The Big Bang Theory

and the

Creation of Matter

by

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Abstract

The prevailing explanation for the creation and development of the Universe is the Big Bang Theory, a violent expansion of extremely dense compressed matter or energy that occurred approximately 13.8 billion years ago. The conventional Science view is quark and electron creation took place in the first millionth of a second post-bang, although no feasible mechanisms are suggested for their almost instantaneous creation. This paper reviews the claimed timings, suggests a modified post-bang timeline, and explores some processes by which quarks, nucleons and electrons may have come into being and built into atomic nuclei and matter. It also identifies the possible source and nature of Dark Matter, Dark Energy and Black Holes.

Introduction: Creationist and Evolutionist Views of the Big Bang

The prevailing Science-based explanation for the creation and development of the Universe is the Big Bang Theory. Rather than being a point explosion, the Big Bang was the instantaneous and violent expansion of a vast amount of extremely dense compressed matter or energy that occurred approximately 13.8 billion years ago. Big Bang nucleosynthesis resulted in the generation of nucleons (protons and neutrons) and primitive elements. Later, various star-based nucleosynthesis episodes subsequently led to the formation of the more complex elements and compounds and, eventually, to the emergence of life.

The Big Bang model fits pretty well with cosmological observations supporting an expanding Universe. There are two theories about the occurrence of quarks, a necessary pre-requisite for the creation of nucleons and the building of atomic nuclei. One theory is that quarks, electrons and (possibly some) nucleons existed pre-bang; the other is that quarks and electrons were created moments after the Big Bang (in the first millionth of a second). These two theories are at odds with each other, and show how uncertain the timing and nature of the generation processes are; and neither theory puts forward a feasible quark and/or electron creation process.

Until Charles Darwin's theory of evolution was published in his book '*On the Origin of Species*' in 1859, the **creationist** explanation, that God created heaven and Earth and all life that dwells thereon, dominated. Since then, the theory of evolution has become the predominant scientific explanation for the development of life in all its various forms and variety, with many creationists adopting beliefs aligned with scientific findings and contributing to the development of scientific thought.

The total lack of control that their God would have had over possible Big Bang outcomes would be quite disconcerting to creationists; however, they would have no problem with the idea that their God created matter; or the quarks that built into matter; or whether that was deemed to have occurred before, during or after the Big Bang. For **evolutionists** the Big Bang represents the kick-start event for the evolution of matter that involved recycling and re-formation processes within star complexes leading to the creation the Universe as we know it, and the smatterings of life appearing therein. **Conventional Science** (**CS**) presently tends to support the evolutionist over the creationist approach but, for both of these approaches, feasible process detail is rather scant and inconsistent, with explanations appearing to be more belief than fact based.

The main problems of the evolution-orientated CS approach relate to the lack of feasible mechanisms for the creation of quarks and electrons, and to the rather extraordinary timings claimed for the early matter-creation processes. This paper reviews the claimed timings, suggests a modified post-bang timeline, and explores some processes by which quarks, nucleons and electrons may have come into being and built into atomic nuclei. It also identifies the possible source and nature of Dark Matter, Dark Energy and Black Holes.

The Structure of Fundamental Particles

By definition, fundamental (or elementary) particles are those not composed of other particles. To date, the **Standard Model** (**SM**) claims that there are 17 distinct fundamental particles with the possibly of more in the future. Of these, the **electron** is arguably the most-studied and documented of the fundamental particles. It thus represents the best candidate for delving into the possible structure of it and other fundamental particles.

Quantum Mechanics (**QM**) assumes the electron to be a monopole point-form particle that carries a negative charge (-1e) and satisfies the Dirac wave equation. When the point-form elementary particle carries a positive charge it is considered to be a **positron** (the antiparticle of the electron according to SM). Another QM-related model is the zitterbewegung (or zitter) electron for which an electric charge is considered to move in a helical spiral pattern, so providing a radius although being defined in terms of a point-form charge particle.

A well-documented alternative to QM electron models is the **T**oroidal **S**olenoidal **E**lectron (**TSE**), which defines the electron ``as a spinning point electric charge that moves at high speeds in a solenoidal pattern around a torus-shaped pathway. More recently the **C**harged-**E**lectromagnetic-**W**ave-**L**oop (**CEWL**) model, which also satisfies the Dirac equation, differs from the TSE model in that the energy of its torus core has no solenoidal component. The **S**pin **T**orus **E**nergy **M**odel (**STEM**)), as developed by the author over the past 10 or so years, is also a non-solenoidal torus electron model.

Whereas the QM and CEWL models have no explanation as to why the negative electric charge of electrons is different to the positive electric charge of positrons, the TSE, STEM and some forms of the zitter electron model consider that it is due to different **chiral** flow or movement patterns of their electromagnetic fields. An overview of STEM's electron model is presented below, with a more details of the broader aspects of the STEM approach being provided in this paper's Appendix.

STEM is an energy-centric approach based upon the hypothesis that '***there is only one type of energy-generating material***', with that material being **electromagnetic** in nature and referred to by the term **energen**. Although no assumptions have made about where or how energen has come about or been created, some basic assumptions have been made about its **behavioural characteristics**, namely:

1. The physical characteristics of energen are dependent upon its concentration and flow pattern.
2. Energen has a propensity to assume and maintain circular flow patterns with flow rates up to and including the speed of light.
3. Concentrated energen attempts to acquire and hold onto less concentrated energen, so that contact between different energen concentrations and flows results in the development of **force** acting on each, and the consequential performance of **work** (e.g. friction, particle deflection etc.).

This hypothesis is a simple concept, qualified by three equally simple assumed behavioural characteristics. It implies that all matter consists of the same material and that electromagnetic characteristics are related to energen concentrations and flows, whereas the CS approach suggests that positively charged matter (such as positrons and protons) is distinctly different to negatively charged matter (such as electrons). With STEM, all fundamental particles, composite particles, electromagnetic charge and fields, electromagnetic radiation (EMR) and atom-based matter are derived from, and definable in terms of, various energen concentrations and flow pattern combinations, with their properties and behavioural characteristics being structure-dependent.

The STEM electron consists of a torus-shaped **core-energy** of concentrated energen, which acts as a solid torus that spins rather than flows. The core-energy is enveloped by an outer torus of less concentrated energen that moves as an inviscid (frictionless) fluid and referred to as its **field-energy**. The field-energy of the STEM electron has an inflow and an outflow vortex, with energen flowing around and through the core-energy torus. The electron's field-energy has one of two chiral forms (see diagrams below): **left-handed** (or clockwise) **chirality** presenting as **negative charge**; or **right-handed** (or anti-clockwise) **chirality** as **positive charge**.

STEM often uses the term 'electron' generically so as to include positrons, but when specifically referring to a 'conventional' electron, the term **cetron electron** (or simply '**cetron'**) is used. Similarly, a CS **positron** or **positive 'hole'** (in electric current) is specifically referred to as an **aptron electron** (or simply an '**aptron'**).

