Roberts, J Material Sci Eng 2018, 7:2
DOI: 10.4172/2169-0022.1000438

Journal of Material Sciences & Engineering

Research Article Open Access

Implications of the Link between the Periodic Table and the Standard Model

Roberts JO*

Former Open University Tutor, UK

Abstract

The mathematics of quantum physics from the standard model using groups U(1)xSU(2)xSU(3) and the Pauli principle produces two sets of time independent quantum states n(n+1) and n(n-1) where n is the principal quantum number. Oscillations between these states result in a one to one mapping with the Roberts-Janet Nuclear Periodic Table by interpretation of n>0 for condensed matter and n<0 for plasma prior to fusion. The mechanism provides a framework for Periodic Tables for every supernova by excluding mass number.

In the lower half of the table occupation by bosons leads to increased energy densities in which an ensemble of outcomes is discussed. An hypothesis of string theory is proposed at the nuclear end of the table merging into quantum loop gravity at the condensed matter at the top end of the table.

Keywords: Quantum physics; Quantum loop; Spectroscopy; Binding energy

Chemical View

Janet's Periodic Table [1-3] links atomic number with the spectral energy levels observed in spectroscopy (Figure 1). By inverting the table to accommodate spatial variation relative to the nucleus the table transposes to part of the Roberts-Janet Nuclear Periodic Table representing the initial 120 elements.

Quantum Mechanical View

The fundamental group of invariance of all physical interactions is the group of all invertible elements using Clifford geometric algebra. The wave equation is gauge invariant under a gauge group which is the U(1)xSU(2)xSU(3) group of the standard model of quantum mechanics.

If an inertial frame is sufficiently heavy to include a quantum wave stationary in this frame a double link exists between the wave equation and the Lagrangian density.

Normalisation and probability density result from the principle of equivalence between inertial and gravitational mass-energy. By including the Pauli Exclusion Principle properties of the potential terms of the gauge field result in two subsets of energy states. If n is the principal quantum number then the two states or subset energy states are characterized by:

n(n+1) and n(n-1) [4-7]

'$2n^2$ is for children'

Claude Daviau Louis De Broglie Foundation,

San Antonio Conference 13-15 November 2017.

By using n>0 for the electric field in attractive mode a set of energy levels can be generated as can a different though symmetrical set be generated from n<0 for the electric field in repulsive mode.

Oscillations between the two sets of states result in the quantum mechanical table (Table 1). The n(n+1) states are written in red and the n(n-1) states in blue for ease of illustration.

It should be noted that the consequence of this result implies even numbers of energy states as both n(n+1) and n(n-1) are even for all integer values of n. Since $2n^2=n(n+1)+n(n-1)$ consists of two oscillations, the result is a set of states occurring in pairs:

n=1	2, 2
n=2	8, 8
n=3	18, 18
n=4	32, 32.

This would appear to be a scientific explanation for the occurrence of pairs of 8, 18, 32 in the periodic table together with a prediction of a pair of 2 at the beginning of the table as first suggested by Janet [3].

The table is extended to n=6 for ease of comparison with the Roberts-Janet Nuclear Periodic (Table 2).

Biochemistry Subsumed by Quantum Mechanics?

Chemistry emerges from the set of time independent energy states in quantum mechanics as condensed matter represented by the top half of the Roberts-Janet Nuclear Periodic Table while the lower half indicates the energy levels in the phase of plasma prior to fusion.

