Nuclear Transmutations and Mass Defect

Simplified Explanation
with the Structured Atom Model (SAM)

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Poster papers for ICCF-22

Structured Periodic Table of the Elements

SAM in a nutshell – Basic concepts, nuclear reactions and nuclear binding energy

Findings - Introduction

- Nucleus has a stable and rigid structure that is responsible for all the attributes of the elements.
- We consider the neutron not to be a fundamental particle!
- Based on a proton-electron model.
- Electrodynamic nature. There is no need for a strong force.
- Norman Cook's Face Centered Cubic model.
- SAM is comparable to the alpha-particle model.
- Recurring geometric structures in the nucleus which in specific order and number create all the elements and their isotopes.
- Completed PTE.
- We set out to take a good look at the topic of BE and how this relates to the structure.
- Nucleon-nucleon connection multiplied by the Deuterium BE value of 2.225 MeV.
- The second method was to compare the known geometric structures with their element and their BE.
- The graph that emerged from this showed a few surprises.

Findings - Introduction

- The nucleon-nucleon method seems to hold true to certain extent, but is not very feasible.
- Based on geometric groupings (nuclets) we calculated total BE for all the elements from C12 onwards.
- Both data-sets started to deviate from each other at around element 30.
- We looked for a reason.
- We offer a logical explanation how and why the fission products are unequal in mass.
- 70 year old mystery can be solved.
- Fission appears to be the breaking-off of parts of the structure (branches).
- We can calculate the energy being released.
- The branching structure of the nucleus results in internal stress-energy.
- Explanation for the difference in calculated SAM-BE to the known values
- Experiments show that heavy stable elements can be made to fission under relatively mild circumstances.
- This presentation is meant to show to everyone how we came to these findings and conclusions.

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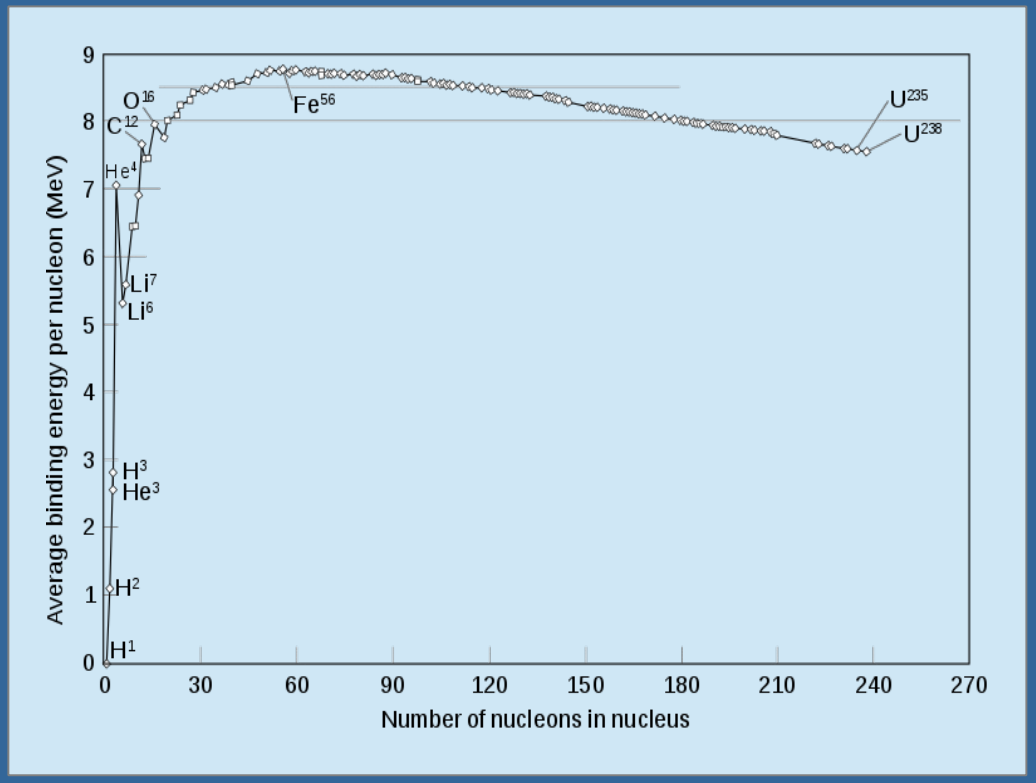
Current Understanding of Binding Energy and Mass-Defect

- Mass-defect elements (average →)
- Mass-defect represents Nuclear Binding Energy (BE) through **$E=mc^2$**
- Mass loss equates to energy release (nuclear energy i.e. Nuclear Power Plants and Atom bombs)
- Higher BE means larger Mass-defect
- Average BE or Mass-defect per nucleon varies throughout the PTE.
- Nuclear fission yields energy that can be calculated using the mass-defect (BE) difference between the source and its fission products.

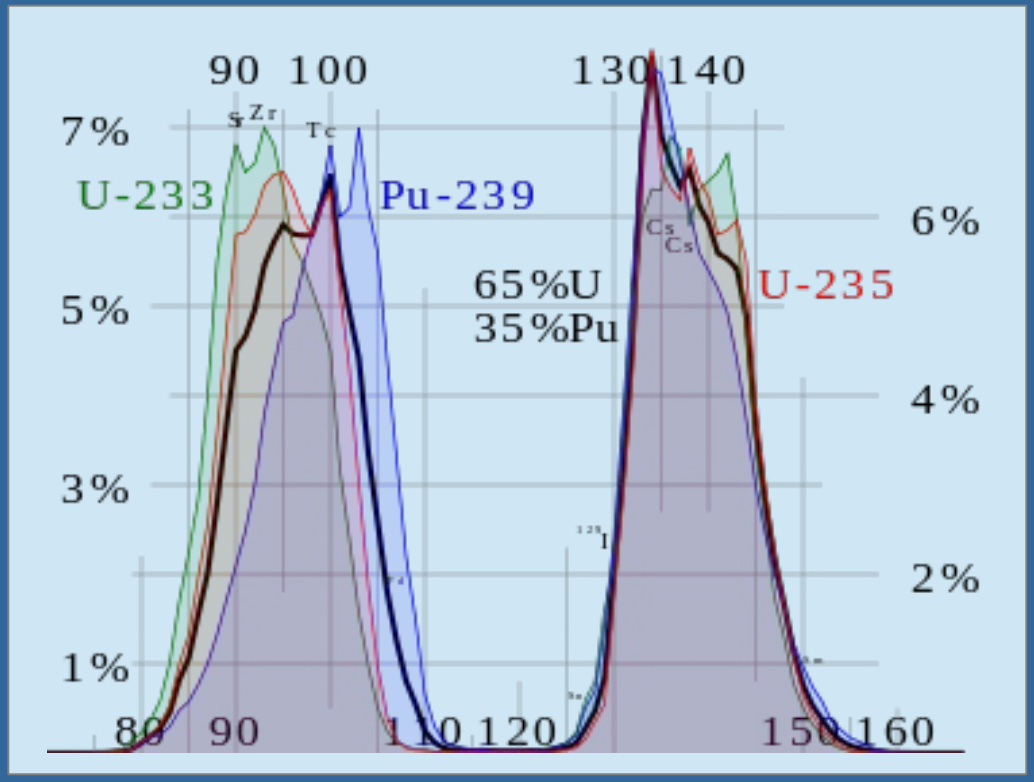


Example: U236 → Ba + Xe +2n + 166 MeV

The Fission Enigma

A longstanding, unsolved issue in nuclear physics is that none of the current models is able to explain the asymmetrical split of fission products, however, Norman Cook's FCC model comes close.

Every current model fails to predict the observed double peak in the mass distribution of the fission products.



Fission product yields for thermal neutron fission of U-235, Pu-239, a combination of the two typical of current nuclear power reactors, and U-233 used in the thorium cycle.

Source: Wikipedia

The Structured Atom Model (Basics)

This presentation will be posted on our website in PDF format.

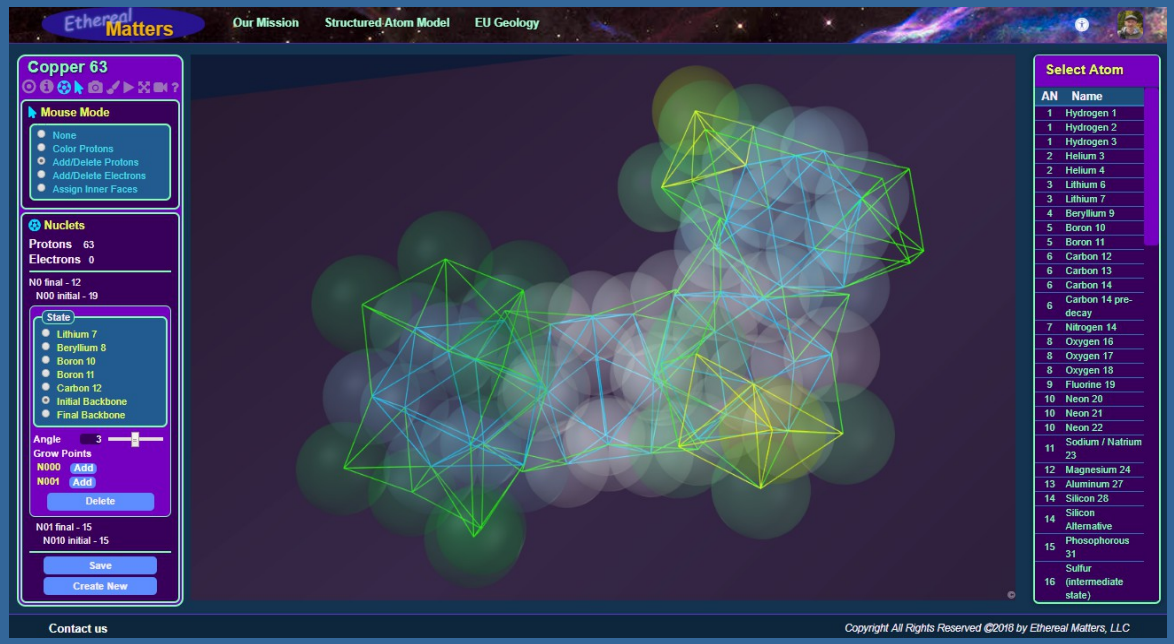
https://etherealmatters.org/sam

Section: published-materials-sam

Summary of Structured Atom Model (SAM)

- We perceive a duality which we call a proton-electron pair with the electro-magnetic force acting between them.
- This force is the causal mechanism for the principle of densest packing that creates geometric shapes based on the platonic solids.
- These geometric shapes in a specific order and number, create all the elements.
- SAM shows the observed nature and properties of the atom.
- The nucleus is NOT a lumped together collection of nucleons!

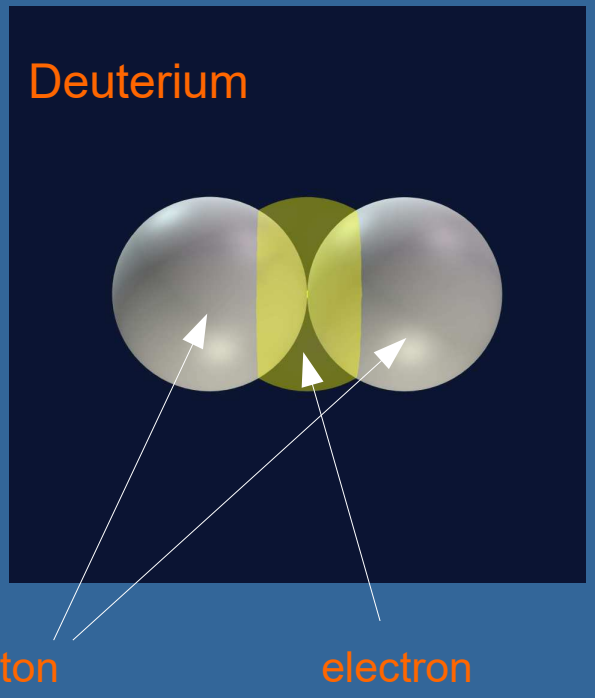
The color of the spheres are for recognizing repeating structures (nuclets)