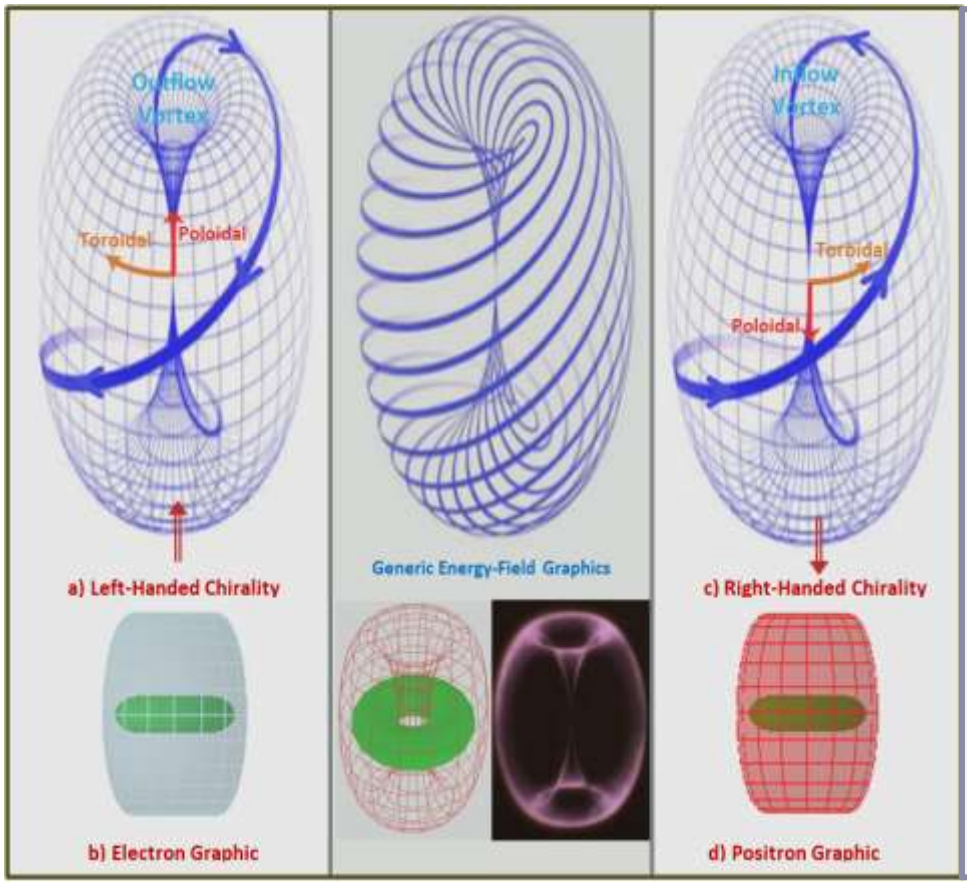


Diagram Notes

The diagrams left representing chiral flow patterns were sourced from 2022 paper '[A ½ Spin Fiber Model for the Electron]' by Markoulakis and Antonidakis.

These authors consider that the electromagnetic characteristics of the electron result from a confined photon travelling in a twisted spinor path that rotates to generate a shell-like flow pattern as shown in the central graphic.

From the STEM perspective, rather than being generated by a rotating ribbon-like spinor, an electron's field-energy consists of an atmosphere-like (or gas-like) concentration of energen that swirls around and through a spinning toroidal-shaped core. The ribbons do, however, highlight the chiral flow patterns of the electron and positron field-energy flows visually.

The lower graphics (b) and (d) are the colour-coded icons STEM uses for electrons: **blue** for cetron electrons and **red** for aptron electrons (positrons).

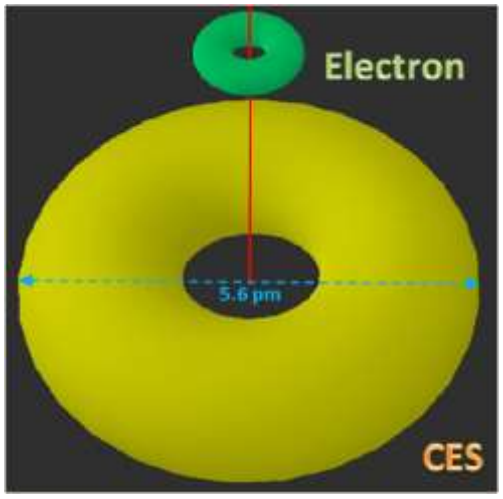
It is also worth noting that with appropriate boundary condition settings, the STEM electron satisfies the Schrodinger and Dirac wave equations, and thus the QM equations that piggy-back onto the wave equations. It has a non-zero radius and mass (the mass equivalence of its core-energy is 0.511 MeV/c^2): thus STEM electron's angular momentum (or spin) is 'real' rather than being deemed 'intrinsic' (or 'unexplained'), as for the QM point-form electron.

Details of how STEM uses this electron model to explain the many aspects of electricity and electromagnetic field phenomena can be found in STEM's first position paper that is titled '[The STEM Approach Volume 1: Electricity and the Duplicit Electron]' (Ctrl+Click to follow link to the current pdf version).

Having established a feasible model for one fundamental particle, the electron (and the positron, its anti-particle), it would seem reasonable to expect that other fundamental particles could have a similar structure.

Until the 1960s, nucleons were thought to be fundamental particles, but now SM contends that they are **composite particles** made from three up/down quarks bound together by the strong force attraction. Some Physicists consider up/down quarks to be fundamental particles, while others consider them to be composite particles composed of even smaller fundamental particles which are often called preons. Initial STEM modelling of up/down quarks as electron-like fundamental particles proved to be quite fruitless. However, their modelling as composite particles using electron-like preons produced quite promising nucleon structures.

STEM's electron-like preon is called a **C**oncentrated **E**nergen **S**ource (**CES**). It has an estimated mass equivalence of 52.17 MeV/c^2, which is about 100 times the mass equivalence of an electron and leads to nucleon structures with a mass equivalence averaging 939 MeV/c^2.



The outer diameter of the toroidal CES **core-energy** is estimated to be 5.6 pm (1 pm = 10^{-12} m), which is 4.7 times the 1.2 pm diameter of an electron's core-energy (the relative scale of their core-energy is shown in the diagram right). They each also have an outer torus of less concentrated energen, which presents as their **field-energy**, and provides their electromagnetic characteristics.

Links to STEM's three position papers that provide a more detailed coverage of these and other related topics are provided on the end page of this paper (page 9) or the References.

The Creation of Matter

The Big Bang defines the point from which matter as we know it was created. As discussed earlier, CS assumes either that quarks and electrons were instantaneously created moments after the Big Bang; or quarks, electrons and (possibly some) nucleons already pre-existed. From the STEM perspective, it is most likely that the highly concentrated energen built up pre-bang and, upon explosive release by the Big Bang, it was transformed into a range of fundamental particles with an electron-like structure, but over a far longer period (in the order of tens of thousands of years). The most common and robust fundamental particles were CES.