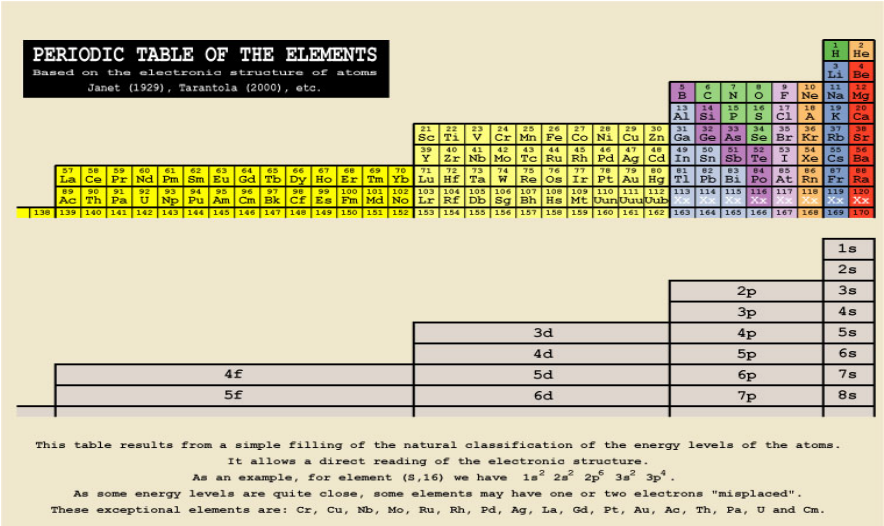
There are no prescribed energy values as in the stable states $\Delta t \to 0$ so Heisenberg's principle implies ΔE is empirical not theoretical. As the energy states in matter move away from the nucleus at the order of 10^{-10} m to 10^{-8} m towards ionisation and classical physics they converge. $\Delta x \to 0$. Heisenberg's principle implies an overlapping of states consistent with a variation in the filling of energy levels by electrons for n>2.

Spatial variation becomes increasingly blurred given the shape form and density of each time independent wave function as predicted by quantum mechanics including quantum tunnelling and electron capture.

***Corresponding author:** John Owen Roberts, Former Open University Tutor, UK, E-mail: johnroberts048@gmail.com

Received March 16, 2018; **Accepted** March 20, 2018; **Published** March 30, 2018

Citation: Roberts JO (2018) Implications of the Link between the Periodic Table and the Standard Model. J Material Sci Eng 7: 438. doi: 10.4172/2169-0022.1000438



Figrue 1: Priodic table.

$2n^2$ = n(n+1) +n(n-1) TABLE								
						n(n+1)	n(n-1)	
22	18	14	10	6	2			
22	18	14	10	6	2	42	30	n = 6
	18	14	10	6	2			
	18	14	10	6	2	30	20	n = 5
		14	10	6	2			
		14	10	6	2	20	12	n = 4
			10	6	2			
			10	6	2	12	6	n = 3
				6	2			
				6	2	6	2	n = 2
					2			
					2	2	0	n = 1
					0			
					0	0	0	n = 0
					2			
					2	0	2	n = -1
				6	2			
				6	2	2	6	n = -2
			10	6	2			
			10	6	2	6	12	n = -3
		14	10	6	2			
		14	10	6	2	12	20	n = -4
	18	14	10	6	2			
	18	14	10	6	2	20	30	n = -5
22	18	14	10	6	2			
22	18	14	10	6	2	30	42	n = -6

Table 1: Quantum mechanical table.

The empirical nature of the energy levels also implies the structure varies for each element and can accommodate hyperfine splitting for isotopes within each element together with molecular band structure.

The top half of the Roberts-Janet table indicates the presence of two sets of $2(1)^2$, $2(2)^2$ etc. states consistent with the oscillation between the n(n+1) and n(n-1) states. The first of the $2(1)^2$ states are occupied by Hydrogen and Helium as first proposed by Janet [3].

There is now a one to one mapping between the quantum energy states of Table 1 and the atomic number of elements of Table 2 and the reservoir energy states in plasma similar to spectroscopy separated by zero states.

A Group System emerges as the framework of quantum energy states converges with chemical properties [8]. Hydrogen and Helium occupy the 1s state. Helium does not have any p state electrons unlike the other inert gases. Recent observations of metallic hydrogen on Jupiter imply that Hydrogen could be regarded as a Group 1 metal under suitable conditions. An implication/prediction from the Roberts/Janet Table follows that metallic helium exists under suitable conditions so Helium can be regarded as a Group 2 metal. This suggests that the Group System incorporates all elements in the table and begins beneath Hydrogen and Helium and not above as shown in Table 2.