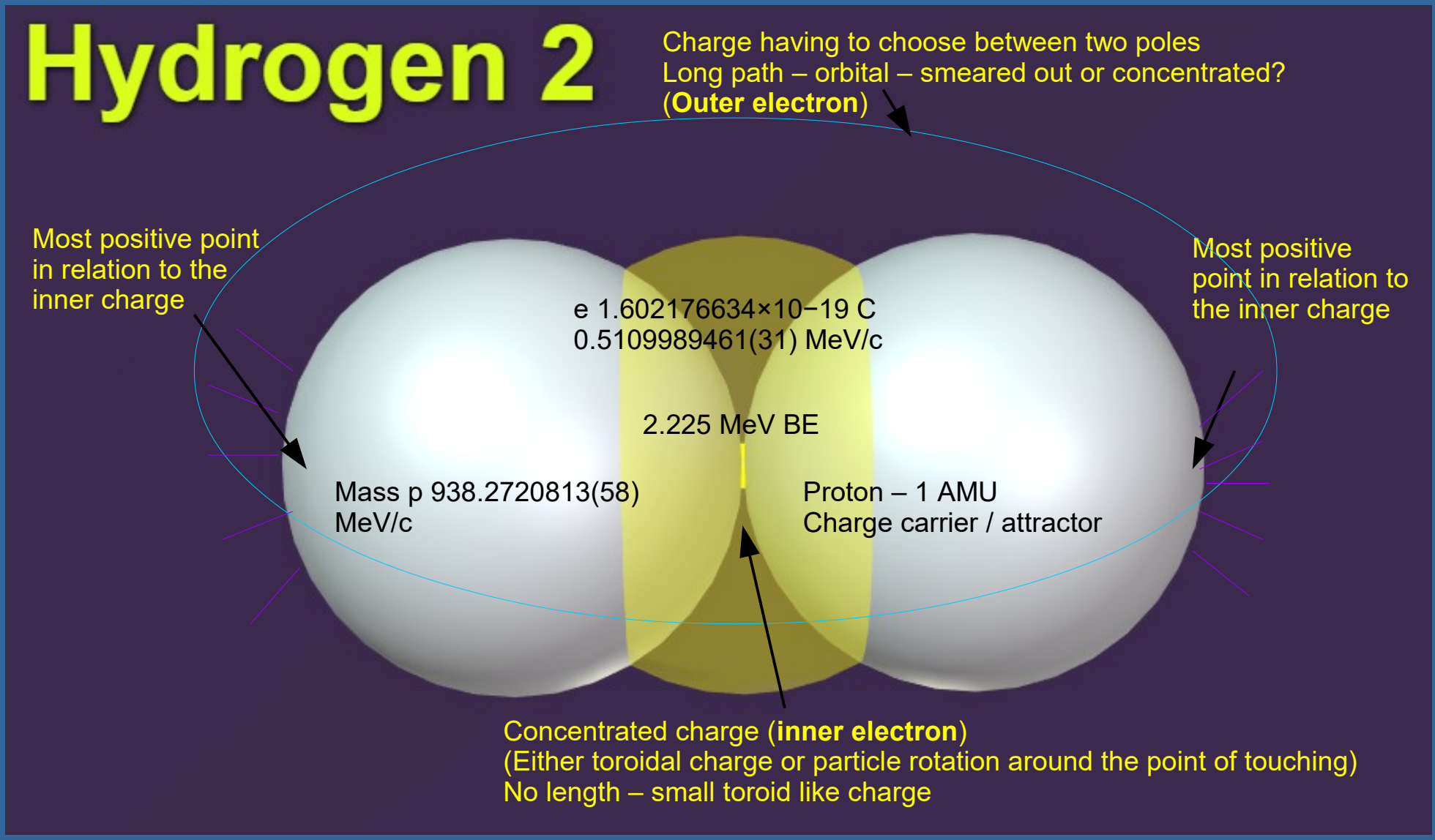
Fundamental Physics in the Structured Atom Model (SAM)

- Recognize a single, electro-magnetic force. No need for a postulated “strong force”.
- Proton-electron concept rather than the proton-neutron concept. This is the “new neutron”.
- Quasi-static structure, no movement of protons in relation to each other, without cause.
- Deuterium is the basic building block for SAM. It creates the more complex geometric substructures called nuclets.
- Densest packing concept. The nucleons are attracted towards a common center for each nuclet: geometric clustering.

Free neutron
→ proton + electron



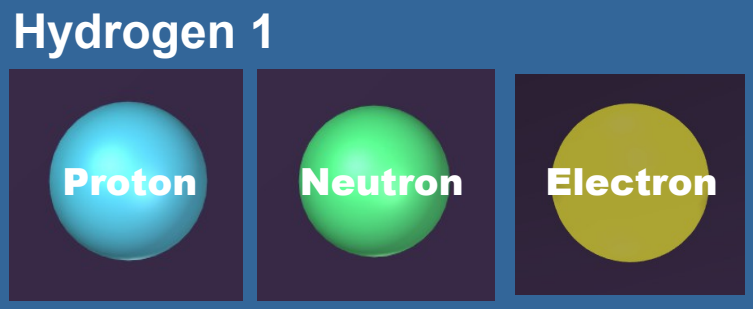
Deuteron

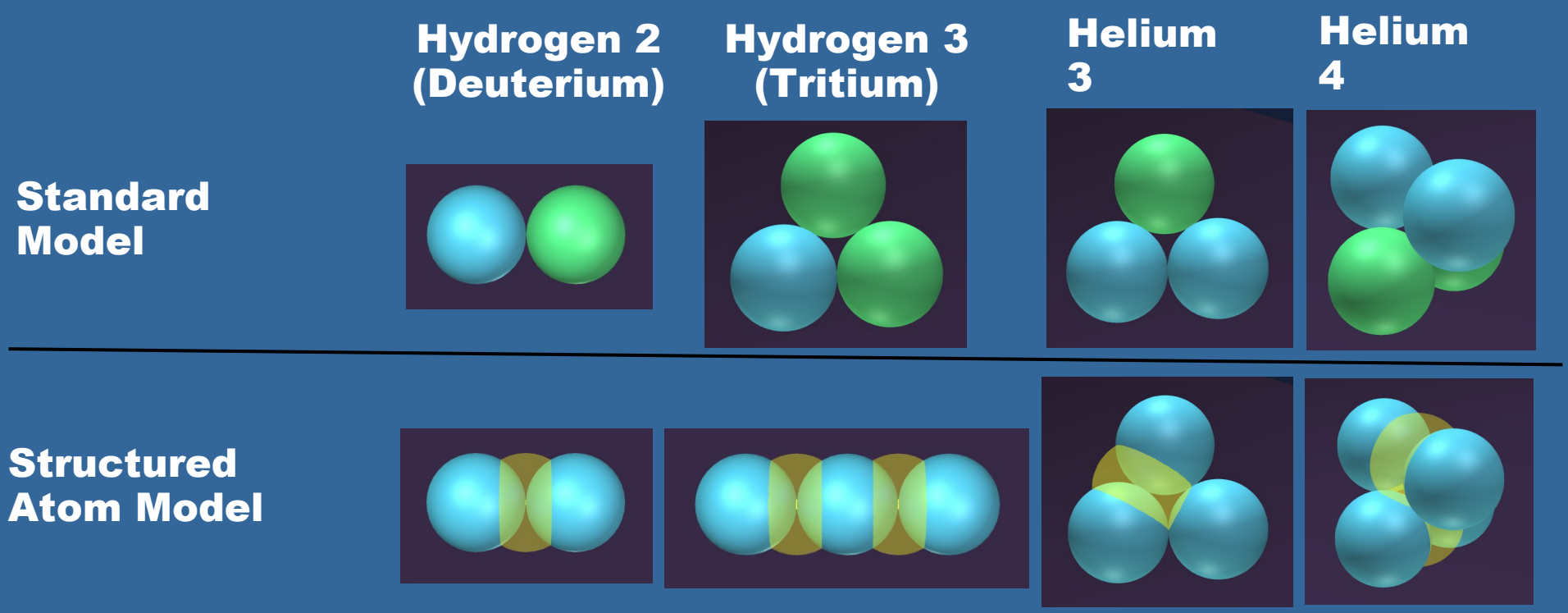


Hydrogen and Helium - The First Two Elements

Comparison of the first two elements and their isotopes between the Standard Model and SAM.

(Outer electrons are not depicted)

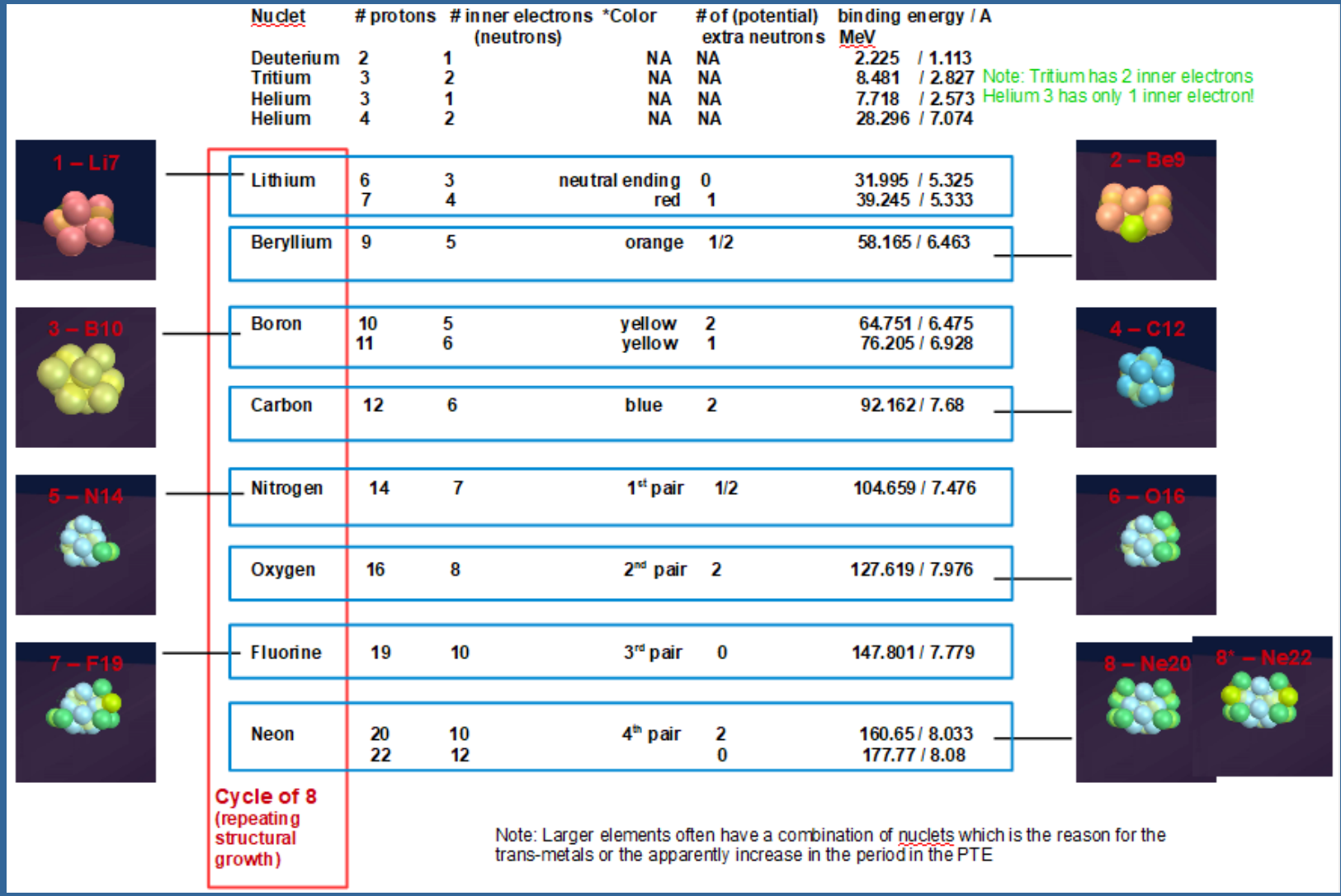




The Cycle of Eight – Periodicity explained with nuclets

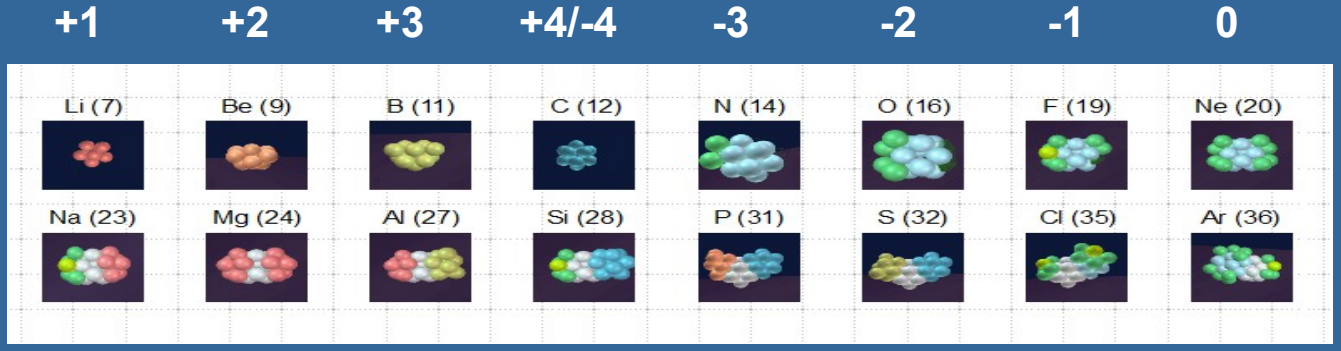
The repeating pattern which creates the PTE

