



The Structure of the Nucleus

Checker Board Model

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<http://checkerboard.dnsalias.net/>

The Structure of the Nucleus

Assumptions of this model:

The Nucleus is flat. The apparent Spherical shape is due to a flat structure viewed from all possible angles.

The structure of the nucleus must be simple

Only the two quarks with like charge rotate in nucleons

Same frequency of rotation for proton and neutron

The Structure of the Nucleus

Requirements:

The structure must agree with the stability of known nuclei.

The structures must predict all discovered nuclei.

The theory must be able to explain the neutron skin effect.

A nucleus may have more than one structure (isomer).

The structure must be able to logically explain alpha, beta, and gamma decay.

The Structure of the Nucleus

MAGNETIC MOMENTS: (given)

$$\begin{aligned}\text{Proton} &= 1.41060761(47) \times 10^{-26} \text{ Joules/Tesla} \\ &\quad 2.7928473(37) \pm 29 \text{ Bohr Magnetons (PDG 2000)} \\ \text{Neutron} &= -0.96623707(40) \times 10^{-26} \text{ Joules/Tesla} \\ &\quad -1.913042(7) \pm 5 \text{ Bohr Magnetons (PDG 2000)}\end{aligned}$$

The Structure of the Nucleus

MASS: * = PDG 2000

Proton = **1836.15(3) mass electrons**

$1.672623 \times 10^{-27} \text{ Kg} *$

$938.327200(0) \pm 4 \text{ MeV} *$

$1.007276466(88) \pm 13 \text{ AMU} *$

Neutron = **1838.683(7) mass electrons**

$1.6749286 \times 10^{-27} \text{ Kg} *$

$939.5653(3) \pm 4 \text{ MeV} *$

$1.008664915(78) \pm 55 \text{ AMU} *$

Electron = $9.1093897(54) \times 10^{-31} \text{ Kg}$

The Structure of the Nucleus

Given:

CONSTANTS:

Electron/Proton charge = 1.602095×10^{-19} coulombs

Speed of light “c” = 2.997925 meters / sec

Plank’s constant “h” = 6.62618×10^{-34} J s

EQUATIONS:

