Relevance of Atomic Structure to the Physical Characteristics of Matter

Energy to Matter (E2M) proposes a structure for quarks and nucleons, and uses these to generate 3-dimensional models of atomic structure of elements in the Periodic Table and their bonding characteristics. This short article and associated videos present some of the modelled atomic structures and shows how the structure of the nucleus relates to the observed physical and bonding characteristics of the elements involved.

Nucleus Modelling Conventions

The ***proton*** and ***neutron*** (collectively the ***nucleons***) are the building blocks of atoms. A proton consists of two ***up quarks*** and one ***down quark***, whereas a neutron consists of two down quarks and one up quark. This is widely recognised by the Physics establishment (see the Wikipedia link https://en.wikipedia.org/wiki/Quark).

E2M considers that up quarks have a strongly directional positive or negative electromagnetic field referred to as a **C**oncentrated **U**p-quark **F**ield (***CUF***). CUFs act as electromagnetic hooks to bond nucleons together to form atoms, molecules, ions and compounds. They are represented by the wedge/bat shaped projections of figure 1 indicating their directional zone of influence, with their polarity indicated by colour (red/maroon for + and blue for -).

Down quarks, on the other hand, are considered to only have weaker down quark electromagnetic fields (labelled **minor**). Minor fields serve to counter balance attraction between matched CUF pairs within nucleons (as described in more detail shortly).

Nucleons are represented as stick figures, **Golden-Yellow** for protons and **mid-Green** for neutrons.

Each proton has 2 CUFs (variously with + –, + + or – – patterns) and an associated down quark (or minor) electromagnetic field.

E**ach neutron** has a single CUF (+ or -) and two minor fields.

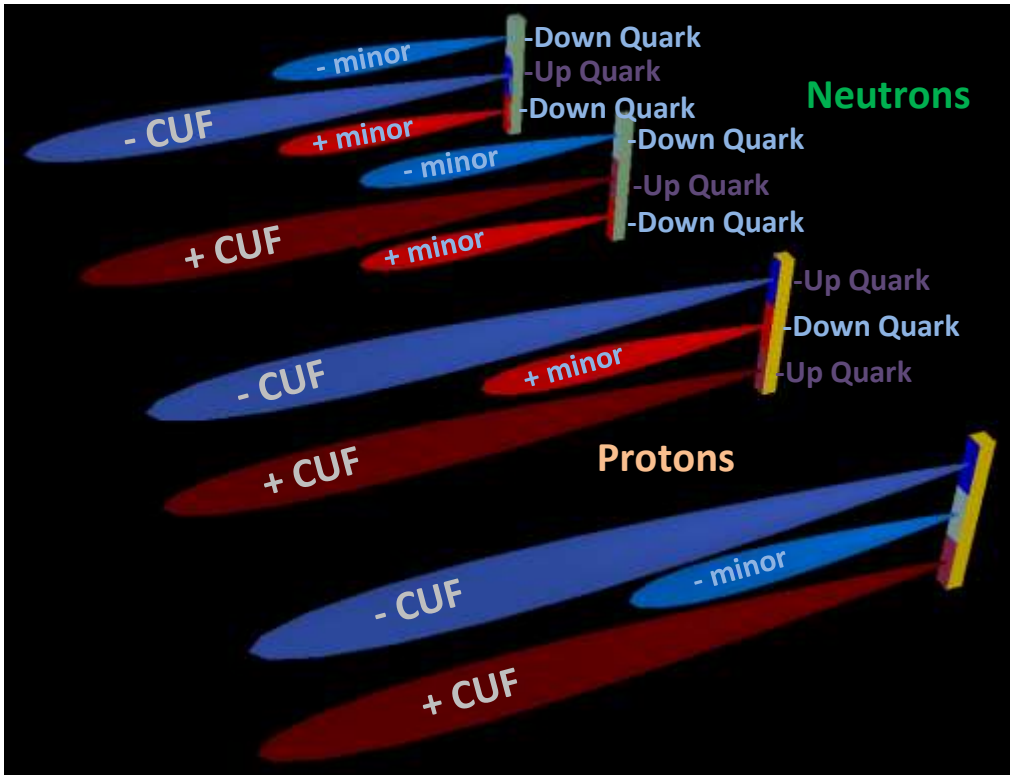


Figure 1: Nucleon Stick Models

Thus each nucleon has three electromagnetic fields that are important to bonding characteristics of elements.

> **Note**: *At the risk of overloading you with a myriad of new concepts, a little explanation is needed. The weird nucleon stick figures used to build nuclei structure are for visualisation purposes only. E2M considers that up/down quarks each consist of six small **concentrated energy** (the **E** of E2M) **sources** held in place by their electromagnetic characteristics. The quarks form into nucleons as 'L' shaped triads which interlock to create the strong framework of an atom's nucleus. Due to sequencing symmetry, the interlocking nucleon pattern gives the illusion of linear proton and neutron **layering within the nucleus**, allowing E2M to use the linear stick figures to build and represent 3D models of atomic nuclei structure.*

The 3D Nucleus Models

Hydrogen is the first element in the Periodic Table having an atomic number of 1. Its nucleus consists of a single proton. The ***Standard Model*** (SM) considers that in its diatomic H_2 molecular form it covalently shares two electrons.

The E2M view is that the H_2 molecule consists of two protons held together by strong CUF attraction between their two opposite polarity up quark pairs, but held apart by the repulsive force of a pair of matched same-pole minor fields as in figure 2, with electrons represented by the green disc/torus held mid-way between CUF pairs.

