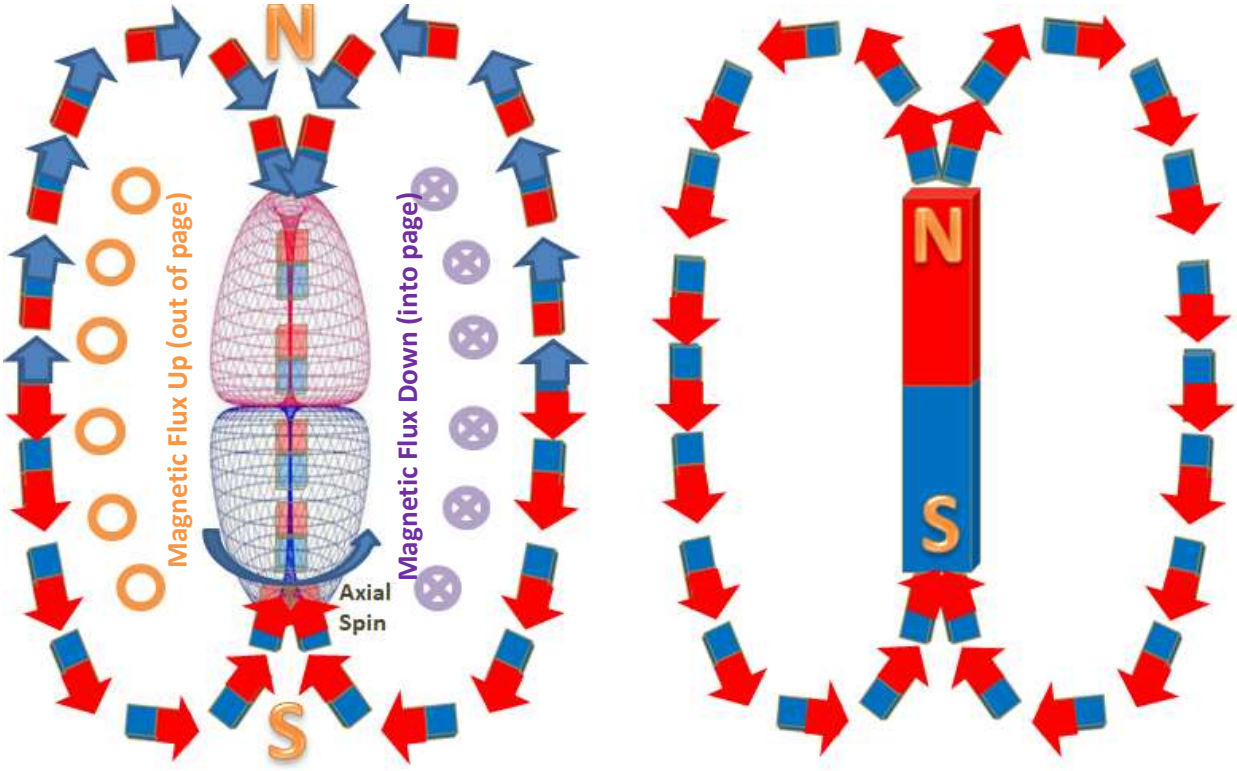


Figure 2: Right Hand Rule to Identify Magnetic North for an Electron

The concept of energy spiralling in opposite directions in two separate hemispheres (i.e. up and down as drawn in figure 2) is different to the magnetic energy pattern of a dipole magnet, which moves from a North to a South Pole without a rotational component to the flow.

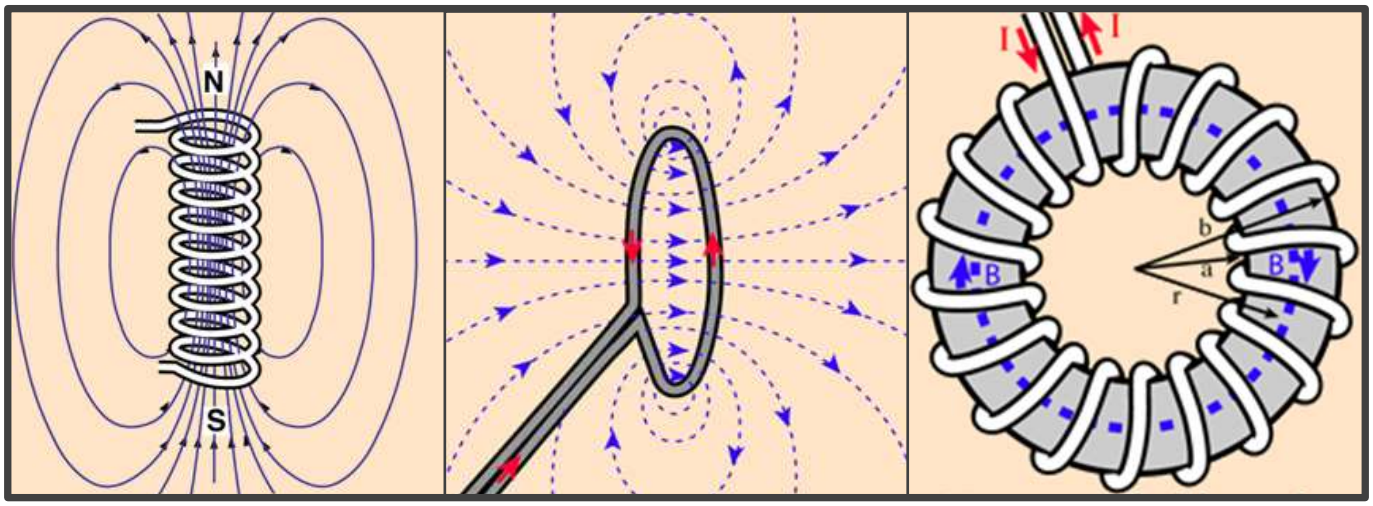
However, should it be possible to place a series of mini dipole magnets around an electron, as shown in figure 3(a), then the orientation pattern of the mini dipoles would be the same as for a dipole magnet (figure 3(b)). In that regard CESs and dipole magnetism is similar. Also they both display magnetic attraction of opposite poles and repulsion of like poles. They are similar but distinctly different in magnetic field pattern.



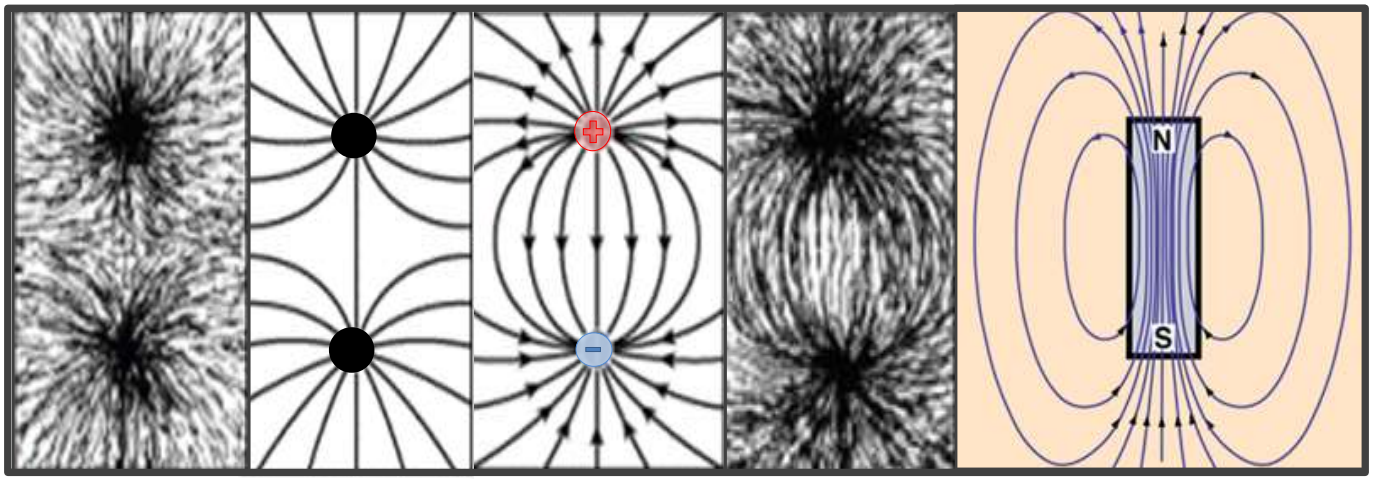
(a) Electron Magnesphere Energy Flow Pattern *(b) Dipole Magnet Magnetic Energy Flow Pattern*

Figure 3: Electron and Dipole Magnet Energy Flow Patterns

Although the iron filing patterns tracing magnetic flux for dipole magnets are similar to the electric field lines from electrodes (figure 4(d) and (e)), electric and magnetic fields are considered as distinctly different but related forces (hence the term **electromagnetism**) warranting different maths and units to quantify and predict their behaviour.



(a) Multi-loop Solenoid *(b) Single Loop* *(c) Toroidal Loop*



(d) Same-Charge Flux Pattern *(e) Opposite-Charge Flux Pattern* *(f) Dipole Magnet Flux*

Figure 4: Dipole Magnetic Fields, Induced Magnetic Fields and Electric Fields

As already noted, the magnetic energy flow patterns of CESs are superficially similar but distinctly different to those of dipole magnets. A magnesphere's magnetic energy flow is to its North and South poles, and it has a strong rotational component corresponding to the rotation of the CES's core energy. Also CESs have a splitting of flow direction equatorially, and inwardly facing vortices returning energy to each pole. Fora dipole magnet, its magnetic energy flows uninterrupted from the North to South Pole with no discernible rotational component. However, both energy fields are attributable to the same form of energy – that of magnetic energy.

By definition, electric fields are created by electric charges. They are very important to physics, and exploited practically in electrical devices and electronics technology. Electricity is defined as the movement of negatively charged electrons within a wire conductor. When electricity flows, magnetic fields and related forces are generated; and electricity can be induced to flow by a magnetic field.

At the atomic level, the electric field attraction between a positively charged atomic nucleus and negatively charged electrons are considered to prevent electrons from flying from the nucleus, and to be responsible for chemical bonding between atoms. Although there is apprehension about the actual orbital patterns, the electric field concept of atomic structure is well engrained in Physics texts and the psyche of the general public through education.

The most important concept underpinning electrical field theory is that electric charges have a property called "charge" which is the same magnitude, but opposite in polarity. The terms "negative " and " positive" are arbitrary, but well-entrenched historical labels, with the essential implication at the sub-atomic level that that a proton and electron will strongly attract each other, and that a pair of protons or electrons would strongly repel each other.

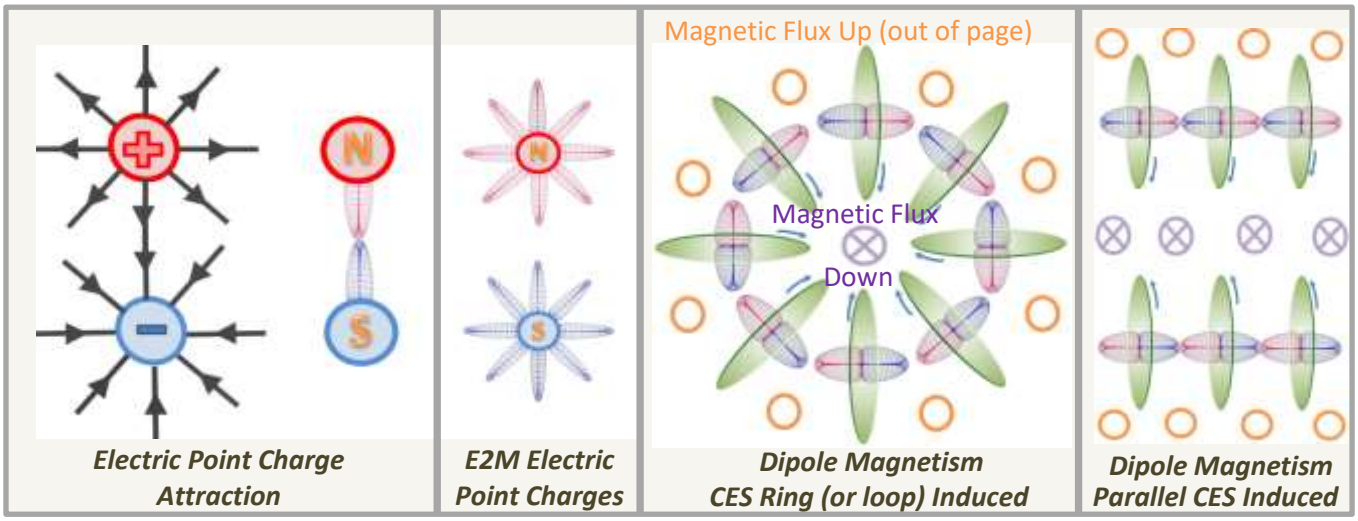


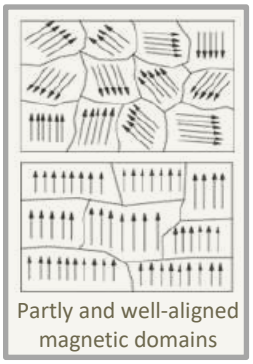
Figure 5: Electric Point Charges and Induced Dipole Magnetic Fields

The interaction of charges is characterized in terms of the forces between them, as underpinned by **Coulomb's Law** ($F = k.q_1.q_2/d^2$, where k = Coulomb's Constant). All definitions of electric charge are tied back to the unit charge attributed to electrons and thus to protons.

E2M hypothesises **electric point charges to be CESs**, and **electric fields to be CES magnesphere fields**. Thus electric point charges (q_1 and q_2 in Coulomb's law quoted above) represent a measurement of the nett dynamic energy of a CES's magnesphere, with one Coulomb charge being the nett energy associated with an electron, the smallest CES.

Electric field lines, which are imaginary lines drawn to enter and exit surfaces at 90°, show the direction that a single positive point charge would move if placed near other positive and negative charges. A point charge is thus represented by a small sphere with flowlines entering for negative and exiting for positive charge as in figure 5.

The equivalent E2M representation of a point charge is a small sphere with CESs protruding from its surface with either North or South Pole magnespheres facing outwards (the petal-like symbols on the right-hand side of figure 5), indicating the 360° range of possible orientations of a CES at that point. For two close-by CESs, their magnespheres align and merge, defining lines of magnetic flux paralleling electric field lines, as shown for attraction in figure 5.



The magnetic fields of dipole magnets are created by the alignment of groups of CESs, or unpaired CUFs (to be discussed next chapter) at the atomic level, in parallel or in closed loop patterns (figure 5), within irregular adjacent domains (see figure right). The more aligned the

CES induced domains become, the stronger the dipole magnetic flux. Magnetic domains are well documented in the Physics literature and will not be addressed in this paper.

An electric field is a **primary field**, being the magnesphere of a CES, whereas a dipole-styled magnetic field (to be simply referred to as a '**magnetic field**' henceforth) is a **secondary field** derived from the side-on merging of multiple magnespheres. Both electric and magnetic fields, however, consist of the same type of energy: it is their uniquely different flow patterns that distinguishes them and defines their distinct physical characteristics.

Because electric and magnetic fields are both made up of the same type of energy, but with different flow patterns, the dual 'electric' and 'magnetic' aspects of electromagnetism are more integrated under the E2M model with electric charge still having the same physical characteristics as before. No change is required to either equations or units of measurement related to electric field theory and practice: even the conventional +ve and –ve notation for electric charge remains the simpler and preferred notation.

There is, however, **one significant change** to current practice relating to electric point charges that is pertinent for atomic structures: **there is no need to balance positive and negative charges to achieve electrical neutrality** because electric and magnetic fields consist of the same type of (magnesphere) energy. Attraction and repulsion effects for each are due to the co-flow joining and counter-flow deflection of magnesphere energy. Furthermore, there is no fundamentally different or unique electric-field-specific energy causing attraction and repulsion between proton and electron attributable to their charge: +ve and –ve electric charge allocation is essentially a convention and a descriptive annotation indicating that electric field equations and units of measurement apply.

And because both fields consist of the same type of (magnesphere) energy, within atoms it is only the magnetic moments that need to be balanced; with angular and linear momentums needing to be accounted for.

The ramifications of this one change are significant as it challenges the consensus model for atomic structure (viz. negatively charged electrons orbiting around a positively charged nucleus). The dilemma is '*if it is not the attraction between positively charged protons and negatively charged electrons keeping electrons in orbit around the nucleus, then what is?*' Perhaps the answer is that the mathematically derived 'spdf' orbital models (see figure 15) and those elusive orbital electrons ('elusive' because there is no experimental evidence to date proving that they do populate the claimed orbitals although there are allegedly hundreds available enveloping larger atoms) do not exist in the way envisioned and promoted in Science literature.

Although possibly not sitting well with the consensus atomic orbital model, this one significant change opens up a whole range of options not previously countenanced for atomic structure, such as described by the E2M model and outlined in this paper. E2M is more intuitive than the Standard Model and better reflects the physical and chemical characteristics of elements. It creates new and exciting opportunities to develop more reliable, predictive, linked mathematical and 3D computer models that will advance Physics and related areas of Science.

Whether magnetically or chemically induced, or created from circuitry (e.g. A-to-D convertors), E2M considers an **electric current** within a wire conductor to be caused by the **movement of axially aligned free electrons with their North poles facing the direction of flow**. Electric **circuit energisation** is effectively instantaneous, and is **due to the energy flow of the combined merged magnespheres of the aligned free electrons** rather than the physical movement of the electrons themselves, which is only in the order of centimetres per minute.

Just as a group of CESs can induce a magnetic field, aligned free electrons create a magnetic field around the wire conductor as shown in figure 6. The direction of the induced magnetic flux corresponds to the magnesphere/electron rotation direction. When the current in a wire conductor stops, free electrons become randomly aligned within the conductor wire's atomic structures (see the 'Free Electrons and Electrolysis' section for more detail) and the current-induced magnetic flux disappears.

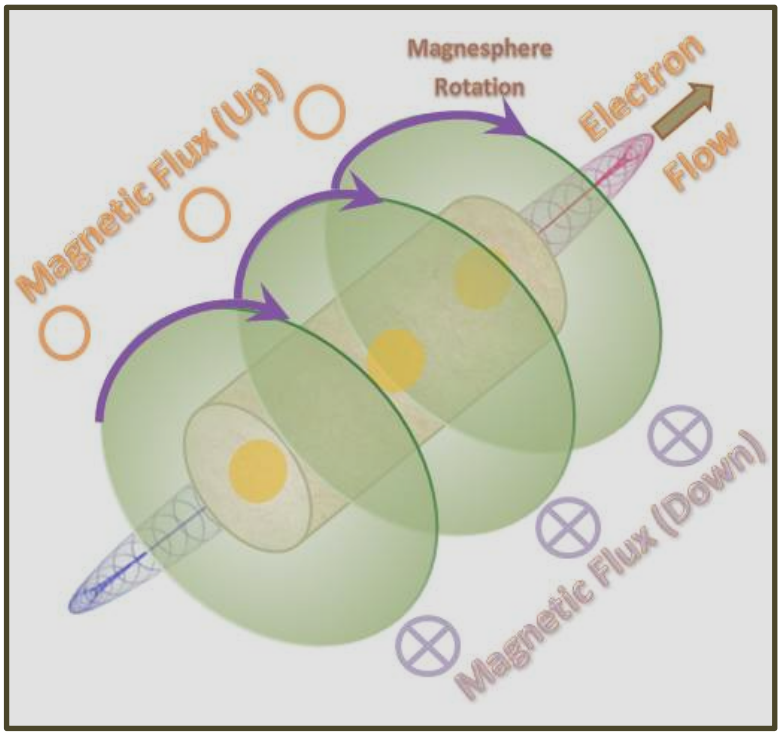


Figure 6: Electric Current and Induced Magnetic Flux around a Wire Conductor

Conversely, free electrons can be induced to align and move to create an electric current by passing a wire conductor through a magnetic field, as summarized by **Faraday's Law of electromagnetic induction:** *whenever a conductor is forcefully moved in an electromagnetic field, an electromagnetic force is induced which causes a current to flow*. And that current flow is the synchronous movement of aligned free electrons within the conductor.

Quarks and the Nucleons : Protons and Neutrons

Up to the 1960's, nucleons (protons and neutrons) were considered to be fundamental particles. With the discovery of quarks, nucleons have been classified as fermions, being made up of 3 quarks. Quarks are now considered elementary particles within the fermion grouping of the **Standard Model** (see Appendix).

Quarks are certainly larger than an electron but are still extremely small in the range of 10^{-16} to 10^{-17} metres in diameter. Mass estimates, at 4.8 MeV/c^2 for down quarks and 2.4 MeV/c^2 for up quarks, are highly conjectural because the combined mass of the three quarks forming into nucleons falls well short of the mass of nucleons (approximately of 938.8 MeV/c^2 each). By way of explanation, the Standard Model claims that **Gluons** bridge the mass gap, but that is a lot of glue and quite an unconvincing proposition.

At this point in time (2018 AD) quarks are still considered to be elementary particles, although this opinion may be under review (www.scientificamerican.com/article/the-inner-life-of-quarks-extreme-physics-special/). E2M contends that the only fundamental particle is the CES, and quarks are thus most likely made up of multiple CESs.

E2M proposes a structure for quarks involving six CESs. These CESs are considered to be larger and contain significantly more energy than electrons and are called **Enertrons**.

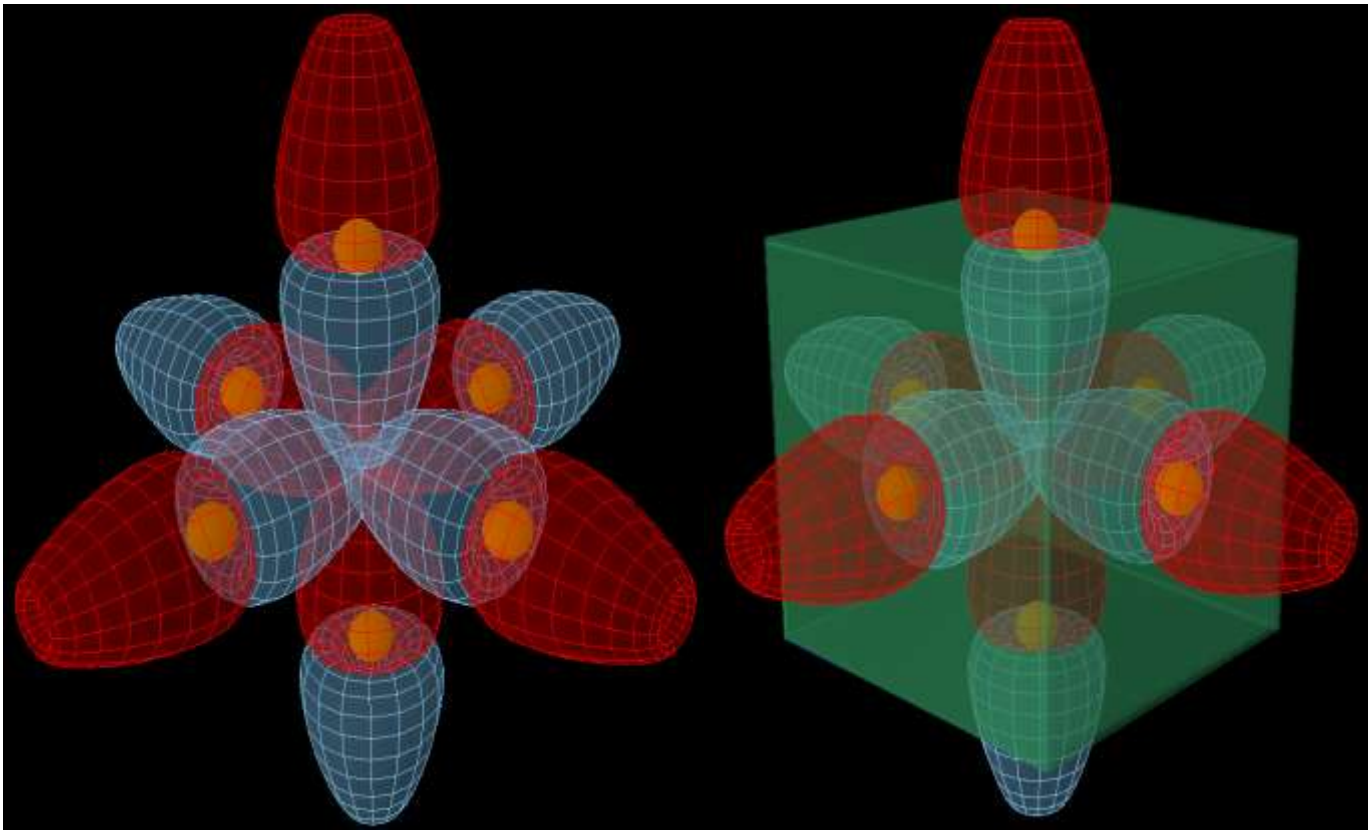


Figure 7: Enertron Models of a Down Quark

Figure 7 shows a 3-dimensional enertron representation of the E2M model for the **down quark**, with the strong attraction internally between opposing pairs of enertrons (yellow spheres), with their opposite polarity forming the six enertrons into a very strong cubic form, as emphasised by the intersection of each enertron's equatorial plane (green in figure 7), making it an ideal building block for the nucleons.