$$\mu = I(A) = ef (\pi r^2) = 1/2 (e v r)$$

$$m_v = m_o (1 - v^2/c^2)^{-1/2}$$

$$\lambda_v = h / m_v v$$

Magnetic Moment

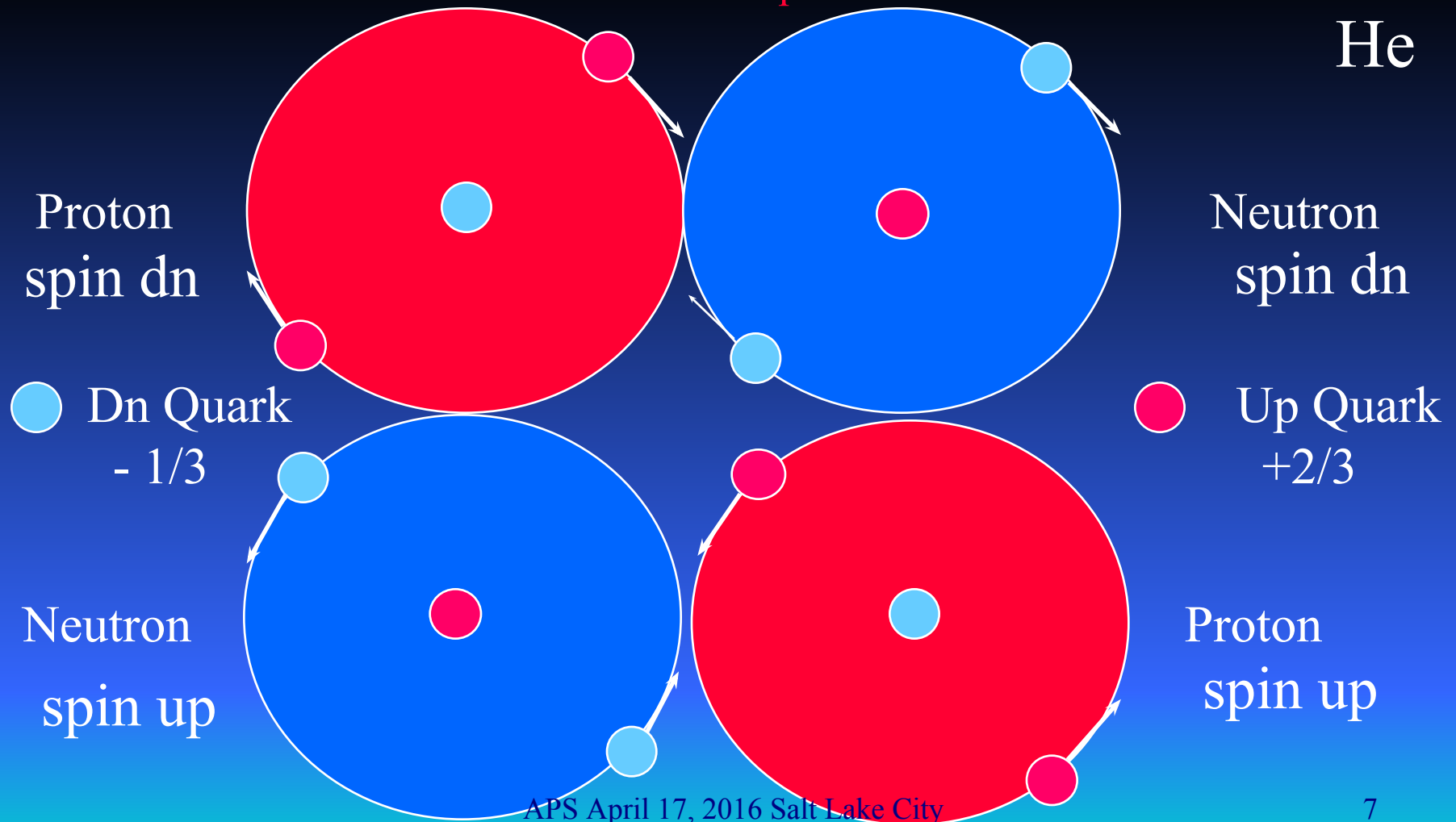
Einstein

DeBroglie

The Structure of the Nucleus

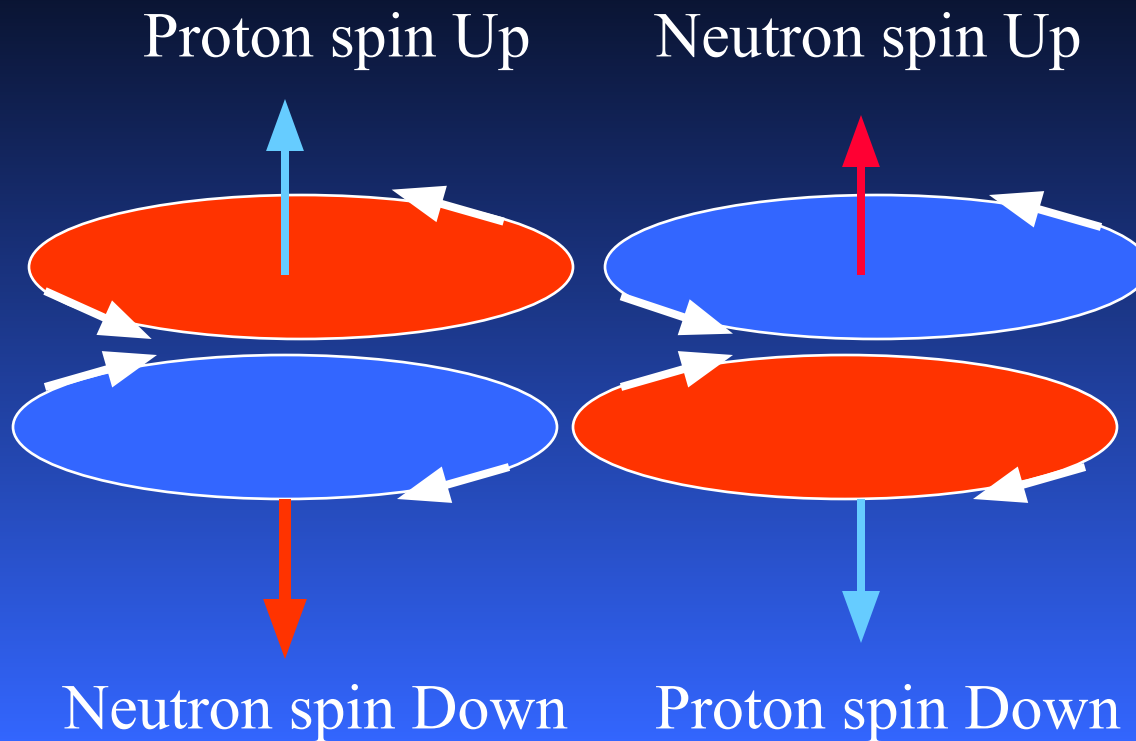
⁴He

Basic Principle



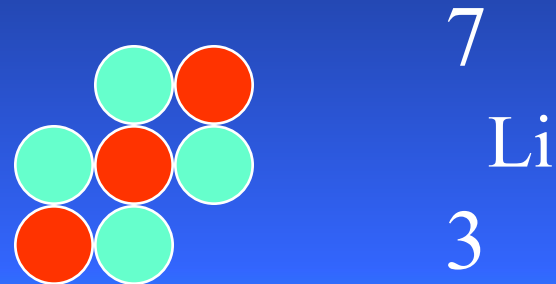
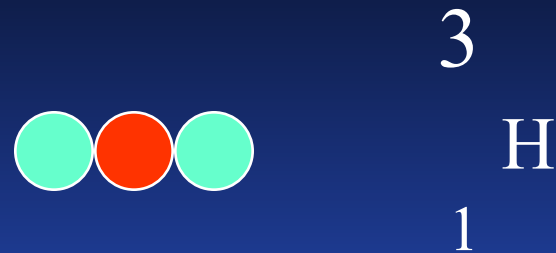