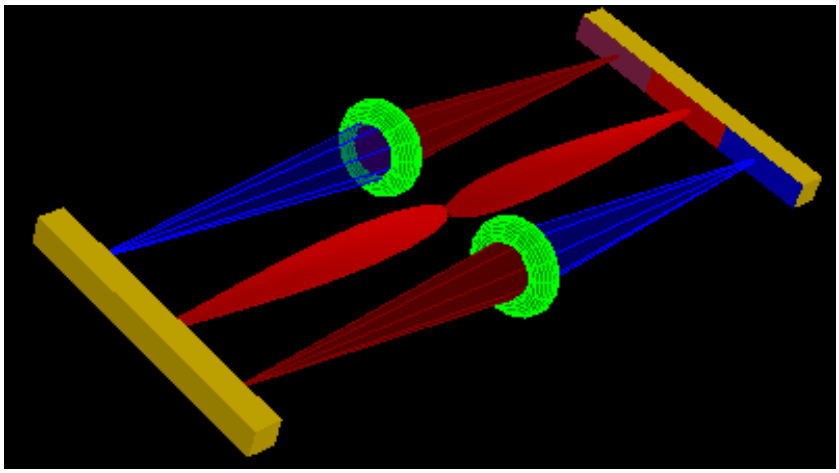


Figure 2: Model of Diatomic Hydrogen Molecule

The first major point of difference between the SM and E2M is the nature of nucleon bonding and electron orbitals. For SM the mathematically defined 'spdf' patterns apply, that, except for a minor degree of covalent sharing, are external to the nucleus. However, no electrons have ever been identified in the claimed orbital zones (not even for larger atoms supporting 100's of orbital electrons), with only a small statistical probability of them being there at all.

On the other hand, E2M requires no orbital pattern, with a majority of an atom's electrons being held internally, bonded within the structure of the nucleus, and some externally to bond atoms together to form molecules, ions and a wide range of chemical compounds. The internally bound electrons are considered to be an integral part of the nucleus's structure, whereas the outer bond-hook electrons can be gained, lost and/or exchanged dynamically and dictate valency options and bonding patterns.

So what are the implications of E2M's brave new world view of atomic structure? Let's start with **Carbon**, the sixth element in the Periodic Table; it is non-metallic and only 3 of its 15 known isotopes occur naturally. C-12 and C-13 are stable forms almost all of the carbon on Earth. Carbon-12 has two allotropic forms (figure 4): a tetragonal form presenting as **Diamond** and an hexagonal form presenting as **Graphite**. Physically these allortopic forms are completely different; Diamond is hard, capable of cutting glass, and clear; Graphite is soft, layered and pencil-grey. As soon will be made clear, E2M considers these differences to be derived from the differenct structure of their nuclei.

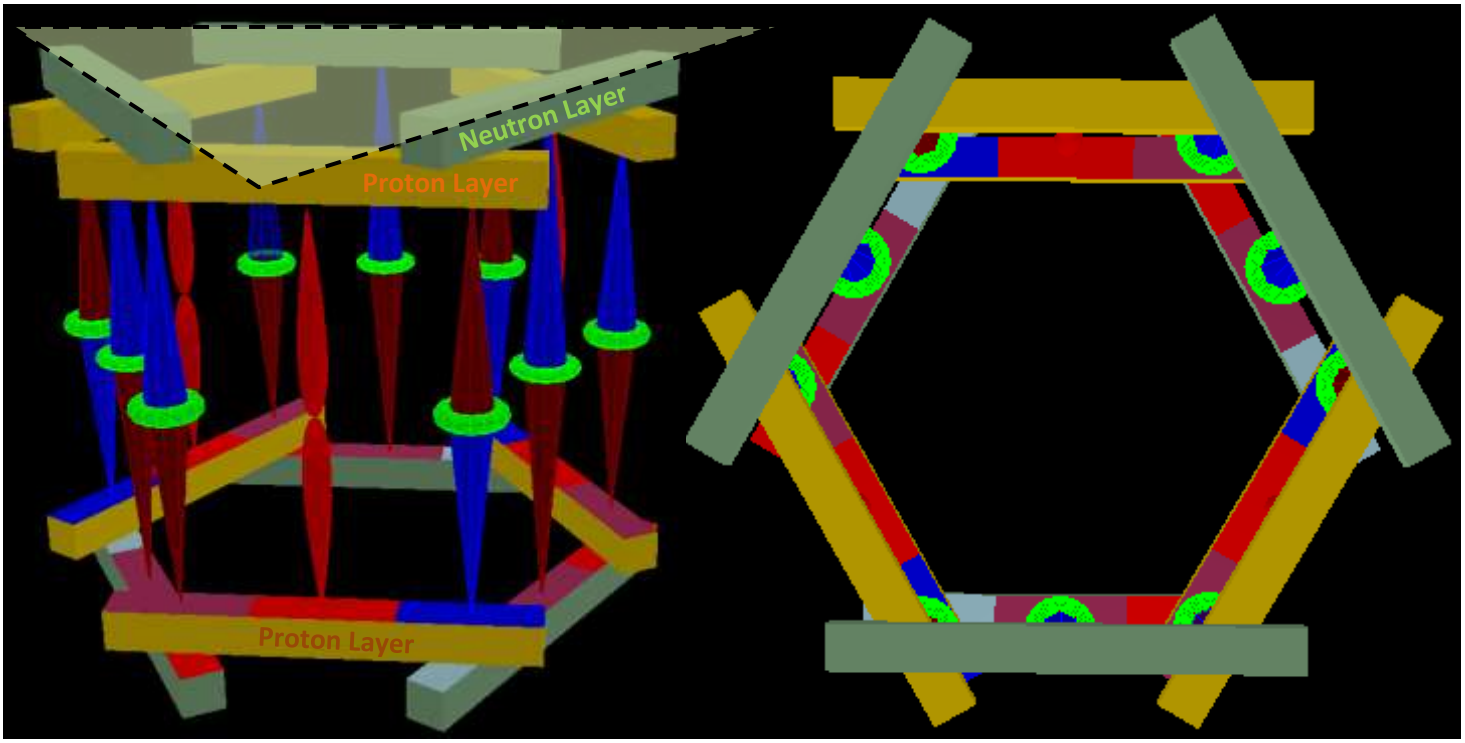
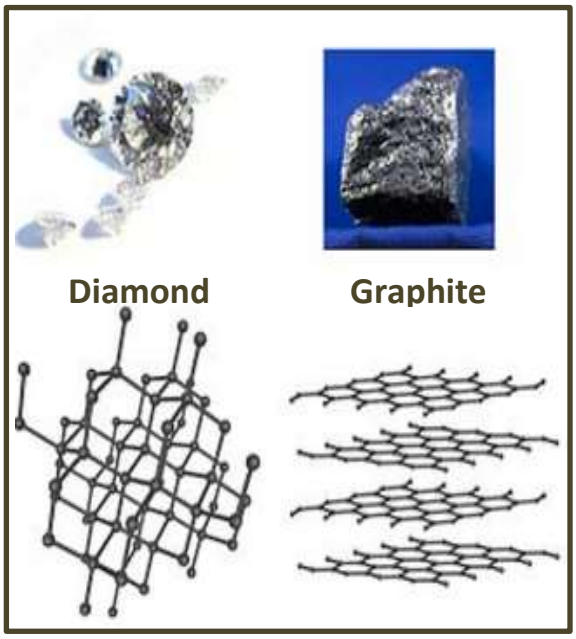