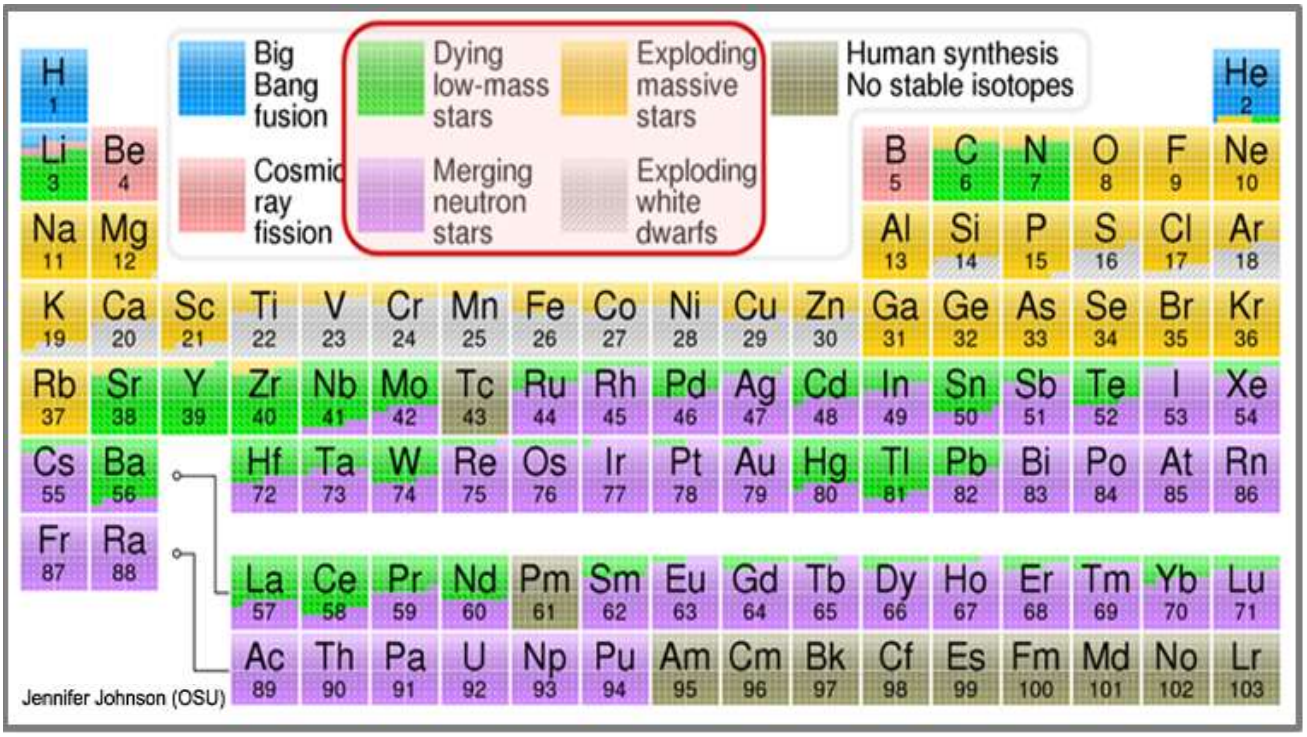
Within a sea of pre-bang energen, STEM suggests that multiple regions of high energen concentration developed and contributed to the Big Bang. The 3 possible scenarios that could apply to these regions are:

1. The concentrated pre-bang energen was structureless, with the crushing Gravity-like attractive forces within the concentrated energen imploding and triggering the Big Bang. Post-bang nucleosynthesis then generated CES that built into quarks; then quarks into nucleons and primitive atomic nuclei. This is a purely **evolutionary post-bang process** that led to the creation of matter, and eventually life.
2. With energen having the propensity to assume and maintain circular flow patterns, CES formation could have developed within the concentrated energen pre-bang. Strong force bonds can readily form between CES as exemplified by the creation of up and down quarks by strong force bonds between CES, and by the strong force bonding via CES of three quarks to create nucleon. Such unstructured confined inter-CES bonding could have developed and become unstable, leading to the sudden and explosive release of their combined strong force energy that was the Big Bang.
3. The concentrated pre-bang energen contained quarks, and possibly nucleons and primitive atomic nuclei, with the crushing force of Gravity within the mix leading to the Big Bang.

With quarks, nucleons and atomic nuclei all consisting of CES, both STEM scenarios 2 and 3 above are quite similar to the CS viewpoint that some matter-building structures (quarks and possibly nucleon) existed pre-bang and, in part at least, survived the Big Bang. However, this assumes that there were pre-bang processes that created the pre-bang particles, for which there is no evidence. Furthermore, should all such pre-existing particles and structures have been destroyed by the Big Bang, then their post-bang development would align

with that of scenario 1, and equate to a purely evolutionary process for the creation of matter and life from initially unstructured energen post-bang. Noteworthy, none of these three scenarios, or the CS approach, explains the origins of pre-bang energen, although creationists would most likely suggest a faith-based answer to this seemingly unanswerable question.

Science's understanding of the creation of the elements is quite incomplete and far from being exact. The inter-mixing and re-cycling of material between different processes complicates matters, as does the induced and natural fission-related decay of elements. The elements resulting from **Big Bang nucleosynthesis** (or **Big Bang fusion**, and indicated by **blue highlighting** in Jennifer Johnson's Periodic Table diagram below) consist mainly of elements with atomic numbers less than or equal to three (H, He and Li). Elements with an atomic number greater than 3 have mainly been produced by the matter re-cycling processes of **star nucleosynthesis**.

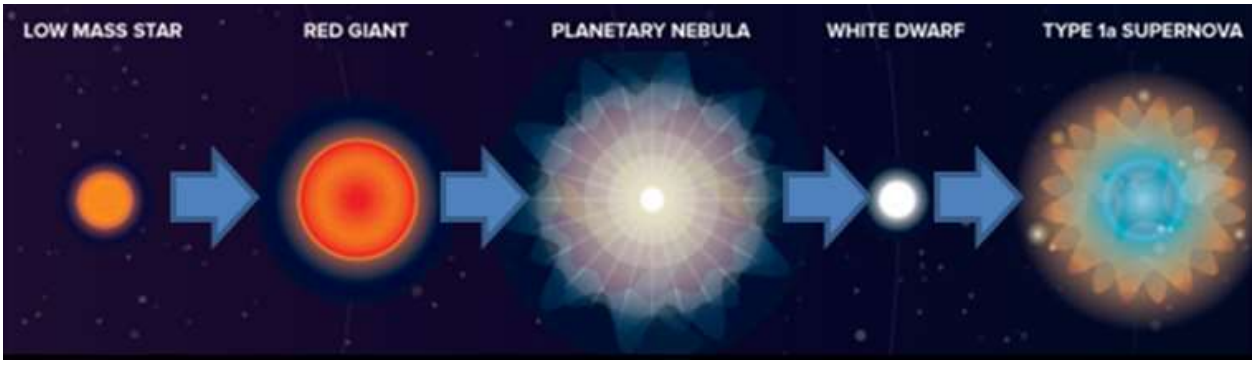


STEM's preference is the purely evolutionary scenario 1 approach, with the first stages of Big Bang nucleosynthesis involving the formation of CES over a period of tens of thousands of years post-bang rather than in a millionth of a second. As CES numbers increased, they combined to build quarks, the most stable being up and down quarks; quarks then built into nucleons (neutrons and protons) which in turn led to simple nuclei development: hydrogen (a single proton) and nuclei of deuterium (1 proton + 1 neutron); and deuterium built into helium nuclei. Further reactions between protons, neutrons and different isotopes of helium produced lithium. The hydrogen and helium mix resulted in the first stars and the start of star nucleosynthesis.

Within early stars, fusion processes turned concentrations of hydrogen into helium within their cores. When stars larger than about half the mass of the Earth's Sun run out of hydrogen within their core, they begin to collapse under their own gravity, which created additional pressure in their core and generated by-products such as carbon and oxygen. For stars more than twice the Sun's mass can also generate nitrogen as well. Once the bulk of a star becomes depleted of hydrogen due to the fusion process, they become **red giants**