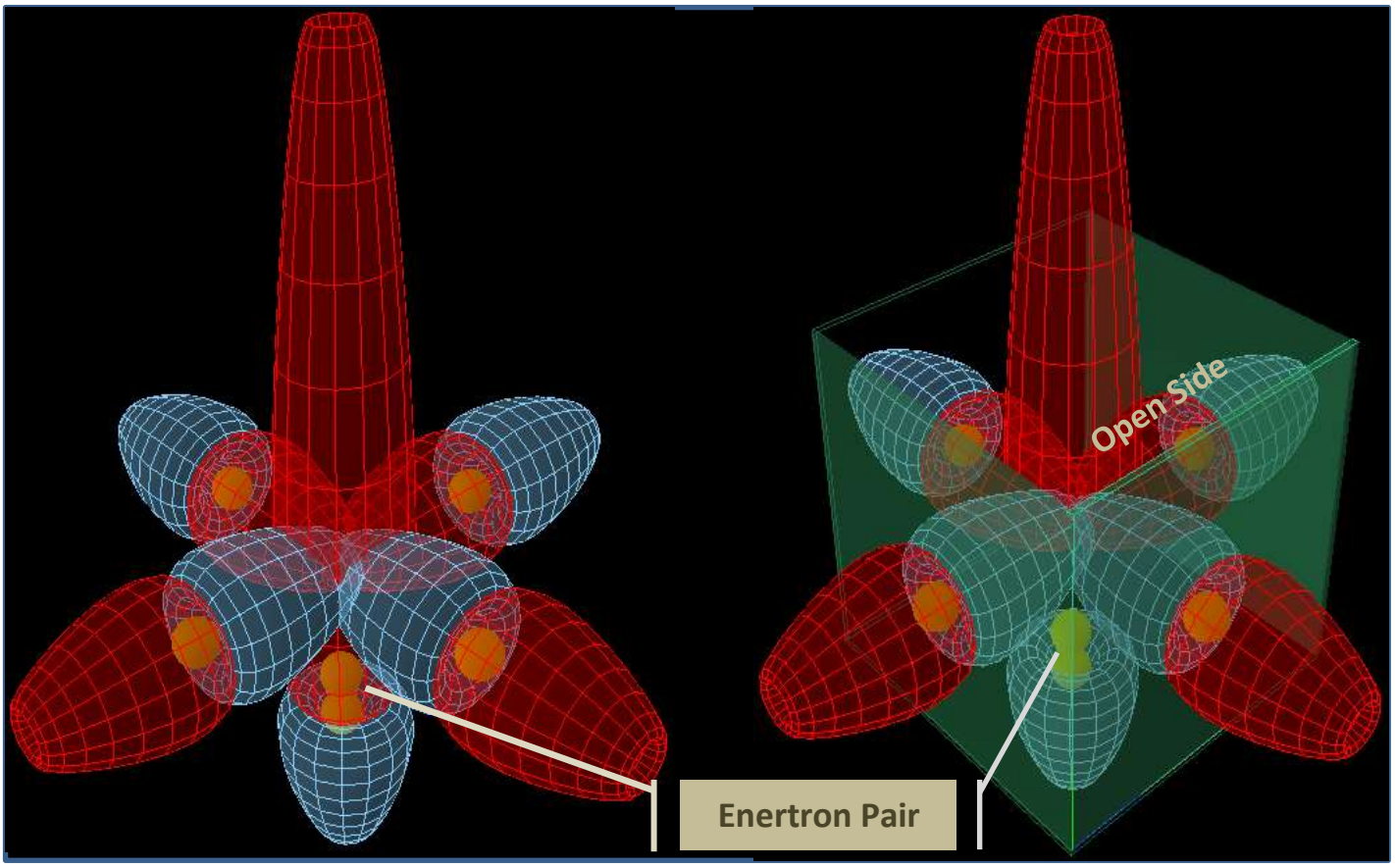


Figure 8: Enertron Models of an Up Quark

The **up quark** is similar to a down quark except that one pair of opposing pair of enertrons group together, leaving the cube open on one side as shown in figure 8.

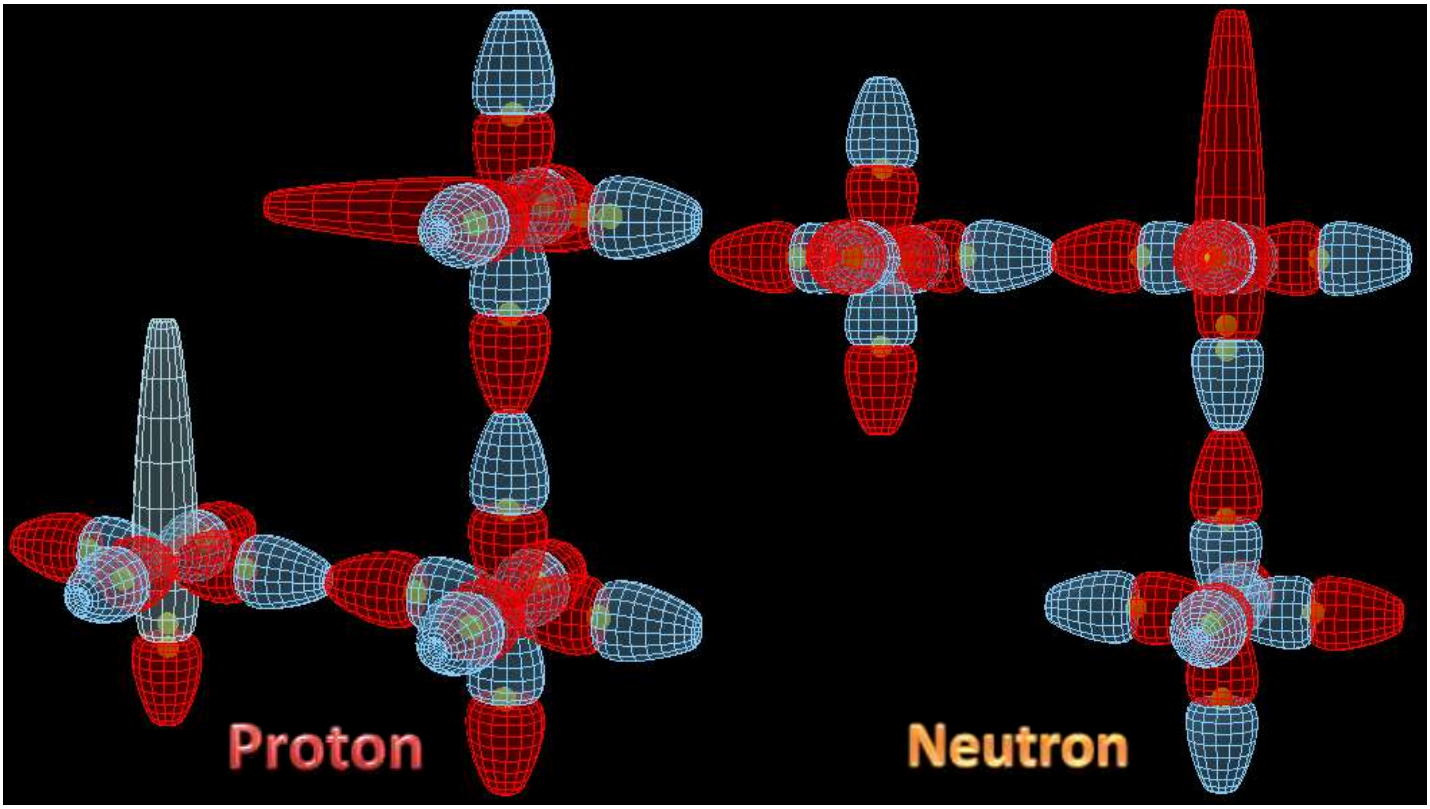


Figure 9: Enertron Model of a Proton and a Neutron

The baryons consist of three quarks. The **neutron** and **proton** nucleons represent two 'L' shaped (L-form) baryon configurations as shown in figure 9 (nucleons can have an I-, L- or Δ-form to be discussed later). A **proton** consists of two up quarks connected by a down quark and a **neutron** consists of two down quarks and a central up quark.

Note that the enertrons involved in up and down quark connection are most likely to be much closer to each other and even form enertron pairs. Also, unconstrained each quark or quark group may rotate around their common axis, which is important for the alignment of bonds between nucleons.

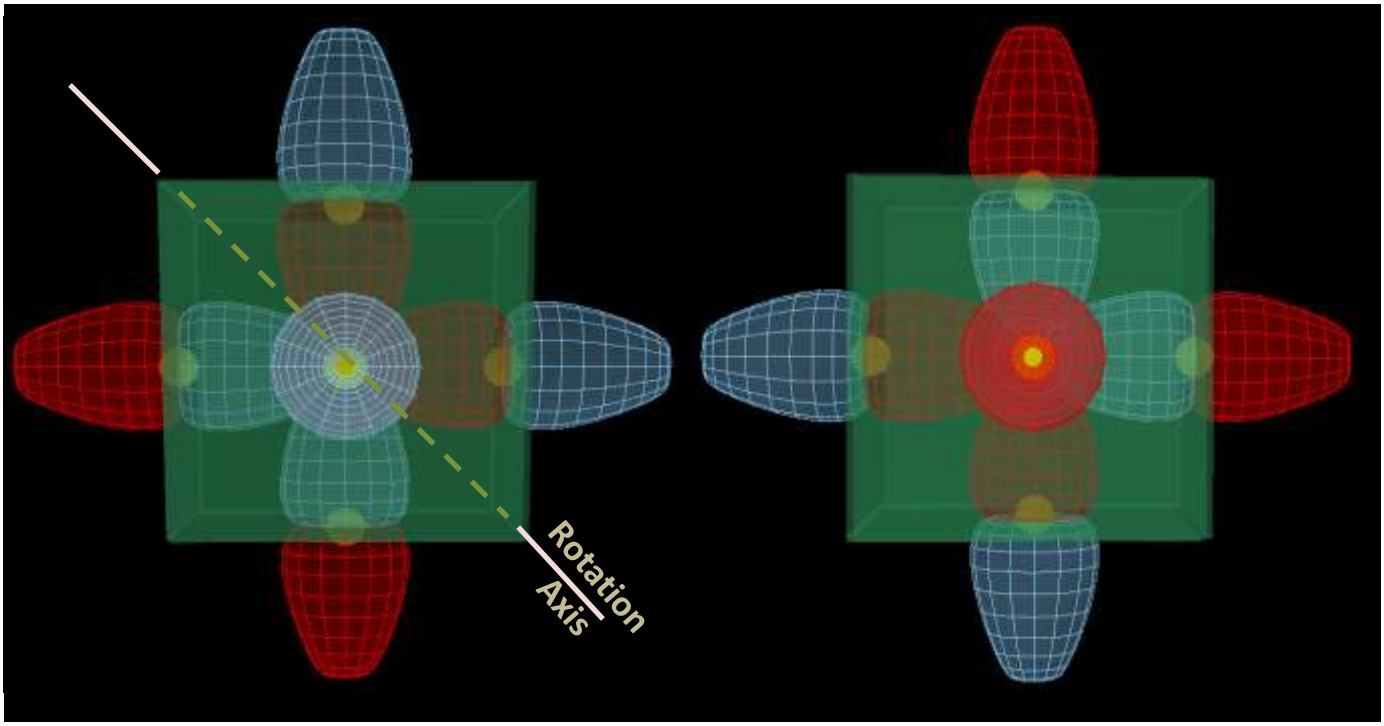


Figure 10: Enertron Model of a Down Quark and its Anti-Particle

With regard to **anti-particles**, an electron is its own anti-particle due to symmetry, which only becomes an issue when an electron-sized CES moves: when it moves with its North pole facing in their direction of travel (e.g. as an electric current) it is considered to be an **electron** ($\mathbf{e^-}$); when moving with its South pole forward it is considered to be a **positron** ($\mathbf{e^+}$), the anti-particle of the electron. Positrons are created from only limited sources such as radioactive isotope decay, ultra-intense laser to irradiation and cosmic rays rather from normal matter.

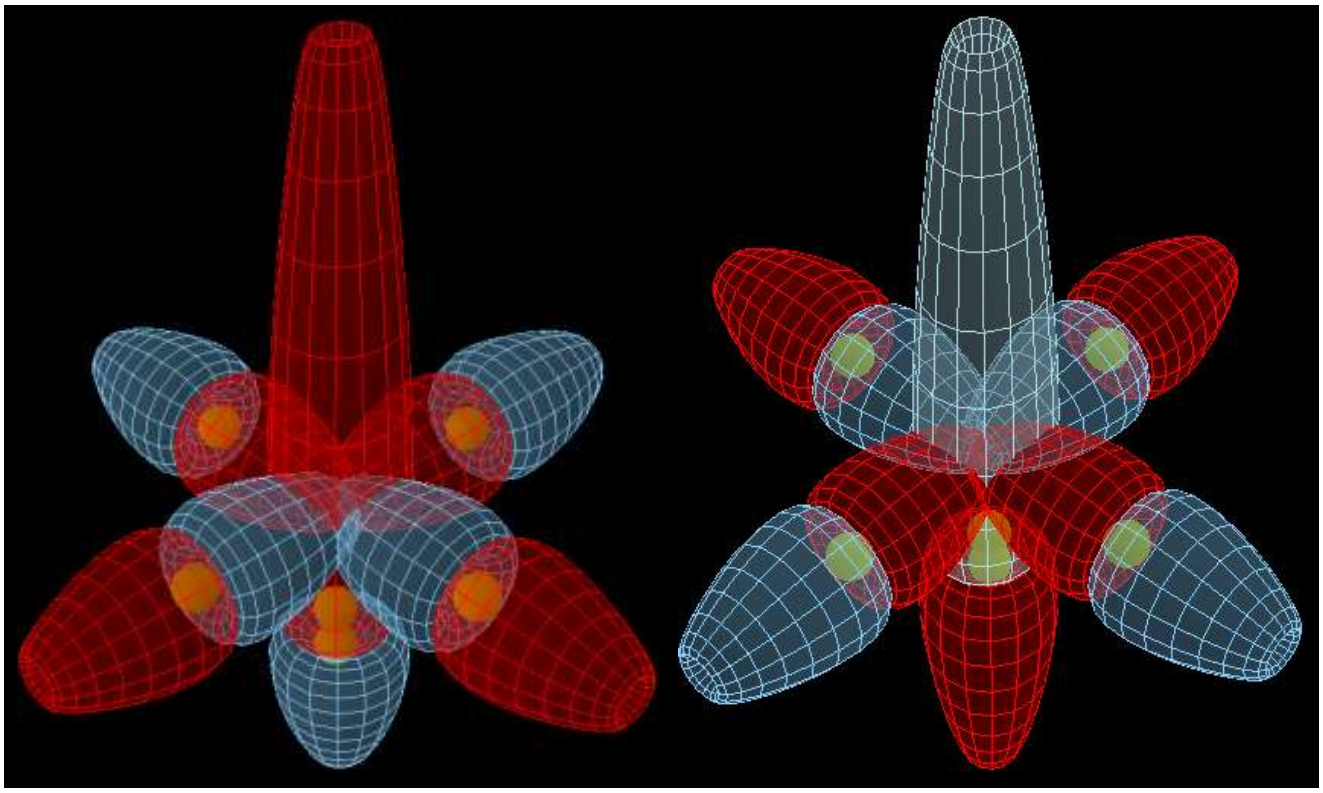


Figure 11: Enertron Model of an Up Quark and its Anti-Particle

Due to symmetry, a down quark can be orientated to form its own anti-particle by rotation, as shown in figure 11.

Thus it is only the up quark that has a geometrically distinct anti-particle as shown in figure 12. It is possible that when these two forms are observed from different perspectives (e.g. front, back and side as shown) they look different. Such magnetically different orientations could account for the mysterious characteristic called **quark colour** and the rules relating to quark colour change.

A major problem for the Standard Model is the lack of anti-matter, when it has equal probability of occurring. The E2M model indicates that only the up quark has a geometrically distinctive anti-particle, with the electron and down quark anti-particles being a simple rotational transformation.

Within the structure of an atom's nucleus, the up -quark and its anti-particle are considered to be pretty much evenly distributed within bonded of proton-to-proton and neutron-to-neutron pairs; similarly, the orientation of the down quarks is considered to be random and pretty well balanced throughout ordinary matter.

Thus the overall distribution of quarks and their anti-particles is considered to be evenly distributed throughout nucleons of ordinary matter, with the occurrence of **anti-matter** is not representing a feasible possibility.

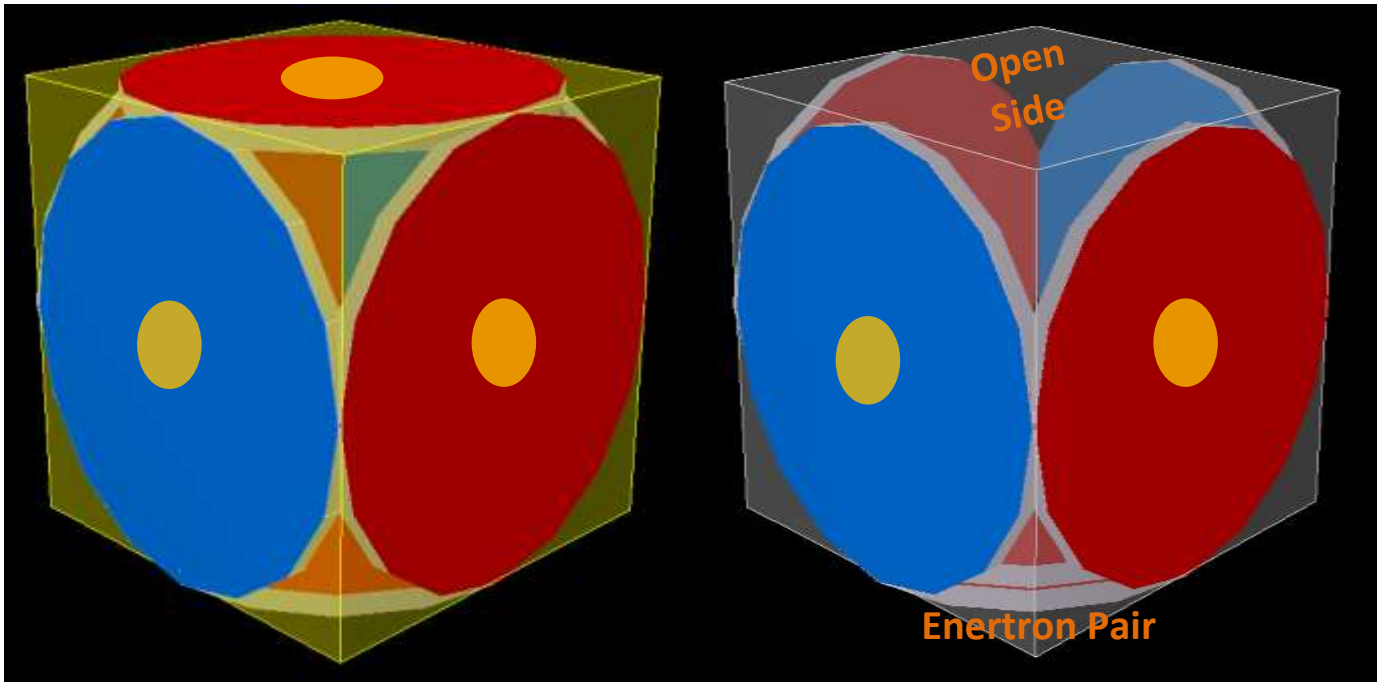


Figure 12: Block Models of Down and Up Quarks

The block model cube forms used to represent quarks are for visualisation purposes only. Quark structures are formed by enertrons held together in 3-dimensional space by their mutual magnetic interaction and should not to be considered to be solid or rigid. Also, the core energy (yellow spheres) representing enertrons in figure 12 are omitted in the block modelling from this point onwards as they are too distracting and unhelpful.

The block models are only suitable for atoms with lower atomic numbers. For atoms with atomic numbers higher than 20 they become too unwieldly, and a more compact stick model is used as can be seen in figures 25 to 27.

The orientation of the polarity of quark faces can vary considerably, but two basic rules apply: opposing external faces have opposite polarity and abutting faces have opposite polarity.

The open side of an up quark (or its anti-particle) is fed by the combined magnetic and flow energy of the five enertrons. The combined energy far exceeds the magnesphere of the individual enertrons of the quark. The merging of these spiralling fields has a **cyclonic multiplier effect** (analogous to cyclone vortices and plasma vortices of superfluids such as Helium II) that generates a powerful focussed magnetic field (as highlighted in figure 14) that is far stronger than an additive effect of the magnetic fields of the enertrons involved.

This directional cyclonic effect is called a **Concentrated Up-quark Field** (CUF), and is a most important component of atomic structure, being responsible for the formation of electrons, the capture and holding of free electrons, and the bonding process for molecules and compounds.

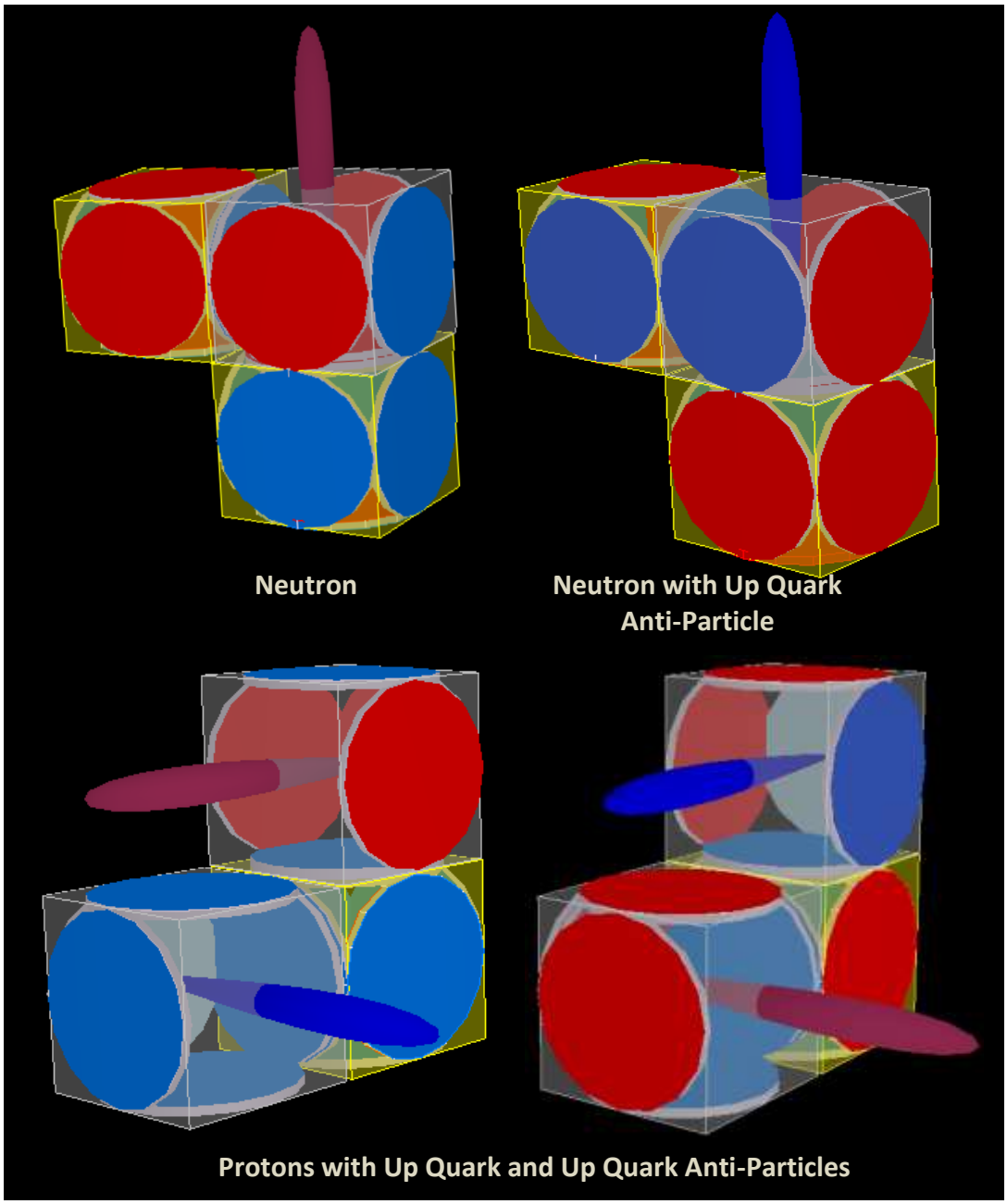


Figure 13: Block Models of L-Form Protons and Neutrons

A feature of CUFs is that the volume of energy directionally extends the magnesphere and the return vortex has difficulties coping with returning and distributing it to the enertrons involved. The result of the limited ability of an up quark to return the combined energy is a series of congestion blockages called **choke zones** (see figure 17), wherein energy is concentrated and frequently released. Also there is an inevitable amount of energy leakage.