Nuclets define the cycle of eight

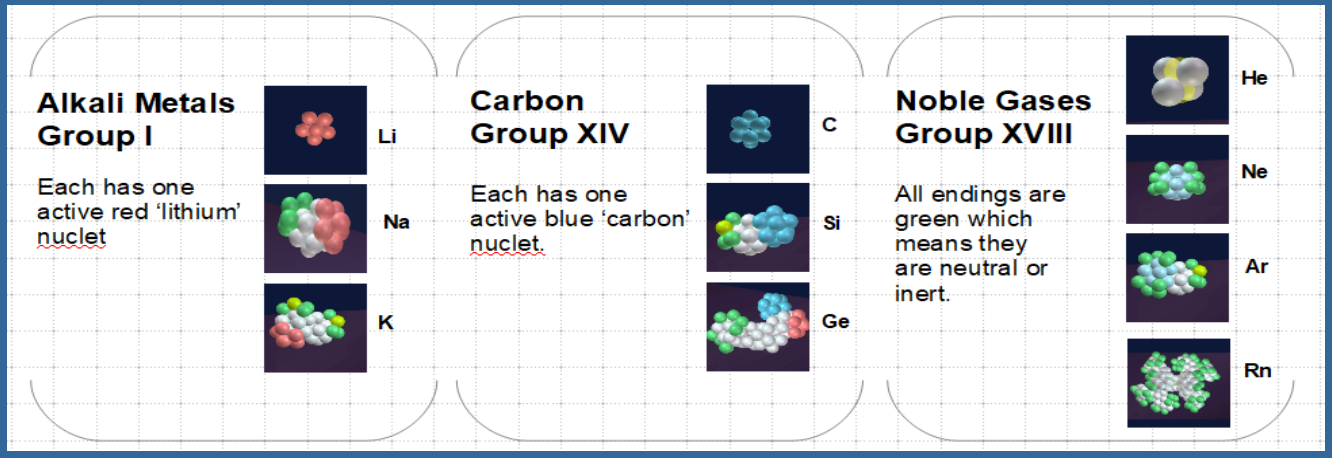


SAM Linked to the Properties of the Elements
-Cycle of 8-

The periods



Groups



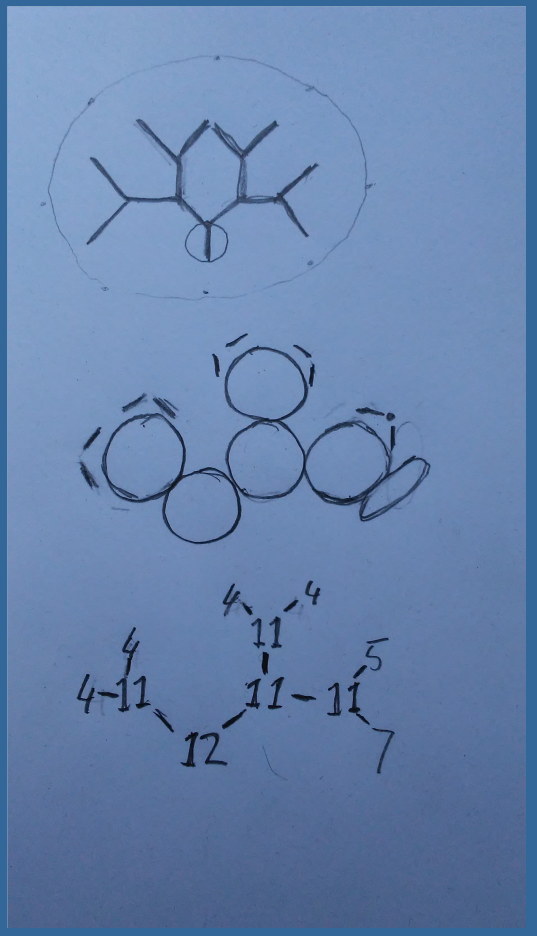
The Structured Periodic Table of the Elements

*Just in Time for its 150th Anniversary

The Shape of the Larger Elements

- The nucleus grows like a tree developing into branches as it gets larger.
- The center has 1 Carbon nuclet, this splits into 2 nuclets, which splits into 4 nuclets and finally 8 nuclets. This completes the series of stable elements, creating the “backbone structure”.
- The structure has a “point of interference” where the branches want to occupy the same spot.
  This occurs in Lead and any element above Lead is inherently unstable!
- This implies that there is no “Island of stability”.

12 + (2*11) + (4*11) + (8*11)



Observation Data used when Developing SAM

- Neutron / Proton ratio
- Valence / Oxidation State
- Isotopes & Stability
- Nuclear Reactions
- Nuclear spin

SAM the “Next Gen” Model?

- Gas model - Fermi **Gas** Model, Nucleus behaves as a free moving gas – (thermal equilibrium)
- Liquid drop model – Nucleus behaves as if it were a **liquid** such as water in a droplet form
- Shell model – Protons, Neutrons and Electrons in a shell around the nucleus
- Alpha particle model – Nucleus is created using building blocks in the shape of tetrahedrons (groupings of 4 nucleons).
- FCC – Norman Cook shows that all models are “not good enough” and offers the concept of a structure (**Solid**) for the nucleus based on the Face-Centered-Cubic symmetry concept.
- SAM – Fractal and organic (solid) structure based on the Deuteron as basic building block concept with a few larger geometric groupings that repeat throughout the Periodic Table of the Elements.

The Competition

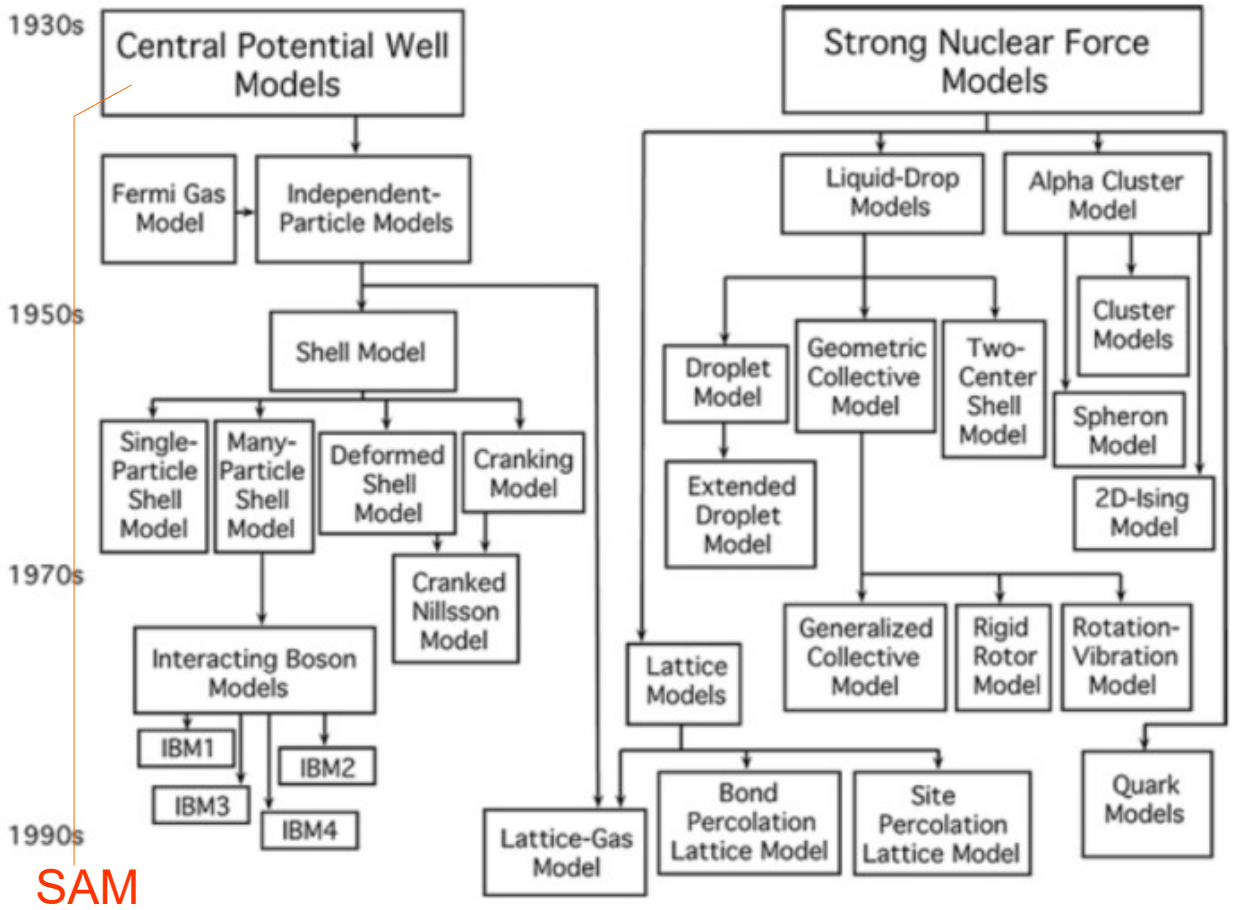


Fig. 3.3 A chronology of the evolution of nuclear models. Note that the roots of the lattice-gas model lie in both the independent-particle model and the strong nuclear force models (Cook et al.,

Source: Norman Cook MAN2.pdf

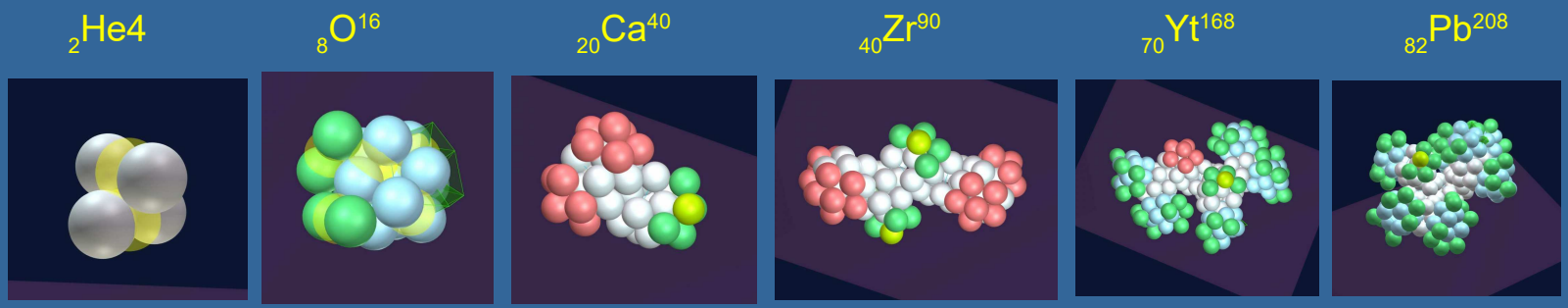
Similarities and Differences Between SAM and FCC Model

- Both models assume that discovering the structure of nuclei is key to understanding their properties.
- FCC uses protons and neutrons, whereas SAM uses protons and (nuclear) electrons.
- SAM has discovered the specific rules that govern the growth trajectories of the elements, consistent with known elemental properties. Growth is based on the nuclet concept. I.e. the placement of the next nucleon in the structure is easily determined.
- FCC works with a fixed lattice structure, where nucleons are placed at specific sites. In contrast, the SAM structure is adaptable and changes as the number of nucleons increases. The nucleons are allowed to situate themselves according to a minimum energy configuration.
- Both stipulate that stability of the nucleus is provided by electromagnetic forces. Therefore, for stability, no strong force or strong interaction is needed.

Stability of the Nucleus

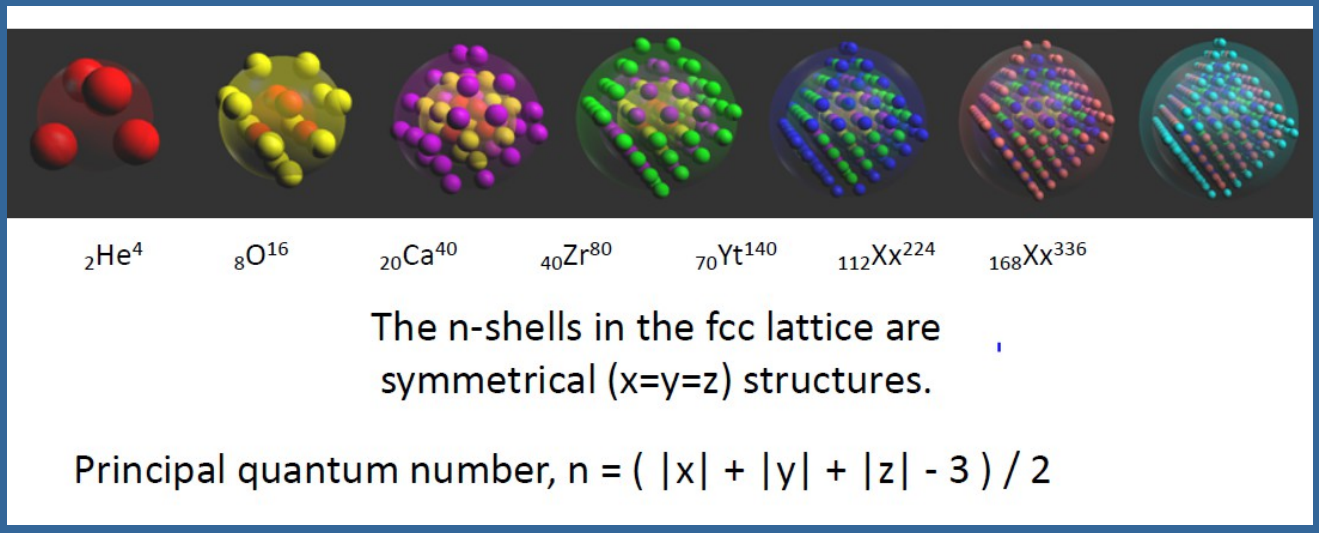
- Chapter 10.3.1 of "Models of the Atomic Nucleus" by Norman Cook gives an analysis jointly written with Valerio Dallacasa and Paolo Di Sia with the title "The Magnetic Force Between Nucleons. An update of their analysis can be found in a recent paper by Di Sia.
- The proton is modeled as a circulating charge. They conclude: "by taking the phase-relationship into account when calculating the magnetic field effect of two circulating charges, an attractive force that exceeds the electrostatic repulsion of the charges is generated. A major component of the so-called nuclear force is therefore likely to be magnetic."
- Since the analysis by Di Sia et al. is made in the context of the FCC model, it should also apply to the Structured Atom Model (SAM): for both models the positions of the nucleons are precisely known.
- We have concluded that their approach to explaining nuclear stability, is defensible and that it can be applied to calculate binding energies and magnetic moments to a good approximation.
- This model of coupled ring currents appears to imply that the nucleus is a resonant system at a specific frequency, continuously exchanging energy between nucleons, manifested as mutual attraction or repulsion. All nucleons in a specific element/isotope accommodate each other, finding a way to resonate together.
- This also explains that there is a definite limit to adding protons or neutrons to a specific structure: at some point a "dissonant" candidate will not fit in.