The overall framework in both tables is unaffected. The first $2(2)^2$ state indicates the beginning of two quantum states s,p; the first $2(3)^2$ indicates the beginning of three quantum states s,p,d; likewise the $2(4)^2$ indicates the beginning of s,p,d,f states in spectroscopy.

The periodicity of eight intuitively recognised by Mendeleev can be explained by anecdotal evidence from flocks of starlings. They can perform a mesmeric murmuration or wave dance – the nearest macroscopic movement we have to an electron probability density wave with the birds acting as particles and the flock as the wave. Research models have shown that provided the birds monitor the speed and direction of their seven nearest neighbours no collisions occur; so with the electrons and their electric field.

Group number is now defined as the maximum number of electrons in any one period. A period is defined by the s states. Period 1 corresponds to 1s, period 2 to 2s etc. For illustration purposes the table is extended to $2(6)^2$ to indicate the relationship between periods, quantum states and group number. This leads to atomic number 292 at the top of the table. However nuclear instability is the most likely determining factor as to how far beyond the current 118 the table extends.

As the atomic number increases the inner electrons may reach relativistic energies which alter the shape of the electron probability density cloud and could affect the first ionisation level for heavy nuclei.

								∞	∞
	LIMITS TO QUANTUM ENERGY STATES OF ELECTRONS							↑	↑
Period 11		$221^{6h}242$	$243^{7g}260$	$261^{8f}274$	$275^{9d}284$	$285^{10p}290$	$291^{11s}292$	$2(6)^2$	
Period 10			$171^{6g}188$	$189^{7f}202$	$203^{8d}212$	$213^{9p}218$	$219^{10s}220$		$2(5)^2$
Period 9			$121^{5g}138$	$139^{6f}152$	$153^{7d}162$	$163^{8p}168$	$169^{9s}170$	$2(5)^2$	
Period 8		ELECTRON STATES OCCUPIED BY ATOMS OUTSIDE STARS		$89^{5f}102$	$103^{6d}112$	$113^{7p}118$	$119^{8s}120$		$2(4)^2$
Period 7				$57^{4f}70$	$71^{5d}80$	$81^{6p}86$	$87^{7s}88$	$2(4)^2$	
Period 6					$39^{4d}48$	$49^{5p}54$	$55^{6s}56$		$2(3)^2$
Period 5					$21^{3d}30$	$31^{4p}36$	$37^{5s}38$	$2(3)^2$	
Period 4						$13^{3p}18$	$19^{4s}20$		$2(2)^2$
Period 3						$5^{2p}10$	$11^{3s}12$	$2(2)^2$	
Period 2							$3^{2s}4$		$2(1)^2$
	∞								
		51 - 72	33 - 50	19 - 32	Sep-18	03-Aug	01-Feb	GROUP	
	←								
Period 1							$1^{1s}2$	$2(1)^2$	
	ZERO POSITIVE ELECTRIC POTENTIAL								$2(0)^2$
	INFINITE NEGATIVE ELECTRIC POTENTIAL							$2(0)^2$	
	RESERVOIR ENERGY STATES OCCUPIED BY PROTONS IN PLASMA PRIOR TO FUSION						2		$2(-1)^2$
							2	$2(-1)^2$	
						6	2		$2(-2)^2$
						6	2	$2(-2)^2$	
					10	6	2		$2(-3)^2$
					10	6	2	$2(-3)^2$	
				14	10	6	2		$2(-4)^2$
				14	10	6	2	$2(-4)^2$	
			18	14	10	6	2		$2(-5)^2$
			18	14	10	6	2	$2(-5)^2$	
				∞ ∞					
				↓ ↓					
∞ ∞									

Table 2: Strong field cloaks quarks forming larger nuclei after trigger of fusion by weak force.