Figure 3: C-12 Graphite Stick Model : Side and Plan Orthographic Views

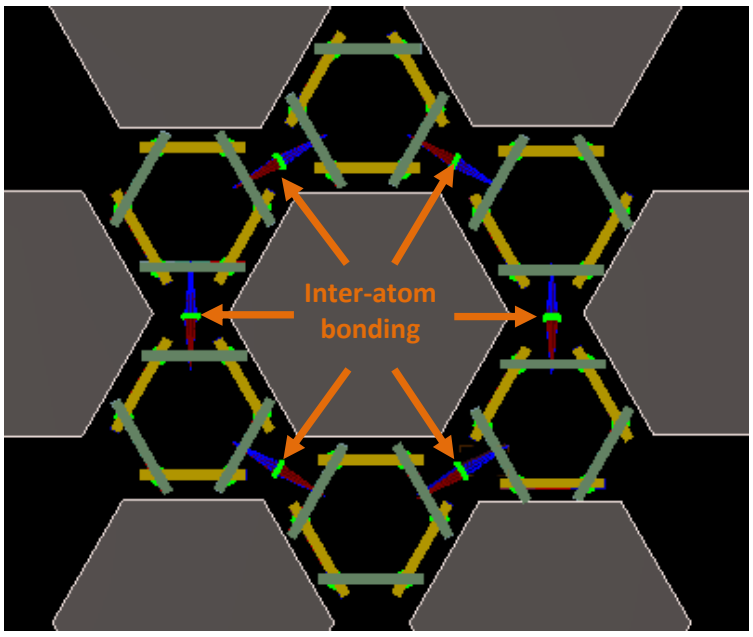
The nucleus of the graphite allotropic form takes on a hexagonal form. The stick figure neutron (upper and lower) and proton layering effect can be seen in figure 3.

Graphite commonly occurs in sheets wherein horizontal bonds are formed by neutron up quark bonds (CUFs) between adjacent atoms as shown in figure 4 to create a larger-scale hexagonal sheet pattern. E2M contends that the structural geometry of the nucleus explains many physical and chemical properties of elements and makes much more sense than assuming that nucleons bond as an amorphous spherical nucleus as shown in most reference texts.

And where are those elusive SM electrons? For the E2M model some electrons are tucked away within the structure of the nucleus and others, here from the neutron layers, are an integral part of the inter-atom bonding holding the graphite sheets together. No mystical SM planet-like or mathematical 'spdf' orbitals are in evidence or needed.