Difference between SAM and FCC Model for Specific Elements



- "Fractal" structure
- SAM has the observed maximum of stable elements

- Nested geometry
- Based on proton and neutron lattices
- No theoretical maximum to elements
- Uses proton and neutron concept



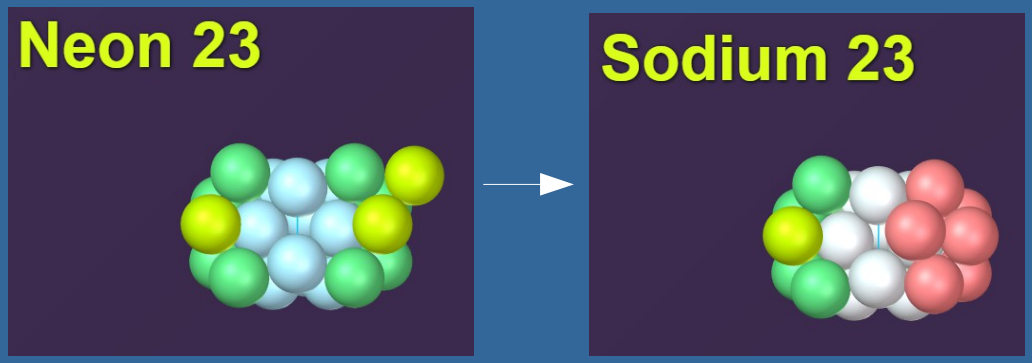
Source: Norman Cook's ICCF-21 slide presentation

Nuclear Reactions in SAM

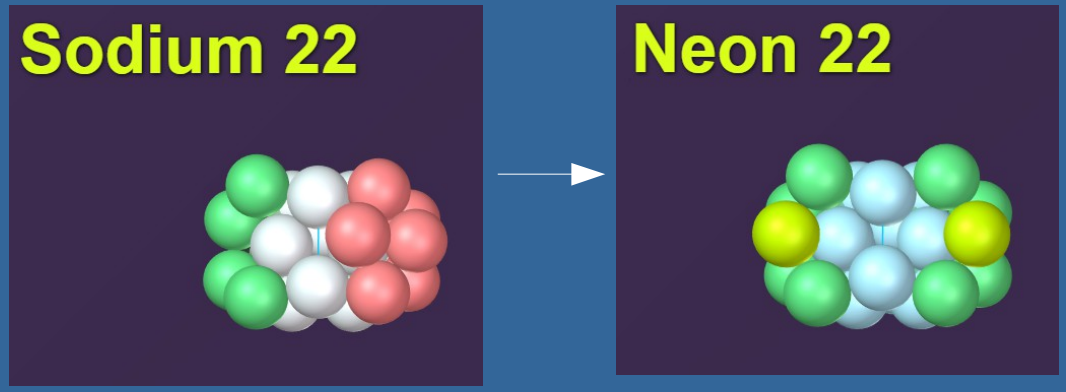
1) β-decay and β+decay, creation / disintegration of deuteron building block.
2) Alpha particle release, decay scheme of U236 to Lead 208
3) Splitting of the atom, cluster fission
4) Fusion of nuclets, cluster fusion
5) Thorium cycle

β-decay and β+decay

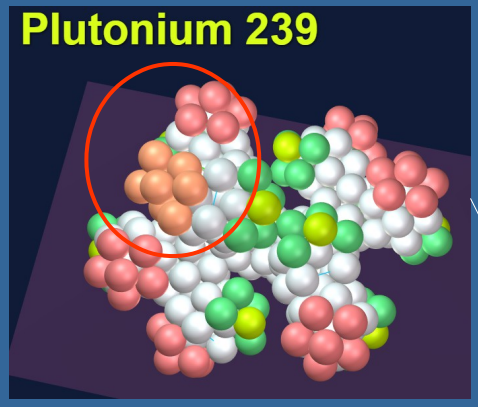
- Beta decay is essentially the creation or disintegration of the Deuteron building block with one electron in between two protons and one electron in its orbital.
- β-decay (Creation of deuteron where the nuclear electron migrated to the orbital)

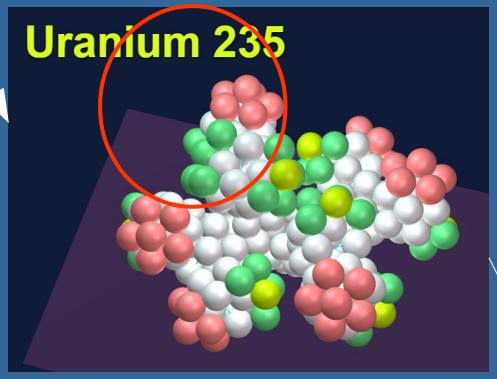


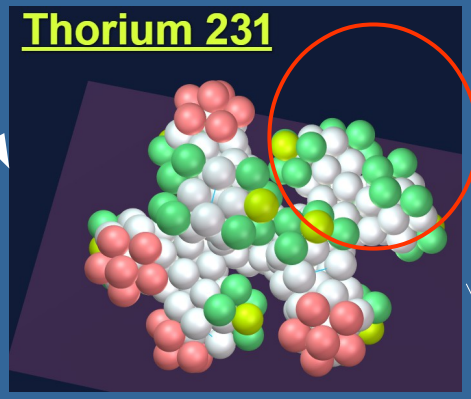
- β+decay (Disintegration of deuteron where the outer electron migrates to the nucleus)

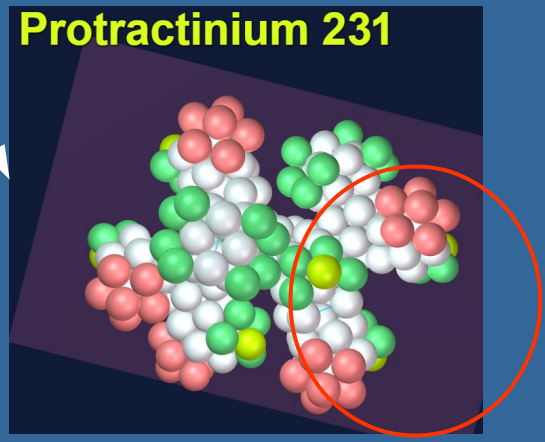


Alpha Particle Decay



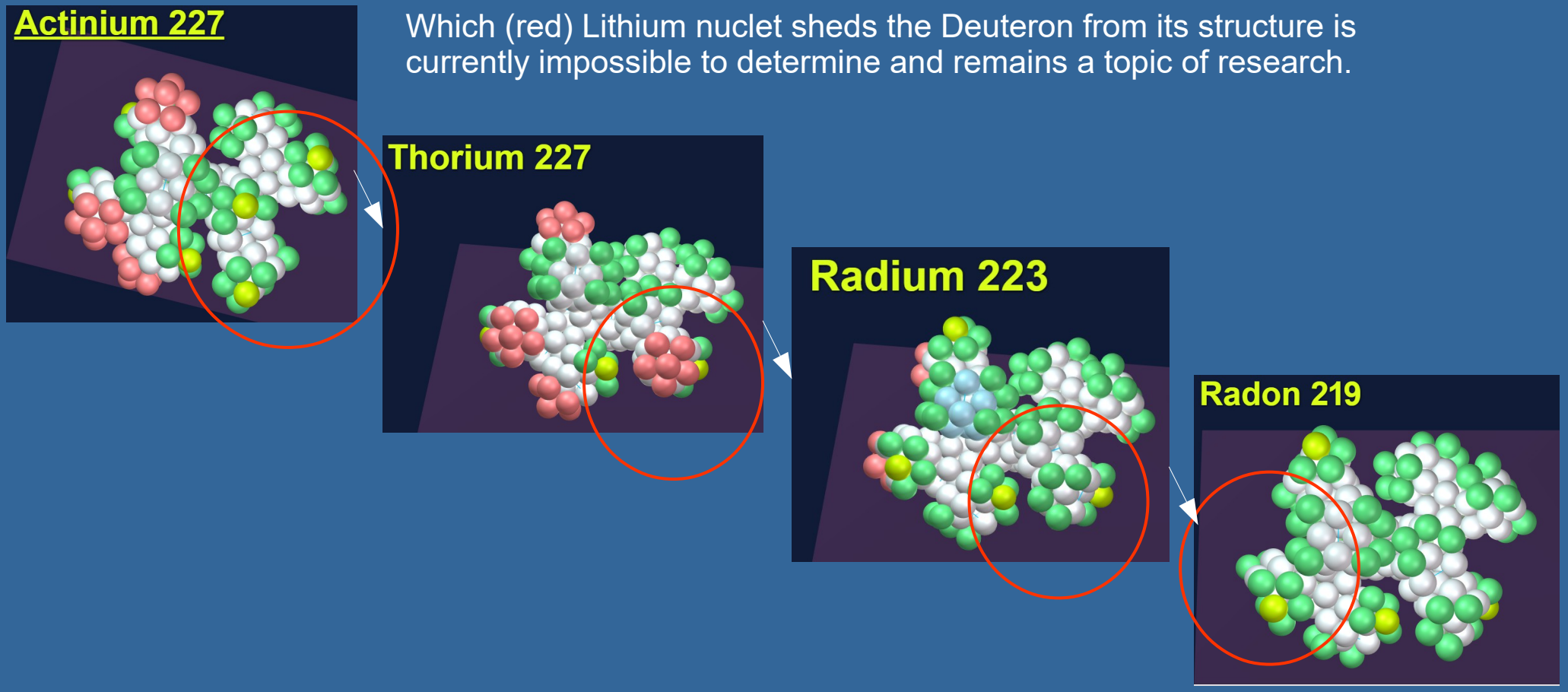






We do not know exactly how and why the nucleus releases alpha particles. We can see that the elements and isotopes are based on each other and there is a certain logic to it. This deserves additional attention as a research topic.

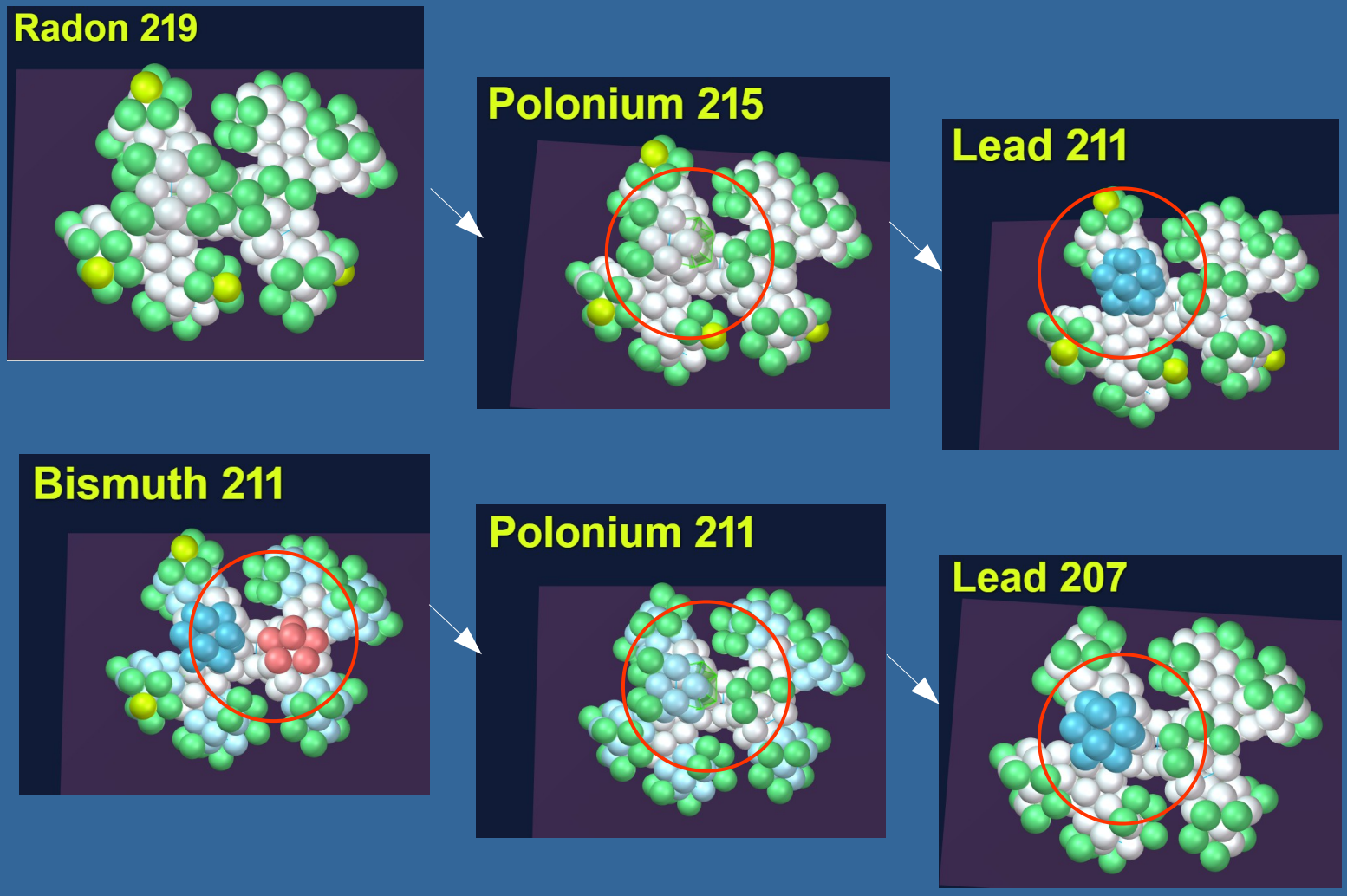
Alpha Particle Decay



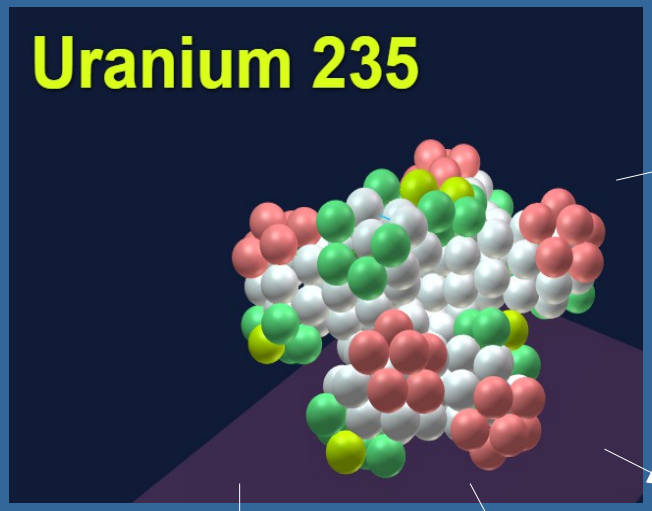
Which (red) Lithium nuclet sheds the Deuteron from its structure is currently impossible to determine and remains a topic of research.