This is exemplified in the chemical debate about the position in the Periodic Table of Lutetium 71 and Lawrencium 103; Lanthanide or Actinide? Given their chemical similarities to these classifications of elements [9].

The framework of energy states is the result of the U(1)xSU(2) xSU(3) group symmetry coupled with the double link between the wave equation and the Lagrangian density. How those energy states are occupied depends on the mass, wave function, position and momentum of the particle occupying those states. In this case it is the electron.

Using Hardy's paradox or Bell's Theorem [10] in its simplest form "No physical theory of local hidden variables or locality can ever reproduce all the predictions of quantum mechanics" implies these energy changes are empirical not theoretical. The size of the first ionisation level is what it is. The one to one mapping between Tables 1 and 2 implies the outermost electron for Lutetium 71 is $5d^1$ and for Lawrencium 103 is $6d^1$ [11]. The requirement for an even number of energy states from the quantum mechanical table (Table 1) suggests that the Lanthanides and Actinides consist of 14 elements not 15 so the Lanthanides finish at atomic number 70 and the Actinides at 102.

Limits to the Periodic Table?

Estimates of an upper limit to the atomic number can be obtained in two ways using linear extrapolation from the stability curve for nucleons and their average binding energy/nucleon. This method is similar to how absolute zero was estimated from Pressure/Temperature and Volume/Temperature graphs for an ideal gas.

There are two cut-off points. One corresponding to 7.1 MeV/nucleon binding energy when any large nucleus has the same average binding energy/nucleon as Helium so an (alpha) particle can decay spontaneously. The second corresponds to when there is zero binding energy between nucleons; the region between 7.1 MeV down to zero being highly unstable but theoretically possible given suitable boundary conditions for nuclei to exist such as baryonic filaments impregnated with a flux of neutrons.

Such conditions could be created by a collision of neutron stars or black holes. This results in such neutron stars emitting electromagnetic radiation for a period of months/years rather than a single burst as very heavy elements cool and decay together with a wide range of isotopes unlikely to be observed experimentally in earth laboratories. Their decay via many channels of alpha, beta or gamma particles not only prolongs the period of emission of radiation but may produce "islands of stability" as some extremely large isotopes in the chain may have relatively long half-lives (Figure 2).

Extrapolated Binding Energy/Nucleon against Nucleon Number

From Fe^{56} to U^{238} the binding energy drops from 8.8 MeV to 7.6 MeV a drop of 1.2 MeV for an increase of 182 in nucleon number

(Table 3). To reach 7.1 MeV requires a drop of 1.7 MeV.

Corresponding increase in nucleon number:

$= 182 \times \frac{1.7}{1.2} = 258$ Total nucleons=258+56=314

Proton: Nucleon approximately 1:2.52 for stability:

Proton Number= $\frac{314}{2.52}$ approximately 125.

From Ni^{62} to U^{238} binding energy drops from 8.8 MeV to 7.1 MeV, a drop of 1.2 MeV for an increase of 176 in nucleon number. To reach 7.1 MeV requires a drop of 1.7 MeV.