Carbon C-12 : Allotropic Forms



Plan View of Graphite C-12 In-Layer Co-Joins

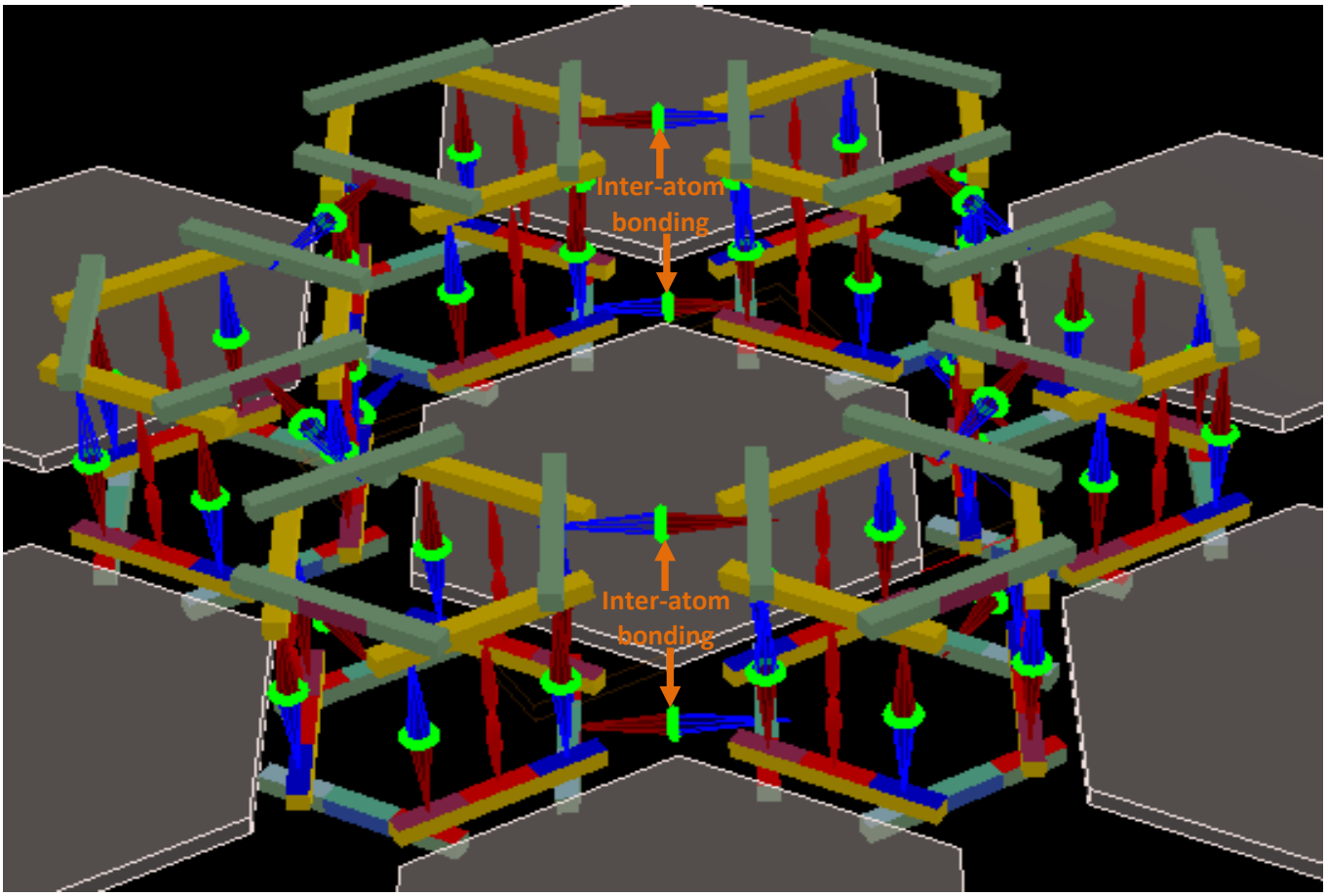


Figure 4: C-12 Graphite Stick Model : Oblique View of Graphite Sheet

The diamond allotropic form of Carbon-12 is tetragonal which develops a cubic-form crystal system. As shown in figure 5, it is a tight, strong structure with nine internal electrons and no external CUF bonding hooks.

The cross-lashed internal bonds and cubic form considerably add to the strength of diamond and the absence of external bonding hooks renders it chemically non-reactive.

The contrast between the physical characteristics of these 2 allotropic forms (i.e. same nucleon count) of C-12 is extreme. E2M contends that the differences are mainly attributable to differences in their nucleus structure.

Furthermore, E2M contends that the nucleus is the essential framework that defines an element, and it is the structural geometry of the nucleus, and of the outward-facing CUFs in particular, that dictates the physical and bonding characteristics of elements.