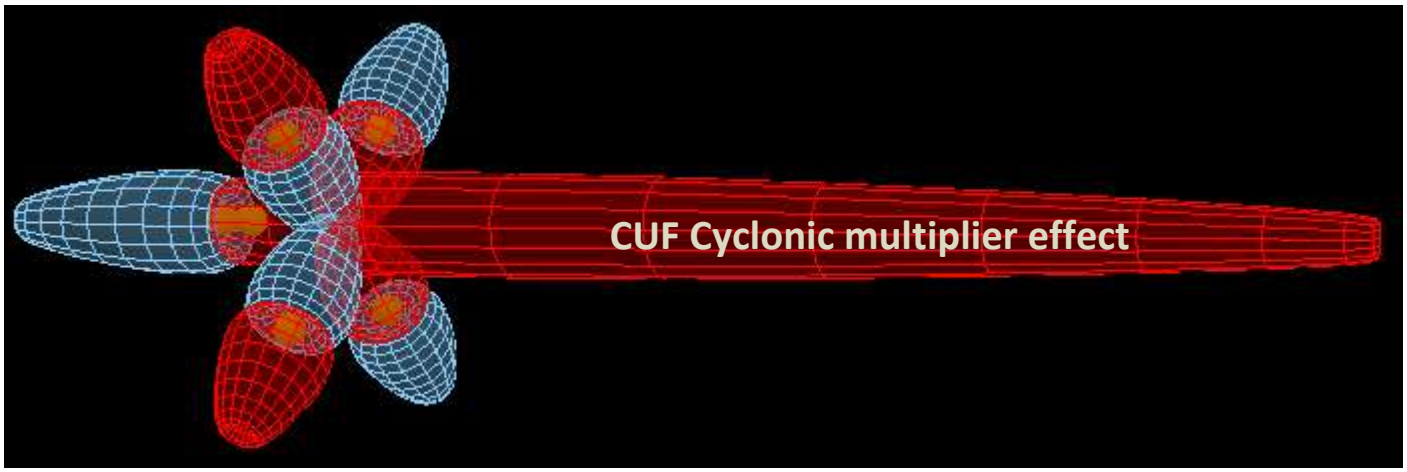
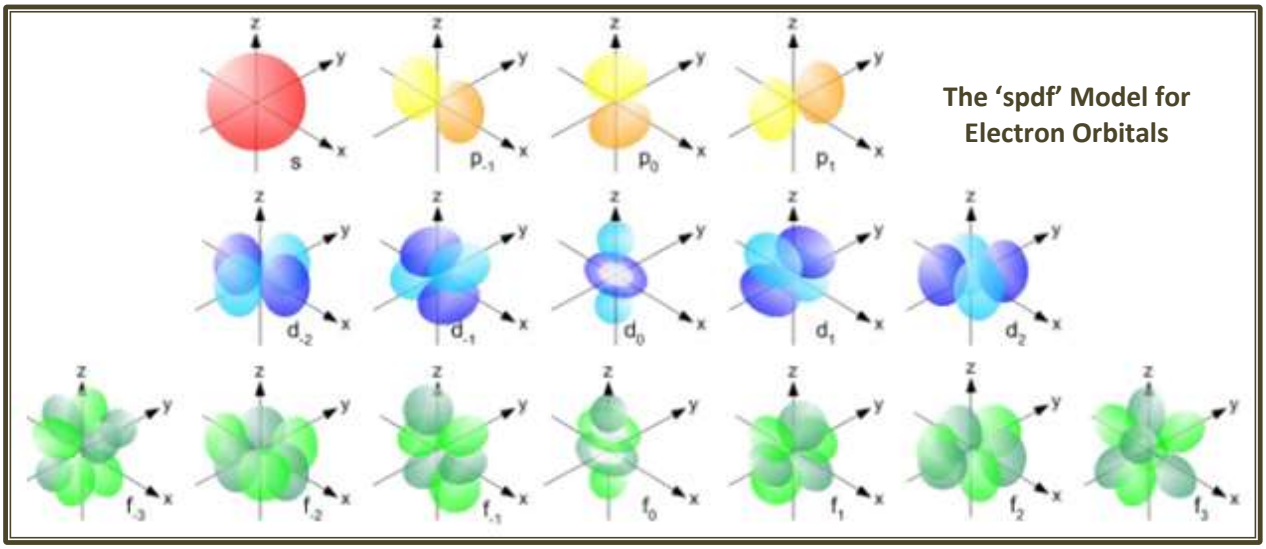
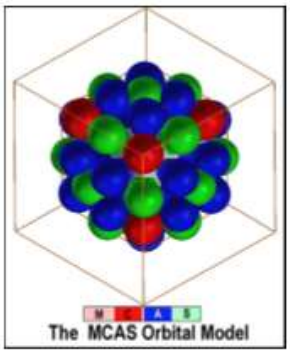


Figure 14: Enertron Model of Concentrated Up-Quark Field (CUF)

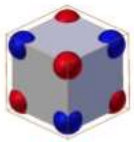
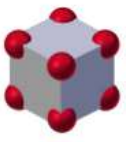
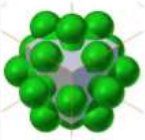
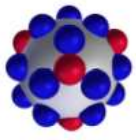
Atomic Orbits

The model for electron atomic orbital patterns is hotly disputed and far from an open and shut case. Figure 15 shows the 3 main contenders. The mathematically derived '**spdf**' model, developed in the 1930's, assumes that electrons and protons to be charged particles. In spite of the weird non-intuitive orbital patterns generated, it remains the preferred model supported in physics teaching texts and institutions. The **MCAS** model is good for explaining molecular structures and chemical bonding. The **Kanarev** model is a good all-rounder in terms of explaining bonding, is backed up by mathematics and laboratory based experimental results; but this model is only mentioned sparingly in Science circles outside the Soviet Union.





Accommodating Atomic Electrons at the Same Period Level

# e in level	2	8	18	32
MCAS Model				
Lobes	M2x4	C8	A18	SC32

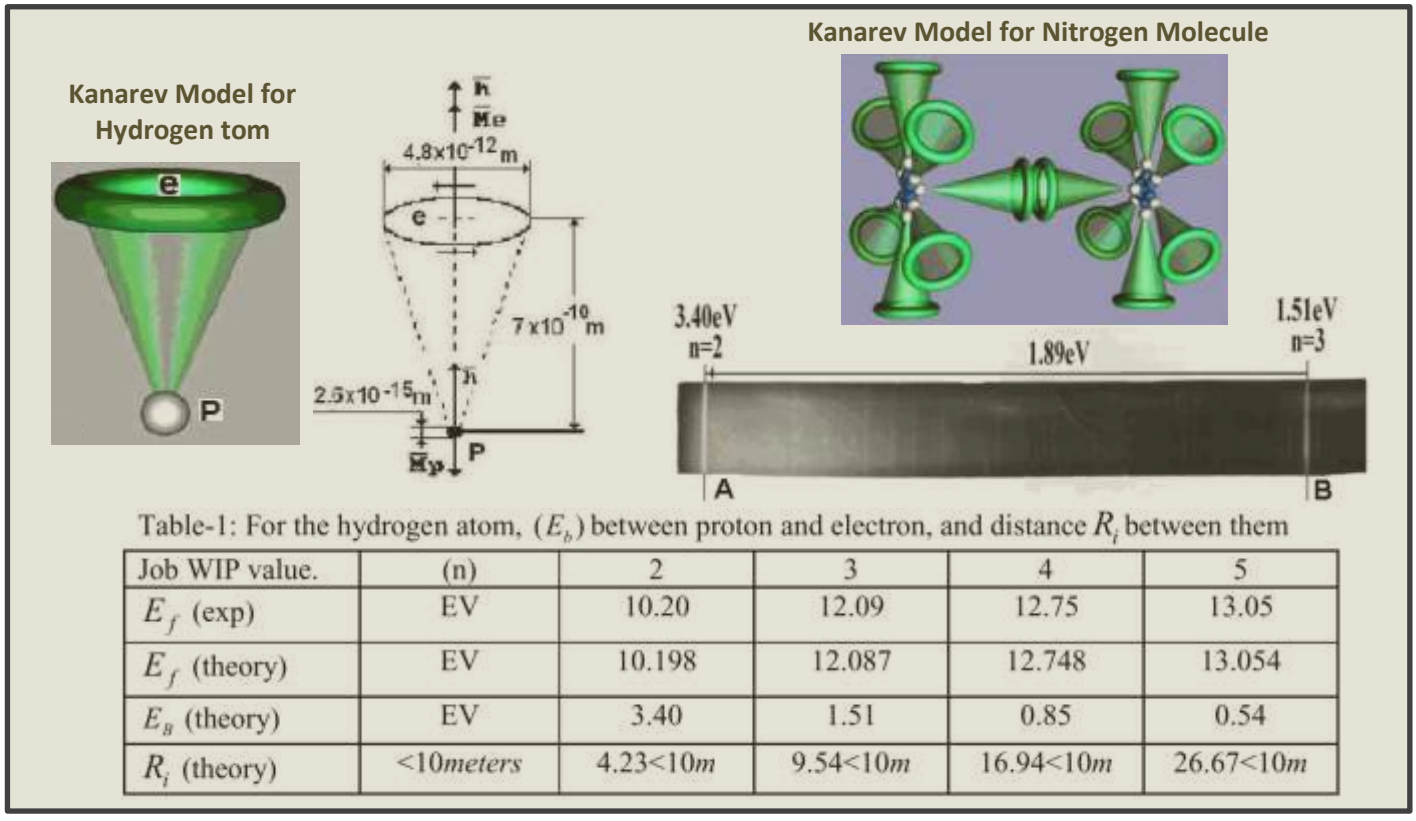


Table-1: For the hydrogen atom, (E_b) between proton and electron, and distance R_i between them

Job WIP value.	(n)	2	3	4	5
E_f (exp)	EV	10.20	12.09	12.75	13.05
E_f (theory)	EV	10.198	12.087	12.748	13.054
E_B (theory)	EV	3.40	1.51	0.85	0.54
R_i (theory)	<10*meters*	4.23<10*m*	9.54<10*m*	16.94<10*m*	26.67<10*m*

Figure 15: Electron Orbital Geometries for the 'spdf', MCAS and Kanarev Models

The next section provides guidelines for establishing 3D nucleon models for elements, concentrating upon the first period of the Periodic Table, and mapping out how nucleon modelling extends to the higher periods in the Table. The purpose of the 3D modelling is to show how nucleon structure and geometry generate the magnetic fields that create electron orbitals, isotope structures, and chemical bonding characteristics of elements, molecules and ions.

Nuclei Structures and Chemical Bonding

The simplest atom is that of **Hydrogen**, the first element in the Periodic Table with an atomic number of 1. Hydrogen is the lightest element on the periodic table and, in its monatomic form (H) is the most abundant chemical substance in the Universe, constituting roughly 75% of all baryonic mass. Hydrogen is a colourless, odourless, tasteless, non-toxic, non-metallic, highly combustible diatomic gas with the molecular formula H_2.

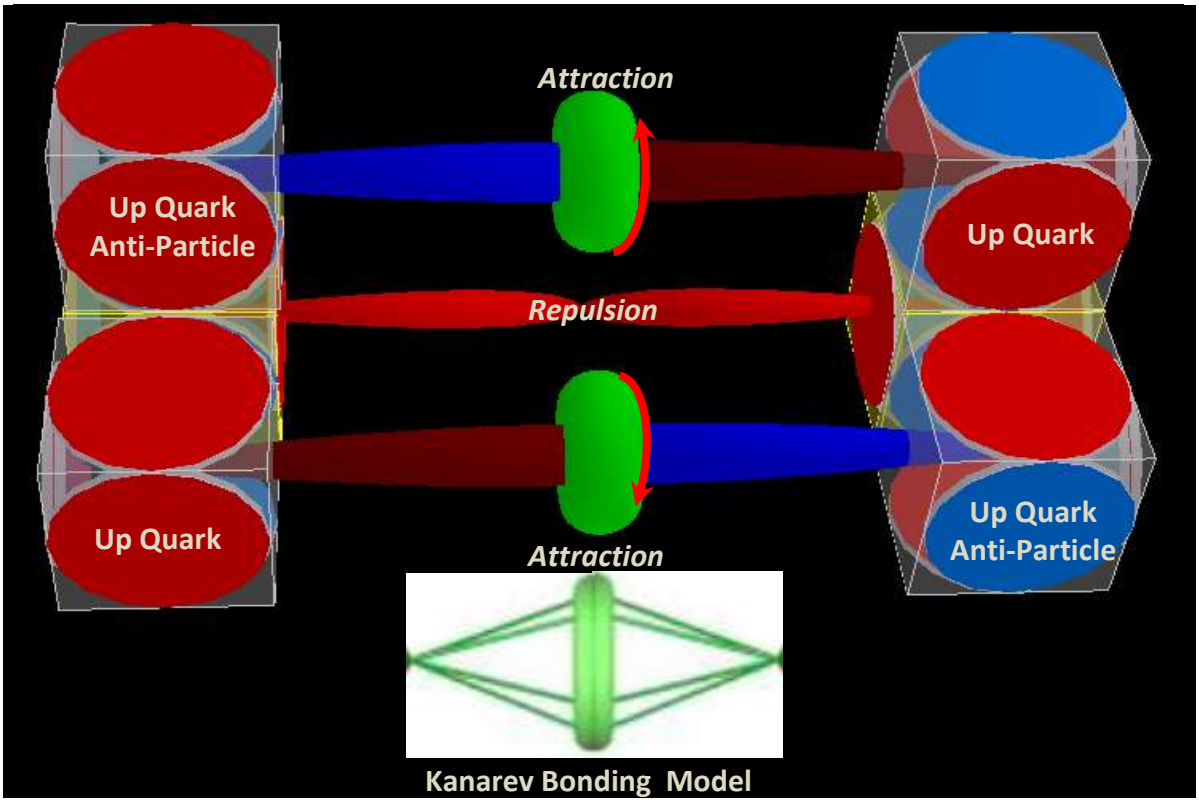


Figure 16: Block Model of a Diatomic Hydrogen Molecule

The Hydrogen nucleus consists of a single proton, and its diatomic H_2 molecule consists of 2 protons held together by strong attraction between the open faces of 2 pairs of up quarks(i.e. CUF pairs), held apart by the opposing force of repulsion of matched same-pole down quark enertrons (the 2 North poles in figure 16).

The green rings of figure 16 represent an **electron** orbiting within a torus mid-way between the bonded CUF pairs, rotating is in the direction of the conjoined magnespheres as detailed in figure 17. This model resembles Kanarev's electron orbitals rather than either the 'spdf' or MCAS models. The Kanarev model, with its conical, witch's hat form, contends that bonding electrons have 2 rotations within the torus; one around the torus in the direction of the conjoined magnesphere rotation, and the other around the ring axis of the torus. This produces a corkscrew trajectory within the torus which Kanarev's mathematical modelling and experiments are claimed to support.

It is possibly worth noting here that an alternative to the torus model for a pair of bonded CUFs is for the electron to be spinning with the same spin axis and in the same direction as the CUF pair's conjoined magnesphere. Because this simpler alternative has no research support, the more complex Kanarev-supported torus alternative is used to represent CUF pair electron bonding throughout this paper. However this simpler alternative is used to represent the attachment of free electrons to un-paired CUFs (see the section 'Free Electrons and Electrolysis').

Also, because the protons in the Hydrogen nucleus are virtually unconstrained (except by each other), they are more likely to be Δ-form protons (to be discussed later) rather than the L-form ones shown.

Due to the combined energy from five enertrons, un-paired CUFs produce energy at a rate greater than can be retrieved by the associated magnesphere vortex, leading to energy leakage. For a bonded CUF pair the excess energy is more contained by the conjoined magnespheres, and internally forms multiple ring-like zones (the **choke zones** of figure 17) along the return vortex wherein surplus energy is concentrated, compacted and formed into a mini-CES. When the energy compaction limit is reached and/or when CUFs are in an excited state, the choke zones act as pressure-release valves, releasing mini-CESs as **photons** of energy observed as **Electromagnetic Radiation** (EMR). The internal geometry of each element's nucleus dictates the separation distance of up quarks within bonded CUF pairs and the location of the choke zones, resulting in the release of EMR photons with slightly different energies and release frequencies, so forming a distinguishing **spectral line** signature for the element.

There is also the possibility that compaction and concentration of excess CUF energy in the central torus of a bonded CUF pair actually builds into an electron, leading to the speculation that **electrons can be dynamically formed within bonded CUF pairs**. Implicit in this speculation is a similarity between the nature of electrons and EMR photons, with both being considered to be CESs formed within choke zones, and with the electron representing an upper limit for the core energy of EMR photons (which is at the Gamma end of the spectrum). The **photoelectric effect**, whereby incident EMR photons above a threshold energy level trigger or are converted into electron emissions, adds credibility to this speculation; and certainly the possibility of dynamic electron creation would explain the ready availability and seemingly endless supply of free and bonded electrons within ordinary matter.

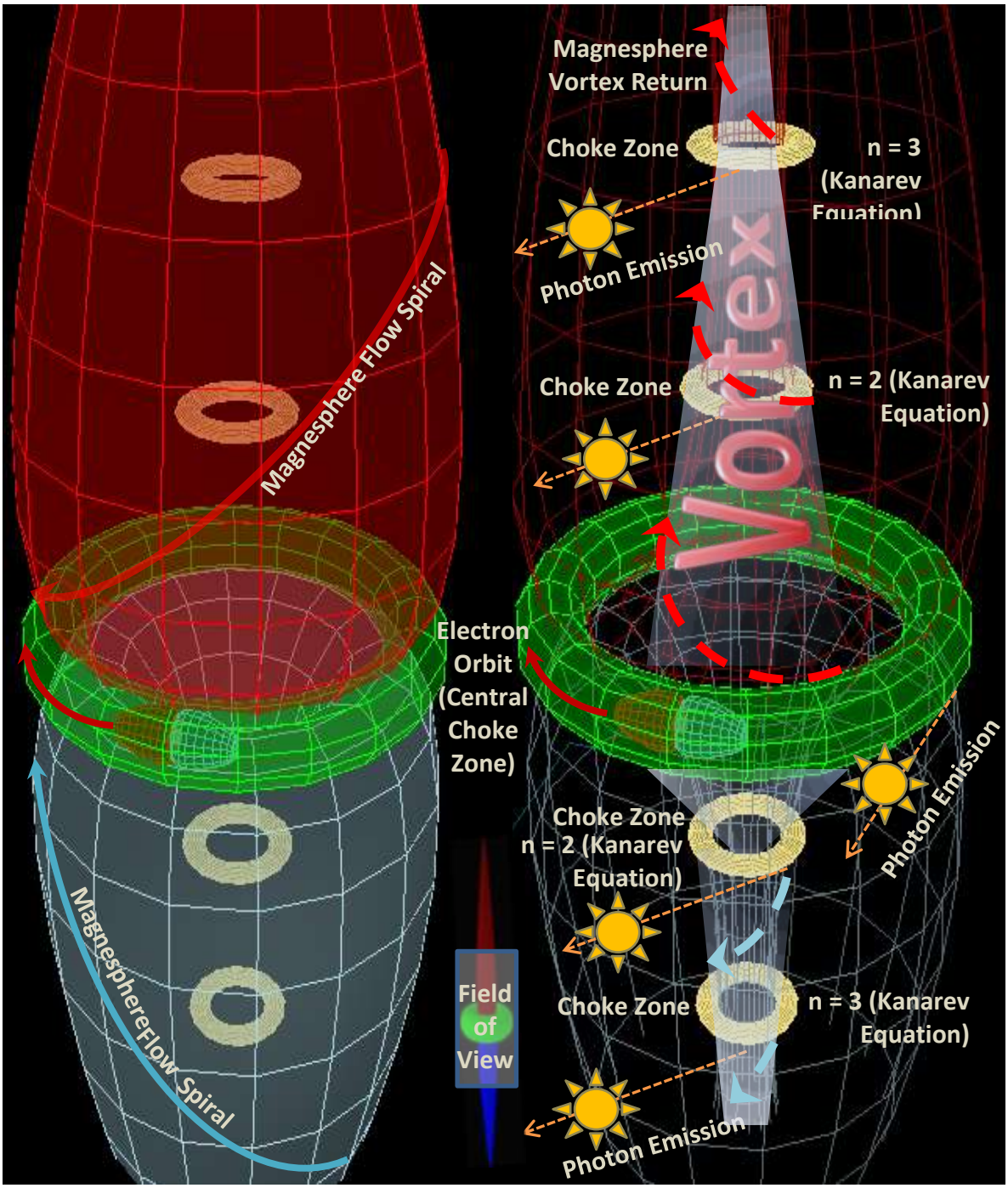
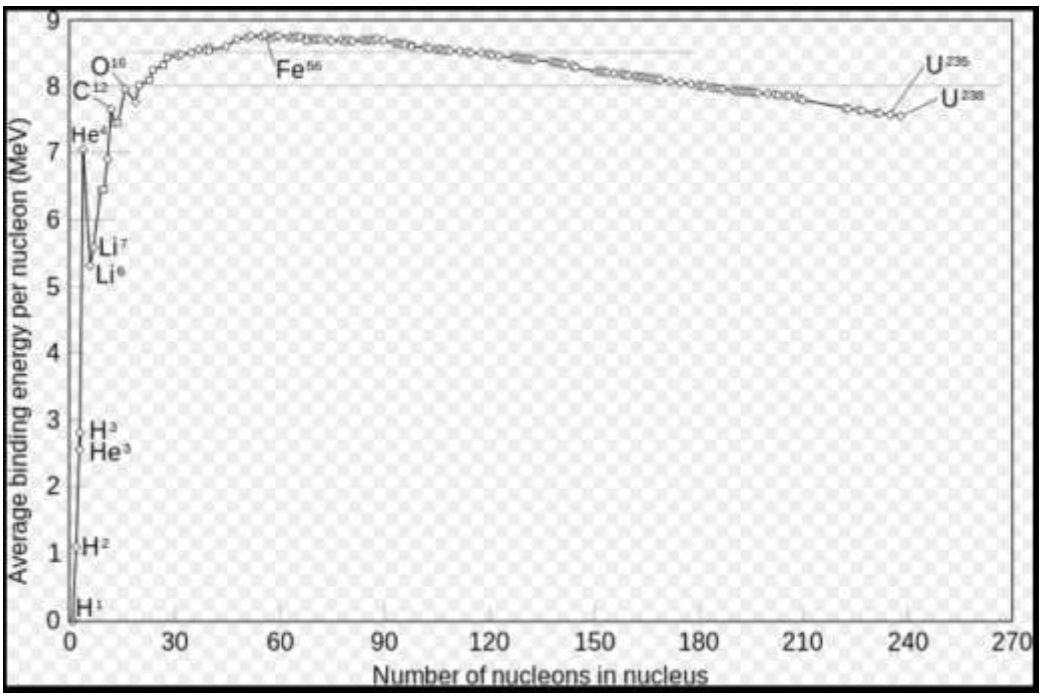


Figure 17: Paired CUF Dynamics - Bond Electron and EMR Emission

The second element in the Periodic Table is **Helium**, which is a colourless, odourless, tasteless, non-toxic, inert, monatomic gas, the first in the **noble gas** group in the periodic table.

The geometry of helium-4 results in a high binding energy compared with He-3 (see graph right). As alpha radiation, its nucleus can be quite damaging to other matter over short distances.

Only helium-3 and helium-4 isotopes are stable with one atom of He-3 for every million He-4 found in the Earth's atmosphere.



He-4 consists of two L-form proton and neutron pairs (figure 18) inter-locking to form a proton and a neutron layer. These layers have a duality: they can be considered to be inter-locking L-forms, or over-lapping I-form nucleoids. As the complexity of nuclei increases with increasing atomic number, I-form nucleon layers are easier to deal with.

The high binding strength and inert nature of He-4 is due to its cubic form, internal CUF bonding (2 proton pairs and one neutron pair) and reasonably inert due to the lack of external CUF bond hooks. Other noble gas elements are considered to have similar internal bonding patterns. Helium-3 is a weaker structure, consisting of three Δ-form or L-form nucleons: two protons and one neutron.