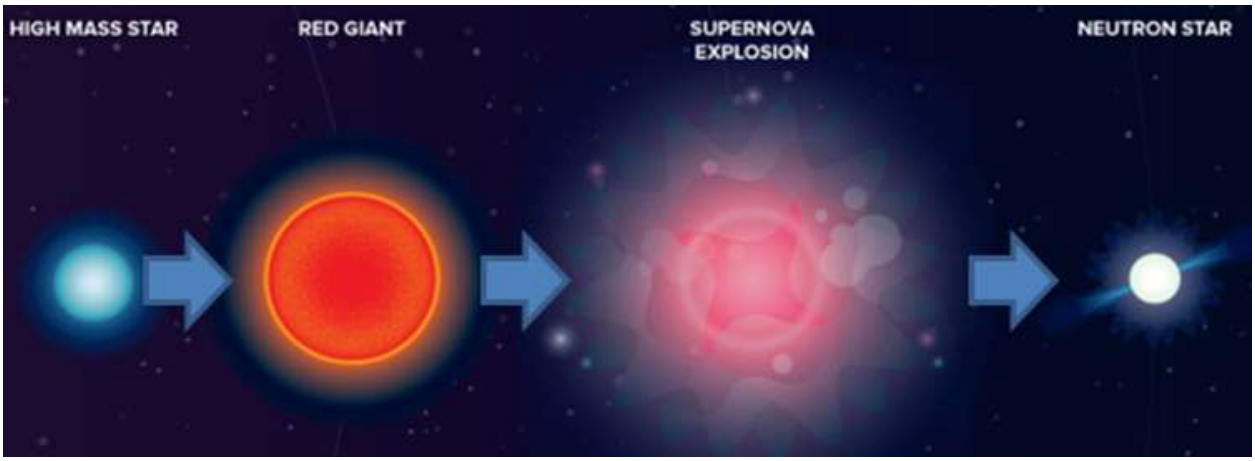
Stars with up to about eight times the mass of the Earth's Sun are categorised as **low-mass** stars. Collapsing dying low-mass stars begin a slow neutron-capture process (the **s-process**), creating heavier elements like strontium, lead and mercury (elements highlighted **green** in J Johnson's Periodic Table above).

As the collapse of a low-mass star continues, the outer gaseous layers of helium and hydrogen expand around the carbon and related heavier elements, and can no longer be contained by gravity. These gases are ejected into space to create a **planetary nebula**, leaving behind an essentially carbon core known as a **white dwarf** (see the diagram below). A planetary nebula represents the release of elemental material into interstellar space, where it can be recombined and recycled into new stars and planetary systems. Along similar lines, sometimes a white dwarf acquires elemental material from a nearby companion star to become unstable and to subsequently explode as a **type 1a supernova**, which produces the range of elements highlighted **grey** in J Johnson's Periodic Table (note that this table shows trends that are being continually being updated).



High-mass (or **massive)** stars are those greater than about eight times the mass of the Sun. When a massive star reaches the end of its life, it can explode as a **core-collapse supernova** (or exploding massive star) that produces elements highlighted **yellow** in the J Johnson's Periodic Table, and can result in a **neutron star**.

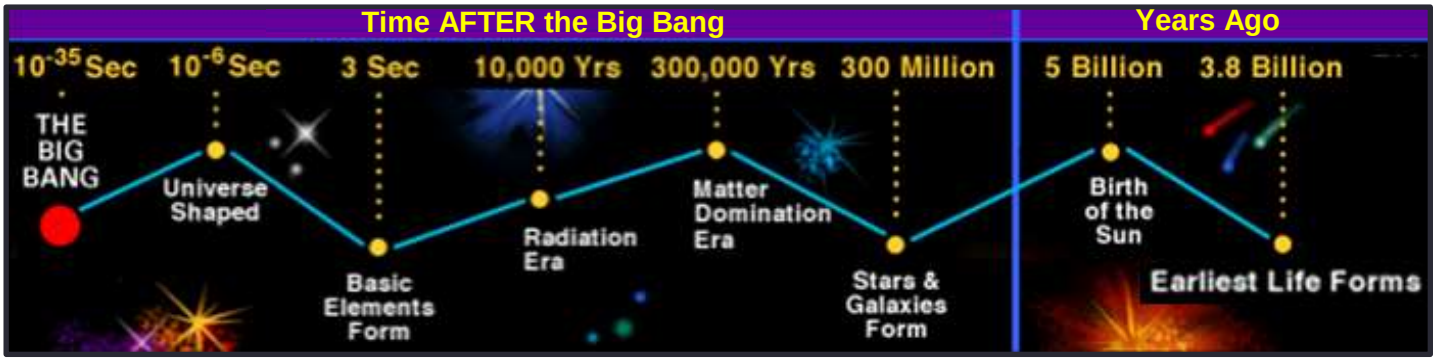
When neutron stars collide or merge, they create heavier elements via rapid neutron-capture (the **r-process**) to produce a mix of stable (e.g. silver, gold and lead) and radioactive heavy elements (e.g. uranium and thorium): these elements are highlighted with **purple** in J Johnson's Periodic Table). The radioactive elements produced by merged neutron stars are represented in the fission-related **radioactive decay series**.



Most elements have been generated by the fusion-based processes associated with Big Bang and subsequent star nucleosynthesis. However, fission-based processes such as **cosmic ray spallation** and the various **radioactive decay series** (active on Earth and elsewhere in the Universe) produce various elements as well.

In general, the more complex an atom is, the less abundant that it is and the more natural variation it has in terms of its structure and isotropic forms. And interestingly, nuclei with an even number of protons seem more abundant than those with an odd number; and those with even number of protons and even number of neutrons (even-even) are more frequent than even–odd, which in turn are more common than odd–odd ones.

Although some CS descriptions of the Big Bang suggest that quarks and nucleons existed pre-bang, more commonly quarks, electrons and neutrinos are considered to have been generated within the first millionth of a second (10^{-6} sec) post-bang, with nucleons forming afterwards within the first 3 to 1200 seconds (20 minutes). However, it would be quite a feat for all the sub-atomic matter-building particles within the Universe to have been so magically and quickly generated within the unbelievably chaotic high-energy Big Bang event! The (non-linear) timeline below shows the CS sequence and claimed post-bang timings...



A. Klesman's excellent response to the question '[How did the first element form after the Big Bang?]' stated that '*the problem at this point* (i.e. 3 to 1200 secs post-bang) *was that electrons couldn't stay in orbit around any atomic nucleus because of the immense heat and radiation still flooding the universe*' and that '*after 380,000 years or so, the universe had again expanded and cooled enough for conditions to favour electrons staying in orbit around atomic nuclei. This is when recombination occurred - neutral hydrogen (and helium) finally appeared because they could hold on to electrons without easily losing them to stray radiation*'.

The Big Bang theory supports cosmological observations that the Universe is expanding, but the expansion (or inflation) does not seem to have a single identifiable central explosion point, which is a difficult concept to visualise. To help explain such expansion, STEM suggests that separate regions of high energen concentration developed within the sea of pre-bang energen, with each region acquiring and concentrating increased levels of energen from its immediate surrounds: these regions of build-up of energen concentration are called **Growth Regions** (**GR**). At some point, one such GR would have become so large that it imploded, which instantly changed the energy-balance of the entire system, triggering a chain-reaction of explosive releases of energen from other exploding GR.

The chain-action explosion of multiple GR, each of which produced its own huge shock-wave of concentrated energen, together generated the rapidly expanding plasma soup and chaos that was the Big Bang event. Thus, rather than just one explosion, STEM contends that the Big Bang consisted of multiple GR exploding simultaneously (or within seconds of each other), pushing concentrated energen outwards from their centre of mass, which pushed other GR further away from them to create the ongoing inflation effect of the Universe.

The rapidly expanding energen fronts from exploded GR would have intersected each other over a considerable timespan due to the vast distance of their initial separation. With this scenario, Big Bang nucleosynthesis would have taken place over a period of time in the order of thousands of years, but certainly not within the first 20 minutes post-bang as claimed by CS. It is likely that Big Bang nucleosynthesis and star nucleosynthesis are simply part of the same evolutionary post-bang continuum that extends to the present day.

Within the resultant post-bang chaos generated by the chain reaction explosion of GR, three broad categories of **P**ost-**B**ang **E**nvironments (**PBE**) can be identified, which are referred to as type-1, 2 and 3 PBE.

A **type-1 PBE** occurred when concentrated energen fronts from multiple (at least two) exploded-GR intersect and interact. These regions were conducive to CES formation because of the significant increase in energen concentration due to combined flows from the GR involved; the cross-flow of the intersecting energen flows which would have generated whirlpool-like circular flows and turbulence; and the earlier stated behavioural characteristic of energen that it '*has a propensity to assume and maintain circular flow patterns*'.