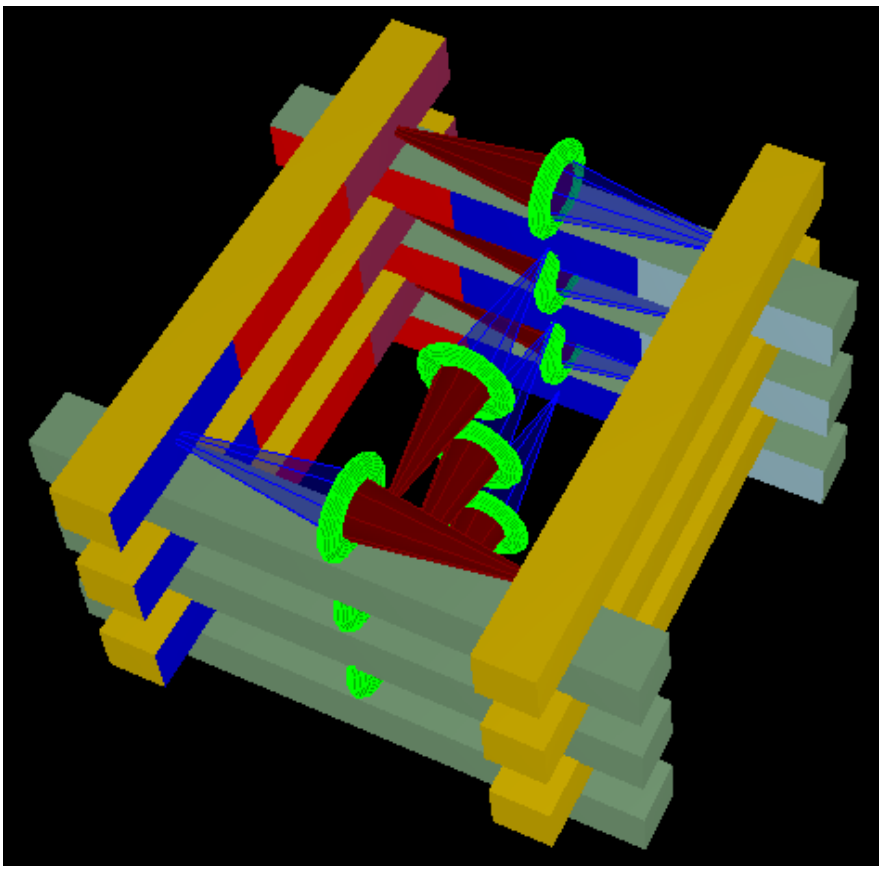


Figure 5: C-12 Diamond Stick Model

With an increase in atomic number there is a commensurate increase in the complexity of atomic structures. Within E2M models the increased numbers of nucleons within the nucleus are accommodated by the embedding of polygonal structures within the nucleus. Such embedding can well be demonstrated by the precious metals Copper, Silver and Gold which have atomic numbers 29, 47 and 79 respectively, spanning periods 4 to 6 in group 1B of the Periodic Table.

The Cu-63 model (figure 6) shows a central simple tetragonal structure firmly attached to a hexagonal structure which is in turn suspended within an outer octagonal structure by eight pairs of proton-based CUF bonds. The horizontal layers are supported by a mixture of proton and neutron CUF bonding. Cu^{++} bonding is via a top or bottom mounted valency proton hooks (i.e. an as yet un-bonded proton).

The conventional SM view of the Cu-63 atom (inset in figure 6) shows four orbitals (shown here as spherical rather than 'spdf' style) whereas the E2M model shows three embedded structures involving two horizontal layers.

As atomic number increases, the 'excess' number of protons of neutrons in relation to neutrons within the nucleus increases significantly (excess neutrons is also a problem with smaller atoms such as for Lithium and Carbon isotopes). The conventional orbital atomic view offers no explanation of this apparent **neutron obesity problem**. However, for E2M, each proton and neutron is needed and can be fully accounted for, forming an important part of each atom's unique structure. This is demonstrated by the nucleon summary table below for Copper, Silver and Gold.

Note. →+ and →++ indicate valency potential as shown in figures

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

Note: It is difficult to relate to the complex 3D geometry of even a simple element such as graphite via 2D diagrams such as in figures 3 to 5. Thus simple videos showing the rotation of the 3D models for single atoms of Graphite, Diamond, Copper, Silver and Gold, and for Graphite sheets are provided to show more detail.