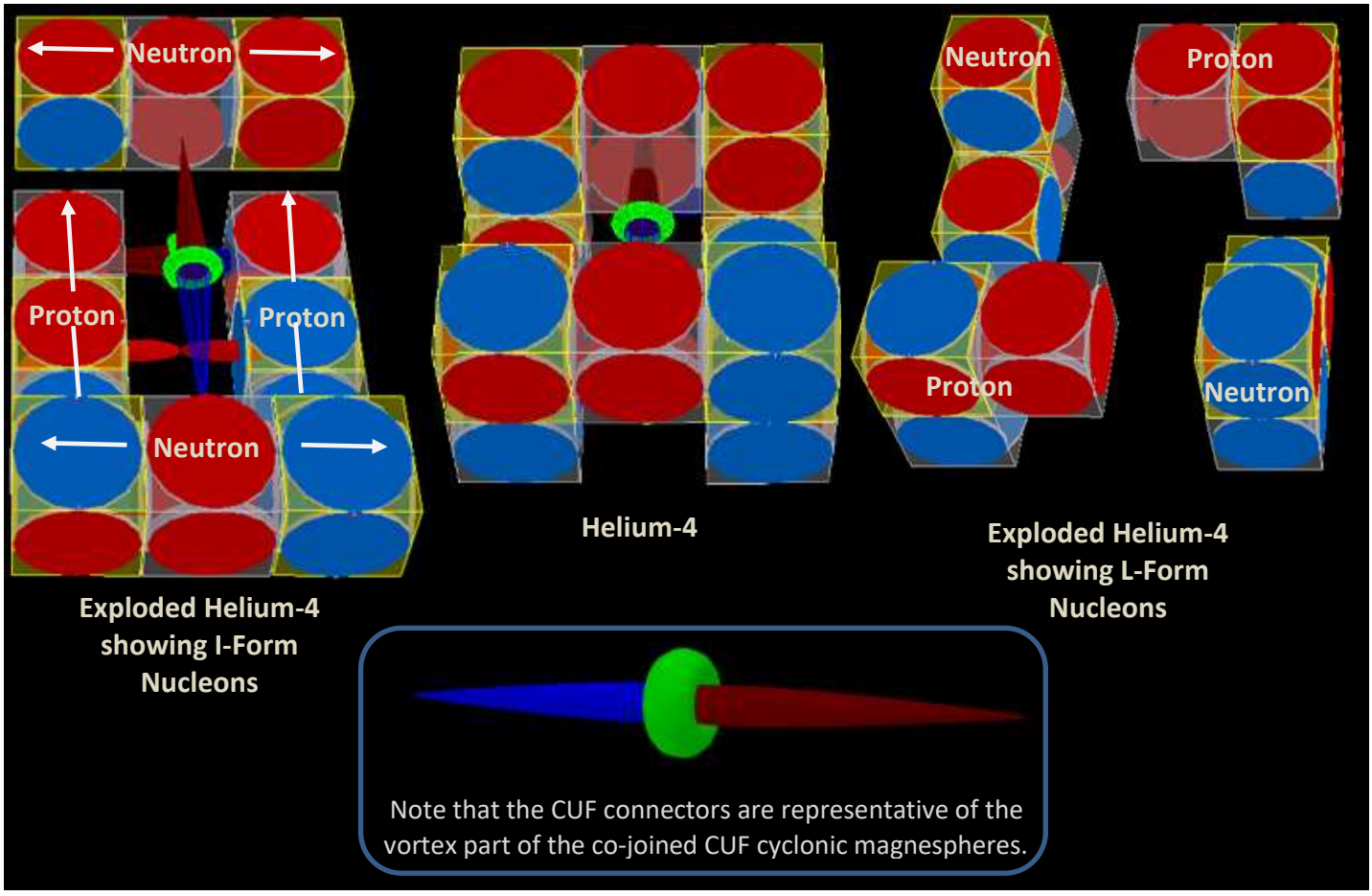


Figure 18: L- and I-Form Nucleon Block Models for Helium-4

Rather than the 2 electrons ($1s^2$) claimed by the 'spdf' model, E2M considers that He-4 contains 3 electrons that are internal to the nucleus.

The prospect of electrons embedded within the nucleus does not sit well with the 'spdf' and MCAS models that consider electrons to orbit around the nucleus; and certainly internal electrons would not be possible should electrons have a negative charge and protons positive charge.

The forth element in the Periodic Table is **Beryllium**, which is a divalent element only occurring naturally in combination with other elements within minerals. As a free element it is a steel-grey, strong, lightweight and brittle alkaline earth metal.

Primordial Beryllium predominantly consists of only one stable isotope, Be-9 (figure 19), and thus can be considered monoisotopic. In effect it consists of 2 He-4 nuclei bonded together by 4 CUF bonds. The result is 2 co-joined proton layers sandwiched between 2 neutron layers.

Should Be-9 lose its extra neutron it can decay to Helium-4 in the form of alpha radiation.

Radioactive cosmogenic Be-10 simply has an additional Δ-form or L-form neutron that can bond with the other extra neutron. It is produced in Earth's by the cosmic ray spallation of oxygen. It accumulates at the soil surface, where based on a half-life of 1.36 million years, it beta-decays (described later) to boron-10.

As the Atomic number of elements increase, so does the range of nucleus polygonal shapes and thus **allotropic** forms elements can take. The proton and neutron layering can be seen in in figure 20 for the tetragon, hexagon and octagon forms.

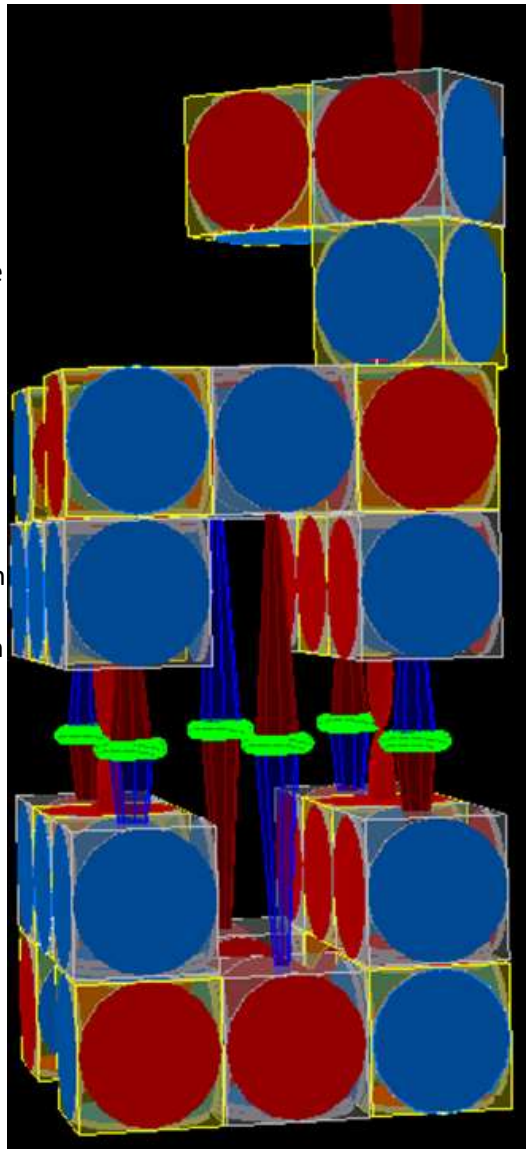


Figure 19: Block Model of Beryllium-9

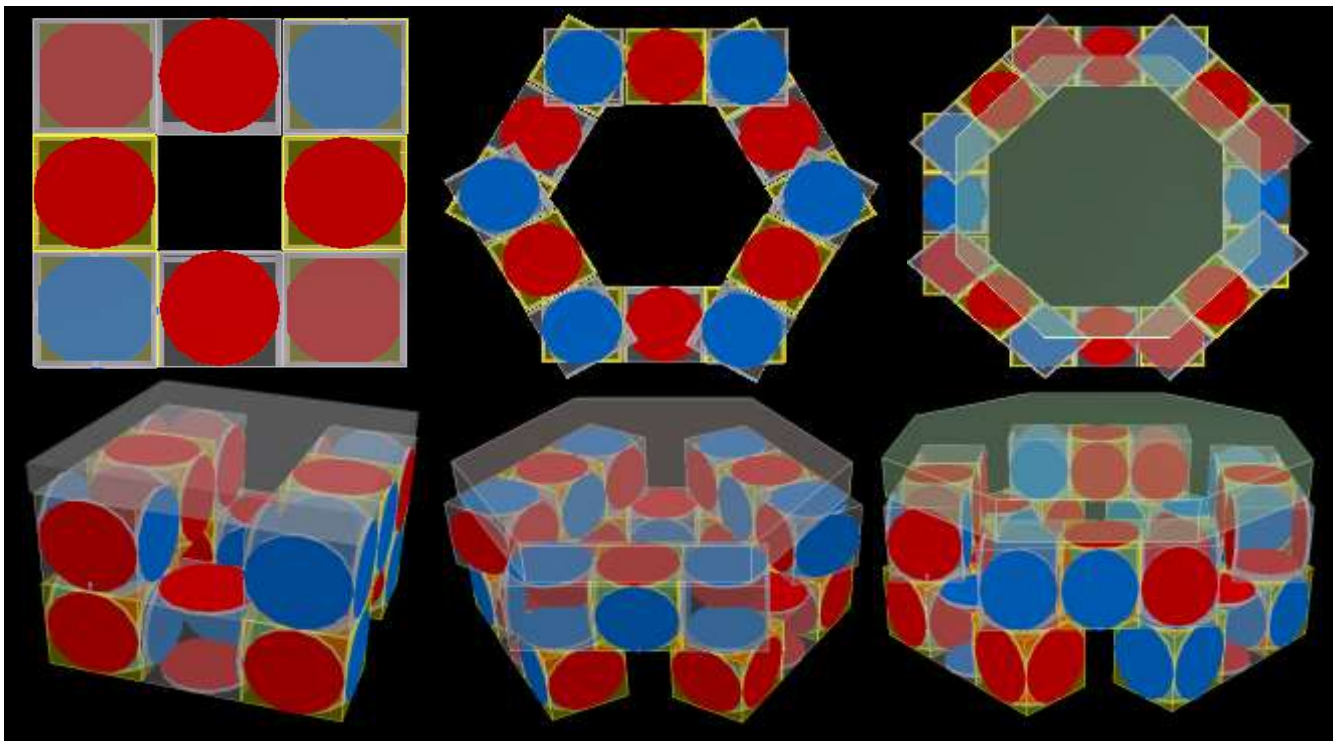
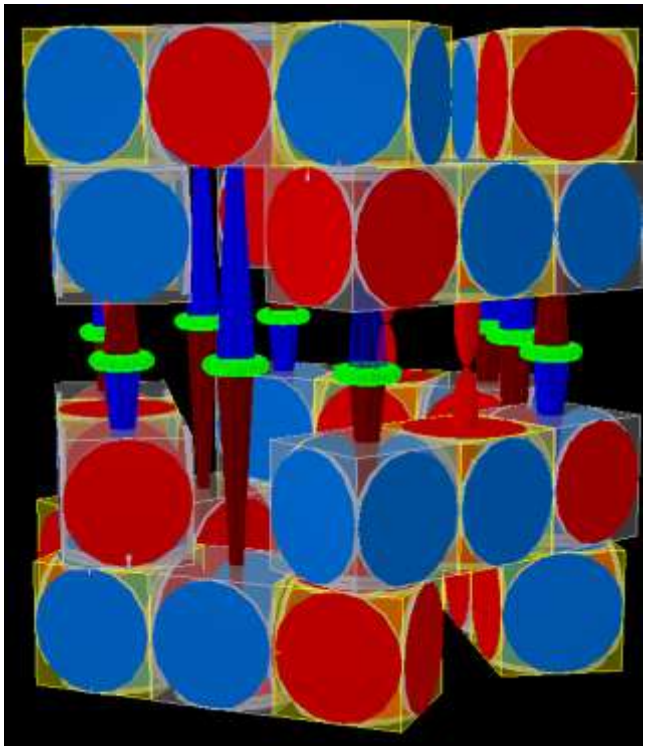


Figure 20: Block Model of Tetragon, Hexagon and Octagon Nucleon Forms

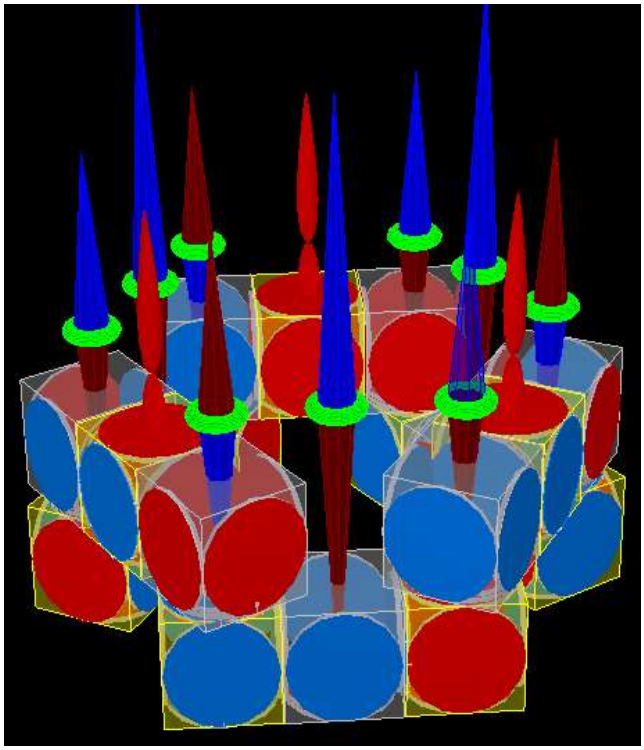
The sixth element in the Periodic Table is **Carbon**. It is non-metallic and only 3 of its 15 known isotopes occur naturally. C-12 and C-13 are stable whereas C-14 is radioactive, beta-decaying (see later) with a half-life of about 5,730 years. C-12 forms 98.93% of the carbon on Earth, while C-13 forms the remaining 1.07%. The concentration of C-12 is increased in biological materials because biochemical reactions discriminate against C-13.

Carbon has two allotropic forms: a tetragonal form presenting as **diamond** and an hexagonal form presenting as **graphite**. Physically these allortopic forms of carbon are completely different; diamond is hard, capable of cutting glass, and clear; graphite is soft, layered and pencil-grey.

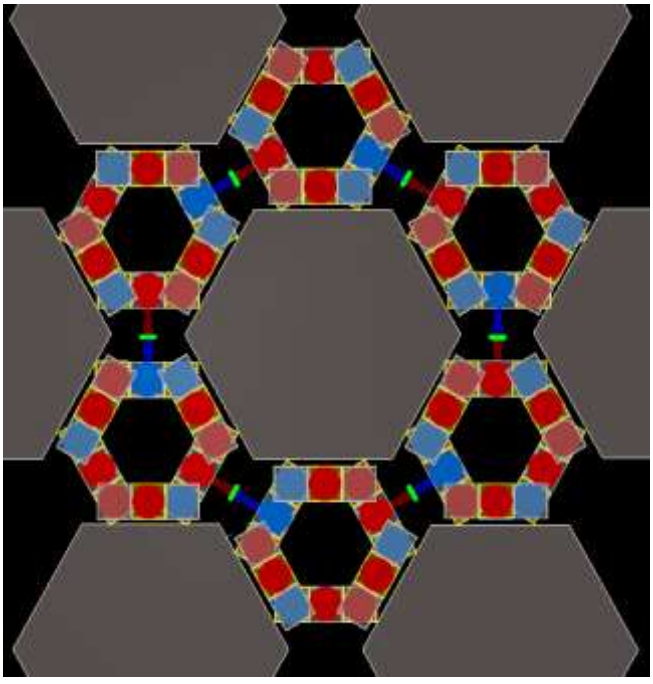
Following the pattern of Be-9, graphite has 2 co-bonded proton layers (and thus at least 6 internal electrons) sandwiched between 2 neutron layers. Adjacent I-form neutron and proton layers form into a hexagonal geometry. Out-facing CUFs within the neutron layers provide 3 pairs of single-bond CUF hooks that bond to adjacent graphite C-12 molecules to create the in-layer symmetry of graphite sheets, which can be clearly seen when viewed from above as in figure 21.



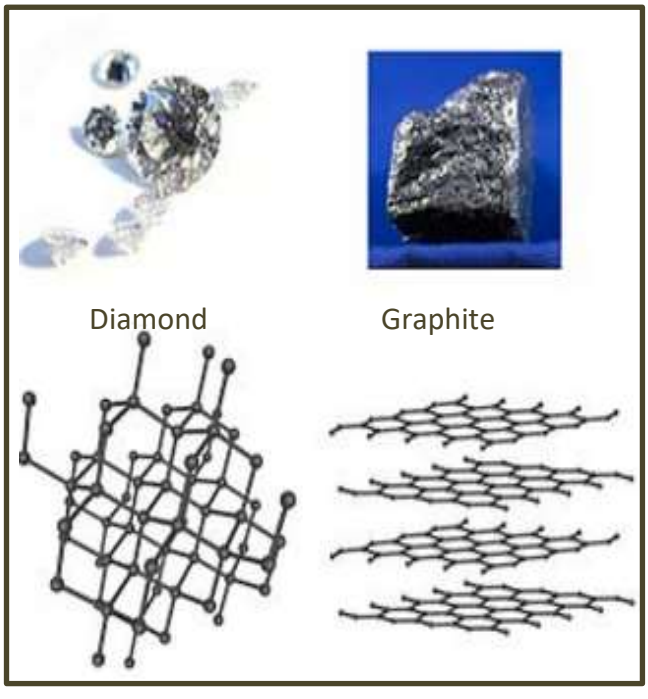
Graphite C-12 : 2 Co-Joined Layers



Graphite C-12 : Co-Joined Layers Bond Detail



Graphite C-12 : In-Layer Co-Joining



Carbon C-12 : Allotropic Forms

Figure 21: Block Models of C-12 Graphite Allotropic Form

The **diamond** allotropic form of Carbon is tetragonal that forms into a cubic crystal system. As shown in figure 22, it has 9 internal electron orbits and no external CUF bonding hooks. The internal bonding adds to the strength of diamond and the absence of external bonding hooks renders it chemically non-reactive.

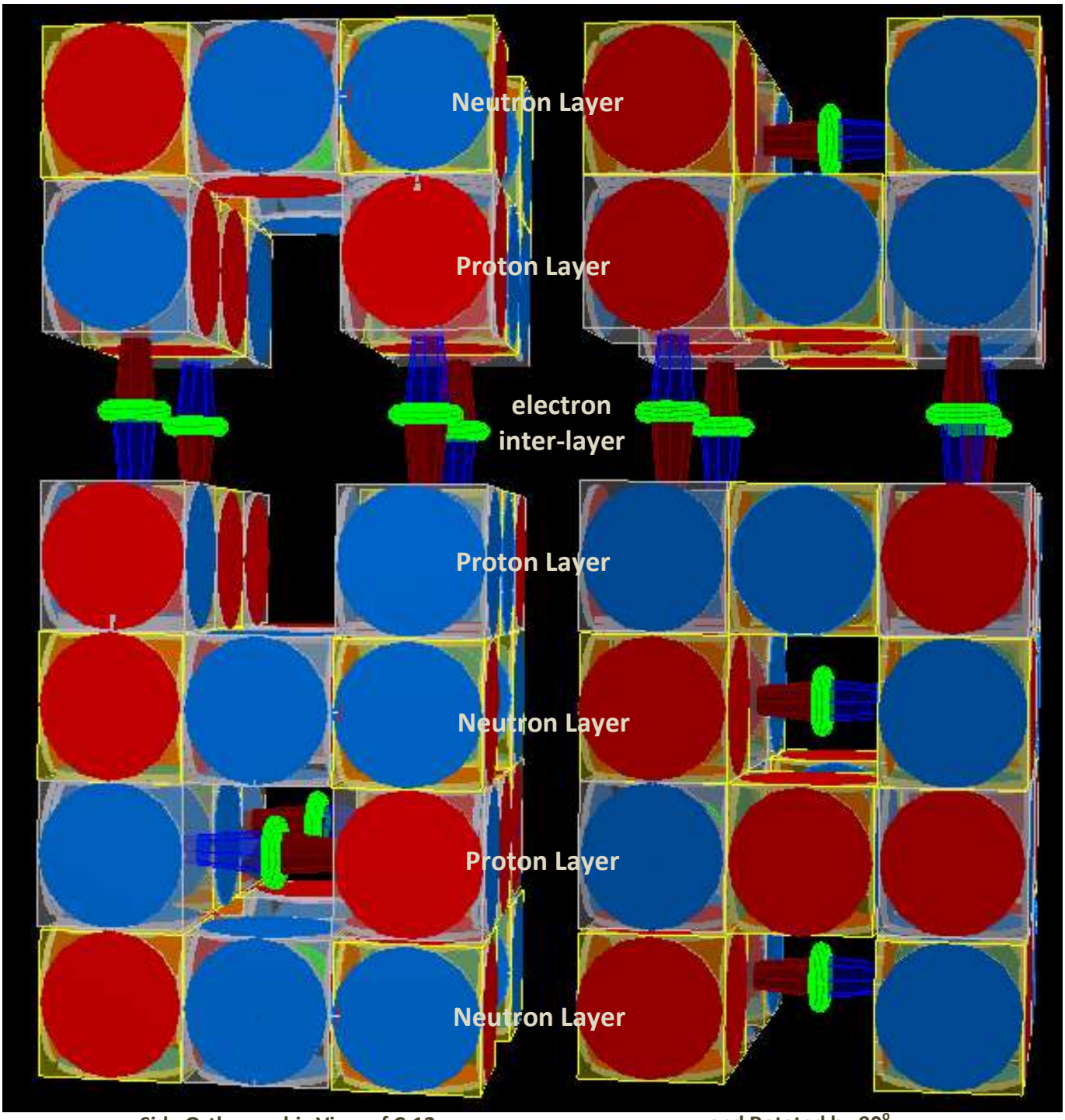


Figure 22: Block Model of C-12 Diamond Allotropic Form

At this stage it is worth discussing the evolving patterns within the E2M nuclei models. Protons and neutrons tend to form separate layers within the nucleus, which interlink to form polygon forms. When there are two or more proton layers, the co-joining of pairs of proton layers (the top 2 proton layers in figure 22) is preferred over the direct joining of layers (lower part of figure 22), which only occurs if there is an odd number of proton layers as for C-12.

Polygonal forms for nucleus geometry can only increase in even side number increments, as they are formed from the linked I-form nucleons (or inter-locked L-formms) as adjacent proton and a neutron layers. Polygons with an odd number of sides can only appear as a subset of a larger polygon with an even number of sides (e.g. pentagon geometries can only be a subset of a decagon geometry). The range of polygonal possibilities and their layer count (per pattern per element) can be seen in the arithmetic progressions of the figure 23 tabulation.

Key evidence for determining which allotropic and thus polygonal forms are appropriate for any element in the Periodic Table can be gleaned from chemical structures and chemical bonding preferences it forms with other elements and ions. Once the polygonal form(s) is established, an excellent working E2M model of the atom can be created that defines its internal geometry and its bonding hook availability, orientation and related physical properties.

Periods 1 to 3 Potential Nucleus Structures

		Polygon Names/No. Sides of Polygon/External Angles/Level Ajacent Face Angles																
	names	Tetra	Hexa	Octa	Deca	Dodecа		HexaDecа				Tetracosa				Triacontadi		
	# polygon sides	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
	# protons	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Extrernal Angle Degs	90	60	45	36	30	25.71	22.5	20	18	16.36	15	13.85	12.86	12	11.25	10.59	10
	Level Adjacent Angle	180	120	90	72	60	51.43	45	40	36	32.73	30	27.69	25.71	24	22.5	21.18	20
AN	Element	Possible Nuclide Geometries and Layer Counts																
1	H																	
2	He	1																
3	Li		1															
4	Be	2	1+1	1														
5	B		1+2	1+1	1													
6	C	3	2			1												
7	N		2+1		1+2		1											
8	O	4		2	1+3			1										
9	F		3						1									
10	Ne	5			2					1								
11	Na										1							
12	Mg	6	4	3		2						1						
13	Al												1					
14	Si	7			2+4		2							1				
15	P		5		3										1			
16	S	8		4	3+1			2								1		
17	Cl																1	
18	Ar	9	6			3			2									1

Magnesium Diborate (MgB2) = Hexa Decaborane (B10H14) = Hexa

Racetams (drug class) and Pyrrolidine/tetrahydropyrrole (CH2)4NH, NH3 = Deca

Tetrahydrofuran (THF)

Siloles (silacyclopentadienes) = Deca

Figure 23: Nuclei Polygonal Forms for Periods 1 to 3 of the Periodic Table

As the atomic number of elements increases, with the E2M model there is no need to match growing numbers of protons within the nuclei with oppositely charged electrons in increasingly more complex orbital shells. It is the polygonal geometry of the nucleus, and of the geometry related outward-facing CUFs that dictate the bonding characteristics of elements. Electrons only appear in response to CUF bonding, and orbit only within the toroid that forms mid-bond rather than around the nucleus.

The increase in the number of nucleons, as per the Periodic Table, is accommodated by a combination of larger polygonal forms and the embedding of one form within another. Such embedding of one atomic structure within another starts with Helium, if it is considered to contain embeeded H_2 molecules, at the lower end of the Periodic Table and continues with larger pollygonal forms further up the Periodic Table.

Elements of the 3rd period are transitional embedding tetragon forms within octagon forms (figure 24 and ↓ in table right).

By the 4th and 5th period the hexadecagon (16-gon) form is added (lower figure 24 graphic), with the triacontadigon (32-gon) by the 6th period.

Similar embedding of hexagon forms within the dododecagon (12-gon) form is possible, even extending to the tetracosagon (24-gon) form.