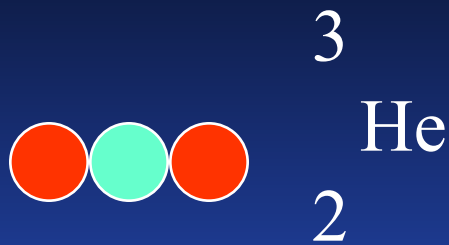
The Structure of the Nucleus

Basic Principle



The Structure of the Nucleus

Two examples of nuclear mirror nuclei (e.g.. exchange the protons with neutrons you get the other nuclei)



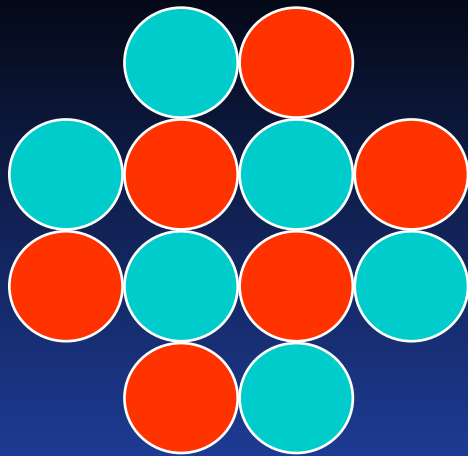
Proton



Neutron

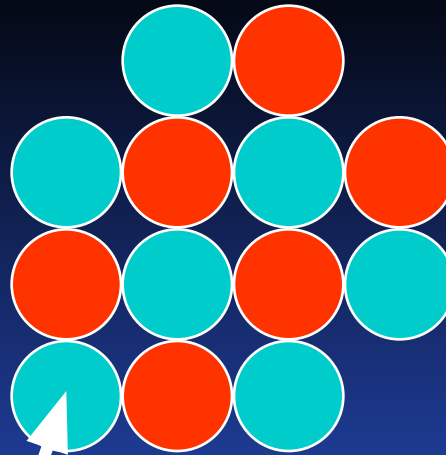
The energy spectrum of the mirror nuclei are the same.