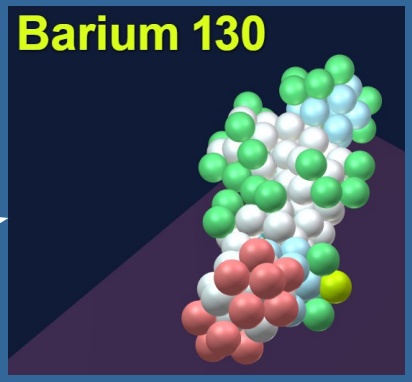
Alpha Particle Decay

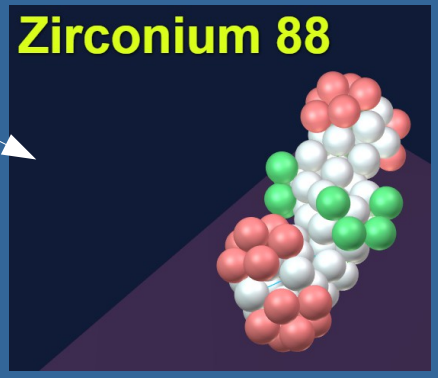
Alpha particle release and β-decay steps



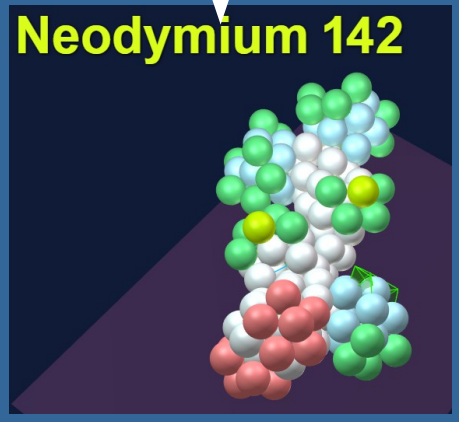
Splitting of the Atom – Or Breaking off Branches?

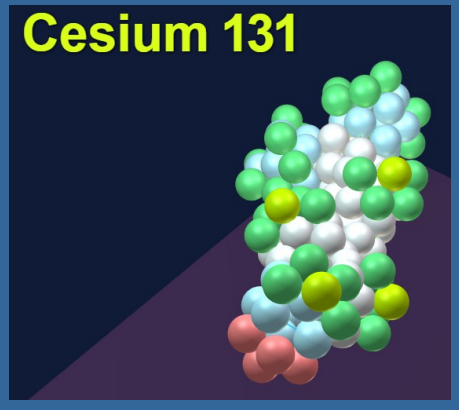


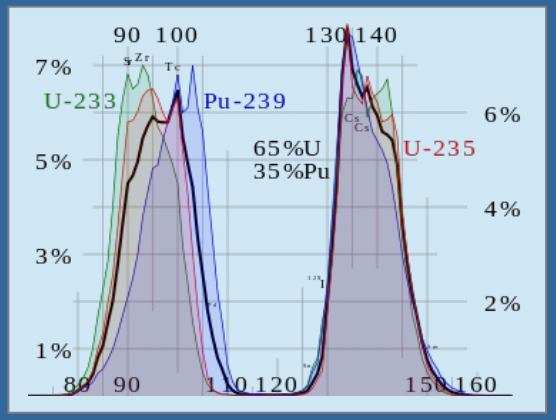


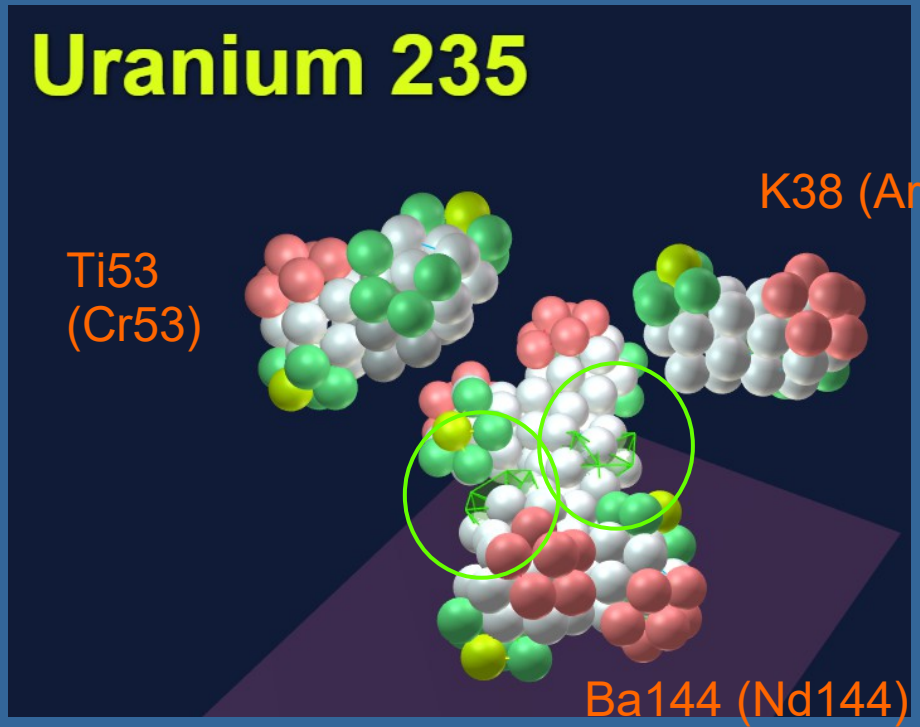


Possible fission products



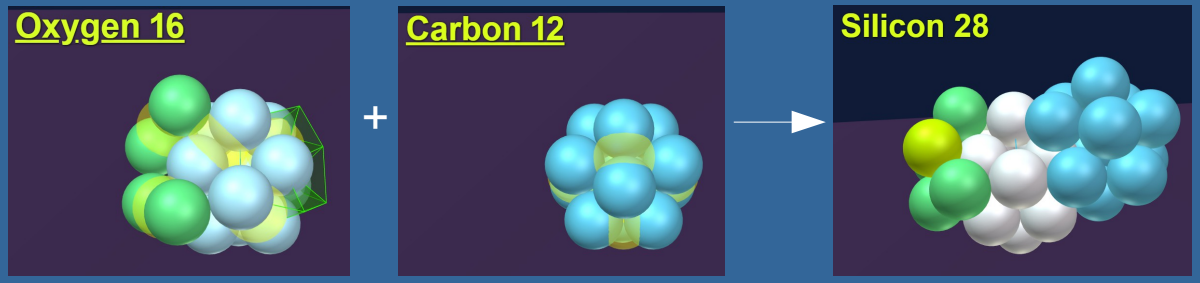




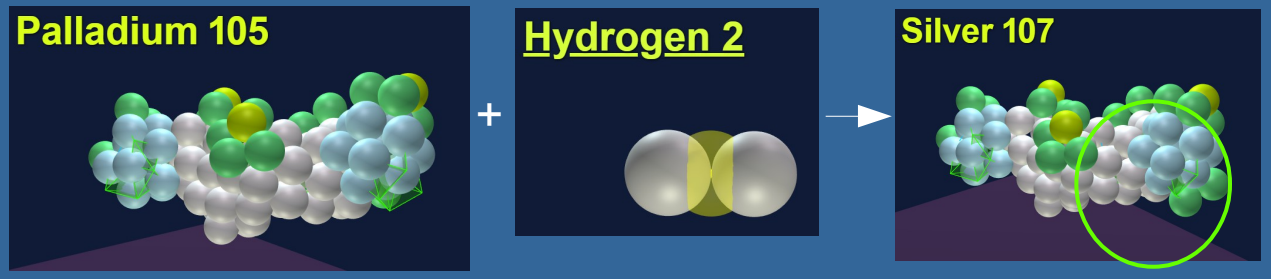


Cluster Fusion (Nuclets)

- This can be viewed as the reverse of the Fission process and appears to be energetically feasible below Iron.
- This type of fusion doesn't involve the creation or destruction of the deuteron which is responsible for many types of "hard" radiation.
- Thus, most of the energy release should be in the form of heat and light, without production of gamma rays or free neutrons.



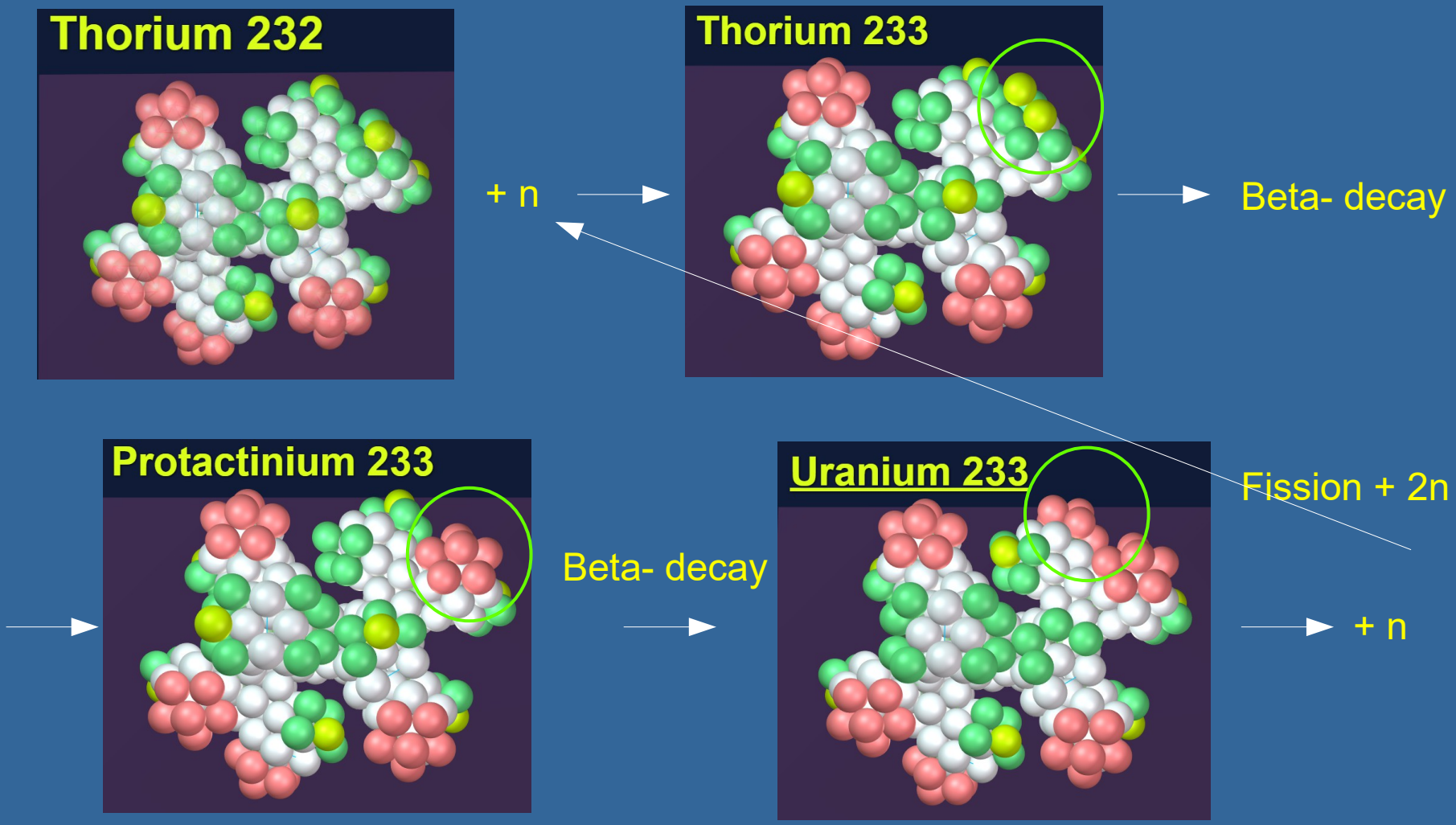
This would be fusion of Deuterium and Palladium 105, transmuting it into a Silver 107.



Note that the isotopes Palladium 104 and 106 would have to transmute into Silver 106 and 108 respectively. These are not stable isotopes and they decay back into Palladium 106 and 108.