Framework Geometry	Period Number						
	1	2	3	4	5	6	7
Tetragon			↓	↓	↓	↓	↓
Octagon			↓	↓	↓	↓	↓
Hexadecagon				↓	↓	↓	↓
Triacontadigon						↓	↓

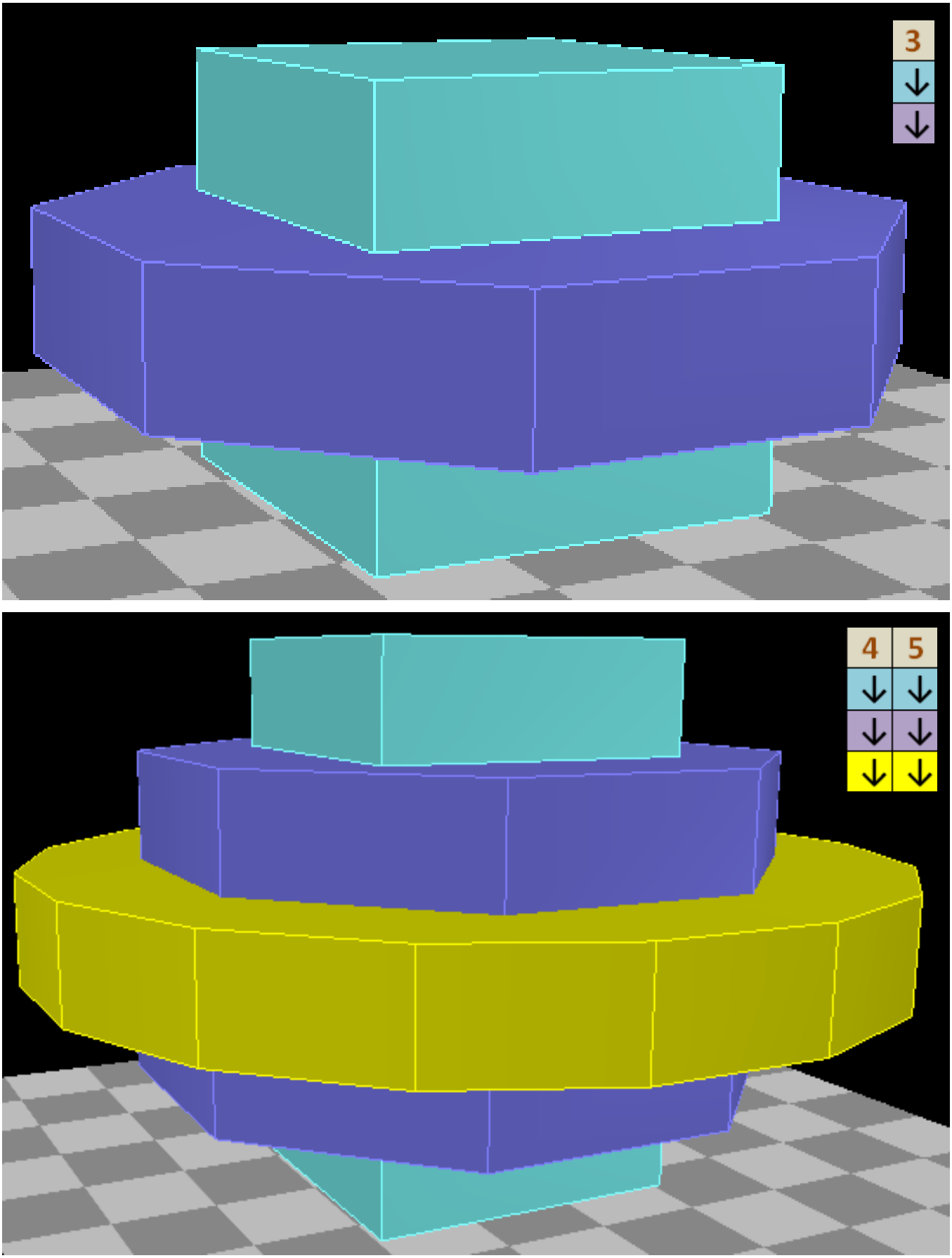


Figure 24: 4-8-16 Polygonal Embedding of Nuclei (Period 3 and Onwards)

Radioactive decay of atoms, which occurs across a wide range of elements, and particularly for those with high atomic numbers, causes an unbundling of the embedded nuclei. Proton and Neutron radioactive decay is addressed in greater detail shortly.

The embedded nuclei and the combination of polygonal forms are demonstrated by comparing the atomic structure of Copper, Silver and Gold in group 1B spanning periods 4 to 6 of the periodic table and having atomic numbers 29, 47 and 79 respectively. To reduce the chunkiness of the detailed block models used so far, a simpler stick block notation with **protons** coloured gold and **neutrons** green is used for larger atoms. Keep in mind that these still represent 3-D patterns of CESs held in place by magnesphere interactions rather than being rigid rectangular forms.

Figure 25 shows nested proton/neutron tetragon, octagon and hexagonal layers. For Cu-63 there are 2 proton/neutron polygonal layers joined by paired CUF bonds. The octagonal layers are also attached to the enclosing hexagonal layers by 4 pairs of CUF bonds, whereas the nested tetragon is more rigidly attached to the enclosing octagon by neutrons. Cu^{++} bonding is via a top or bottom mounted valency proton.

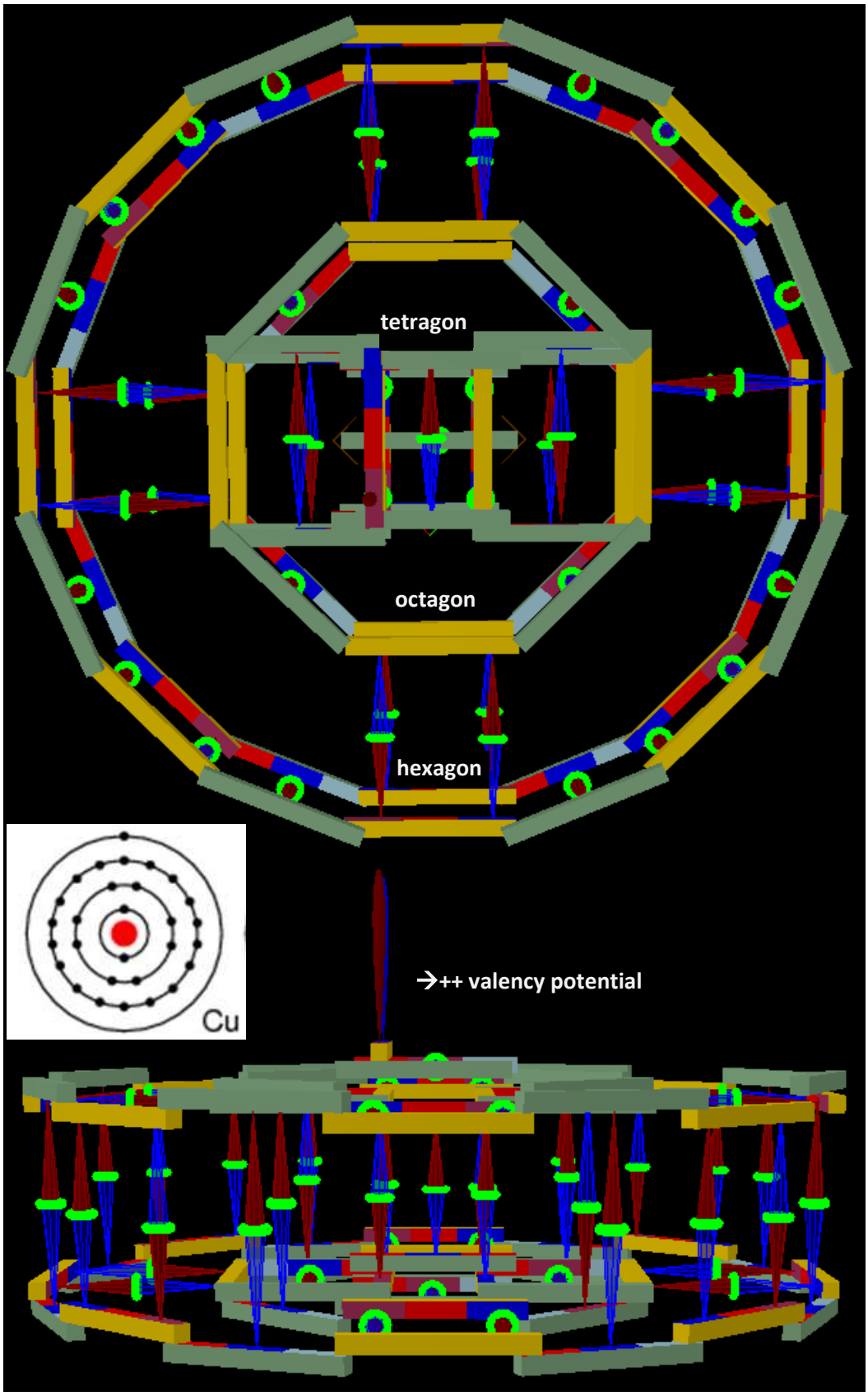
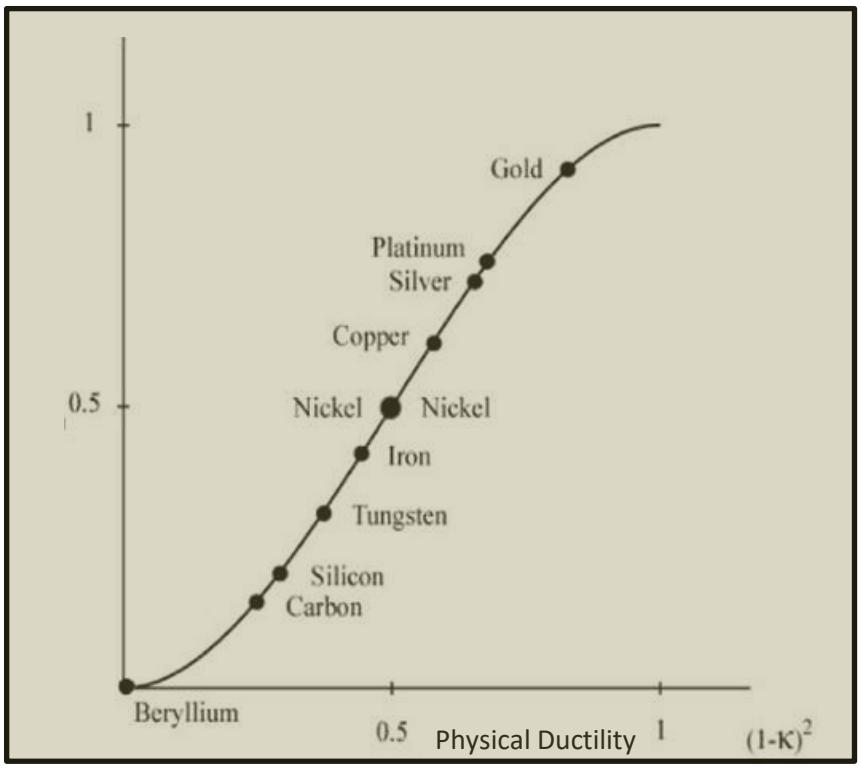


Figure 25: Stick Model of Copper-63

The physical characteristics of these metals match quite well with their E2M atomic structure model. Gold's two triacontadigon (32-gon) layers (figure 27) overlap its central hexagon layer contributing to its malleability - Gold is the most malleable of metals, followed by Silver, Aluminium and Copper.

Gold and Silver are also the 2 most ductile of metals (see graph right) with Copper being the 6th behind Platinum, Iron and Nickel. Also, the Shear Modulus of Copper is 48 GPa, reflecting its more compact form, compared with 30 and 27 GPa for Ag and Au respectively.



The 'spdf'-modified Bohr models offer absolutely no explanation for the neutron obesity problem (i.e. the high number of neutrons in 'excess of needs' or expectation).
However, as shown in the table below summarising the statistics of E2M models, each proton and neutron is needed, forming an important part of each atom's unique structure and physical and chemical characteristics, and is fully accounted for.

Note. →+ and →++ indicate valency potential of nuclides with external-facing CUFs

Metal Isotope	Level 1 (Top)		Level 2 (Middle)		Level 3 (Bottom)		Totals	
	Protons	Neutrons	Protons	Neutrons	Protons	Neutrons	Protons	Neutrons
$_{29}$**Cu-63**	14+1(→++)	17	-	-	14	17	29	34
$_{47}$**Ag-107**	15	15+1(→+)	18	28	14	16	47	60
$_{79}$**Au-197**	30+1(→++)	45+1(→+)	18	24	30	45+1(→+)	79	118

The polarity of the faces of individual I-form nucleons must be compatible with adjacent abutting nucleons, but the external quark face polarity patterns can vary considerably. However, the geometric arrangement of the nucleons is unique and specific for each element, reflecting the natural selection process to find a preferential configuration for the magnetic fields of the nucleons. Should one or more nucleons be out of place, then you have a different element or isotope that may or may not be stable.

The Standard Model suggests that the nucleus to be an amorphous central ball of nucleons, whereas the construction of E2M's 3-D stick models proved to not be much more than just a numbers game involving the ad hoc addition of a few nucleons here and there to build up nucleon numbers to transform one element's structure into that of another similar one (e.g. from Copper to Silver to Gold). To the contrary, some variations proved to be quite subtle and non-intuitive, such as the tetragon structures formed by six neutrons for Copper but only four for Gold; the additional neutron layer to support the central hexagonal layer in Silver and Gold; the additional neutron layer to support Gold's two triacontadigon (32-gon) layers; and the staggered neutron CUF supports between the tetragon layers within Gold. There is little room to vary the nucleon geometry for a given isotope of an element.

Copper, Silver and gold are good **conductors of heat**. Heat is caused by the excitation of CESs, including bonded and attached free electrons. The extra energy causes free electrons to move about repeatedly bumping into each other and to even bump-release more bond electrons (see 'Free Electrons and Electrolysis' section). The excited free electrons migrate away from the areas of greatest excitement, the areas where heating is concentrated, presenting as **heat conduction**. Increased energy levels within bonded CUFs generate more electromagnetic radiation presenting as **heat radiation**.

The bond hooks (un-bonded CUFs) of all of these three metals can acquire and hold free electrons, that can be readily induced to move as an electric current by an applied electromagnetic force as described earlier in this paper. Thus they are good **conductors of electricity**.

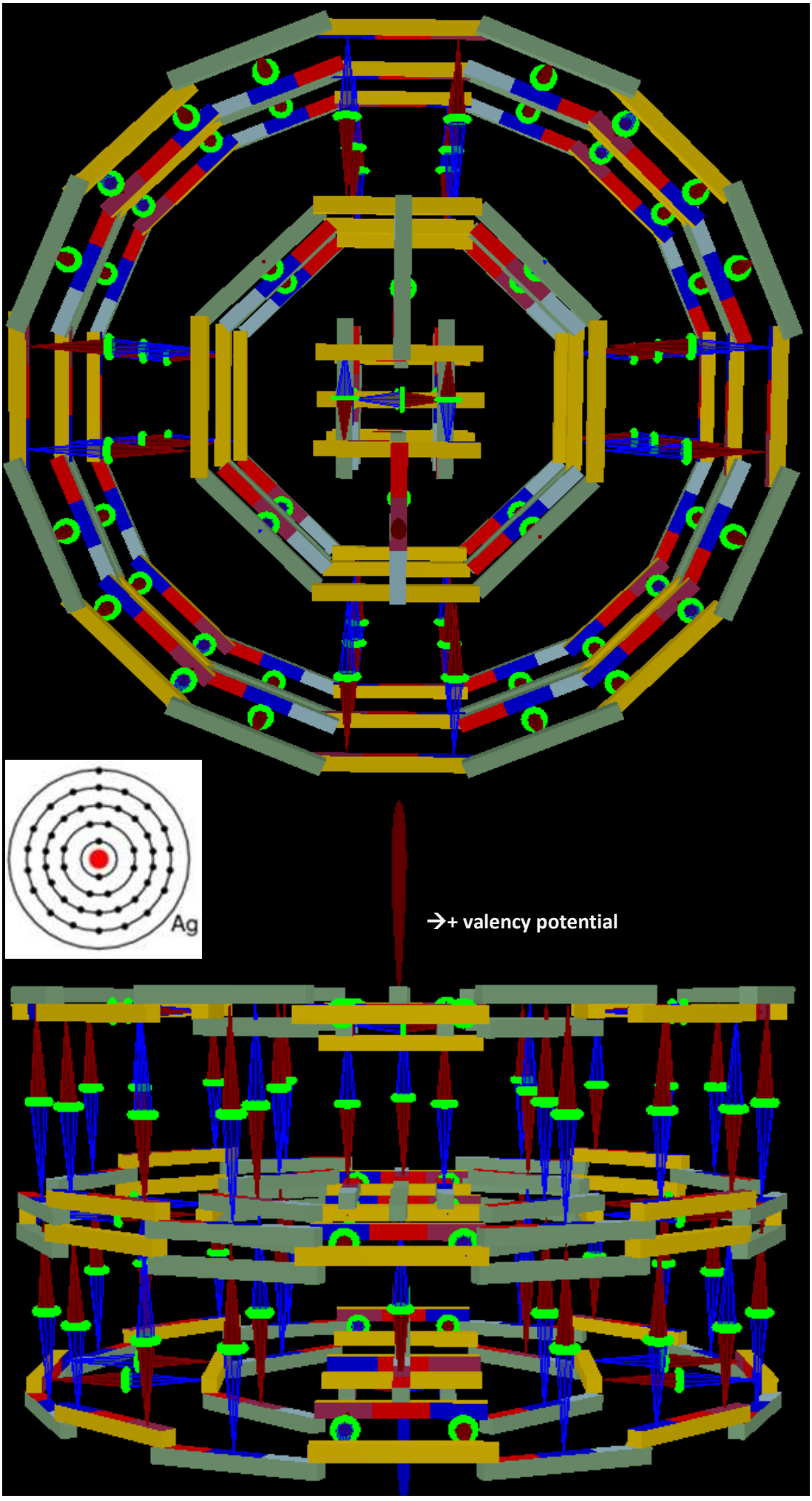


Figure 26: Stick Model of Silver-107

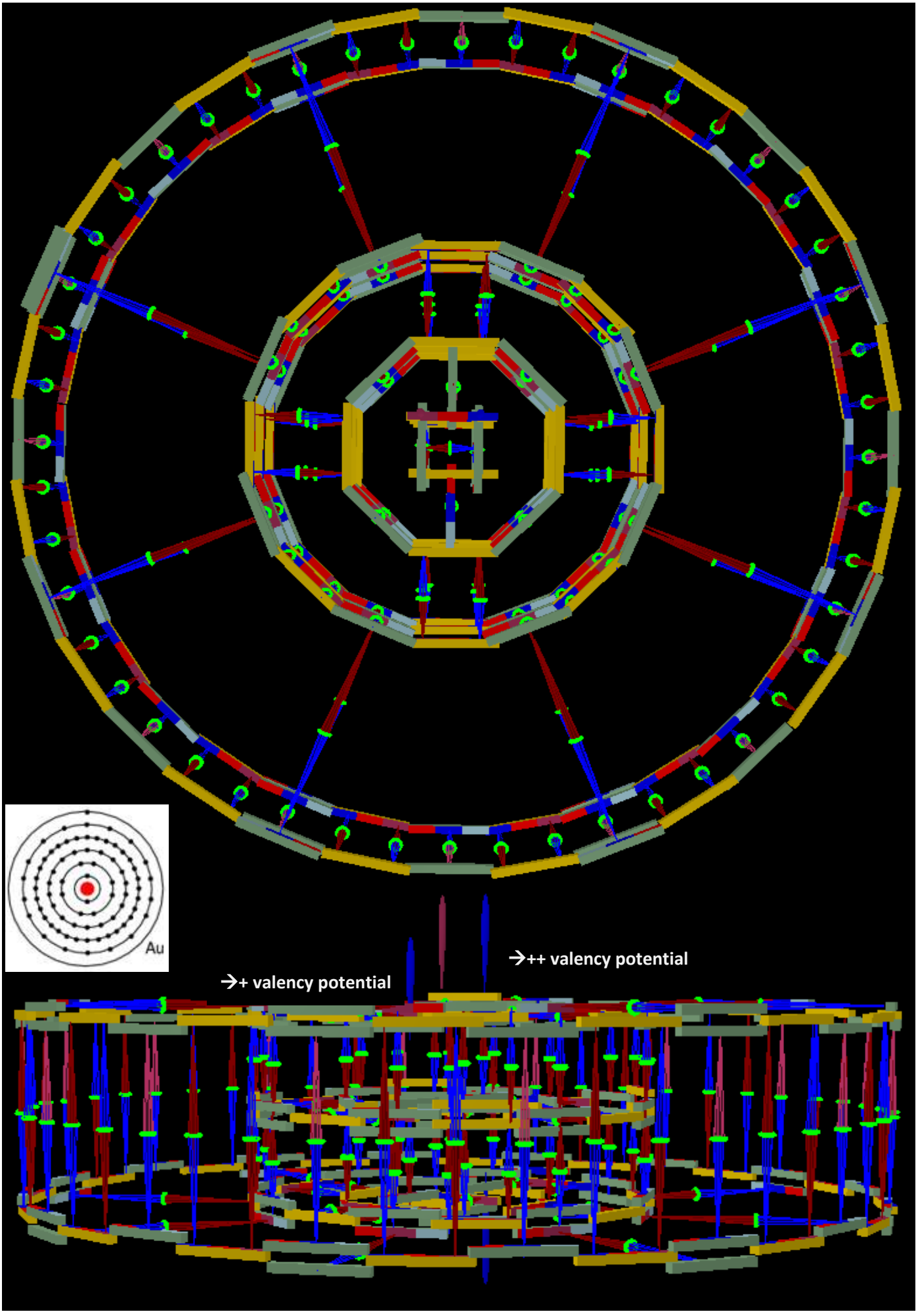


Figure 27: Stick Model of Gold-197

Figure 28 shows two alternative models of nanoparticles for gold. Both models are compatible with the E2M models with water molecule potential bonding locations shown by the symbols ⊗ and ⊕. As a noble metal, oxygen does not electron bond with oxygen. For the nanoparticles the bonding is in the form of oxygen adsorption which is only slightly less strong than that of electron (or chemical) bonding.