As CES develop and start to amass and swirl around within the type-1 PBE plasma, stable groupings of CES emerged as up/down quarks and, as quark numbers increased, nucleon formation occurred. Protons are hydrogen nuclei, and they readily bond to form H_2 (or $^1H_2$) molecules or, via fusion, bond with a neutron to form a deuterium atom ($^2H_1$). However, the deuterium atom bond is a strong-force bond, whereas H_2 molecular bonds are far weaker and thus are more easily broken. CS considers H_2 molecular bonds to be covalent bonds and thus require the prior existence of electrons, whereas STEM considers them to be **bitron-bonds** (or **b-bonds**) that do not require the availability of electrons. So exactly what are bitron bonds?

Bitron bonds are a type of chemical bond that effectively acts as a pre-cursor to electron creation. A **bitron** is a particle-like concentration of energen that forms centrally within a bitron bond; it has the toroidal structure of the core-energy of an electron. When a bitron bond is broken, the bitron is released as a free electron and the participating atoms become uncoupled; or a new b-bond forms should the atoms be restrained (e.g. within a crystalline structure). Thus, STEM claims that the process of H_2 molecule creation, and subsequent ionisation releasing two protons and a newly created electron, is the mechanism by which electrons are generated within hydrogen-rich plasma (note that, much later, electrons were, and continue to be, produced from chemical reactions involving chemical compounds). CS has no equivalent to the bitron bond or explanation of how electrons were generated: they are just considered to have magically materialised.

The earliest signs of **electromagnetic radiation** (**EMR**) production have been placed at about 10,000 years post-bang within our region of the Universe. With EMR generation being dependent upon the existence of orbital electrons, it would seem likely that it took 10,000 years or so post-bang for hydrogen-based electron

production within type-1 PBE to reach levels necessary to support significant amounts of EMR generation. This is not to say that all early electron production from hydrogen-rich plasma occurred at this point in time: such production would have occurred far later, possibly millions of years post-bang, due to the vast distances between the GR involved. All that can be said is that, within our region of the Universe, electron generation most likely commenced about 10,000 years post-bang.

According to the CS view, quarks and electrons were amazingly created within the first millionth of a second post-bang, and nucleons within the first 20 minutes. From the STEM perspective, the generation of hydrogen and electrons, originally within type-1 PBE, would have continued for extended periods of time within various **early star** formations, eventually leading to the generation of **helium** and **lithium**: within our region of the Universe this appears to have taken place some 300,000 to 380,000 years post-bang. The CS development timeline for our region of the Universe before 380,000 years post-bang is thus disputed, but the timeline beyond the 380,000 years marker is not, although the structure of the atomic nuclei so produced is.

As alluded to earlier, electron generation within hydrogen-based plasma is not the only source of electrons. As heavier elements formed within late-stage star nucleosynthesis, and molecules and chemical compounds formed, further electrons were generated via the mechanical and chemical breakdown of b-bonds. Furthermore, STEM contends that ionisation-based electron generation processes continue to the present day in the form of some Redox reactions (e.g. those in a chemical battery) in environments far removed from star-based plasma.

Within **type-2 PBE**, energen predominately moves radially outwards from an exploded GR with minimal side-contamination from other GR explosions: it includes the area of a GR (i.e. its footprint) after its explosion and resultant loss of energen. Type-2 PBE represent zones in which CES development is minimal. However, at any time in its life, a type-2 PBE can be impacted by energen from other exploded GR and, should the combined energen concentration be sufficiently high, become a type-1 PBE and so develop more CES, which might or might not lead to the formation of a up/down quarks and possibly even some nucleon.

Type-3 PBE are GR that did not explode as part of the Big Bang that have remained relatively intact, having been shaken but not stirred by other exploding GR, and continue to acquire more energen from the system. STEM suggests that these are the **Black Holes** of our Universe. They have huge gravitational fields but contain no EMR-emitting electrons (except possibly some around its outer limits); and, as for pre-bang GR, they can implode when they get sufficiently large, so spawning more matter building and recycling processes. Potentially, Black Holes represent fragments of the pre-bang world.

STEM suggests that **Dark Matter** (approximately 27% of the Universe's energy) consists of type-1 PBE regions that contain a CES and quark energen mix, but with insufficient quarks to begin or sustain significant nucleon formation. Along similar lines, **Dark Energy** (approximately 68% of the Universe's energy), which is fairly evenly dispersed throughout the entire Universe, is most likely remnants of concentrated post-bang energen which is structureless except for low levels of CES formation. Thus, it consists of type-2 PBE and, possibly, some type-1 PBE energen with insufficient CES to sustain the effective building of quarks.

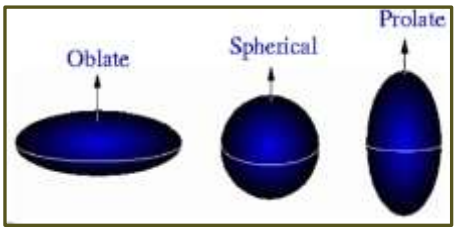
After accounting for Dark Matter and Dark Energy, only a small proportion (about 5%) of energen has resulted in the creation of normal matter, with only Earth being known to host life.

STEM Implications beyond the Creation of Matter

Apart from providing a truly evolutionary model for the creation of matter, the STEM approach has other significant implications for CS in terms of sub-atomic structures (electron, quark, nucleon and nucleus structure) and the nature of electricity, electromagnetism and EMR. Let's start with atomic nuclei structure.

Although most (almost all) CS diagrams of atoms represent their atomic nucleus as being a spherical aggregation of protons and neutrons despite, as noted in Victoria Atkinson's recent article Why isn't an atom's nucleus round?, it has been established experimentally that about 90% of atomic nuclei have the shape of a

prolate spheroid (e.g. an Australian Rules or American football). Others have the shape of an oblate spheroid (i.e. are M&M-like), and several heavier unstable nuclei are pear-shaped, with only a few being spherical. STEM, on the other hand, contends that atomic nuclei have a **polygonal lattice-like** structure which would pretty well approximate in shape to the observed range of spheroid geometries, including those few elements that do have a spherical-shaped nucleus.



STEM also contends that the polygonal lattice-like structure of their atomic nuclei has a major influence upon the physical properties and chemical bonding characteristics of elements.

Another distinct difference is that STEM claims that the **electron orbitals** are **planar** above and/or below the nucleus rather than Bohr-like shells that encompass the whole nucleus, or spindly as for the 'spdf' and QM hybrid orbitals. An atom can have up to 2 planar 'ionic' orbitals, each with up to 2 cetron or 2 aptron electrons. CS, on the other hand, considers a **neutral atom** to have an equal number of orbital electrons as it has protons in its nucleus (e.g. Thorium would have 90 orbiting electrons!). Thus for elements with atomic number above 5 (Boron), STEM-defin0ed atoms have far fewer orbital electrons than their CS equivalent.

As discussed earlier in this paper, STEM considers that all fundamental particles have a toroidal electron-like structure. Specifically, electrons (and positrons) have mass and spatial extent and thus their angular momentum (or spin) is not intrinsic, and they are considered to be derived from **bitron bonds** (**b-bonds**) that can form when chemical inter-atom bonds are less than 100pm long. CS has no equivalent to b-bonds; nor any explanation of where electrons (or positrons) come from; how they are created; or why there would seem to be an endless supply of them in our world.