The Structure of the Nucleus



$^{12}_{6}\text{C}$

Abundance = 98.93%



$^{13}_{6}\text{C}$

Abundance = 1.07%



$^{14}_{6}\text{C}$

half life = 5715 years

ONLY Three stable forms of the Carbon nucleus (notice how the two extra neutrons “fit” nicely into the pattern).



Proton



Neutron

The Structure of the Nucleus

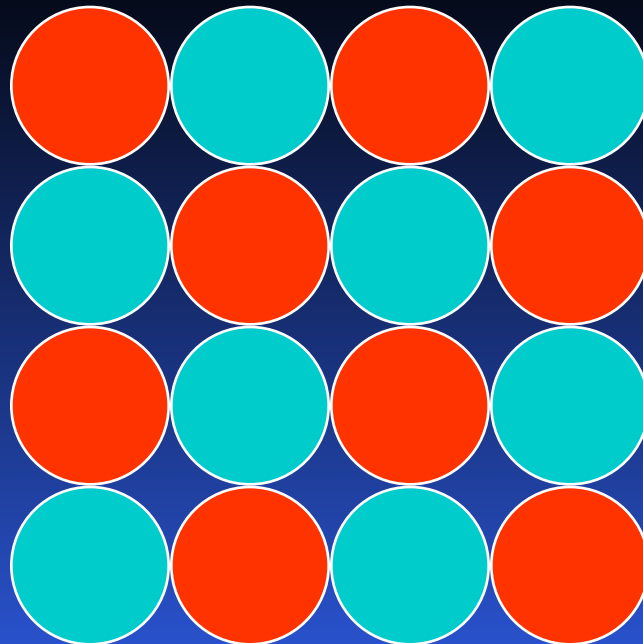
Two stable isomers of Oxygen 16.