Corresponding increase in nucleon number= $176 \times \frac{1.7}{1.2} = 249$,

Total nucleons=249 + 61=311,

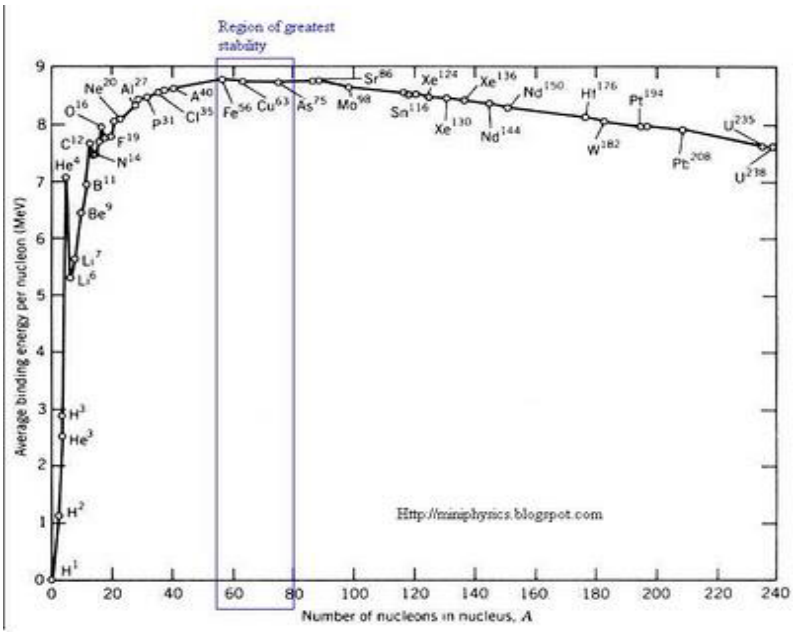


Figure 2: Graph of average binding energy per nucleon plotted against nucleon number.

	FUSION		FISSION		ENERGY	PROTON NUMBER
B		Fe^{56}	Ni^{62}		8.8MeV	
I						
N						
D						
I						
N						
G						
E			U^{238}		7.6MeV	
N	He^4				7.1MeV	123-125
E						
R						
G						
Y	CONDENSED MATTER		BARYONIC FILAMENTS			
P	STABLE		FROM			
E						
R	LONG		COLLISION			
N	SHORT		OF			
U						
C	HALF		NEUTRON			
L						
E	LIVES		STARS			
O						
N					0MeV	500-515

Table 3: Nucleon Number.

Proton: Nucleon approximately 1:2.52 for stability,

$\text{Proton Number} = \frac{314}{2.52}$ approximately 123,

Range of Proton Number Z at 7.1 MeV cut-off approximately 123-125.

For Zero Binding Energy

Fe^{56} change of binding energy=8.8 MeV. Using U^{238} as a marker change of binding energy=1.2 MeV for a change of nucleon number 182.

$$\text{Total change of nucleon number} = \frac{8.8}{1.2} \times 182 = 1335$$

Total nucleon number=1335 + 56=1391

Proton: Nucleon approximately 1: 2.7 for stability,

Proton Number $Z = \frac{1391}{2.7}$ approximately 515.

Ni^{62} change of binding energy=8.8 MeV. Using U^{238} as a marker change of binding energy=1.2 MeV for a change of nucleon number 176.

$$\text{Total change of nucleon number} = \frac{8.8}{1.2} \times 176 = 1291,$$

Total nucleon number=1291 + 62=1353,

Proton: Nucleon approximately 1:2.7 for stability,

Proton Number $Z = \frac{1353}{2.7}$ approximately 500,

Range of Proton Number Z at 0 MeV cut-off approximately 500-515,

Beyond this lies a quark gluon fluid.

A General Periodic Table?

The zero quantum states represent a boundary between the phases of condensed matter and plasma. The red 0 of Table 1 and the $2(0)^2$ in the left hand column of Table 2 represent a cut-off point of no more time independent states in matter; quantum tunnelling and electron capture occur before this. The blue 0 of Table 1 and the $2(0)^2$ in the right hand column of Table 2 represent an infinite separation of either protons or nuclei being forced together by gravity and/or magnetic fields prior to fusion.

Following the recycling process of fusion from the lower half of the Roberts-Janet Table and condensation to the top half heavier elements is produced. There are other possible ways by which this may occur via collisions of black holes and neutron stars resulting in gravitational waves.

In the lower half of Table 2 the energy values will again be empirical due to Heisenberg but the changes will be considerably larger than in the condensed matter state because of the increased rest energy of the nuclei and the isotopes involved. The distribution of the energy values will be unique for each star as the composition of nuclei inside stars of the older universe will vary compared with the nuclei of stars of the primordial universe.