CS considers that charge is an intrinsic property of certain material, which implies that electrons (and down quarks) consist of negative charge material; and that positons (and up quarks) consist of different material of positive charge; all without any explanation of why they are different. In contrast, STEM considers that electrons and positrons are made of exactly the same material (energen); have been derived from b-bonds; and have the same structure (a toroidal core-energy and outer field-energy) except that their field-energy has different chirality. Electrons with left-handed chirality (cetron electrons) present with negative charge characteristics, and those with right-handed chirality (positrons or aptron electrons) present with positive charge characteristics. Similarly, the chirality of CES field-energy defines positive p-CES and negative e-CES that in combination provide the charge characteristics of up and down quarks (+2/3e and -1/3e respectively).

According to CS, an **electric current** consists of electrons moving from negative to positive terminals and positive 'holes' (conceptual quasiparticle entities) moving in the opposite direction. Subtly different, STEM contends that an electric current consists of cetron electrons and aptron electrons (both physical entities) moving in opposite directions under the influence of an applied or induced emf. The chiral field-energy of cetron and aptron electrons moving as an electric current within a wire conductor combine (the toroidal flow components are additive and the poloidal cancel out) to generate the **circular magnetic field** around the wire.

Electric fields can be generated from the positive and negative terminals of an electric current. As exemplified by capacitor plates or a pair of probes attached to a DC power source, a break in a powered up electric circuit stops current flow, with cetron and aptron electrons become concentrated at each side of the break point to create the equivalent of a negative and positive electric charge pair and their associated electric fields. Unlike **magnetic fields**, which have curved field-energy flow from a North (real or implied) to a South pole, an **electric field** has no net flow of field-energy between a pair of positive and negative charges, although a weak circular magnetic field is generated that is analogous to that around an electric current carrying wire.

The STEM approach provides the basis for the post-bang development of matter that is entirely evolutionary and a pre-cursor to the evolution of life. A brief overview of the STEM approach can be found in this paper's appendix, with far more detail available within STEM's 3 position papers accessible via the pdf links below:

The STEM Approach Volume 1: Electricity and the Duplicit Electron

The STEM Approach Volume 2: Atomic Structure

The STEM Approach Volume 3: Light As You Have Never Seen It Before

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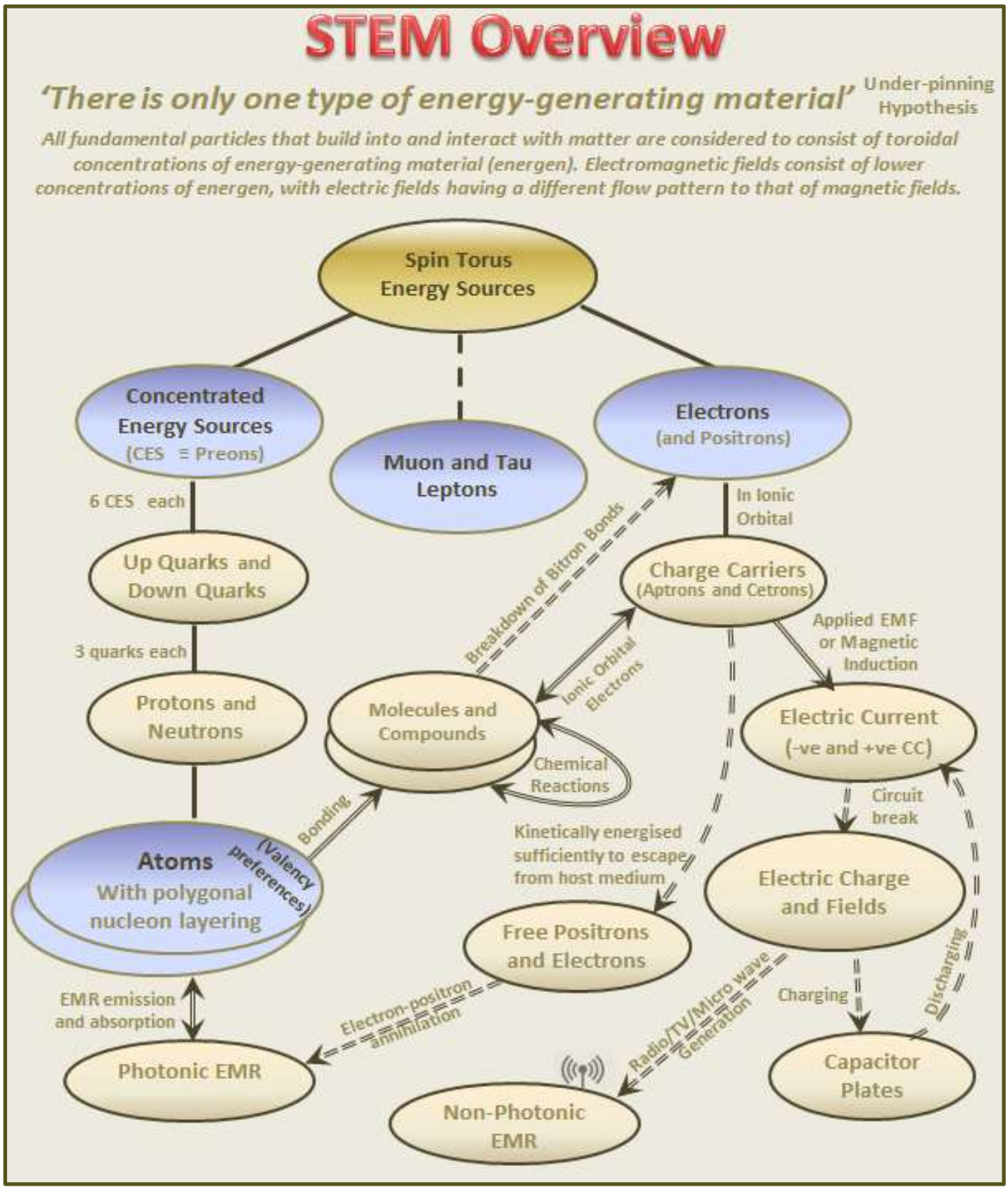
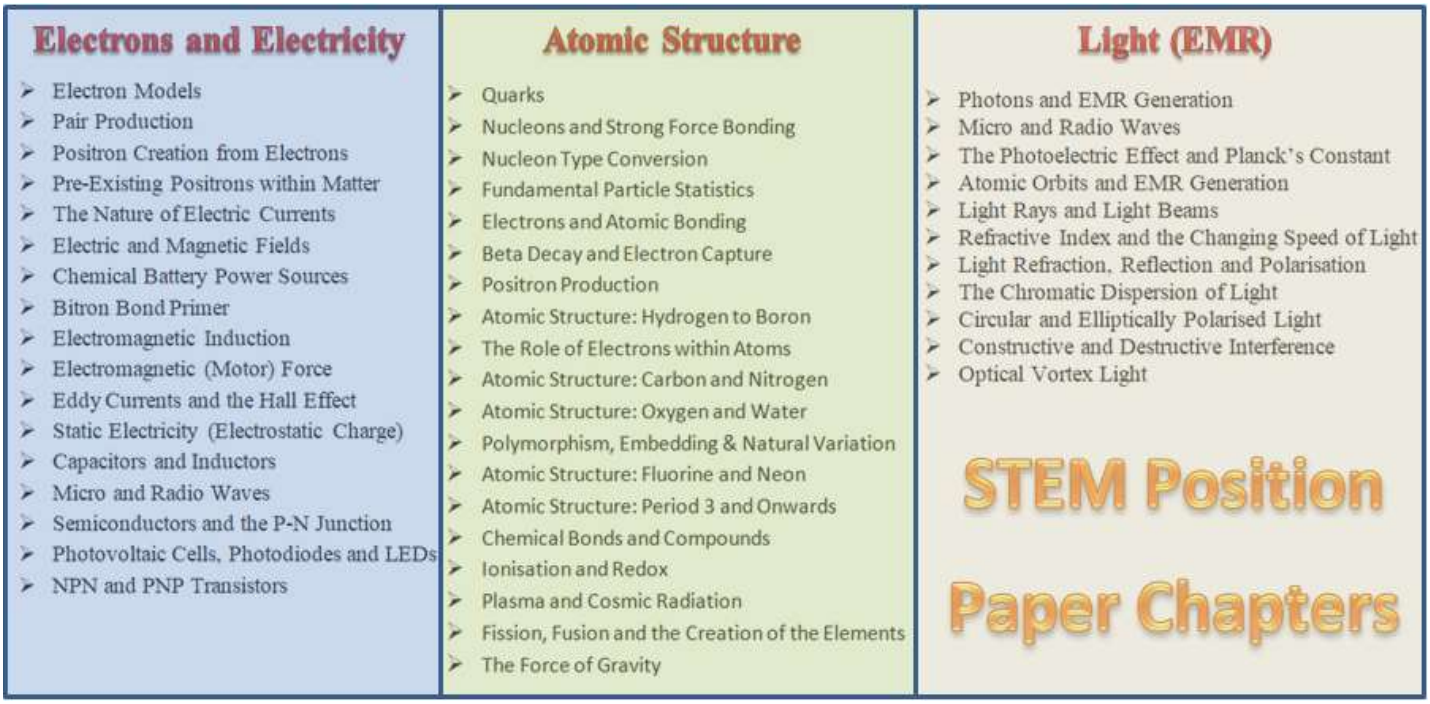
Appendix: Overview of the STEM Approach