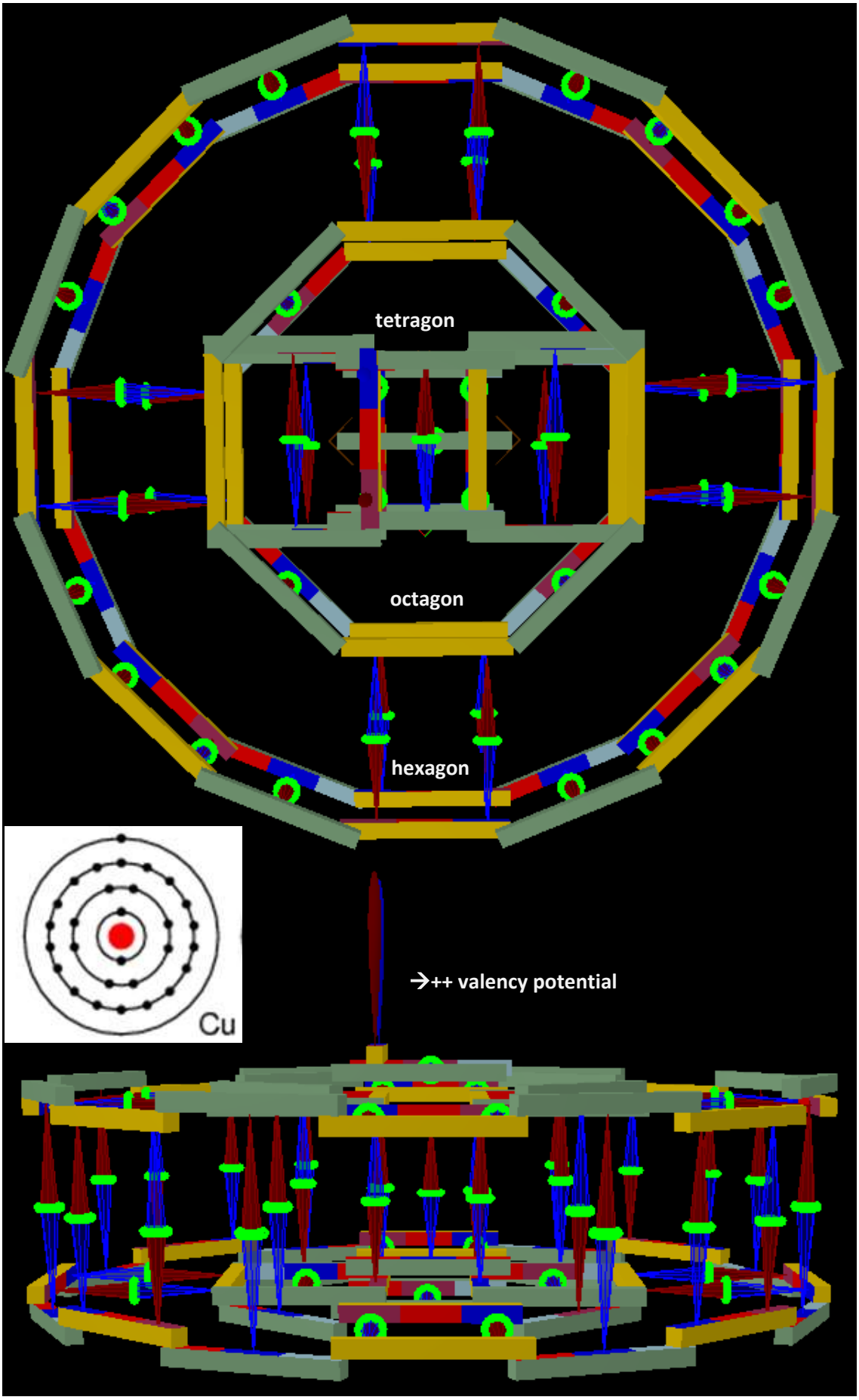


Figure 6: Stick Model of Copper-63

Copper-63 (figure 6) has two horizontal layers and Silver (figure 7) has three: both have 2 embedded tetragon and octagon structures within an outer hexagonal structure. Along similar lines, Gold-197 (figure 8) consists of an outer two layer 32-gon structure with three embedded three-layer polygonal structures (hexagon, octagon and tetragon).