Because of the dynamic nature of the explosions each supernova has its own signature of products; similar elements due to the quantum nature of the atomic number but different ratios of isotopes because of the differing fluxes of neutrons, heavy nuclei and their isotopes in each explosion.

The Roberts-Janet table provides the mechanism by which every supernova recycles and the consequential condensation of elements. It does not include mass number as this is not a fundamental property and will be unique for every "Periodic Table" produced by each supernova confirming Mendeleev's intuitive overriding of mass number in favour of atomic number.

It is recommended that the Roberts-Janet Nuclear Periodic Table be submitted for registration alongside the Periodic Table as a general mechanism appropriate for all supernovae and the production of elements in the Periodic Table.

Materials Science

Atoms are viewed in isolation in the table. Diverse quantum properties e.g. phase transitions, entanglement emerge from the study of atoms in materials. At the critical temperature near to absolute zero topological phase transitions of superconductivity develop as it appears fermi-dirac statistics merge with bose-einstein. Close to absolute zero a heat inversion appears at the atomic level preventing the achievement of absolute zero itself. Quantum thermodynamics interprets this as quantum particles making and breaking entanglement so information itself is a form of energy [12].

Astro-particle Physics and Cosmology

The states in plasma of the Roberts-Janet Nuclear Periodic Table as well as being separated by considerably larger energy changes than the condensed matter states of the table have the counter intuitive property that the nearer the nucleus the greater the number of energy states. This increases the energy density until at 10^{-20} m having already come within range of the strong force a weak interaction is triggered causing an up quark to change to a down quark producing neutrons. Consequential fusion results via an interplay of gravitational and magnetic fields, leading to helium and other heavy elements including carbon and oxygen. Some of these heavier nuclei are bosons.

The lower half of the table enables energy densities to increase further as multiple bosons can occupy a single energy state subject to the limits of Heisenberg. Further heavy elements result during the birth, death and rebirth of stars with an increasing binding energy/nucleon until a peak is reached at Fe^{56} or Ni^{62}. The core collapses inwards producing at the centre neutron stars, pulsars, black holes or white dwarfs whilst ejecting other matter consisting of hydrogen, neutrons and atomic nuclei producing even heavier nuclei. These begin to form baryonic filaments between newly formed galaxies. Due to the dynamic nature there are a variety of outcomes leading to classifications of supernova, stars, pulsars etc.

As the cosmological constant becomes more accurately known together with variations in the past, estimates in the fluctuations of entropy and of acceleration/deceleration of space time may be established to a greater degree of certainty.

Such fluctuations will continue as the entropy increases though in local regions it could decrease via gravity intrinsic attraction and dark matter repulsion. If sufficient time elapses there may be enough suitable heavy nuclei, hydrogen and other nuclei compressed by a critical density of dark matter to begin to create a route back to the big bang via a collapse that is so rapid it overrides previous types of explosions.

This may not happen in every universe some regions of which may end up as cold baryonic filaments occasionally flaring up to produce stars before becoming cold again. In other regions black holes, quasars and neutron stars may be produced as distances between galaxies expand. The role played by magnetic fields and/or magnetic monopoles has yet to be established.

However in those regions where the boundary conditions are conducive to a rapid collapse first generation quarks cascade to second and third generation quarks and mesons via interactions with W^+, W^- and Z bosons including the scattering absorption and emission of neutrinos.

The Higgs field tenses, fermions fuse to form bosons which may or may not have anti-particles due to their symmetric wave functions. Space-time deflates. Event horizons are crossed, space-time inverts. Gravity changes from attractive mode to repulsive in a quark gluon boson soup.

During these compressions phase changes take place in which topological properties of materials create artificial vacuums including particles with possible symmetry breaking characteristics [13]. At between 10^{-50} m to 10^{-65} m gravity becomes of the order of the weak, strong electromagnetic forces [2] producing an interaction between them and the Higgs field via a massive boson particle. The result is a big bang and the production of dark matter/energy resulting in the condensation of matter into a pocket universe. When applied to other universes multiverses may result.