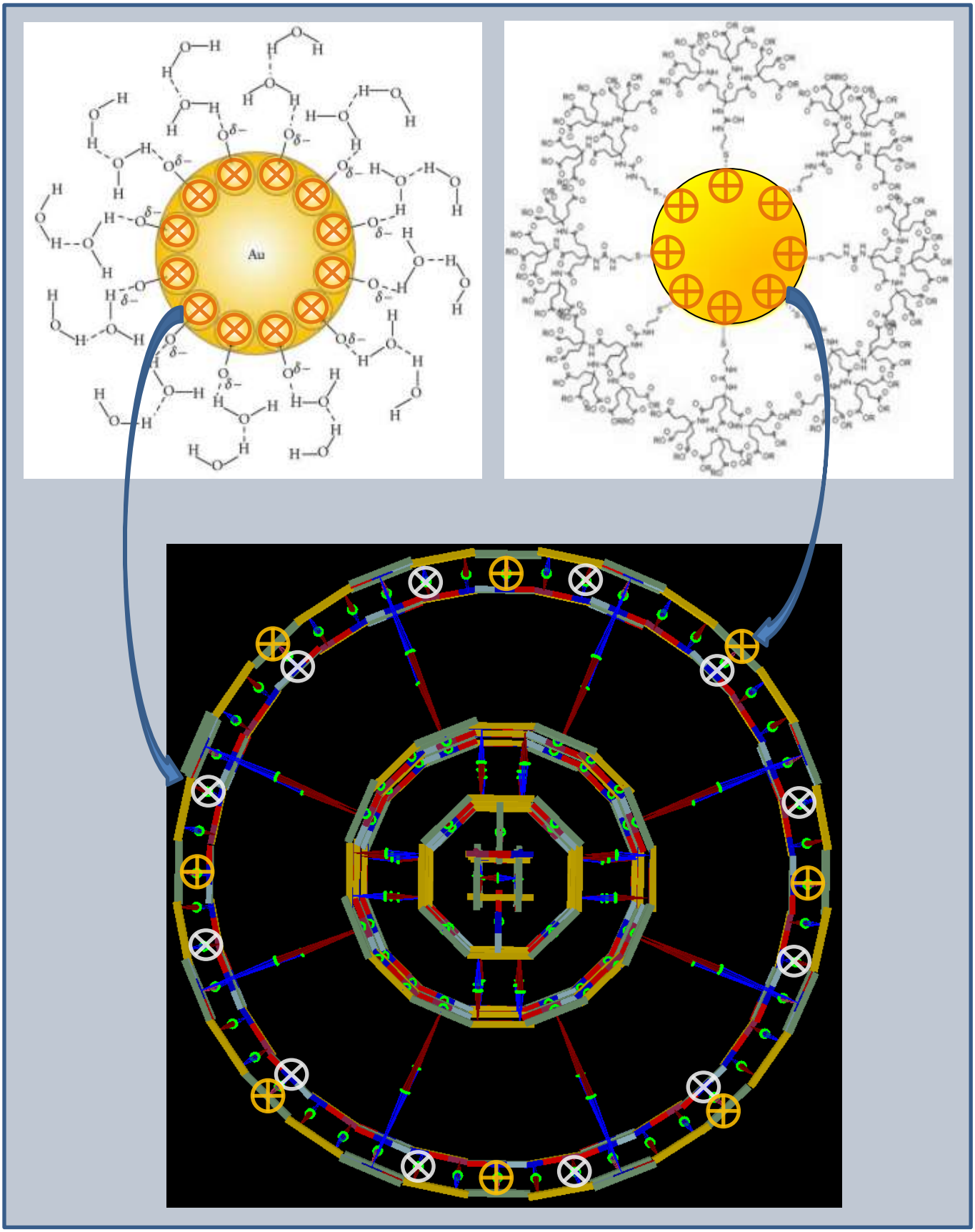


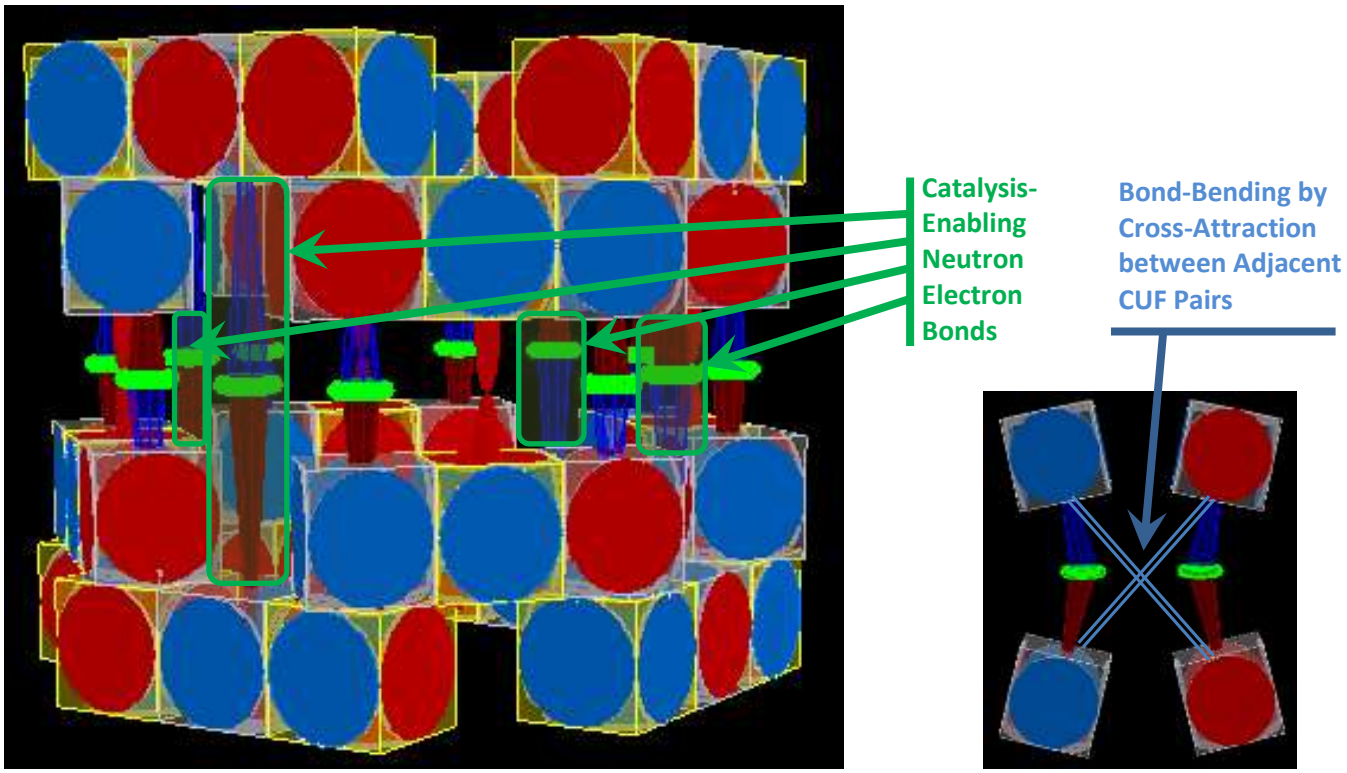
Figure 28: Models for Gold Nanoparticles in Water

Figure 29(a) highlights the I-form neutron pairs whose electron bond is most likely involved in oxygen adsorption evident in water-based Au and Ag nanoparticles and in catalysis (a pre-cursor to many chemical reactions). Figure 29(b) shows how bond-bending cross-attraction (═) of CUF pairs in adjacent atoms/molecules enables adsorption.

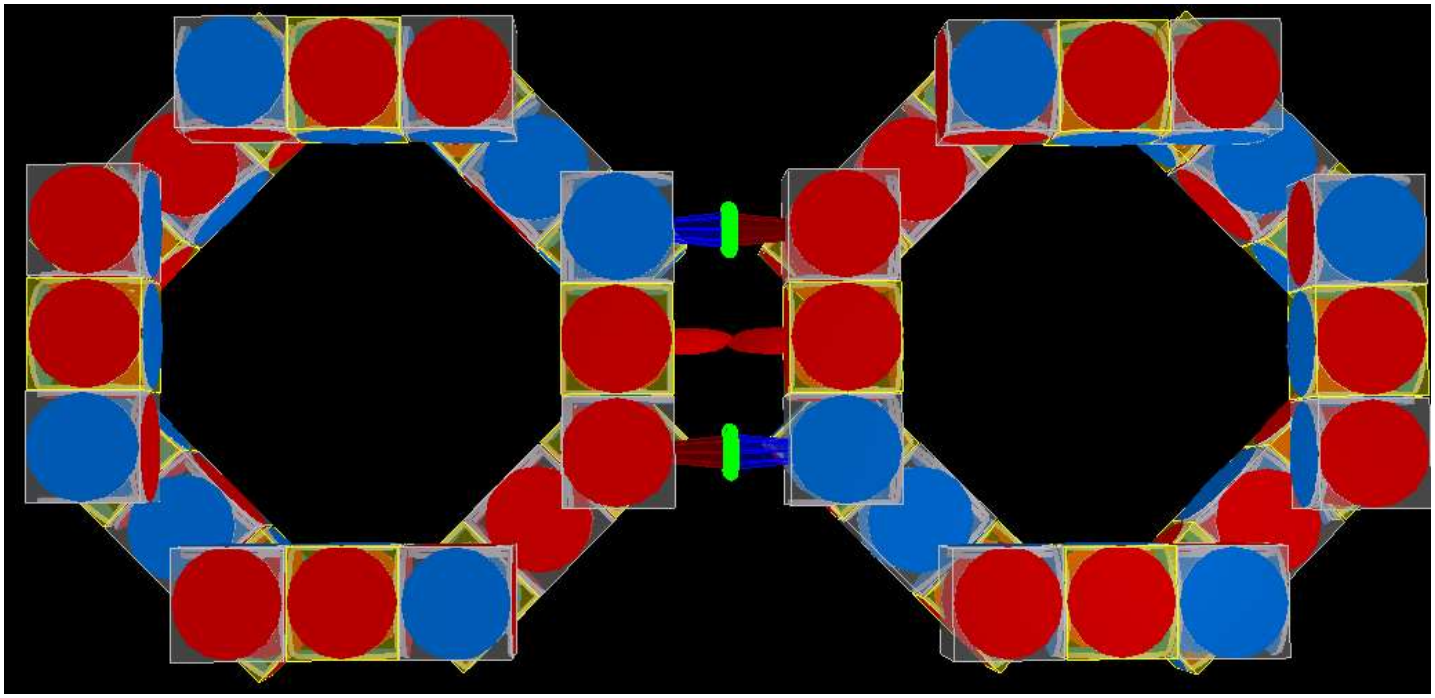
Returning to the 2nd Period, the eighth element of the Periodic Table is **Oxygen**, which is a highly reactive non-metal and oxidizing agent that, by mass, is the third-most abundant element in the universe after hydrogen and helium. At standard temperature and pressure, two atoms of the element oxygen bind to form dioxygen, a colourless and odourless diatomic gas with the formula O_2 (figure 29(b)), that constitutes 20.8% of the Earth's atmosphere. As compounds, including oxides, the element makes up almost half of the Earth's crust.

Dioxygen has 16 well protected electrons (12 inter-layer electrons and 4 covalent bond electrons). In a chemically non-reactive environment some/all of the bonds can be internal, strengthening the nucleus as shown in figure 29(a), making is a reasonable electrical insulator.

The Oxygen atom has 8 down quark bond hooks (up to 16 for dioxygen) at its disposal that are flexible and compatable with the bonding hooks of many other elements and compunds, making oxygen quite chemically active.



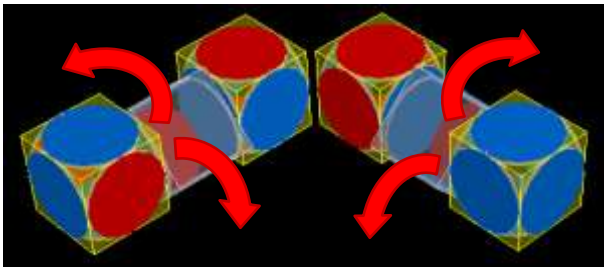
(a) Oxygen Atom *(b) Detail of Bond-Bending*



(c) O_2 Diatomic Molecule

Figure 29: Block Model of Oxygen

Although E2M block models of the nuclei suggest rigidity, there is considerable bonding flexibility within and between the nucleons, which consist of CESs held suspended in space by a complex inter-play of magnetic fields. The 3-D block models only indicate orientation for one of multiple possible compatible nucleon configurations, and CUF bond hook orientations when there is no magnetic influence from the bonding hooks of other atoms.



As mentioned earlier, up quarks within a nucleon can swivel rotate in response to other external and/or internal magnetic fields. In the form of a hydrogen atom, each of the up quarks of a proton can swivel 360° around the long axis. However, within the structure of other nuclei, I-form proton up quarks are connected to an I-form neutron and thus cannot swivel. Up quarks within I-form neutrons layers have no such restriction, and, as shown right, can swivel 360° around the long axis as required to adjust to magnetic forces.

An example of flexibility in bond geometry is provided by **Methane** (CH_4). The carbon atom is the hexagonal form of C-14. The 3 basal bonds shown in figure 30 are formed by the outfacing pairs of I-form neutrons (one on the lower neutron layer and the other in the upper) on three sides of the hexagonal nucleus, with the up quarks swivelled downwards by about 21°. The top bond is formed from the 2 top-mounted Δ-form neutrons of the C-14 isotope. The four Hydrogen atoms are equi-distributed in 3D with a 109.5° H-C-H angle subtend - perfect natural symmetry.

(*The brown connector of figure 29 represents attraction from two pairs of bonded CUFs and a counterfoil repulsion as for H_2*).

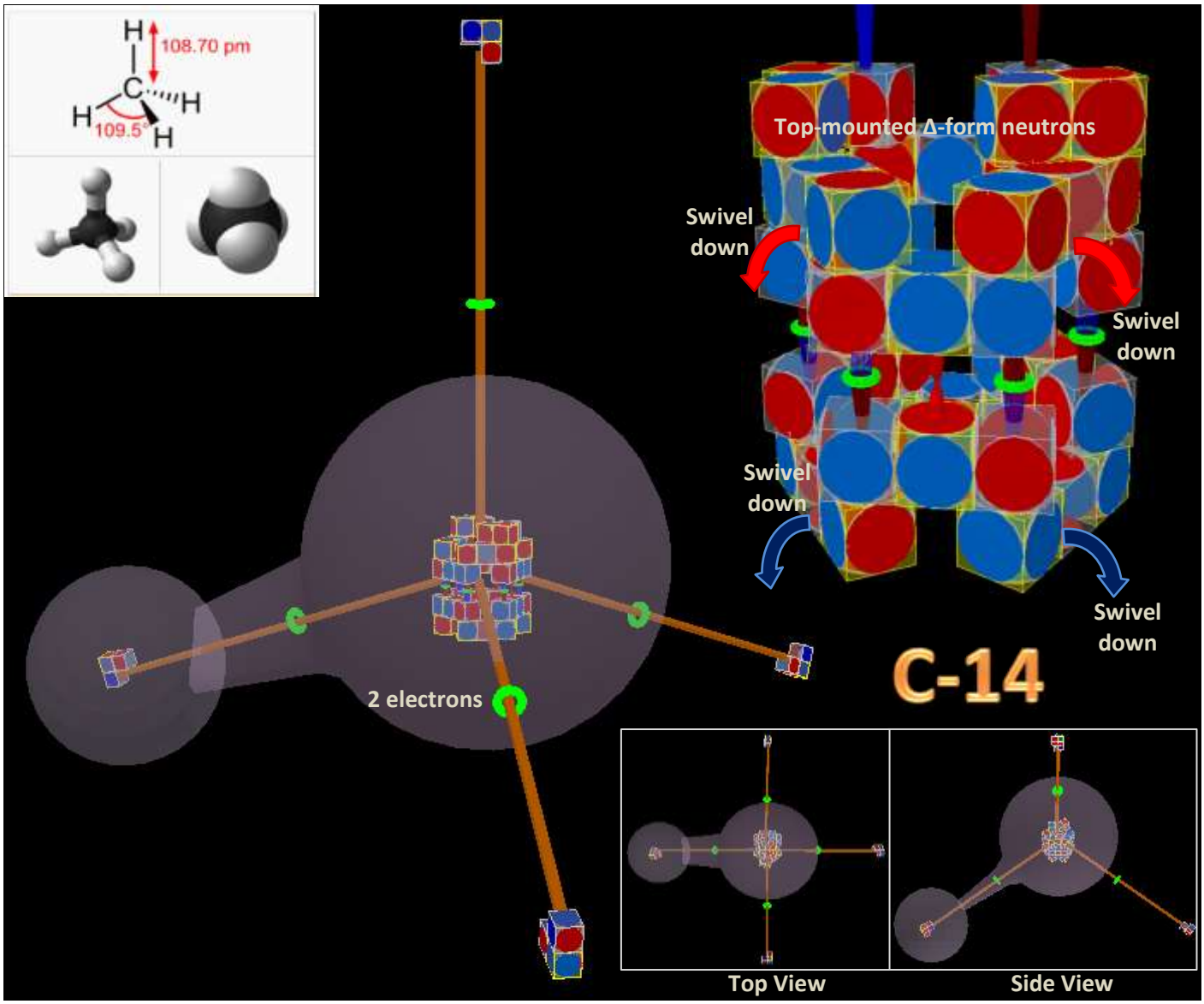


Figure 30: Block Model for Molecular Structure of Methane (CH_4)

C-14 is the longest-lived radioisotope, with a half-life of 5,700 years. It is also the only carbon radioisotope found in nature, with trace quantities are formed from N-14).

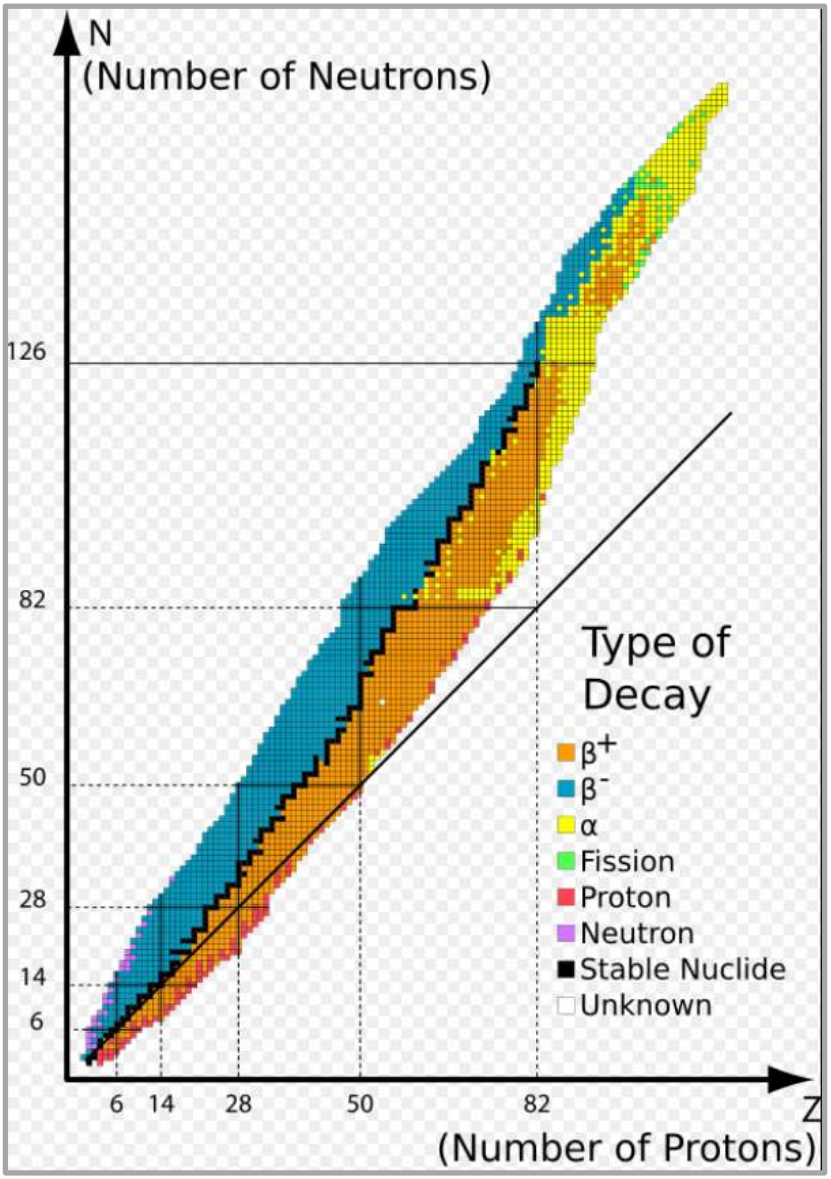
Beta Decay and Electron Capture

Beta decay (**β** decay) is a type of 'weak reaction' radioactive decay in which a **beta ray** (fast energetic electron or positron) and a neutrino are emitted from an atomic nucleus. As shown in the plot right, it is widespread across many elements of the Periodic Table. Stable isotopes map as a tenuous black line roughly demarking the two types of decay.

Beta minus (or β^-) decay is when a neutron converts into a proton and **beta plus** (or β^+) decay is when a proton converts into a neutron.

Nucleons within complete layers are strong force bound and stable within the nucleus.

However top and/or bottom layers of nuclei are often incomplete. Protons and neutrons in these layers are less constrained, more subject to rotational movement and stress from a variety of transient external magnetic fields. They need to be robust to survive in such an exposed position, and are thought to assume a triangular or Δ-form (figures 31 to 35) that is more robust than the I- and L-forms constituting full nucleon layers.



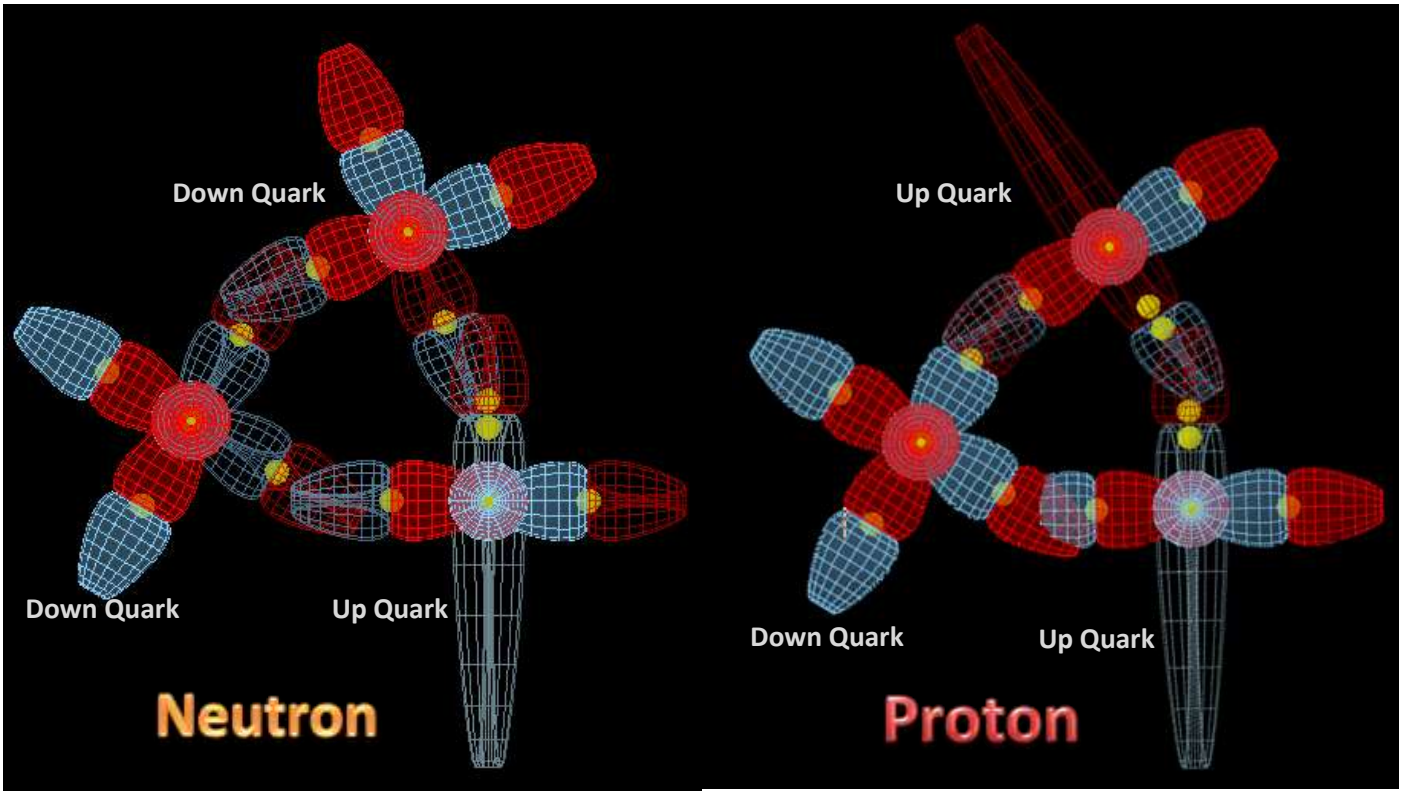


Figure 31: Enertron Models of Δ-form of Unconstrained Nucleons

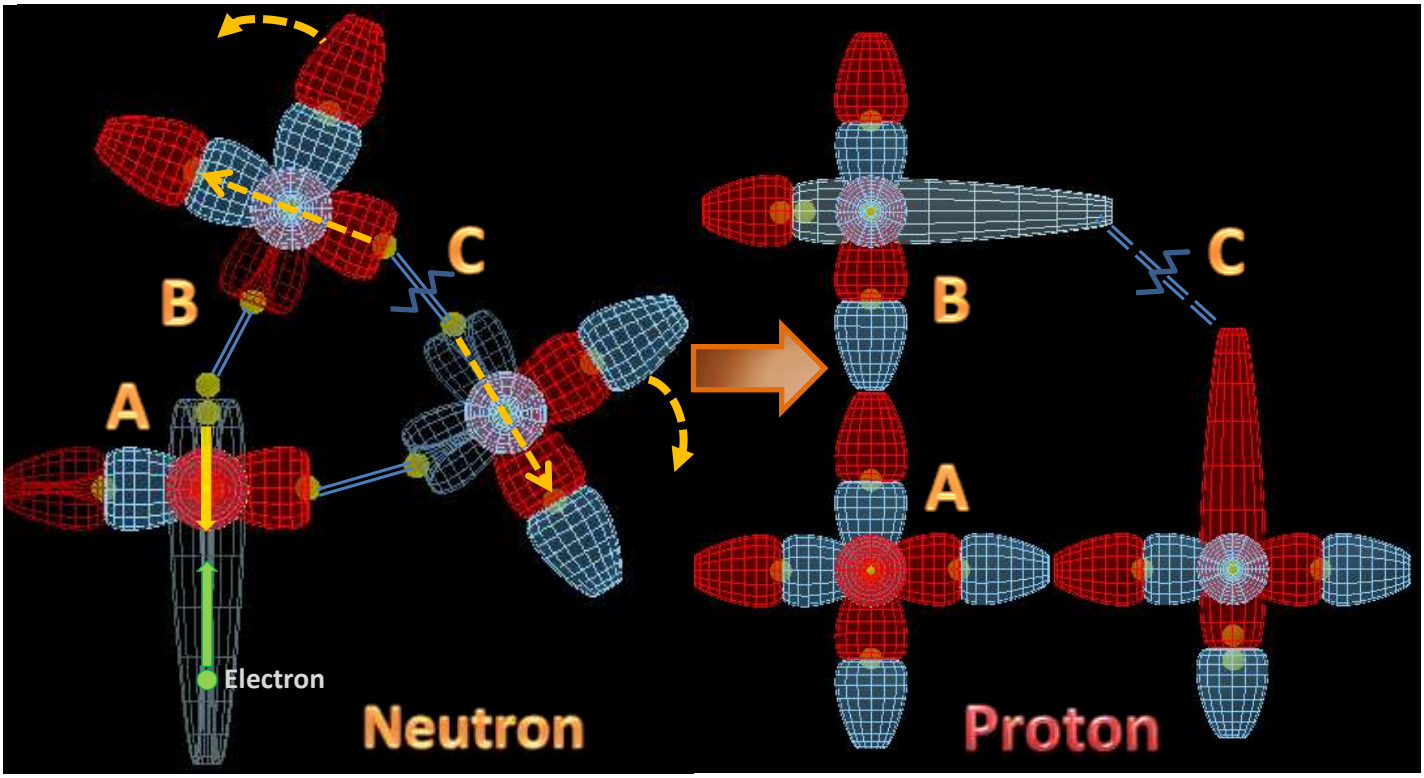


Figure 32: Neutron to Proton Conversion

When attached to the top and/or bottom layers of the nucleus, pairs of Δ-form nucleons form electron bonds (see figure34), with beta decay resulting when these bonds break.