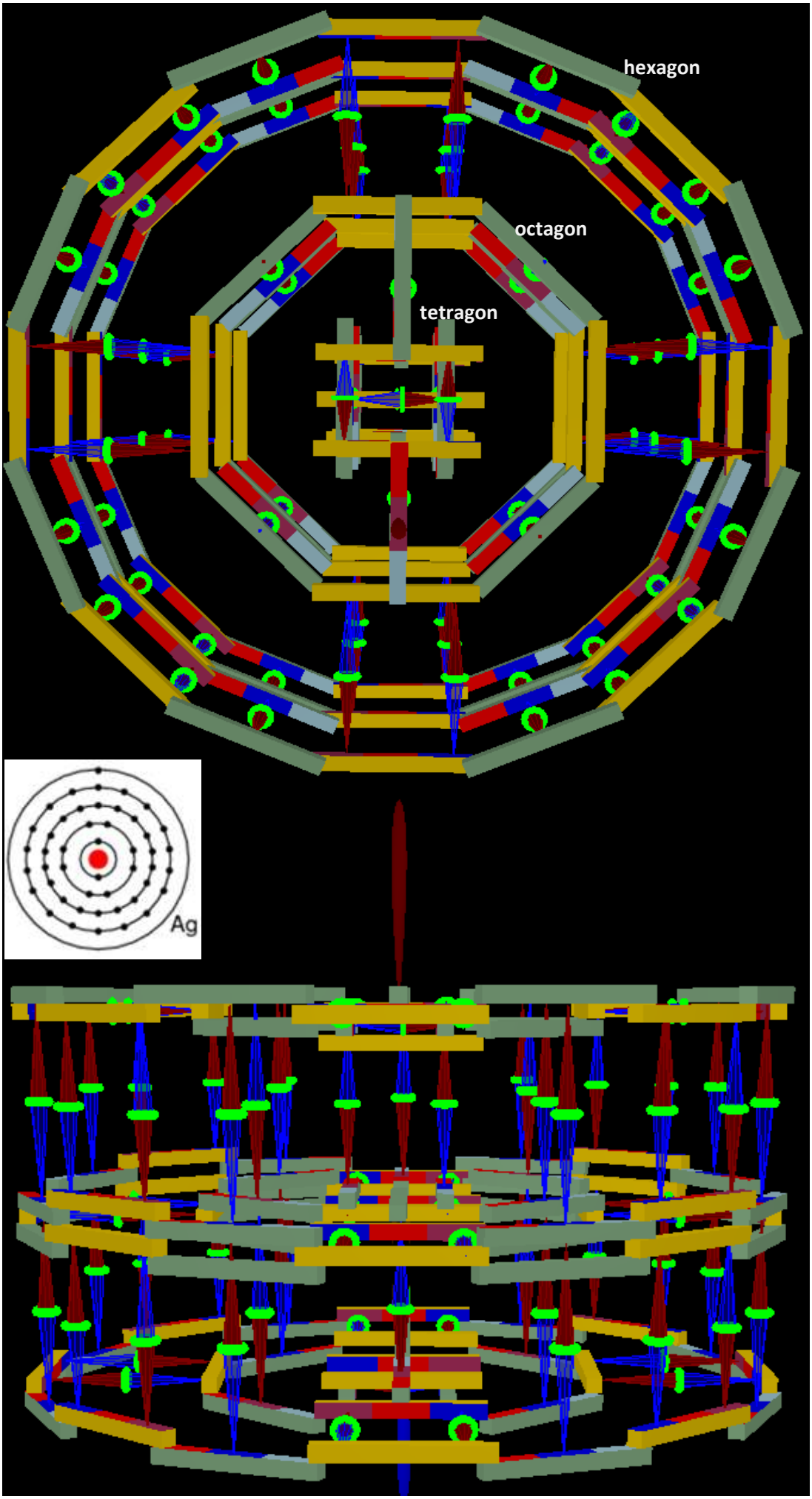


Figure 7: Stick Model of Silver-107

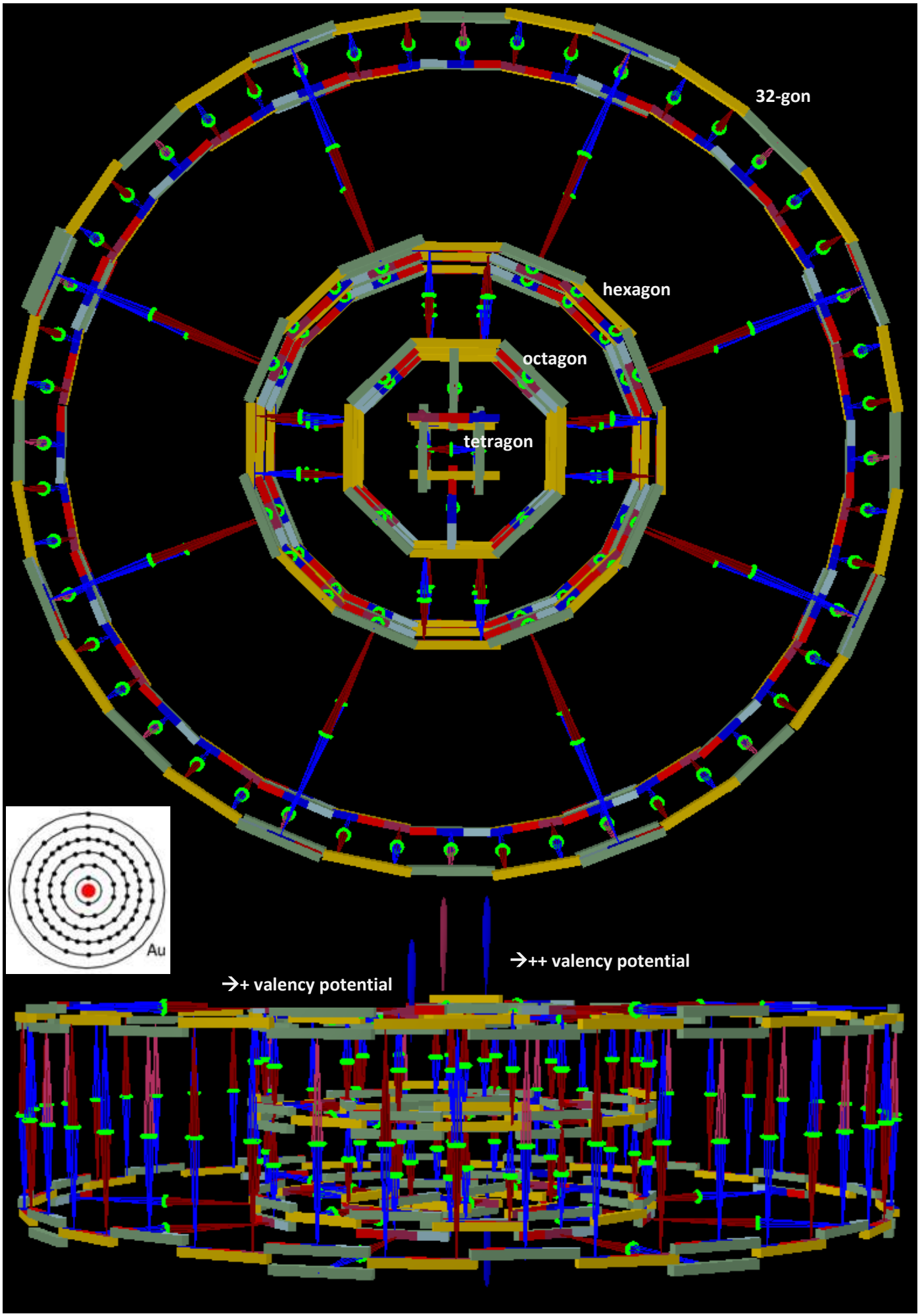


Figure 8: Stick Model of Gold-197

As for the allotropic forms of Carbon, the physical characteristics of Copper, Silver and Gold are closely related to the structure of their respective nuclei. For instance, Gold's embedded hexagonal structure is held by only sixteen well-spaced spoke-like bonds to the outer two 32-gon layers 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 with Copper being the 6th behind Platinum, Iron and Nickel, with the Shear Modulus of Copper being 48 GPa, reflecting its more compact form, compared with 30 and 27 GPa for Ag and Au respectively. A combination of size variation and geometric compatibility also facilitates well annealed amalgam mixes of the three metals.