Proton



Neutron

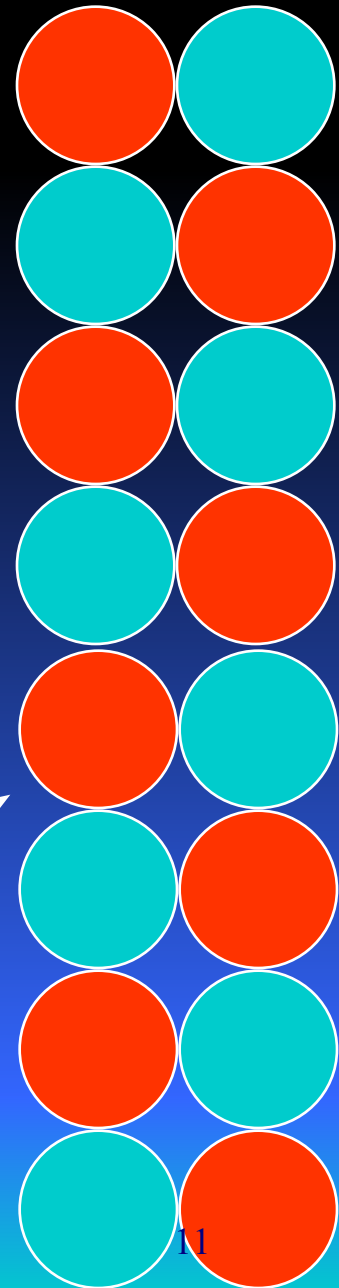


16

O

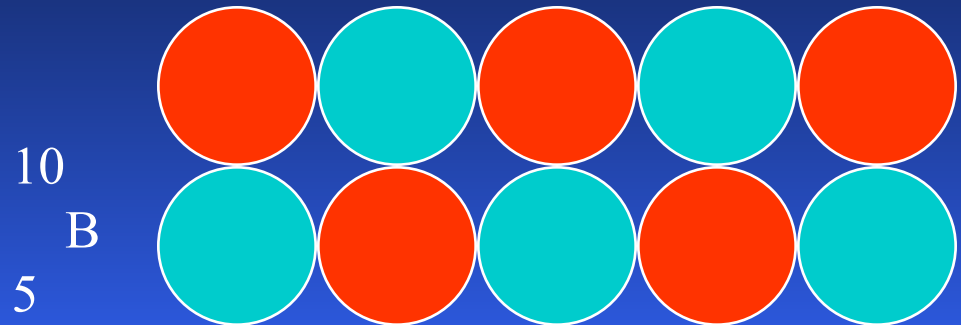
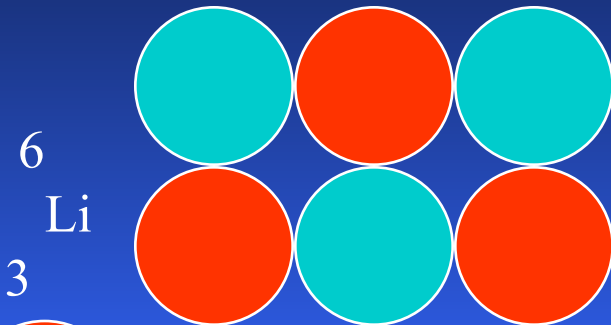
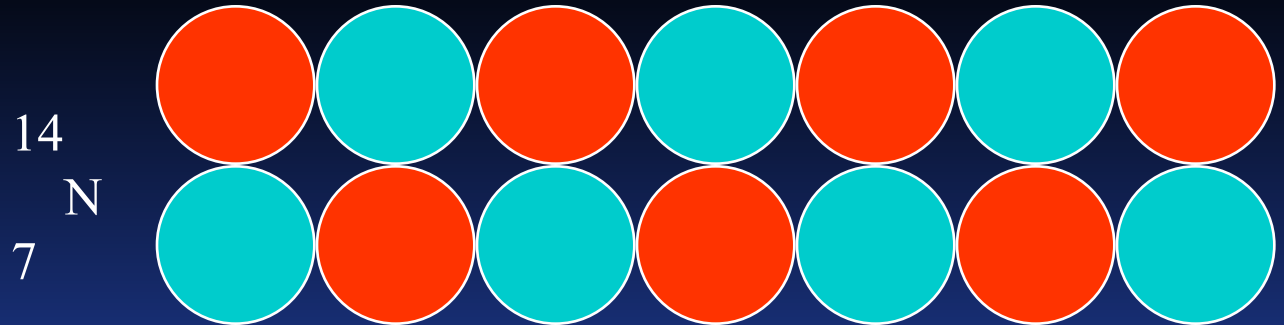
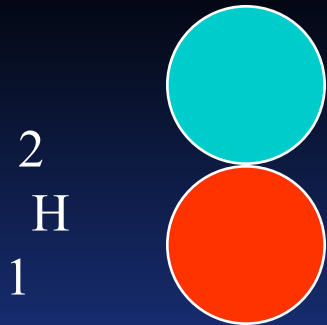
8

or



The Nuclear Cluster Model, which predicts **linear** structures such as Oxygen 16 and Mg 24 is described in the Handbook of Nuclear Properties, D.N. Peonaru and W. Greiner pg 103 Evidence for linear Mg 24 was published by Wuosmaa et.al Phys. Rev. Lett., 68, 1295, 1992.

The Structure of the Nucleus



Proton

Neutron

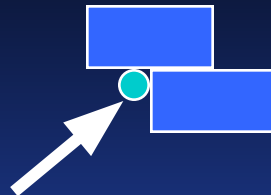
Only stable forms of odd proton-odd neutron nuclei.