Neutron to proton conversion is triggered by an electron caught in the strong magnetic field emanating from the neutron's sole CUF, is accelerated rapidly it towards the enertron pair 'A'. In response, the closest (i.e. inner) enertron of the pair is drawn towards the approaching electron, locking into position in the up quark's open face to transform the up quark into a down quark. With the nucleon's magnetic equilibrium now completely out of balance, the top down quark aligns with the new down quark below, straightening the 'A-B' elbow and causing join 'C' to break. That break causes the two enertrons forming the 'C' join to fly back towards their respective internally paired enertron to create two CUFs. The electron is deflected as a beta ray, and the result is a L-form proton as shown to the right of figure 32.

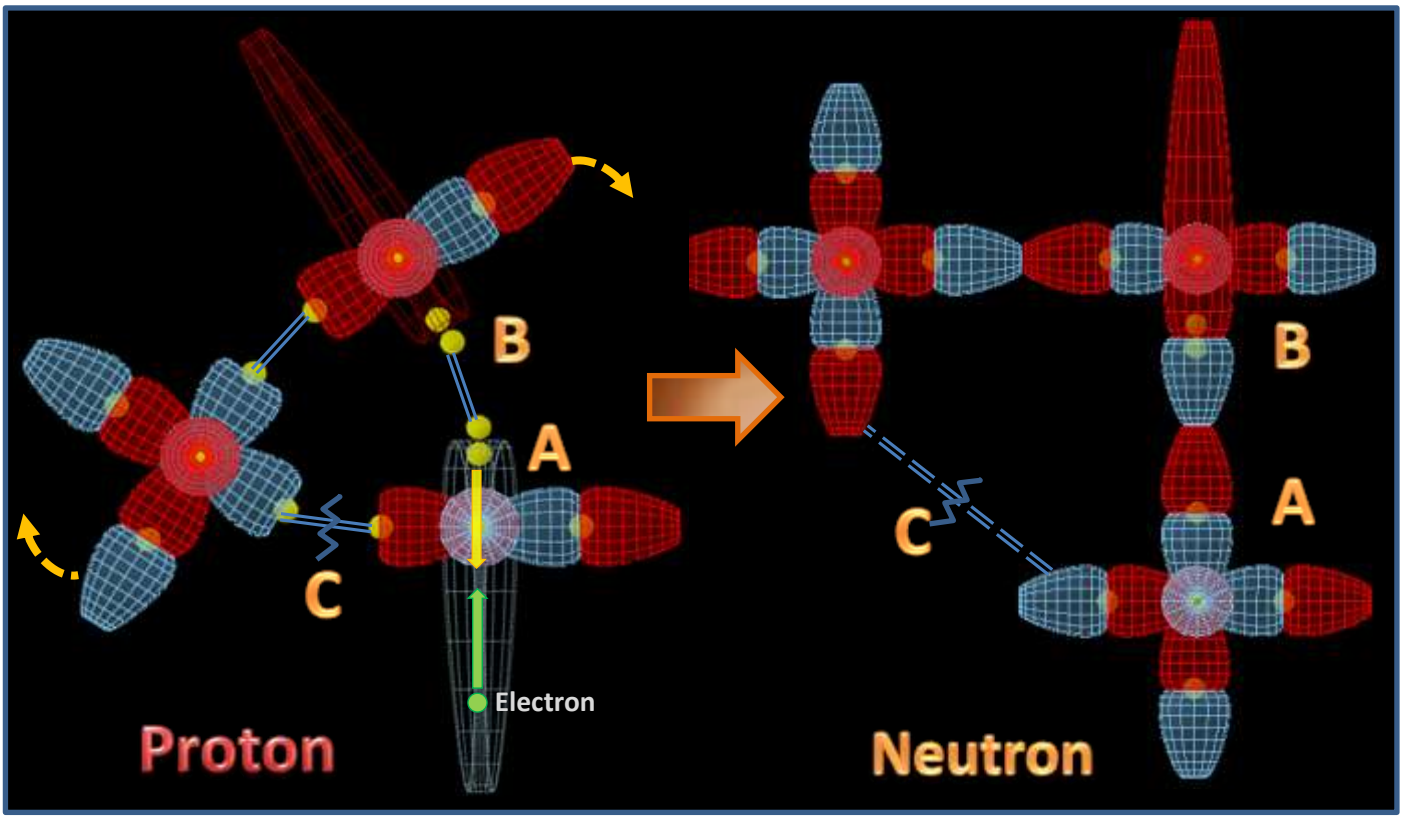


Figure 33: Proton to Neutron Conversion

The process is similar for proton to neutron conversion as shown in figure 33. Here the trigger electron is caught in the strong magnetic field emanating from one of the proton's two CUFs and accelerated rapidly it towards the enertron pair 'A'. In response, the closest (i.e. inner) enertron of the pair is drawn towards the approaching electron, locking into position in the up quark's open face to transform the up quark into a down quark. With the nucleon's magnetic equilibrium out of balance, the other up quark is aligned with the new down quark, straightening the 'A-B' elbow and causing join 'C' to break and the pre-existing down quark to form the L-form neutron .

The Δ-form (or T-form) is simply a folded L-form, as shown in figure 34 for a neutron, and thus the two forms are fully compatible. A physical transformation would be needed to convert a L-form into an I-form but this is unnecessary because the inter-lock pattern of L-form protons and neutrons results in distinct I-form nucleon layers for completely closed polygonal groups. The L-form nucleons can be identified in over-lapping I-form layering as highlighted in figure 35 for the Copper-64 nucleus.

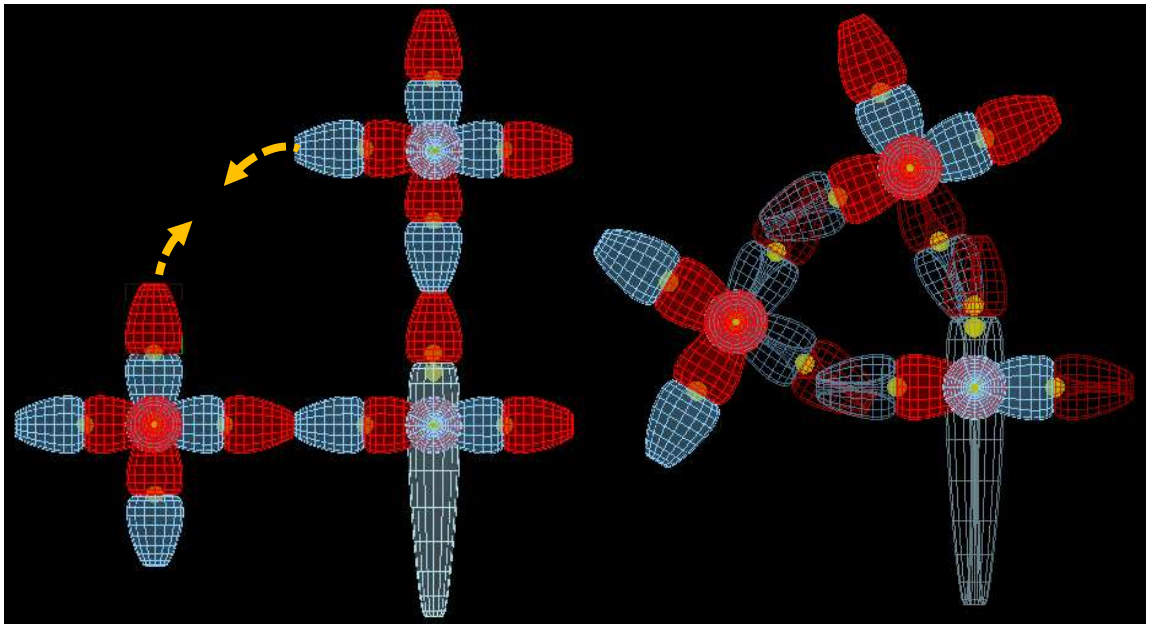


Figure 34: Conversion of a L-form Neutron to a Δ-form Neutron

$^{64}_{29}Cu$ has a half-life of 12.7 hours, undergoing proton decay to $^{64}_{28}Ni$ 61% of the time (18% by beta plus decay and 43% by electron capture decay), and neutron decay by beta minus decay to $^{64}_{30}Zn$ 39%.of the time.

For β^- decay, a neutron is converted to a proton resulting in an electron and an electron antineutrino.

For $^{64}_{29}Cu$ the β^- decay equation is: $^{64}_{29}Cu \rightarrow {}^{64}_{30}Zn + e^- + \bar{\nu}_e$

For β^+ decay, a proton is converted to a neutron resulting in a positron and an electron neutrino.

For $^{64}_{29}Cu$ the β^+ decay equation is: $^{64}_{29}Cu \rightarrow {}^{64}_{28}Ni + e^+ + \nu_e$

$^{64}_{29}Cu$ has one proton and one neutron attached to its upper neutron layer as shown in figure 34 (note the L-form nucleons highlighted in this figure). These two nucleons are of the triangular form and electron bonded together. Because each nucleon is unrestrained the bond is stressed and can be readily broken. The result of such bond breakage depends upon which side of the bond breaks: β^- decay occurs if it breaks on the proton side, and β^+ decay if on the neutron side.

An electron is considered to normally travel with its North pole facing the direction of travel (e.g. moving as an electric current). A positron is an electron that travels with its South pole leading. Neutrinos are CEFs that, due to their core energy radius and axial rotation speed combination, do not generate a magnesphere. However, they still have axial rotation and a similar convention applies regarding their direction of movement and polar orientation with electron antineutrinos paralleling the convention for electrons and electron neutrinos paralleling positrons.

The neutrino emitted from beta decay is the result of the bond electron's toroidal orbital energy, and has the same spin direction relative to its forward motion as its electron. For β^+ decay the reversal of spin upon deflection of the electron and its toroidal energy appears to be due to the dynamics of the beta conversion process, but the mechanics of the spin differences remain unexplained. Hopefully more detailed modelling will reveal the answer.

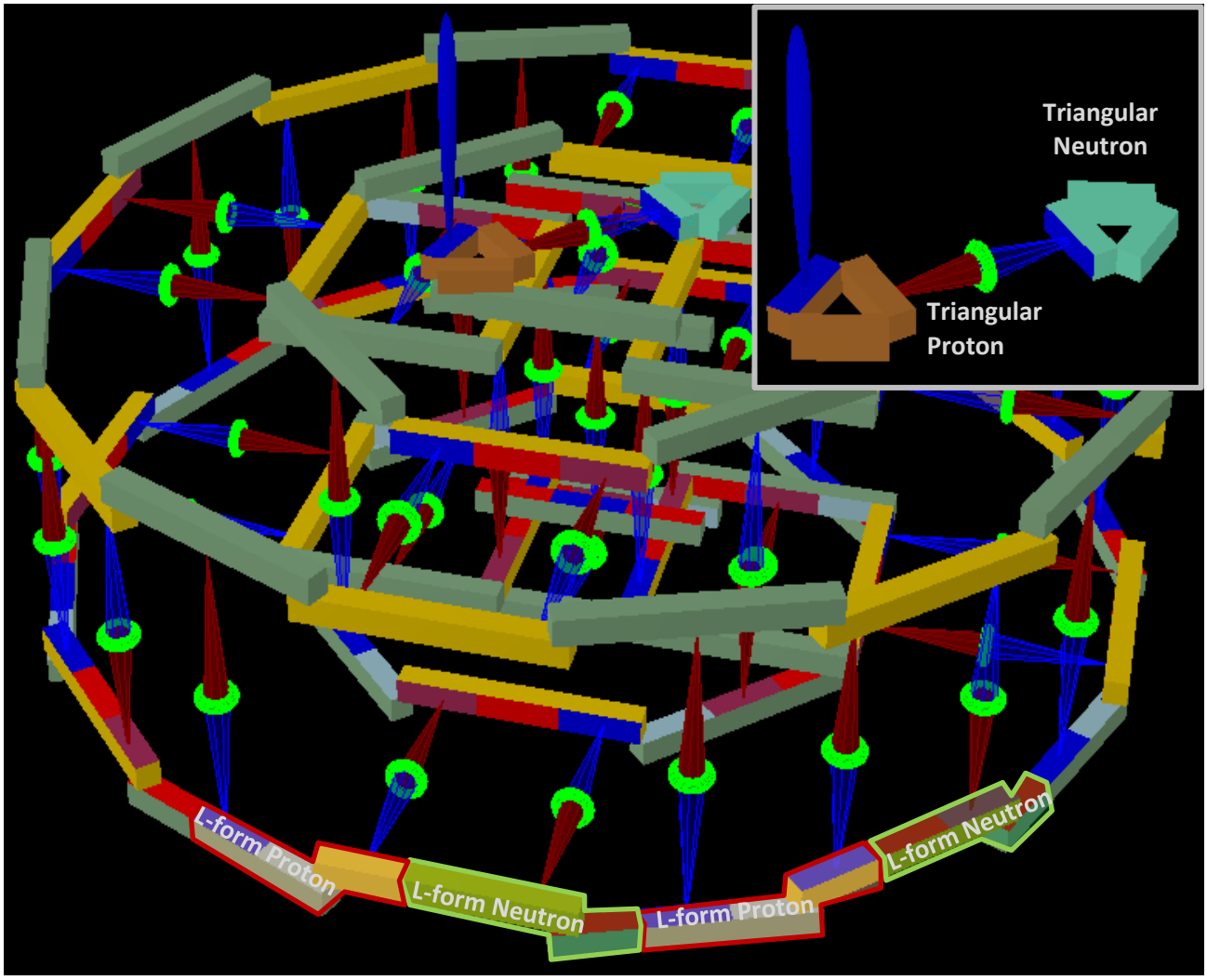


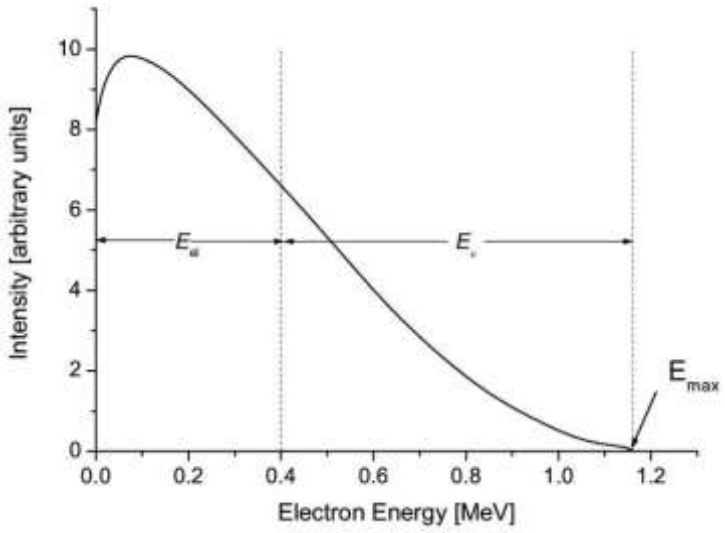
Figure 35: Unpaired Proton and Neutron in Upper Layer of Copper-64

Electron capture and β+ decay are essentially the same process with the main difference being the source of the electron that triggers the decay. The electron capture equation is:

$$p + e^- \rightarrow n + \nu_e$$

For electron capture, source electron is a free electron whose core energy spin marginally slows in the interaction to such an extent that the centrifugal force at its equatorial circumference cannot support a magnesphere, and it thus degrades to an electron neutrino (V_e). On the other hand, the trigger electron for β^+ decay remains pretty much intact, with the neutrino resulting from the orbital toroid's energy.

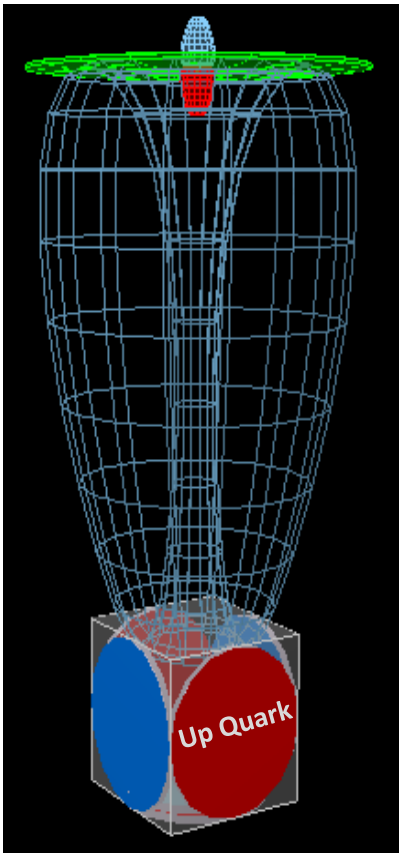
For both β^+ and β^- decay the broken CUF bond's energy is shared between the positron/electron and electron neutrino/antineutrino respectively, as evidenced by energy distribution plot shown right. For electron capture, however, the energy profile is discreet and not spread.



Certainly for unconstrained nucleons, such as in incomplete layers of proton and/or neutrons, the Δ-form nucleon structures would seem more robust than their L-form equivalents, and fit better with an explanation of how neutrons convert into protons and vice versa via Beta decay and electron capture.

In summary, nucleons are believed to have a L-form, assuming a Δ-form (or T-form) that is more physically robust when unconfined. When nucleons are attached to incomplete nucleon layers of a nucleus, electrons may trigger their conversion from neutron to proton (or vice versa) by beta decay should the electron be from an electron bond, or electron capture should it be a free electron. On the other hand, nucleons within complete layers are strongly bound and stable within the nucleus, and can be considered to be either I-form or L-form.

Free Electrons and Electrolysis



Free electrons can be created by the bump-release of the electron in a bonded CUF pair; by radioactive decay; and by chemical reactions (wherein CUF pair bonding is formed or re-assigned).

The central toroid and contained electron of a bonded CUF pair, more likely a neutron-to-neutron bond such as those amenable to catalysis action, can be bump-released by free electrons and other atoms that have been excited by direct heating or bombardment by EMR. The bump-released toroid's energy is partly absorbed by the newly released free electron, with some energy being dissipating and absorbed by surrounding free electrons and structures, and the remainder escaping to the enersphere (see 'The Pull of Gravity'). The parent bonded CUF pair possibly continue to accumulate and concentrate energy in their central choke zone, leading to the creation of a new replacement electron.

Free electrons have a propensity to attach themselves to un-paired CUFs such as the bond hooks discussed earlier in regards to Cu, Ag and Au. When so attached, a (no longer) free electron is held centrally in the outer reaches of a CUF's magnesphere, capping the region where magnesphere energy flow direction changes (the cusp area), as shown in the figure right.

This type of electron bond is very fragile when compared with an electron within the central toroid of a bonded CUF pair, and the electron can be readily aligned and induced to move as part of an electric current by an applied emf.
When the current stops, each participating electron aligns to the closest strong magnetic field, usually an unpaired CUF to which it becomes attached, and the magnetic field (figure 6) associated with electron movement ceases.

An attached free electron can be quite destabilising because it can succumb to CUF attraction and fly into the up quark to trigger Beta decay (proton–to-neutron or neutron-to-proton conversion as appropriate) described earlier.

Metals are the better electrical and heat conductors because their bond hooks are more amenable to free electron capture and they have structures that do not severely inhibit the movement of free electrons between atoms.

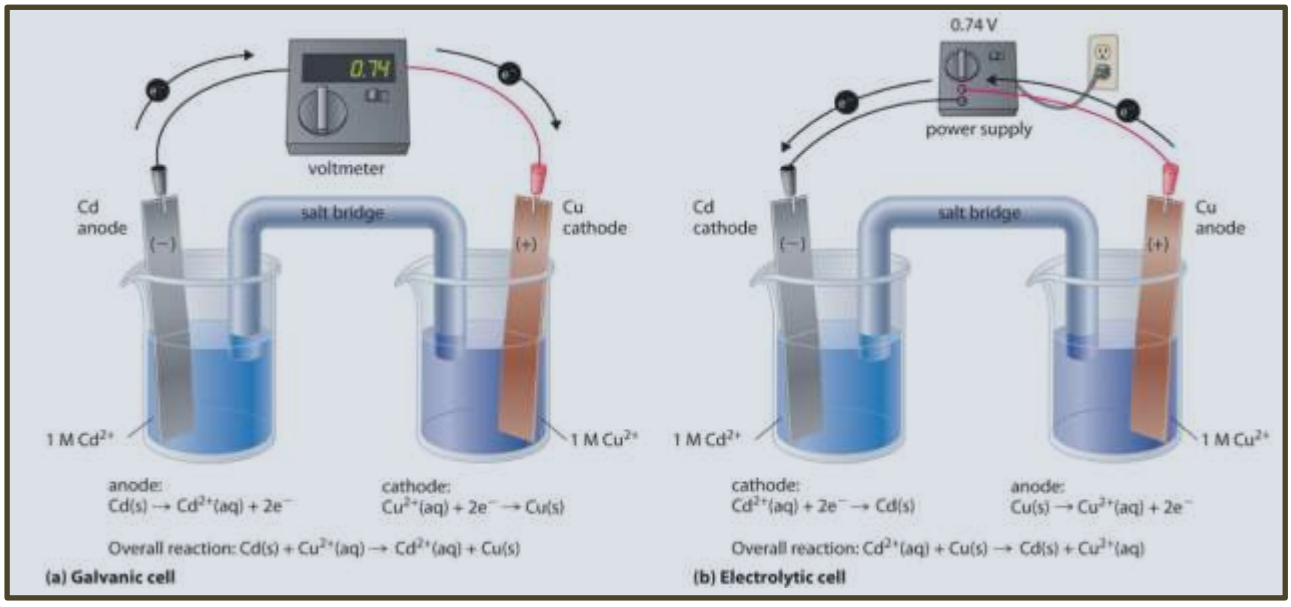


Figure 36: Galvanic and Electrolytic Cells

The **Galvanic Cell** of figure 36(a) exemplifies free electron generation by chemical reaction. The electrolyte releases free electrons attached to cadmium atoms in the anode to create cadmium cations in solution. The newly freed electrons create an emf across the wire connecting to the copper cathode, causing the migration of free electrons towards the cathode, where they attach to copper cations in solution so as to deposit copper metal at the cathode.

For the **Electrolytic Cell** of figure 36(b), when the cadmium plate (cathode) is energised with free electrons by applying a DC current, electrons attach to cadmium ions in solution, allowing them to deposit as cadmium metal on the cathode. The reverse occurs at the anode, with battery-induced emf causing free electrons attached to copper atoms to be released and flow as a current from the anode, enabling the creation of aqueous copper cations.

Photons and Electro Magnetic Radiation (EMR)

As discussed earlier, the energy-return toroid of co-joined CUF pairs cannot cope with their combined energy outpourings and circular zones of congestion, called choke zones, form. When atoms get excited (e.g. by heat application, exposure to EMR or when a sample is burnt in an emission spectrograph) the built-up energy is released by the emission of a photons of energy that fly tangentially from the choke zones. The photon release is functionally analogous to that the of a pressure relief valve, producing regular emissions of photons of energy that present as EMR in the form of **spectral lines**. This scenario aligns with the Kanarev electron model and spectral line equations.