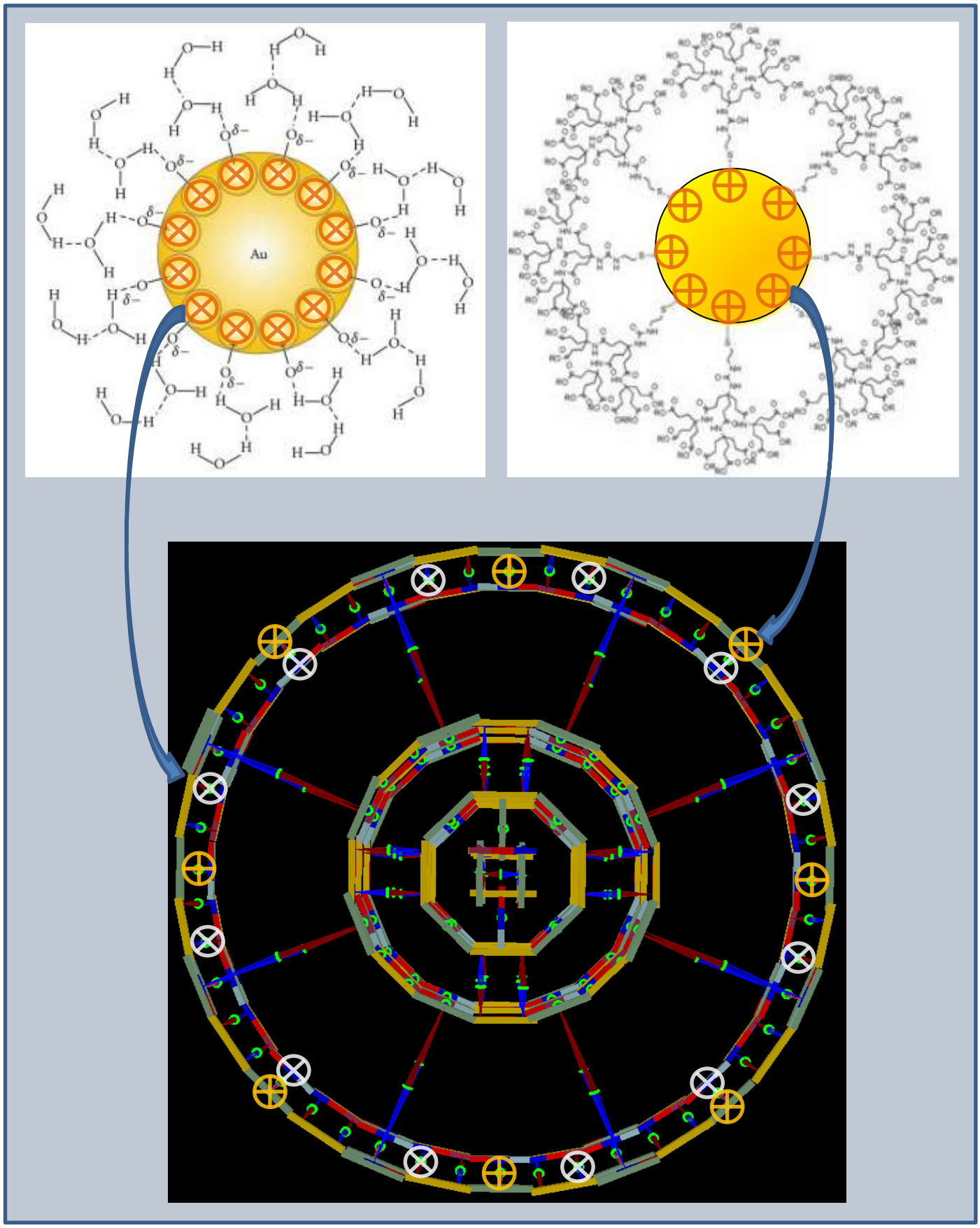


Figure 9: Models for Gold Nanoparticles in Water

The top part of figure 9 shows two alternative models put forward by **nanoparticle research** scientists for the attachment of water molecules to nanoparticles of gold. It is amazing that both models are compatible with the E2M models for Gold, with potential bonding locations for water molecules shown by the symbols ⊗ and ⊕, which correspond perfectly to vertical inter-layer CUF bond locations. Both nanoparticle patterns (one an 8-location pattern and the other 12) can be accommodated without adjustment by the one E2M model for Gold.

Note that oxygen atoms do not electron-bond with other oxygen atoms; oxygen bonding within nanoparticles is in the form of **oxygen adsorption** which forms only a slightly less strong bond than for electron (or chemical) bonding. The marked vertical CUF bonds would facilitate oxygen absorption in these locations, adding to the credibility of the E2M modelling.

Project Status

To date E2M has modelled about 10% of elements (including many allotropic and isotopic variants) in the Periodic Table up to and including Gold. For these each proton, neutron and electron can be accounted for and placed within the structure of the nucleus, and bonding hooks used in chemical reactions and to form compounds, ions and molecules well accounted for. All the required number of nucleons contributing to the unique physical and chemical characteristics of each variant fitted well with very few surprises. Can any other model for atomic structure come close to matching this claim?

With enough developmental resources there is no reason why all elements of the Atomic Table cannot be so modelled. However the development of an automated computer–based site of 3D modelling packages developed would be a pre-requisite to complete such a large project.

A lot of research effort is also required to investigate the structure and nature of nucleons underpinning the nuclei. E2M has provided some initial speculative postulations leading to the 3D nucleus models, but these need to need to be independently checked, corrected and/or replaced.

Although some concepts put forward by E2M may be conjectural, particularly from SM and QED perspectives, the models developed have merit in terms of accounting for nucleons within the atomic nuclei and the strong correlation between the physical properties (including valency and bonding geometries) and nucleus structural geometry. It provides new possibilities that are hard to ignore, and represents something worthy of further attention.

E2M Overview : *E2M provides speculative explanations for the nature and structure of quarks and nucleons, Beta Decay, Electron Capture and Positron-Electron annihilation. It also provides a speculative rationalisation of Electromagnetic Radiation (EMR) and the phenomena of Gravity. All such topics are closely related, and, in some instances, underpin the atomic structure models, but are not considered to be essential pre-requisites for the models presented in this article.*

Links to videos of the 3D models, showing details of the nucleus structure in slow rotation, are …

- Graphite atom video https://drive.google.com/open?id=1mykmYG9wtuIi2RJ5q6Z-7HtaNWyKiaVE
- Graphite sheet video https://drive.google.com/open?id=1tnCeUTF1FjSq_Zsh8faw7U3rJI_6QEiO
- Diamond atom video https://drive.google.com/open?id=1BhUq6wPVfMGz_u5z92oJwX5X4K7bb8V4
- Copper atom video https://drive.google.com/open?id=1-TuN3-dNSMaetuxwkn04XG48opRxEkMO
- Silver atom video https://drive.google.com/open?id=1GR2ywUKmVqcK7CMffcuhnV2DjMvX0Tb7
- Gold atom video https://drive.google.com/open?id=1ha35VLeXyvpJFt7W9Tj4geX1kV9H1Fem