The inter-relationships between the components of the STEM approach are represented in the diagram below.



Being a pragmatic approach, very little new mathematical theory accompanies STEM's development. Thus its 'proof of concept' is in terms of how well it sits with existing mathematical theory (such as the QM wave equations), existing experimental observations, and the practices of the applied Science and engineering areas. This requires STEM to address and sensibly explain all theoretical and applied aspects (the so called 'empirical evidence') of the Physics, Chemistry and Engineering study areas, which is a huge challenge.

The range of topics addressed by STEM to date can be seen from the chapter headings of STEM's three position papers as tabulated below. The explanations provided therein span a wide range of phenomena, applications and disciplines which, as well as being a form of validation for the STEM approach, do demonstrate how far the simple hypothesis that '***there is only one type of energy-generating material***' can extend, and highlight a range of new feasible possibilities that warrant further research and exploration.



Key aspects about which conventional Science and STEM both agree upon include:

- All aspects of Newtonian Physics.
- That electron and positron behaviour is well described by the QM wave equations.
- Nucleons consist of three **U**p/**D**own quarks: protons = UDU and neutrons = DUD
- Atoms consist of a nucleus and orbital electrons; and the nucleus consists of protons and neutrons.
- Neutrons can convert into protons and vice versa.
- Charge movement (electric current) generates a circular magnetic field and wire movement through (or of) magnetic fields can generate electric current.

Below is a point-form list of the main aspects for which STEM is different to conventional Science (CS).

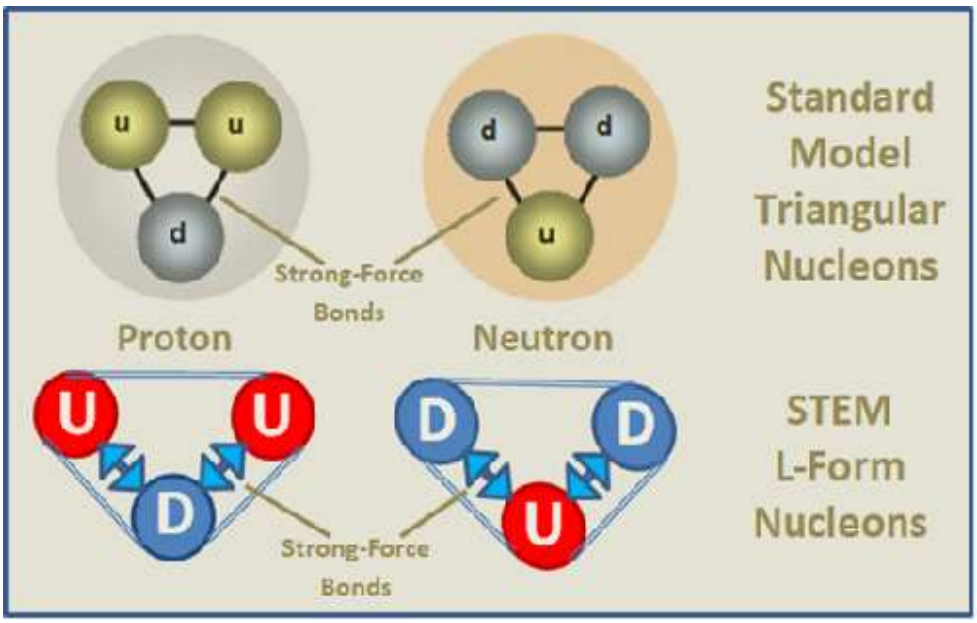
- Electrons and positrons have spatial extent and thus their angular momentum (or spin) is not intrinsic.
- Electric fields associated with electric charge are due to chiral energen flow patterns of particles and related compounds rather than being related to inexplicable intrinsic properties.
- Induced and chemical-battery generated electric current consists of the two-way (duplex) movement of negative and positive charge carriers (CC) rather than the movement of electrons and 'positive holes'.
- Circular magnetic fields around electric current carrying wires are due to the toroidal flow components of cetron (negative CC) and aptron (positive CC) electrons rather than being intrinsic.
- Atomic nuclei have a polygonal lattice-like structure that is reflected by their physical properties and chemical bond characteristics rather than consisting of a ball-like amorphous aggregation of nucleons,
- Orbital electrons occupy planar (or ionic) orbitals above and/or below the nucleus rather than in shell-like (as for the Bohr-like CS model that encompass the whole nucleus) or 'spdf' (QM hybrid) orbitals.
- An atom can have one or two ionic orbitals, each supporting up to 2 cetron or 2 aptron electrons, rather than the number of orbitals of a neutral atom being determined by the number of protons in its nucleus.
- Bitrons are pre-electron concentrations of energen that can form as chemical **bitron bonds** (b-bonds) for bond lengths are less than 100pm long. CS has no equivalent to bitron bonds.
- Photonic EMR (e.g. visible light) consists of **F**ield-**E**nergy **R**ings (**FER**), that are particle-like ringlets of energen whose combined electromagnetic footprint presents as that of a CS electromagnetic wave.
- Non-photonic EMR (e.g. man-made radio and micro waves) structure is different to photonic EMR.

The next page's tabulation is a comparison of STEM and CS key concepts, definitions and interpretations.