To reach this outcome may require extra degrees of freedom/dimensions post deflation to absorb further energy. Entropy appears to be increasing, time reversed and further event horizons crossed. String theory, branes from which gravitons may leak out, may be a mathematical model to describe these processes as may Bell's Theorem [10] and the holographic principle or Anti de Sitter/Conformal Field Theory known as AdS/CFT correspondence [14]. Are magnetic fields one such extra dimension as maybe the 4d quantum hall effect [15]?

At 10^{-45} seconds from the big bang the eleven dimensions separate into two groups. Four expand spacetime some of the remaining seven become frozen out while the rest collapse and merge with space-time. At 10^{-32} seconds the exponential increase of space-time ends; energy is released in many channels. Bosons evaporate releasing fermions producing anti-matter which may be absorbed by symmetry breaking bosons and/or a fourth massive neutrino which is its own anti-particle allowing anti-matter to bridge over to matter. Once equilibrium is established of boson evaporation, dark matter repulsion and white matter condensation first generation quarks appear at 10^{-6} seconds.

Between 1 second and 3 minutes fusion occurs creating Deuterium, Helium and Lithium nuclei; at 300,000 years electrons circulate protons to form hydrogen atoms. At 200 million years the lower half of the Roberts-Janet table operates as gas clouds condense resulting in fusion to Helium.

In some regions at 690 million years using the seed nuclei formed in the first 3 minutes quasars form from jets of matter ejected from the big bang via magnetic fields. These then become engulfed by dark matter [16].

There may well be an ensemble of boundary conditions between dark and white matter to generate super massive black holes. Further experimental observations are required to explain how quasars and super massive black holes are formed by such high accretion rates so soon in the early universe. Implications are for an extra mechanism of repulsion via dark matter to supplement intrinsic gravity. However, recent observations of a thin plane of co-rotating dwarf galaxies aligned within the Milky Way, Andromeda and other galaxies implies that there may be other factors besides dark matter at work–possibly magnetic fields to cause such precise alignment [17].

Space to Think

No timescale is proposed on the frequency of such big bangs until the distribution of white and dark matter is established within the known universe or any interaction with pocket universes or multiverses.

An hypothesis of string theory is proposed at the nuclear end of the Roberts-Janet table merging with quantum loop gravity at the condensed matter end of the table. Such hypotheses remain to be verified falsified or modified by future theoreticians [13,14,18-20] and experimentalists [17,21].

It would appear that the Roberts-Janet table is five dimensional; 4 spacetime and momentum/energy implying that six of the eleven dimensions of string theory have been frozen out during the big bang.

The presence of two sub-set states marked in red and blue in the quantum mechanical table. Table 1 may be the evidence of entanglement within the Periodic Table itself and within Heisenberg quantum mechanics.

The number 496 appears to cancel out anomalies in string theory in the Green Schwarz Mechanism [22]. 496 is also a number whose factors add up to the number itself, a perfect number. The pattern of perfect numbers is $2^n(2^{n+1}-1)$ where $2^{n+1}-1$ is prime leads to a cut-off of factors of 2. This provided the inspiration for Those Infinities and the Periodic Table [2] including the Pauli Principle. Is this a coincidence or part of a theory as yet undiscovered?

The existence of triads in certain periods of the Periodic Table established a repeating pattern of 8, 18, 32 based on chemical properties. The quantum mechanical table (Table 1) not only establishes a retro-diction or accommodation of 8, 18, 32 but also predicts a repeating 2 earlier in the table and a 50 later on subject to nuclear stability by implication questions how isotopes and elements initially created by collisions of neutron stars extend the current table.

The presence of isotopes challenges whether the periodic table is unique and implies there are many solutions for the boundary conditions in the production of elements in stars and supernovae. The Roberts-Janet table appears to unify the mechanism for the production of such elements in stars and supernovae but not the production of elements from collisions of neutron stars.