Thorium Cycle

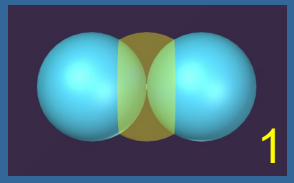
Plausible scheme for Thorium breeding process. (Here shown simplified)

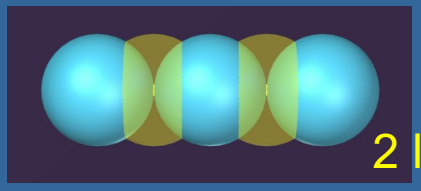


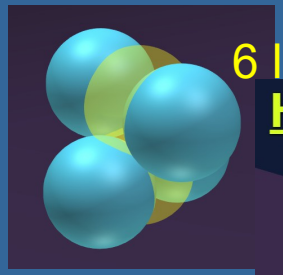
Binding Energy

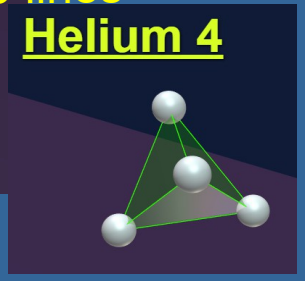
Binding Energy - Number of Connections Between Nucleons (Lines)

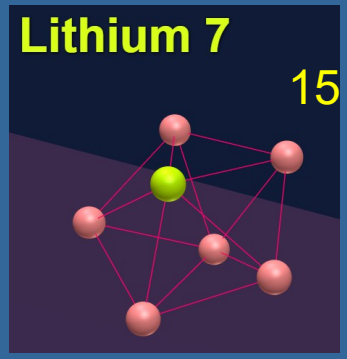
- SAM has already established a strong correlation between the properties of the elements and the structure of the nucleus. (Pillars of evidence)
- In order to compare these with the binding energies for all elements, we tried to discover the logic imposed by the structural properties.
- The Deuteron has a known binding energy of 2.225 MeV which we define as "one line of connection"
- The number of lines varies somewhat due to the morphing geometric structure when the element number is increased. ("lines" break open in the center that is created with Carbon), viz. number of lines is not always an integer but sometimes a fraction.
- Tritium and Helium 4 are the only exception where we need to 'double the value' due to having two electrons in the structure. All other elements do not seem to have this.











Number of Connections (Lines) and Nuclets

1) The number of lines in the nucleus is based only on the structure multiplied by the base value of 2.225 MeV (proton – proton touching).
   This yields the total BE in SAM.

   # lines * 2.225 MeV = Total Binding Energy in MeV

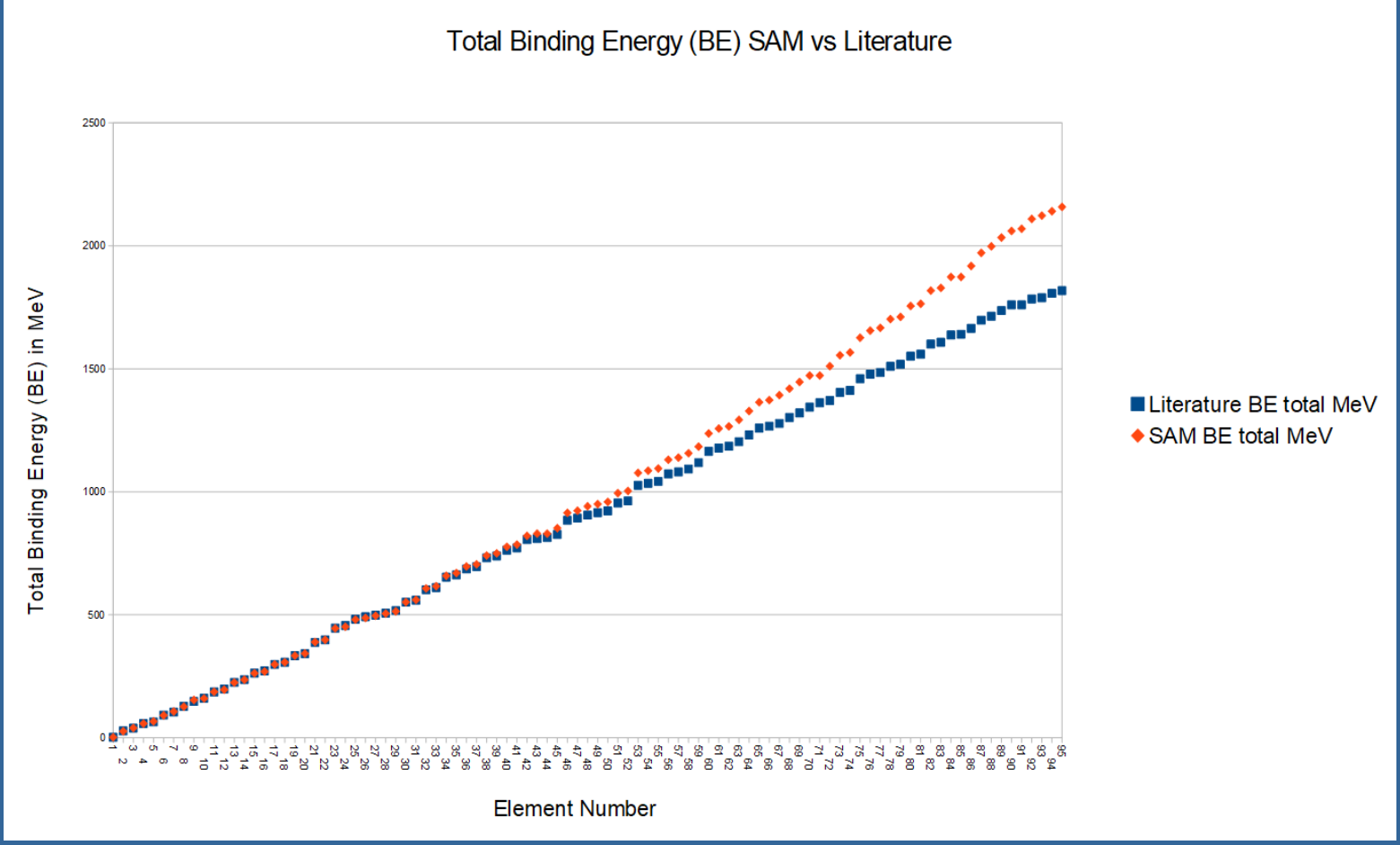
   Neon 20 : 73 lines * 2.225 MeV = 162.425 MeV

2) Nuclets # and combination

	Lines calculator	# of nuclets	# number lines per nuclet	Total lines
Prime Carbon is set as a default value with 41 lines. Closest to 92.162 MeV	Prime Carbon	1	*41*	41
	# Carbon nuclets	12	45	540
	# Boron	0	40	0
	# Beryllium	0	32	0
	# Lithium	1	24	24
	# Neutral 4-endings	9	16	144
Varies between 3, 4 and 5 !!	# extra Neutrons	5	4	20
	Total Lines			769
Example of calculation of number	of lines for **Iridium 191**			

Binding Energy Total - SAM vs Literature Value

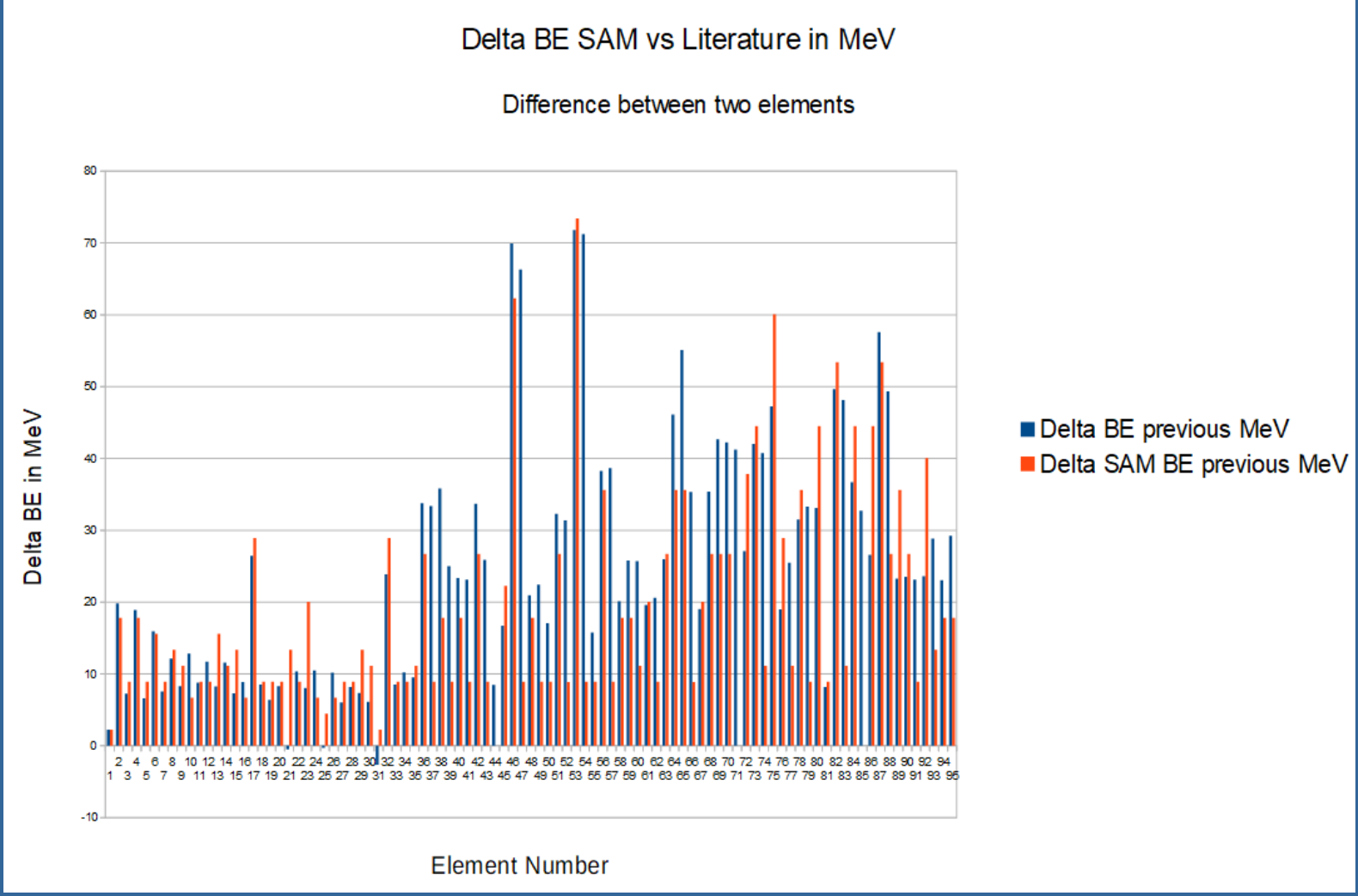
- Up to element 30 strong correlation
- The data sets start to diverge 'suddenly' just after element 26 (Iron)
- There are sudden large “jumps” in the number of nucleons and BE in the PTE



SAM Sources:
- https://www-nds.iaea.org/
- NIST
- https://en.wikipedia.org/wiki/Oxidation_state#List_of_oxidation_states_of_the_elements

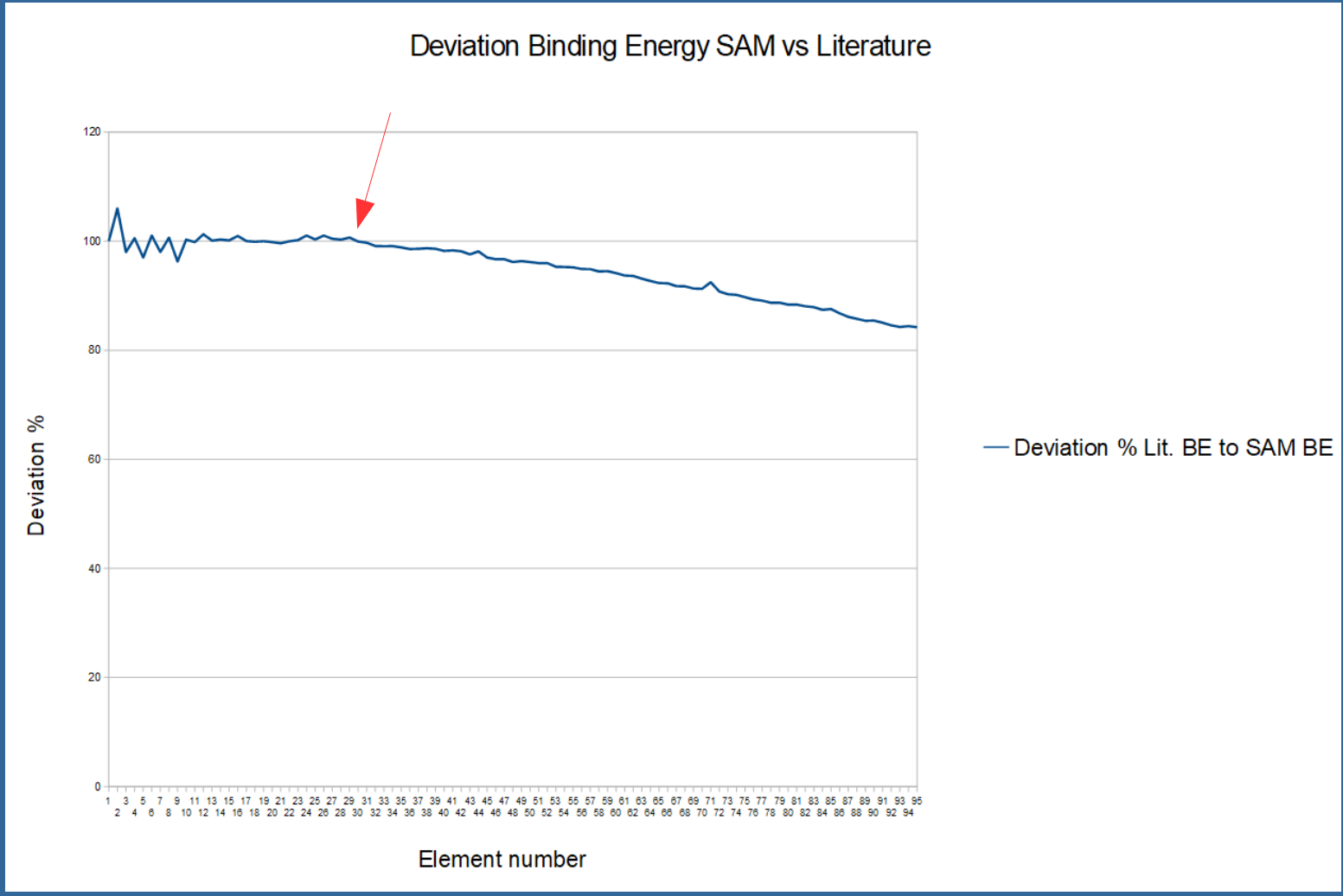
Delta Binding Energy in MeV – SAM vs Literature Values

- Higher resolution graph showing BE differences between two successive elements.
- Some element steps are much larger than others.
- The two Data sets clearly show a similar trend.