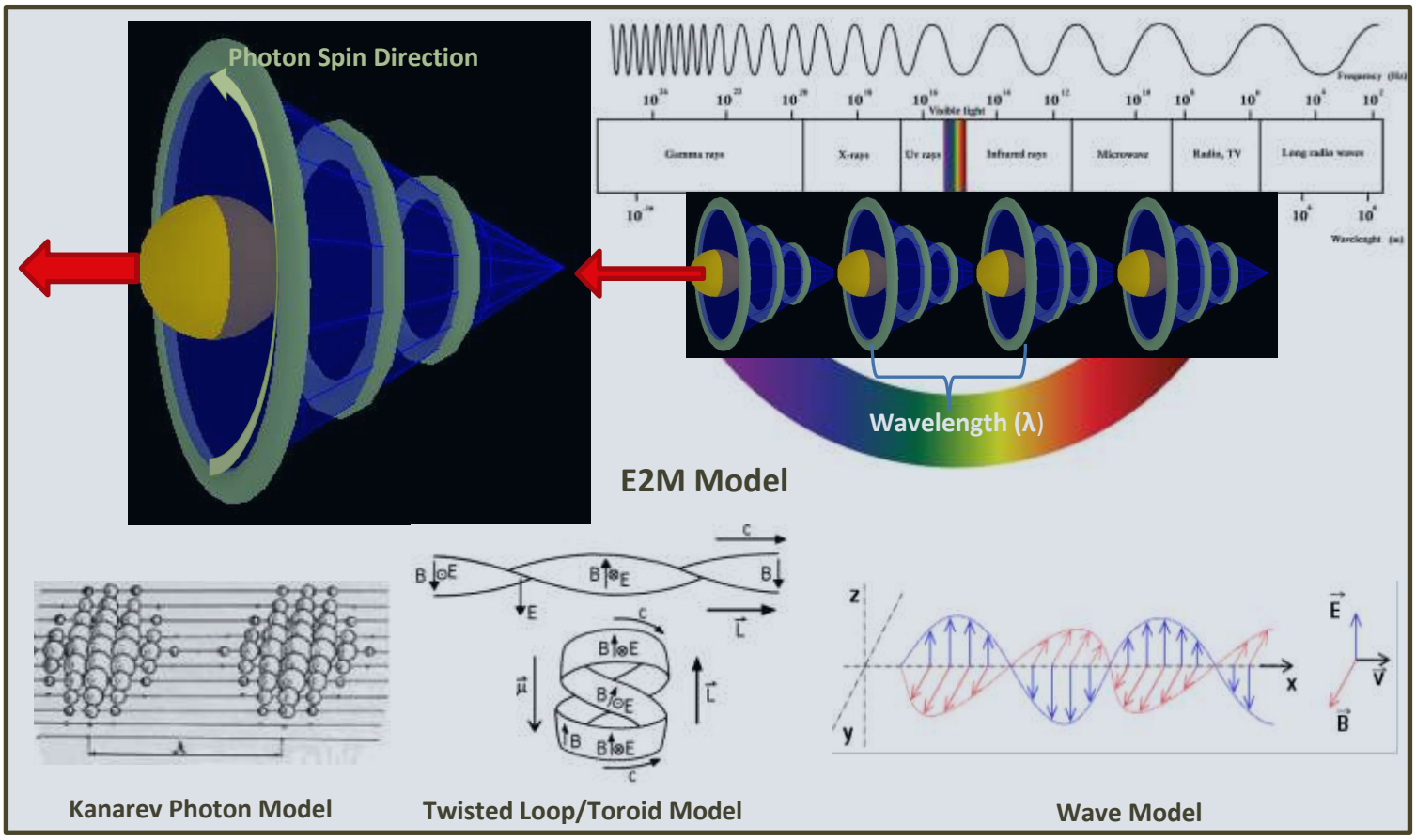


Figure 37: Models for Photons and EMR

Photons are considered to be lightweight or mini-CESs. Because a photon's energy core and the energy escaping from its energy core's equatorial plane are both travelling approximately at same the speed (i.e. the speed of light), its magnesphere cannot spread forwards. Instead, it can only spiral out and backwards to form a comet-like magnesphere tail (blue in figure 37).

Similarly due to the photon's forward speed, energy in its magnesphere tail is unable to return to the energy core, and possibly accumulates as circular zones (analogous to the choke zones within bonded CUFs) along the magnesphere tail that. Eventually (possibly quite quickly) equilibrium is reached and the equatorial movement of energy from its core energy stalls and ceases.

As explained earlier, the frequency of the build-up and release of photon energy from choke zones within bonded CUF pairs (figure 17) defines the frequency of the emitted EMR. As dictated by the internal geometry of each element's nucleus, CUF bond lengths vary between elements so as to produce slightly different unique energies and frequency combinations for emitted EMR, observed as each element's distinguishing spectral lines.

The core energy of the mini-CES photon provides the particle nature of EMR, and the magnesphere tails between successive photons provides its wave-like nature. And because their magnespheres provide no effective vortex suction, EMR photons are effectively massless (see 'The Pull of Gravity' chapter). When EMR impacts an object, each photon potentially delivers multiple energy packages simultaneously in the form of the core energy; the energy within each of the circular energy zones; and their combined angular and linear momentum.

Unlike fast moving lob-sided EMR photons, electrons and positrons are CESs that exhibit symmetric magnespheres and are slow moving to stationary. Gamma radiation would seem to represent the cross-over between mini-CES based EMR to electron/positron EMR, as demonstrated by Positron-Electron annihilation (see next chapter).

Positron-Electron Annihilation

Electron–positron annihilation occurs when an electron (e^-) and a positron (e^+), the electron's antiparticle, collide. In a majority of cases, the result of the collision is the annihilation of the electron and positron, and the creation of gamma ray photons: $e^- + e^+ \rightarrow \gamma + \gamma$. The Wikipedia diagram for the annihilation is shown in the top of figure 38 (with a Feynman diagram insert). Each electron, positron and gamma ray photon is considered to represent 511 keV.

The E2M explanation for electron–positron annihilation is shown in the bottom part of figure 37, with the electron and positron approaching, accelerating towards each other due to attraction, with their magnespheres merging (figure 38(b)) strongly pulling the 2 CESs directly towards each other.

As the CESs approach more closely to each other, their configuration becomes unstable (figure 38(c)), and they deflect each other sideways to start spinning around each other in a circular orbit with radius close to their own radius (figure 38(d)). When their rotational speed approaches the speed of light, at a critical rotational radius, the centrifugal force exceeds their mutual attraction force and the CES pair snap-separate (see figure 38(e)), flying in opposite directions (i.e. 180° to each other) as **Gamma (γ) radiation**.

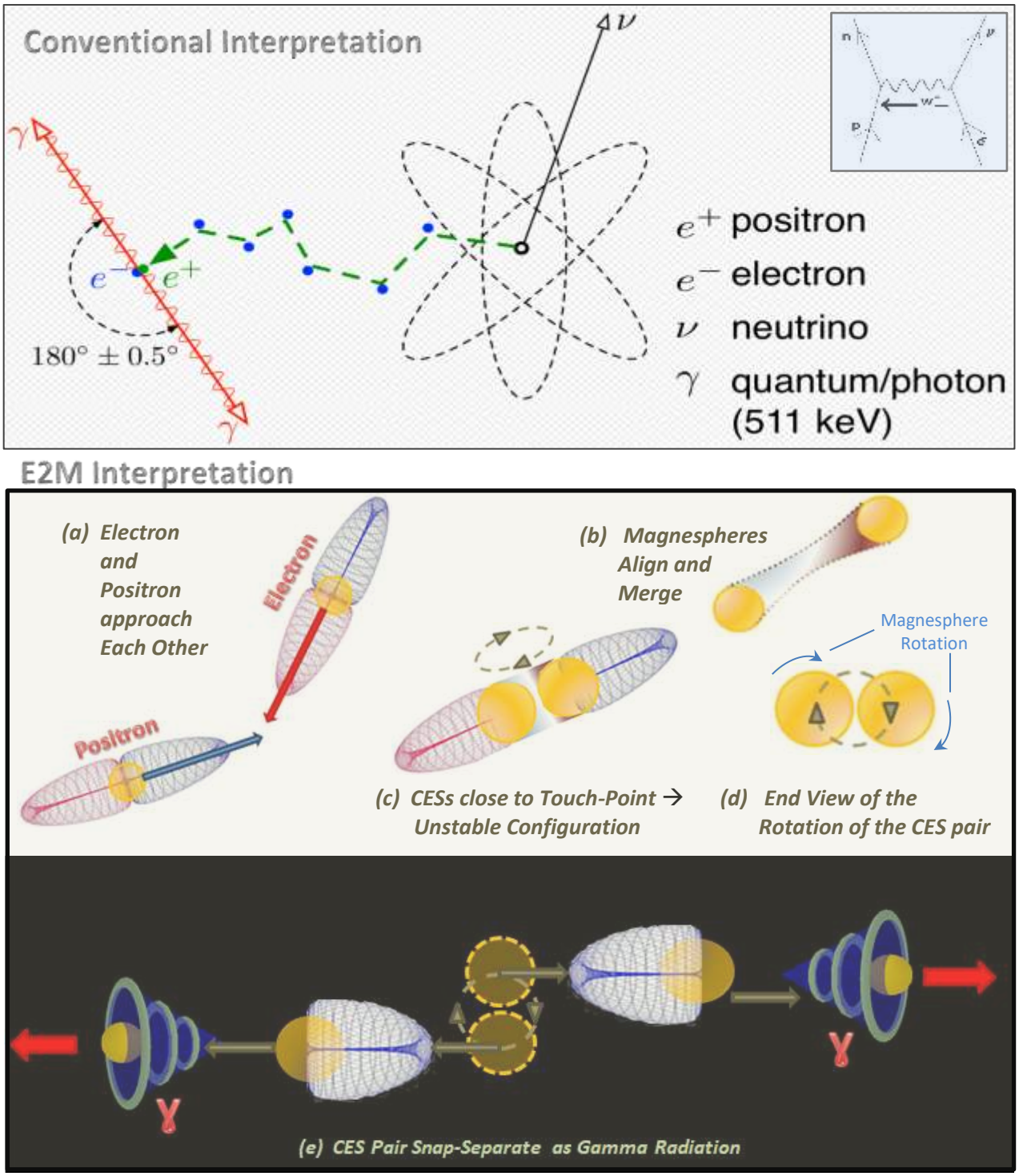


Figure 38: Electron–Positron Annihilation

The Pull of Gravity

E2M contends that all normal matter consists of CESs in the form of enertrons, electrons and photon-sized mini-CESs (i.e. pre-EMR emission). The magnespheres of all the CESs0 interact magnetically and adjust to the presence of each other. The vortices at the polar extremities of each CES retrieves and returns most of their magnesphere energy to its core energy, but minor energy leakage occurs because some energy in the outer reaches of magnespheres gets lost. Such loss is minimal and offset by the vortices acquiring leaked energy from other CESs and absorbing energy from EMR photons that pass close by and/or collide with them.

However the story is different for up quarks: the combined energy outflow from their 5 enertrons through their open CUF face exceeds the capacity of the one return vortex, and the consequential leakage is significant. Up quark energy leakage accumulates and spreads around matter to form an atmosphere of buffered, low intensity, stagnant energy called the **Enersphere**. An enersphere forms around all normal matter and is mainly due to up quark leakage.

Unlike magnesphere energy, cumulative buffered enersphere energy is not under the direct control of a CES, and the vacuum-like suction of outward–facing polar vortices of enertrons within nucleons (there are 12 such enertrons per proton and 13 per neutron) retrieve energy from the enersphere. The **nett resultant inwardly-directed pulling force** of enertrons is called **Gravity**, and can be considered to act at the object's centre of gravity (or mass).

The larger the object in terms of total nucleon count, the larger its enersphere and the number of outwards-facing enertrons contributing to its gravitational pull. It is the **number of enertrons**, and particularly the number of up quarks, within matter dictates the size of its surrounding enersphere and thus its **mass** (implicit in $E=mc^2$). It is the size of an object's enersphere and its location within Earth's enveloping enersphere that dictates its **weight**.

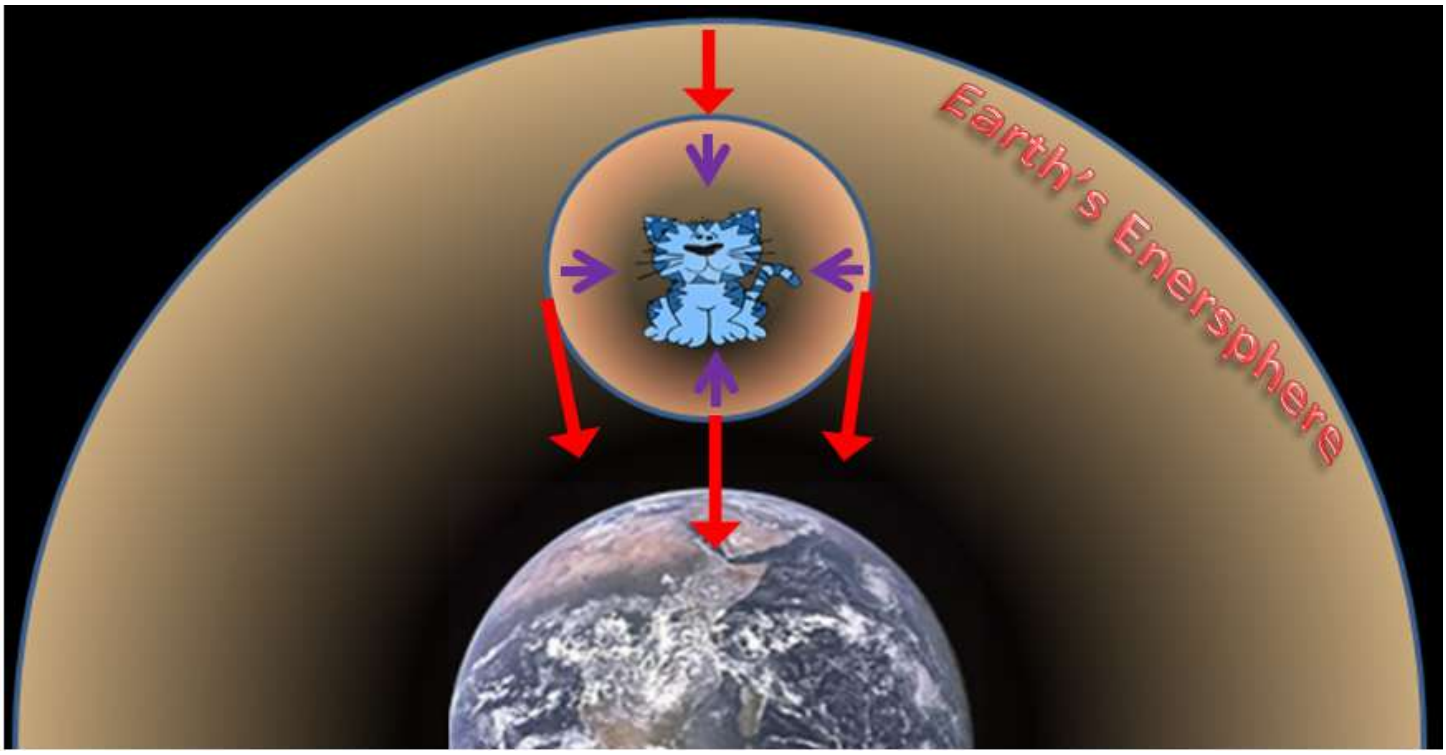


Figure 39: Model for Earth's Gravity

Figure 39 shows a cat sitting with its enersphere fully within the Earth's enersphere. The purple arrows show the direction of the forces pulling the cat's enersphere towards the cat, and the red arrows the considerably greater forces pulling the cat's enersphere towards the surface of the Earth. The cat is heading earthwards, free falling under the influence of Gravity.

Figure 38 is an idealised model because there is no bubble boundary surface as shown - when one object's enersphere enters another's they merge into one, with variations in energy levels within each's enersphere adjusting appropriately. The vortex action of each object's enertrons (here the cat and Earth) would continue to acquire and thus pull energy from their resource-in-common, their merged enerspheres. The forces acting in the zone of the cat, however, would be similar to those shown, as would be their nett effect.

At the macro level, enerspheres of large bodies extend well into space (e.g. the Moon, Earth and the Sun) intersecting and acting together at the inter-galactic level to create Gravity pull between systems. The huge, far reaching

enerspheres of large objects in space suggests that their enerspheres could possibly be in expansion mode, albeit slowly. It is difficult to imagine any region of space without enersphere energy.

Enerspheres are a remarkable bi-product of the way energy combines to make atoms and of atoms to make matter. E2M contends that the pull of Gravity is due to the retrieval of enersphere energy rather than being a mysterious external force or a result from the warping of **space-time**.

Historical Note.

René Descartes, famous for his philosophical assertion ***cogito ergo sum*** ("I think, therefore I am"), in 1644 proposed that **aether**, the medium then considered to separate objects and matter (cf. space), is filled with vortices whose **inward pressure** is '*nothing else than gravity*'.

Place Descartes's vortices within matter (i.e. within nucleons) and then consider the aether immediately surrounding matter to be enersphere energy, then philosophically speaking Descartes' 374 year old explanation for gravity was not far removed from that of E2M.

Summary and Conclusions

In the early 1920's the Standard Model for atomic structure was Bohr-styled atoms consisting of negatively charged electrons orbiting a positively charged nucleus. Angular momentum was accounted for by integer quantum numbers, but it was soon realised that the orbiting electrons possessed magnetic moments associated with electron spin. Paul Dirac's equations in the late 1920's, which factored in relativistic theory, allocated fermions (including electrons) quantum spin 1/2, 3/2 etc., with anti-particles having a corresponding negative half spin number, to cater for spin and associated magnetic moments.

Central to E2M is the belief that all concentrated energy sources (CESs) have spin, and that the magnetic energy generated by that spin (its magnesphere) has characteristics more akin to electric fields than to dipole magnetic fields. An electric field is considered to be a primary field, being the magnesphere of a CES, and a dipole magnetic field a secondary field derived from patterned groups of CESs. Electric field attraction/repulsion is considered to be attraction/repulsion between CESs, with +ve and –ve charge allocation being a notional descriptive annotation.

The E2M rationalisation of electromagnetic field theory requires no change to equations or units of measurement for electric field theory and practice, as these encapsulate the characteristics CES-derived primary energy fields. An electric field is the swirling magnesphere of a CES, and is thus essentially magnetic in nature rather than being a separate intrinsic energy-force within the electromagnetic spectrum. Hence there is no need to balance the notional +ve and -ve point charge values to achieve electrical neutrality: only magnetic moments need balancing.

The Dirac equations have seemed to set the Standard Model and Quantum Mechanics on a mathematics and philosophy driven path leading to complex 'spdf' electron orbits and a large range of elementary particles (albeit neatly classified as Fermions or Bosons according to spin quantum number). The Standard model is now far from an intuitive model, and is very fragmented, seemingly providing more questions than answers.

On the other hand, the E2M approach is based upon an intuitive 'mathematics-to-follow' energy-centric model. E2M can be considered to be an adjunct or branch of the Standard Model that relies upon far fewer elementary particles, and leads to a completely different and detailed model for atomic structure and electron bonding.

Quarks are considered to consist of six enertrons (CESs) arranged in a cubic form. Nucleons are baryon triads consisting of three connected quarks; d-u-d (d = down quark, u = up quark) for neutrons and u-d-u for protons. They have three magnetically-stable configurations (I-form, L-form and Δ-form (or T-form)). Within nucleus neutron and proton layers, L-form nucleons inter-lock and can be considered to assume a stable linear I-form geometry.

Protons and neutrons in incomplete top and/or bottom layers of a nucleus, and those not attached to a nucleus, can be interchangeably transformed from one to the other as demonstrated by beta decay and electron capture.

Unpaired Concentrated Up-quark Fields (CUFs) in the top and bottom layers of a nucleus, and broken bonded pairs of CUFs, can act as bond hooks to facilitate the formation of chemical bonds. They can also capture and tentatively hold free electrons, which can in turn be readily induced to move as an electric current by an applied emf.

Matching pairs of opposite polarity CUFs form electron bonds that are important structurally within the nucleus, providing column and tensor-style strength. Externally they are responsible for molecular and chemical bonding. When an atom is excited, built-up excess energy in the choke zones of bonded pairs of CUFs is released in the form of spectral EMR. The central choke zone possibly builds and supports an electron orbiting within a torus.

Photons are lightweight or mini-CESs that by definition travel at the speed of light as EMR. The core energy of photons provides the particle nature of EMR, and the magnesphere tails between successive photons provides its wave-like magnetic characteristics. When EMR impacts an object, each photon potentially delivers multiple energy packages simultaneously in the form of the core energy; the energy within each of its circular energy concentration zones; and their combined angular and linear momentum.

Nucleon layers within the nucleus can take on several polygonal forms as allowed by their atomic number. For elements onwards from the 3rd. period of the Periodic Table, the increase in nucleons is accommodated by a the embedding of one polygonal form within the other (see Cu, Ag, Au example).

E2M models can be built for all elements of the Periodic Table (as well as their various isotopes and molecular forms), with each 3D model reflecting the element's physical attributes. Unmatched CUFs provide valency hooks for chemical bonding purpose that, in most instances, match the observed valency preferences of elements.

Energy leakage, principally from the open face of up quarks in the nucleons, accumulates around normal matter to form an atmosphere of buffered energy called an Enersphere. The polar vortices of all outward-facing enertrons within nucleons create an inward suction-like force drawing enersphere energy to their core energy to create the pull of Gravity, providing an object with a theoretical centre of gravity and a mass related to its total internal energy.

E2M provides a straight-forward bottom-up model describing how quark-based nucleons build into nuclear structures; interact to support electron bonds that facilitate the formation of chemical compounds; facilitate the flow of electric currents; and contribute to the creation of gravity. As an adjunct to the Standard Model, E2M is at odds with several entrenched mainstream beliefs and requires a rethinking of many basic concepts. It offers many challenges and opens up new exciting opportunities to develop more reliable predictive linked mathematical and 3D computer models. It is, however, a fledgling theory that is bound to change significantly in detail as more work and resources are invested into its ongoing research and development. It is hoped that it will prove to be a catalyst for change and the advancement of Science and industry.

Acknowledgements and References

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Appendix: Elementary Particles of the Standard Model

The **Standard Model** includes two main families of particles: **Fermions** (which is considered to contain all the constituents of matter, split into 2 sub-groups – **Quarks** and **Leptons** and their anti-particles – each containing three generations) and **Bosons** (all claimed force-carrying particles – **Gauge** and **Scalar**). The current Standard Model landscape is summarised in figure 40 (reference Wikipedia https://en.wikipedia.org/wiki/Elementary_particle).

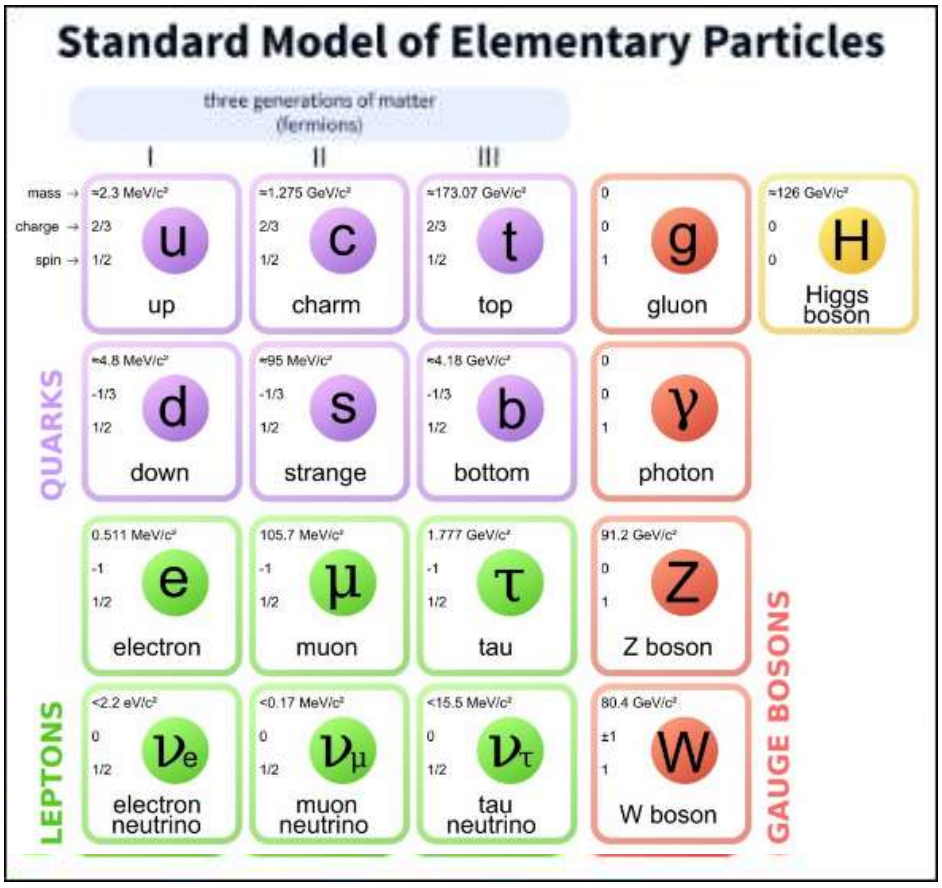

Figure 40: The Standard Model's Elementary Particles

E2M only requires a subset of the Standard Model's 17 elementary particles (plus all the fermion anti-particles and colour charge combinations) to account for atomic structure and behavioural characteristics. The only fermions required for an explanation of atomic structure are the up and down quarks and electrons, plus their anti-particles. Only electrons, positrons, positive and negative neutrinos and photons are needed to explain observed energy and structural transformations (e.g. beta decay) and energy transfer.

Most evidence used to support the existence of the Standard Model's elementary particles has been derived from the analysis of the results of atom smashing experiments in particle accelerators. The high energy brute force smashing of atoms is more likely to reveal more about the smash debris than the particles making up the pre-smash matter.

Using the analogy of a car is being involved in a high speed impact crash, or that of a bomb detonated in or under a car, the debris consists of mangled bits and pieces that often bear little resemblance to the car's pre-existing component parts let alone their original purpose. Violent impact tends to cause material to break at weak points. Even strong join points (corners, welds, bolt support etc.) tend to produce edge-distorted composites looking completely different to the original components and separated from their immediate counter-parts – they also tend to be over-represented and easier to see within the debris. Another complication is that the degree and nature of the trauma depends just as much where parts were located at the time of impact as to their shape and strength.

Useful as it is, atom smashing can only occasionally be expected to release pristine component parts of an atom or to provide much indication of the sub-atomic makeup of atoms. Furthermore, the use of damaged transient smash debris particles to reverse engineer the original nature, structural make-up and/or geometry of matter is bound to produce an unrealistic end-product, even if it can be backed up by supportive mathematical models.

At its current stage of development, E2M only requires the first generation fermions and photons - other elementary particles in the Standard Model set are noted, but are considered to represent collateral damage of the atom smashing process, and as such are not currently needed or used in its model. This stance may change.