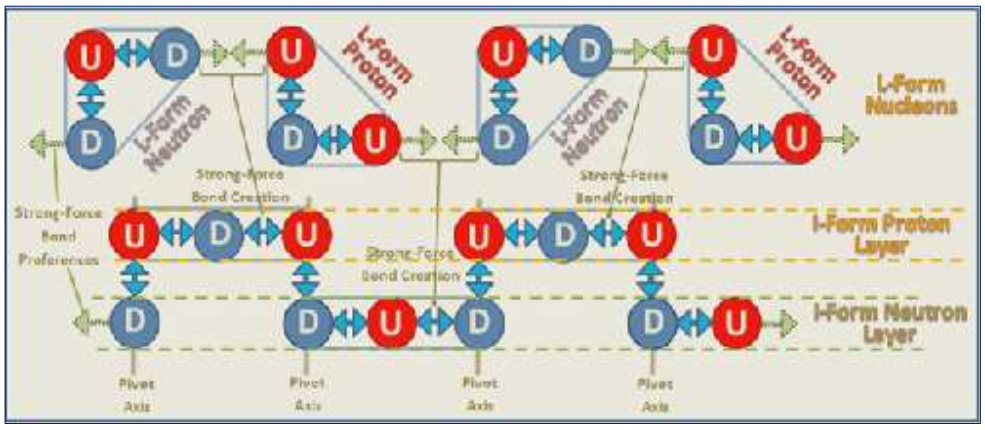
Aspect		STEM	Conventional Science (CS)
Electron (or Cetron Electron or **Negative** CC)	Structure	Toroidal energy core surrounded by a chiral electromagnetic field	Point-form definition (no structure or spatial extent) or spherical (unsupported).
	Size	Energy core R=2.4x10^{-13}m; r =1.6 x10^{-13}m	QM = Nil (point-form definition); CS radius= 10^{-20} to 7x10^{-13}m (spherical model)
	Spin	Newtonian angular momentum = 5.24 x 10^{-35} Js	Intrinsic, derived from reduced plank constant = ħ/2 = 5.27 x 10^{-35} Js
	g-factor	g = 2.012 using Newtonian angular momentum (above)	g = 2.00232 using reduced plank constant estimate for spin (above).
	Charge	negative charge (-1e) due to the left-handed chirality of EM field	Intrinsic negative charge (-1e) Considered to consist of different material
Positron (Aptron Electron or **Positive** CC)		Positive charge (+1e) due to the right-handed chirality of EM field	Intrinsic positive charge (+1e) No fit with CS atomic models.
Electricity	Electric current	Duplex movement of cetron and aptron electrons (cetrons - to +; aptrons + → - terminal).	One-way movement of electrons from the negative terminal towards the positive terminal and 'positive holes' opposite direction
	Circular magnetic field	Due to net toroidal component of cetron and aptron EM fields. Maxwell's RH Fist Rule applies.	No real explanation, but Maxwell's RH (right-hand) Fist Rule used to determine direction with respect to current flow
Electric Fields		Combined field energy of CC that are axially aligned (moving or static). Field Chirality determines whether negative or positive.	No real explanation. Negative and positive fields are generated by particles/materials that intrinsically have either a positive or negative electric charge property.
Magnetic Fields		Generated by the toroidal component of the field energy of cetron and aptron electrons moving as an electric current.	No real explanation. Magnetic fields are considered an intrinsic property associated with the movement of electrons as an electric current.
Up/Down Quarks		Composite particles formed by octahedron array of e-CES and p-CES (large electron/positron like fundamental particles).	No real explanation. Fundamental or composite particles (consisting of preons). Up and down quarks assumed to have an electric charge of +2/3 e and -1/3 e respectively.
Nucleons		L-shaped, with a central quark strong-force bonded to two other quarks (a neutron = DUD and a proton = UDU).	Composite particles; triangular form consisting of three quarks (a neutron = DUD and a proton = UDU). Each quark is bound to the other two by strong force bonds or gluons.
Atomic nucleus		Nucleons strong-force bonded to form linear nucleons to produce a lattice-like polygonal structure.	An amorphous aggregation of protons and neutrons. No specific structure or explanation of why protons don't forcedly repel each other.
Orbital Electrons		Zero to four planar ionic orbitals (unrelated to the number of nucleons in the nucleus).	Neutral atoms have same number of orbital electrons as protons. Orbitals pattern undecided: shell-like (CS) or spdf (QM).
Chemical and Ligand Bonding		**Covalent** (ionic orbital overlap) **b-bond** (pre-electron bond) **p-bond** (more than 100pm long).	**Covalent** (electron sharing via cross-overs) **Ionic** (involving +ve and -ve ions) Requires use of hybridised spdf orbitals.
Gravity		Due to the retrieval of low-level concentrations of background energen by atomic nuclei.	An abstract explanation, being due to the hypothetical displacement (or warping) of General Relativity's distribution of space-time.
EMR	Unpolarised Photonic	Consists of toroidal ringlets of energen (FER) in a single helix structure generated by ionic electrons adjusting to a lower energy level. Particle & wave-like	Electromagnetic waveforms generated by orbit electrons jumping from a higher to a lower energy level. Require Aether to travel though outer Space. Photons are considered to have sufficient energy to act particle-like.
	Plane Polarised Photonic	Reverse-spin groups of coplanar toroidal ringlets (FER) linearly aligned to their travel direction.	The electric field of light is confined to a single plane along the travel direction. The magnetic field is orthogonal to the electric field.
	Non-Photonic	Expanding waves of field energy, with the circular magnetic field of adjacent waves being in opposite directions.	No provision for non-photonic EMR. Man-made micro/radio/TV waves are considered to have the same electromagnetic waveform as all other unpolarised photonic EMR.

Although not intentionally made different, many aspects of the STEM approach are different to school/university promoted Physics, which unfortunately has not been in STEM's best interests. One example of such differences relates to the **positron**. CS cannot and does not support the existence of positrons within matter, whereas STEM claims that they can and do. Specifically, within electrical conductors, STEM claims aptron electrons (CS positrons) rather than 'positive holes' (conceptual quasiparticle entities) move in the opposite direction to cetron electrons (CS electrons) as an electric current. This interpretation of electric current was quite difficult to justify until strong supportive evidence was found in the form of **fractal wood burning** and **DCPE** (**D**irect **C**urrent **P**ositive **E**lectrode) welding, which can only be explained by the presence of aptron electrons (see STEM's Electricity and the Duplicit Electron position paper, pages 16 to17).

On the other hand, apart from STEM's preon-like structure for up/down quarks, the STEM nucleon model is similar to that of SM. However, as can be seen in the diagrams right, STEM nucleons have only 2 strong force (inter-quark) bonds that results in an L-shaped (**L-form**) nucleon geometry, whereas SM infers 3 bonds (or gluons) and a triangular geometry.



When STEM L-form nucleons join together (by strong-force bonds at the quark level) to create an atomic nucleus, layers of linear (or **I-form**) nucleons are generated, with each layer having the same polygonal geometry. Except for hydrogen (a single proton), the STEM nucleus of all atoms has a polygonal form and presents as a hollow lattice-like structure with distinct proton and neutron layers, each consisting of same-type I-form nucleons.



The CS nucleus is promoted as an amorphous nucleon aggregation that is spherical, whereas the STEM nucleus has a distinct lattice-like polygonal structure that approximate in shape to the oblate to prolate spheroid geometry range determined experimentally. For instance, the hexagonal (oblate) graphite and tetragonal (prolate) diamond nucleus variants for carbon-12 produce bond-length and unit cell size estimates close to their known values as well as explanations for their different properties (e.g. clarity/colour, hardness and densities). STEM also provides an explanation for the differences between cubic and hexagonal diamond.

The hollow polygonal lattice-like structure of larger nuclei can contain smaller embedded polygonal nuclear structures, the most common and innermost of which are **helium nuclei**, which may be later released as **alpha radiation** by a variety of processes (such as those of the nuclear decay chains). Rather than the smaller nuclei finding their way into the large nuclei, STEM suggests that the smaller nuclei would more likely act as **seed-nuclei** to which other nucleon attach (possibly via b-bonds) and build an outer higher-order polygonal sleeve.

STEM was not developed to explain the Big Bang event or to provide an evolutionary explanation of the creation of matter, but it does just that. Although STEM requires far more research and development, even in its present state, it provides a re-assuring consistency across many Physics-related phenomena and disciplines, and feasible reasoned interlinked explanations so much lacking in the current quantum-focussed CS world.