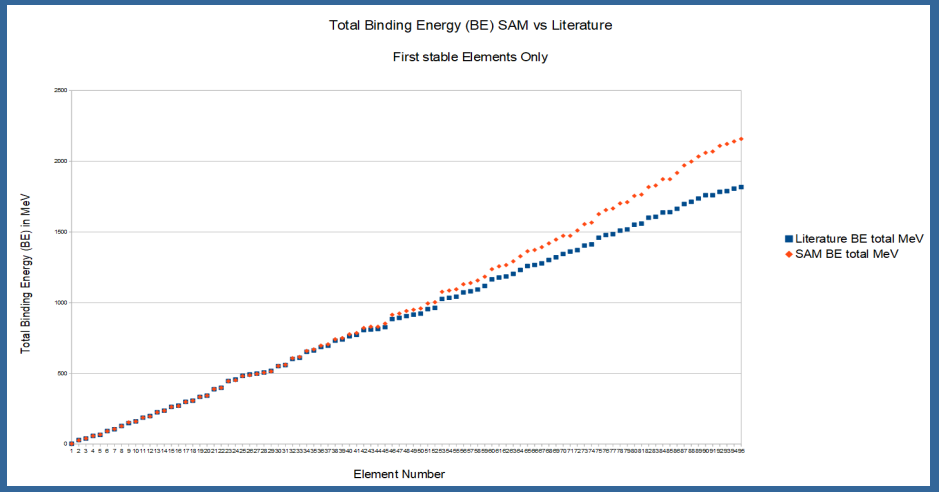


Deviation of the SAM Results Compared to Literature Values

- Drops to about 84% for Uranium or 16% difference SAM vs Literature
- First elements are much more difficult to achieve precision
- Deviation about 1% from element 6 to 32



Conclusions of Graphs



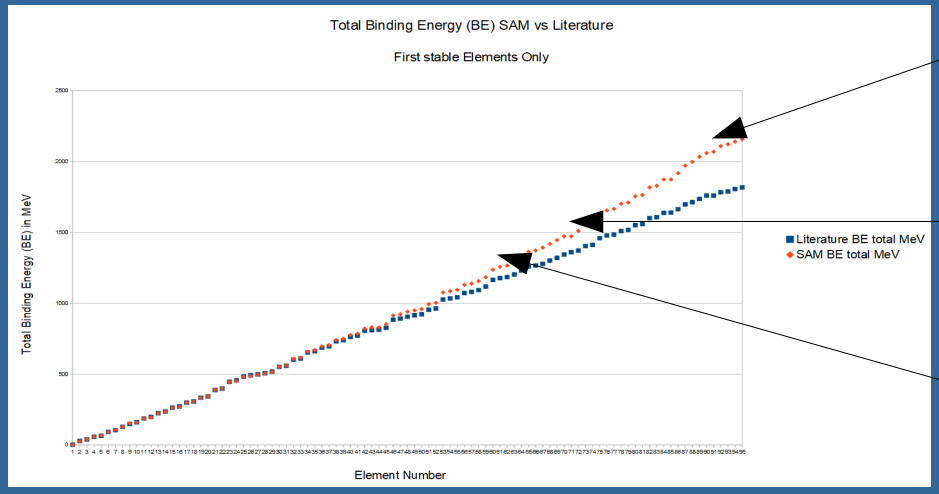
- Linear part up to around Iron
- Datasets correlate strongly
- Deviation (accuracy) is not perfect, which is explained by morphing geometry and a major focus point for further study.
- Jumps in both lines. (blue and red)
- The blue and red datasets are not intrinsically related, yet they correlate
- Large deviation after Iron, which cannot be true without reason, (no change in SAM logic) and why would known values begin to deviate after element 30 (Zinc)?
- Only real difference is that the branching starts to occur when the deviation in BE starts to show as well.
- It seems that the elements have in actuality more binding energy than reflected in observed values (mass-defect).

Note: First “raw” data set and attempt to understand this topic better with the help of SAM.
We are currently looking at more detail and are trying to capture this in 'one simple algorithm' that can accurately calculate the Binding Energy of any element or isotope.

Predictive Capability SAM - Splitting of the Atom

Example calculation
U236 → Praesodymium 141 (stable) + Niobium 93 (stable) + 2n
U235 : 2109 -1783 = 326
Pr141 : 1257-1177= 80
Nb93 : 821- 805=16
2 n : 16
326-80-16-16= 214 MeV

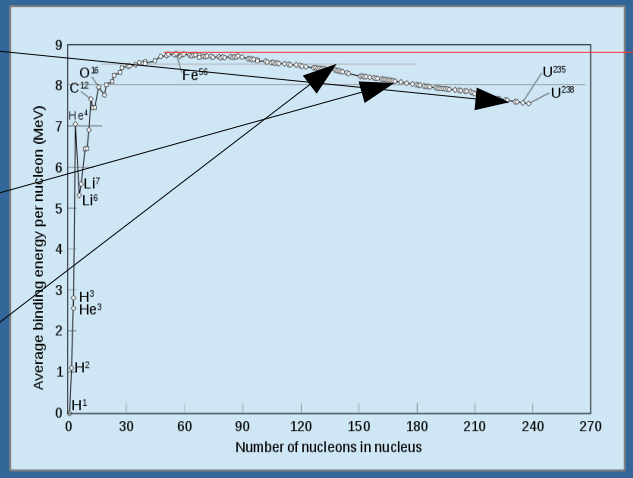
- Generally mentioned Energy release for U splitting is in the order of 200 MeV.
- Calculations seem to reflect this value.
- With the help of these tools, we can predict the energetic value.



U235

Pr

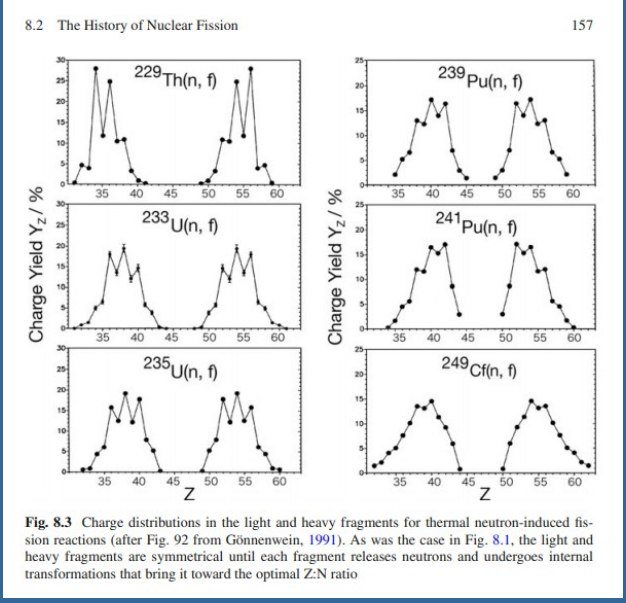
Nb



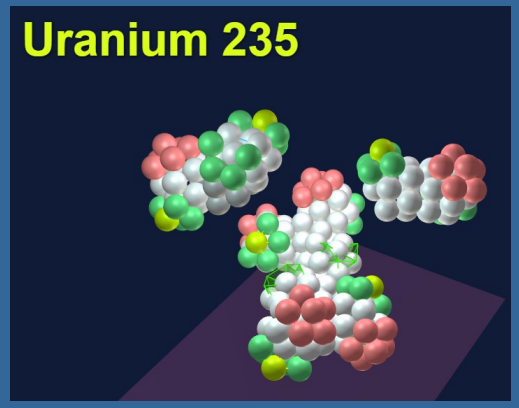
Uranium - Splitting of the Atom II

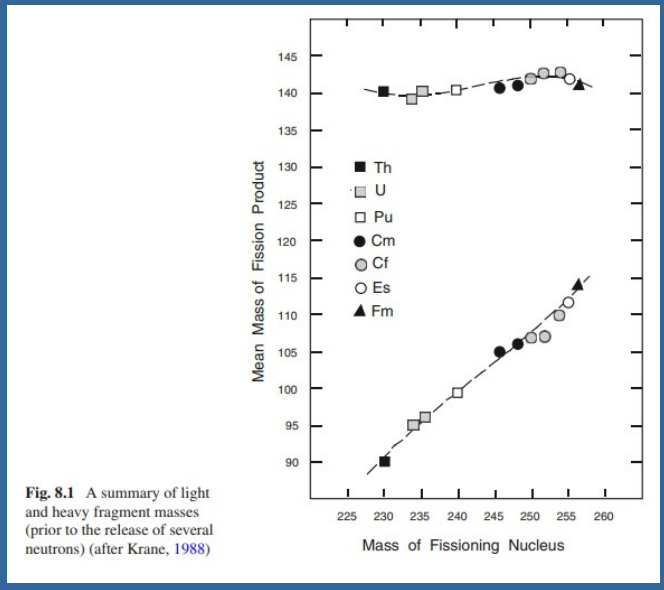
- The branching apparently creates some kind of 'Stress Energy' as a result of the repelling nucleus (itself).
- We identified the source of the energy inherent to the nucleus that is reflected by the structure. It is responsible for the energy release during the fission process!
- SAM shows why Iron/Nickel have the maximum mass-defect/BE
- This concept of breaking-off of branches as a result of the stress-energy seems to be reflected in the observed and known fission products.

Source: Norman Cook book MAN2.pdf
immediate results after fission



The smaller branches together and the larger remaining part reflect these numbers





Mass defect in the nucleus

We see the mass-defect occur in these three instances

1) The creation of a Deuteron shows a small amount of mass-defect.

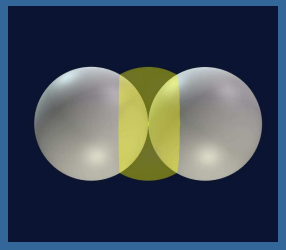
2) The creation of heavier (unstable) isotopes of an element results in less and less mass-defect per nucleon.

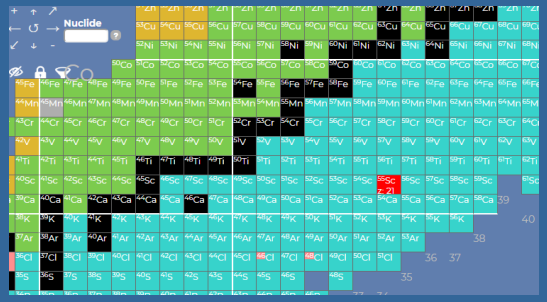
   Trend: Lower BE per 'neutron'

3) The diverging lines in the graph show the increasing stress-energy due to neighboring branches.

Branching is the only factor that changed halfway in the PTE

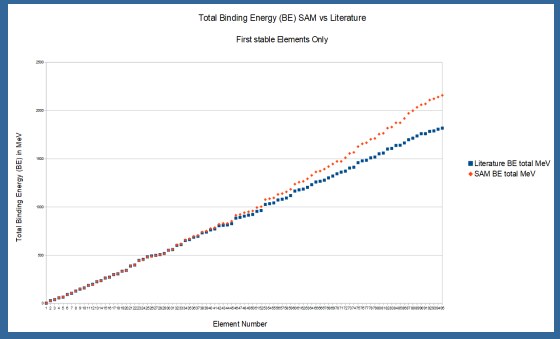
AMU actual (literature)	AMU SAM
1.0078250322	1.0078250468
2.0141017781	2.0156500936
3.0160293201	3.0234751404
3.0160492779	3.0234751404
4.0026032541	4.0313001872





Ti50 (last stable isotope) - 8755 MeV
Ti60 – 8157 MeV

Delta is 0.6 MeV per 10 A lower, meaning the last 'neutron' added had 3.6 MeV less BE in absolute numbers.