Chemistry has to Acknowledge

1. The Periodic Table must integrate into biological science, astro-particle physics and cosmology.
2. It cannot choose to incorporate parts of 20th century science which reinforces and generalises the Periodic Table whilst ignoring or dismissing the implications of other 20th century and 21st century science that challenges some of the reasoning implicit in the table.
3. There exists in principle a form of the Periodic Table which will accommodate all internal and external aspects.
4. Janet's idea of quantum states based on s, p, d, f appears to be dismissed mainly because Hydrogen and Helium would be placed in the groups of alkali metals and alkali earth metals.
5. Observations from Jupiter confirm evidence of metallic Hydrogen and the positioning of Helium in the Roberts-Janet table implies metallic Helium is possible under suitable conditions as both elements' electrons may become delocalised.

In other groups significant differences of physical states between elements does not prevent a group system emerging. E.g. Nitrogen and Phosphorus or Oxygen and Sulphur. So why in the cases of Hydrogen and Lithium or Helium and Berylium is this not possible?

6. Using the extension of negative quantum numbers the Roberts-Janet table also implies quantised energy states in plasma linked with condensed matter.

7. The Periodic Table is too important to be left only to chemists as is the Standard Model too important to be left to particle physicists only.

References

1. Roberts JO (2017) Proposed link between the Periodic Table and the Standard Model. J Material Sci Eng 6: 1-2.
2. Roberts JO (2016) Those Infinities and the Periodic. ISBN 978-0-9934667-3-1.
3. http://www.ipgp.fr/~tarantola/Files/Professional/Mendeleev/
4. Broglie LD (1934) L'Electron magnétique. Hermann Paris.
5. Claude D (1997) Solutions of the Dirac Equation and of a non-linear Dirac equation for the Hydrogen atom. Adv Clifford Algebras 7: 175-194.
6. Daviau C, Bertrand J (2016) The Standard Model of Quantum Physics in Clifford Algebra. Publisher World Scientific Singapore.
7. Roberts JO (2017) Pauli Principle and Clifford Algebra Claude Daviau. Journal Astrophysics Aerospace Technology 5: 3.
8. Kibler MR (2007) From the Mendeleev periodic table to particle physics and back to the periodic table. HAL Id:in2p3-00117015.
9. Castelvecchi D (2015) Exotic atom struggles to find its place in the periodic table. Nature.
10. Bell JS (1964) Physics 1 195-200 (1964) - Bell J.S. Epistemol Lett 9 11-24 (1976)
11. Bonchev D (2004) Periodicity of the Chemical Elements and Nuclides: An Information Theoretic Analysis. Cite Seer X.
12. Merali Z (2017) The new thermodynamics: how quantum physics is bending the rules. Nature 1: 20-22.
13. https://www.technologyreview.com/
14. The holographic principle Raphael Bousso arXiv:hep-th/0203101VZ(29 Jun 2002)
15. Johnston H (2018) Quantum Hall Effect in 4D is created in lab. Optical physics.
16. Dietrich M, Hamann F (2004) Supermassive black holes in the early universe. Proceedings of the International Astronomical Union (IAUS222): 517-518.
17. Ibata RA, Lewis GF, Conn AR, Irwin MJ, McConnachie AW, et al. (2013) A vast, thin plane of corotating dwarf galaxies orbiting the Andromeda galaxy. Nature 493: 62.
18. Gowan JA (2012) The "Tetrahedron Model" vs The" Standard Model": A Comparison.
19. Looking beyond the Standard Model Higgs Centre for Theoretical Physics.
20. Verlinde E (2011) On the Origin of Gravity and the Laws of Newton. Journal of High Energy Physics 2011: 29.
21. Brouwer MM, Visser MR, Dvornik A, Hoekstra H, Kuijken K, et al. (2017) First test of Verlinde's theory of emergent gravity using weak gravitational lensing measurements. Monthly Notices of the Royal Astronomical Society 466: 2547-2559.
22. The Four Dimensional Green-Schwarz Mechanism and Anomaly Cancellation Conditions.