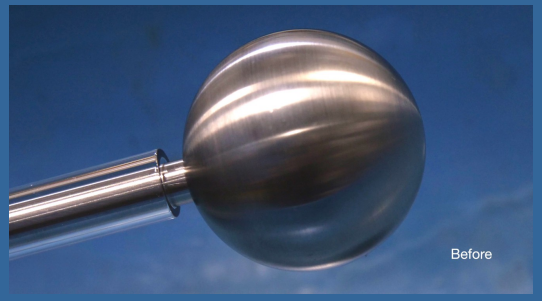


The branches with their "stress energy" reduce the theoretical calculated higher BE to the level of mass defect we actually observe.

Supporting Evidence from SAFIRE Project

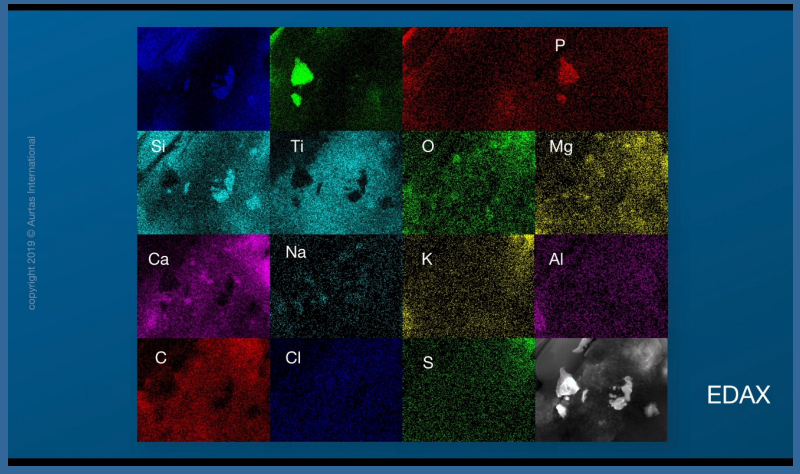
- SAFIRE project confirms transmutations by Mass & Optical spectral analysis, SEM & EDAX and through an independent laboratory recommended by an US agency
- MIT studies show that nuclear waste exposed to Hydrogen isotopes has accelerated decay rate
- The maximum energy output is suddenly achieved at 7 % input power
- Comparison is drawn between the observed elements and interstellar space
- The Electric Sun Model is validated

Source: SAFIRE project EUUK-2019 video



Anode before experiment

Anode after experiment

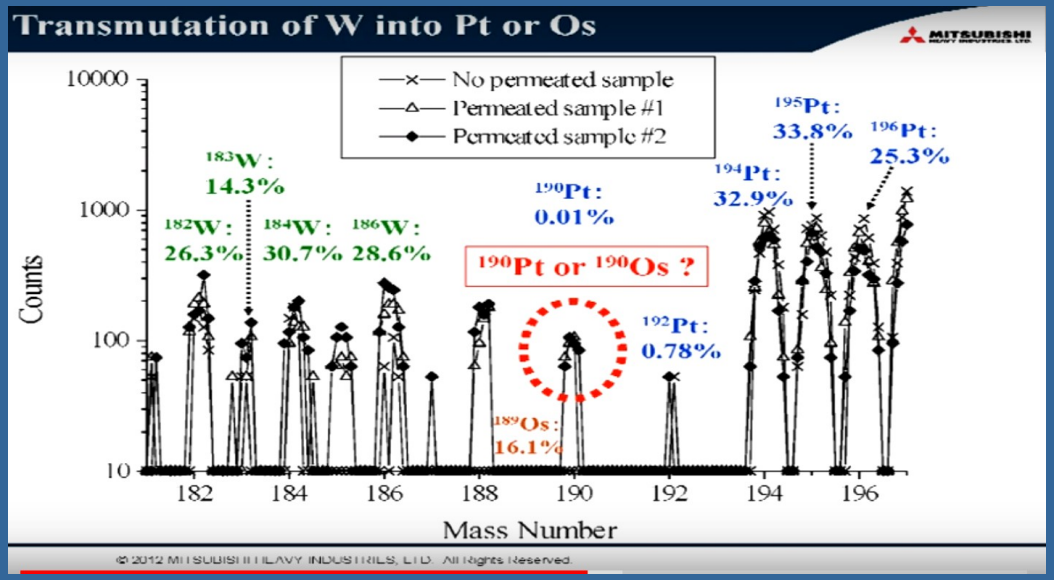


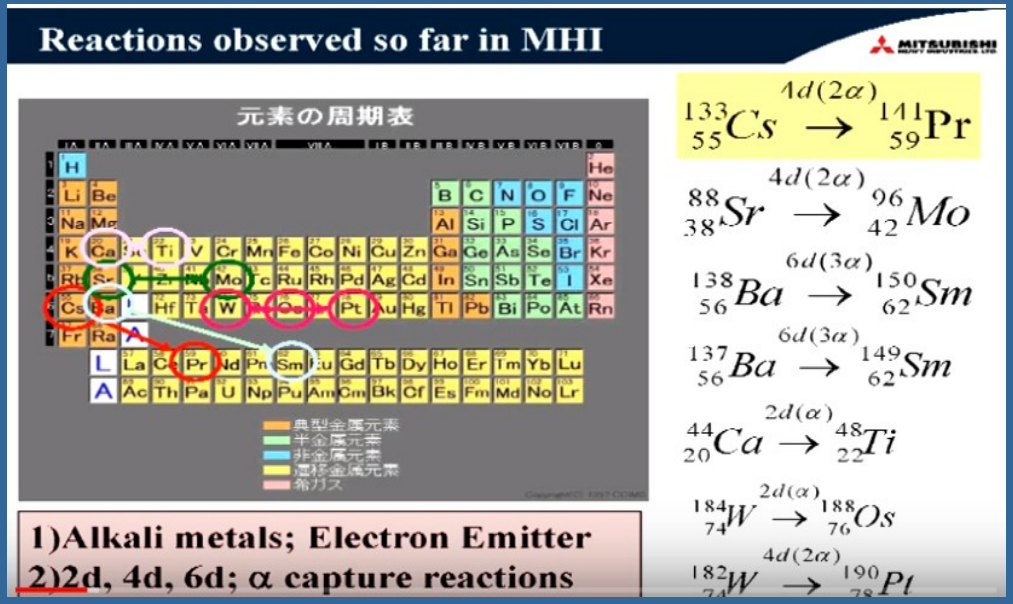
Elements detected which were absent before the experiment

Supporting Evidence from Iwamura

Table 2. Reports of excess power production at ICCF21. The order is the same as in the text. NM stands for NanoMaterials.

Lead Author	Materials & Loading Method	Maximum Excess Power	Longest Run Duration	Power Gain (W/W)
Letts-Cravens	D_2 or H_2	10 W	7.5 days	77/70 = 1.1
Mizuno	Ni + D_2	232 W	3.2 years	480/248 = 1.9
Miley	NM + D_2	20 mW	5 hours	
Takahashi	NM + D_2 or H_2	24 W	1 month	
Iwamura	NM + D_2 or H_2	5 W	150 hours	
Tanzella	Ni + D_2 or H_2	5 W	40 hours	21/16 = 1.3
Swartz	Pd + D_2O	4 W	67 hours	2.3
Celani	Constantan + D_2	12 W	1 day	102/90 = 1.1
Staker	Pd + D_2O	1.2 W	46 days	2.4/1.2 = 2.0
Beiting	NM + D_2 or H_2		950 hours	7.5 %
Dong	Pd + D_2	2-3 W		
Ramarao	Ni + $LiAlH_4$	310 - 350 W	12 hrs	1.3 - 1.4
Zhang	Ni + D_2	2 W	4 hours	32/30 = 1.1





Source: Pesentation Yasuhiro Iwamura - American Nuclear Society 2012

Supporting Evidence from Mizuno

With Palladium as source “results are all over the Periodic Table”

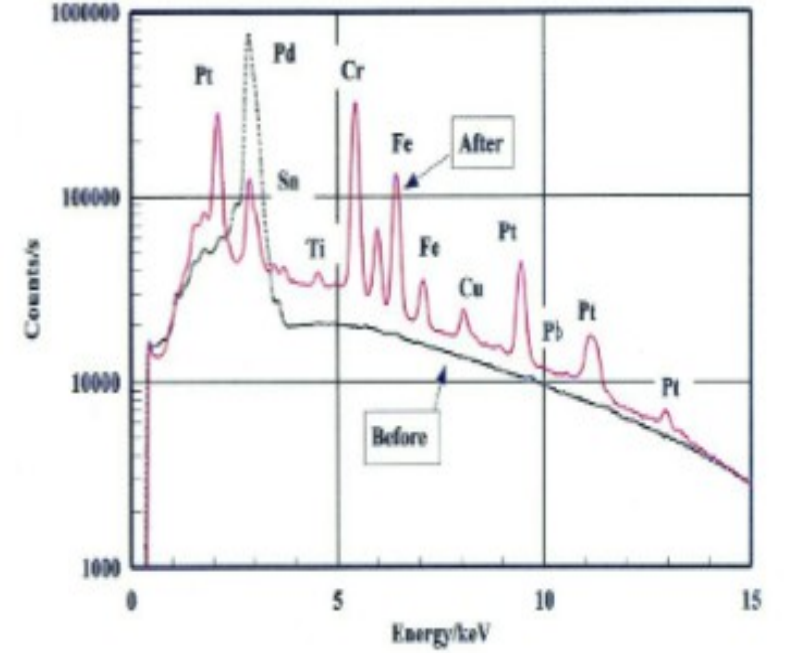
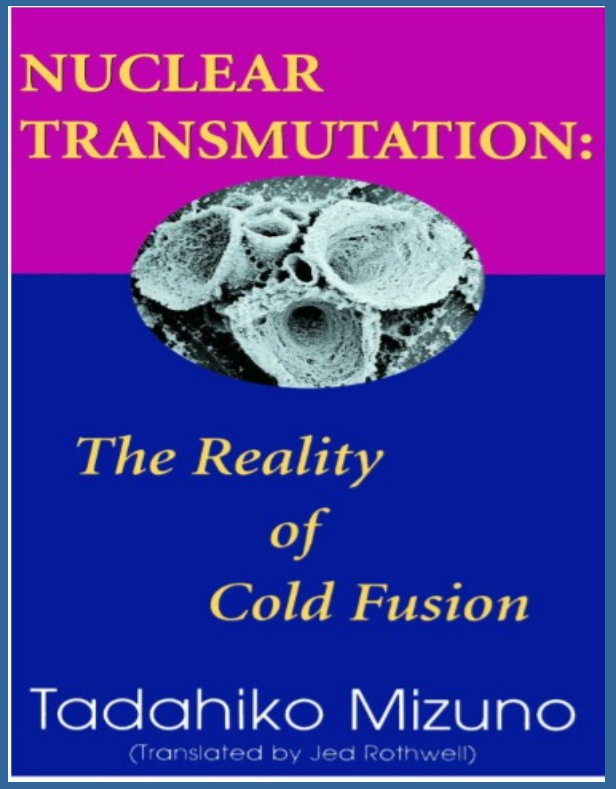


Figure 29. An example of an EDX element analysis of a palladium rod after it produced excess heat during electrolysis. Results from before and after electrolysis are shown. In the palladium rod after electrolysis, all sorts of elements are observed.

Source



Conclusions

- The calculated binding energy minus the observed BE appears to equate to the stress-energy as a result from the branching of the nucleus. (red and blue data-sets)
- Branching occurs just above Iron.
- Nuclear fission is a breaking-off of a part of the nucleus, leaving the fission products with less stress-energy. This is also reflected in the asymmetrical fission products.
- This difference in stress-energy between the parent element and the fission products represents the released energy in fission processes. SAM can calculate approximate values.
- Experimental data suggests that transmutations are occurring.
- This can be explained as a result of fusion and/or fission processes.
- SAM shows the feasibility of fission for heavy elements and we can calculate the predicted energy release.

We have discovered where and how much energy is 'hiding' in which element.

This is represented by the stress-energy or repelling forces between the branches in the nucleus.

Implications

- Understanding nuclear structure is crucial to further the field of nuclear physics as it will provide the next level of understanding of the atom and help unlock the secrets still waiting to be found.
- SAM offers an unprecedented 3D view of the nuclear structure.
- SAM offers tooling that is simple to understand and use.
- SAM makes Physics a practical science and suitable for engineers to work with.
- The topic of binding energy is obscure and its relationship with mass-defect is complicated. It appears that the average dropping-off of BE (mass-defect) from Iron onwards is in actuality a repelling force between the branches (stress-energy).

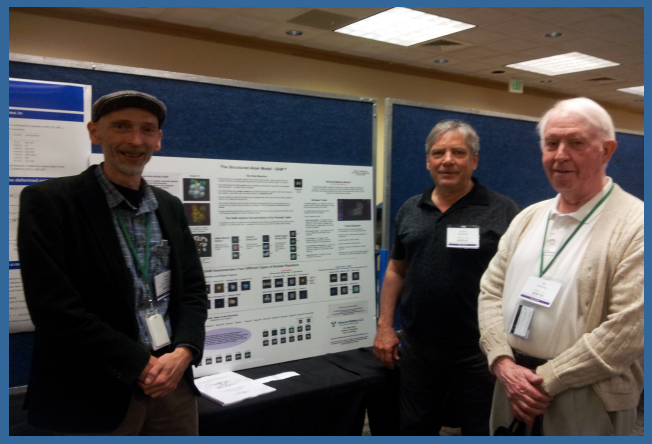
To see the elements in full 3D visit:

https://etherealmatters.org/atomizer/atom-viewer

Thank You on Behalf of the Team!

https://etherealmatters.org/sam

Edo Kaal



Jan Emming

James Sorensen

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- Mark Spann
- Andreas Otte
- Many others out there who helped in their own way