The Structure of the Nucleus

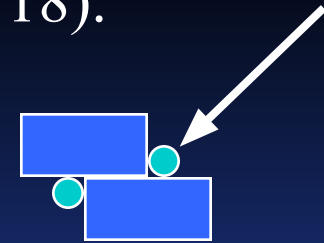
Only Stable structures from Oxygen (16, 17, 18).



$^{16}_8\text{O}$ 99.76%



$^{17}_8\text{O}$ 0.038%



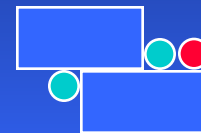
$^{18}_8\text{O}$ 0.20%



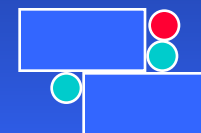
2- Alpha Particles

○ Neutron

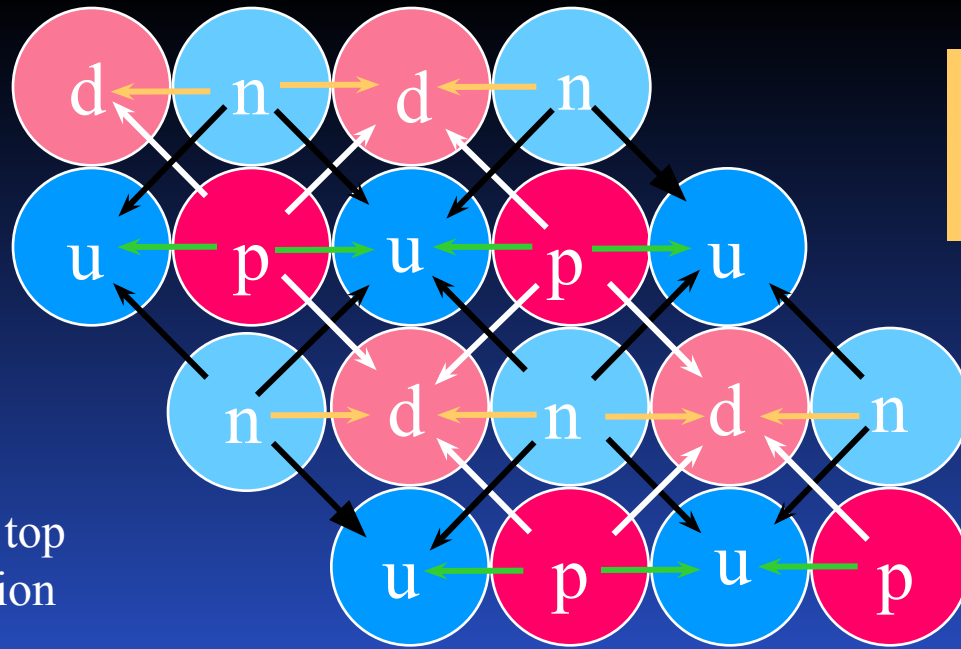
● Proton



$^{19}_9\text{F}$ 100%



The Structure of the Nucleus



18
O
8

0.20%

Neutrons

Protons

spin down

Spin up

spin down

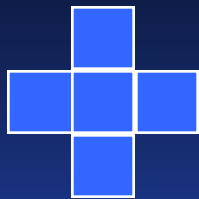
spin up



The Structure of the Nucleus

Stable structures of Neon, 5 alpha particles

spin = 0



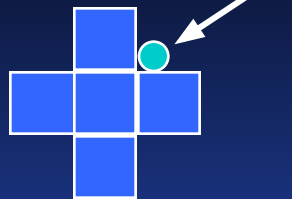
20

Ne

10

90.48%

spin = 3/2+



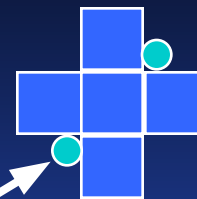
21

Ne

10

0.27%

spin = 0



22

Ne

10

9.25%

Abundance



Alpha Particle



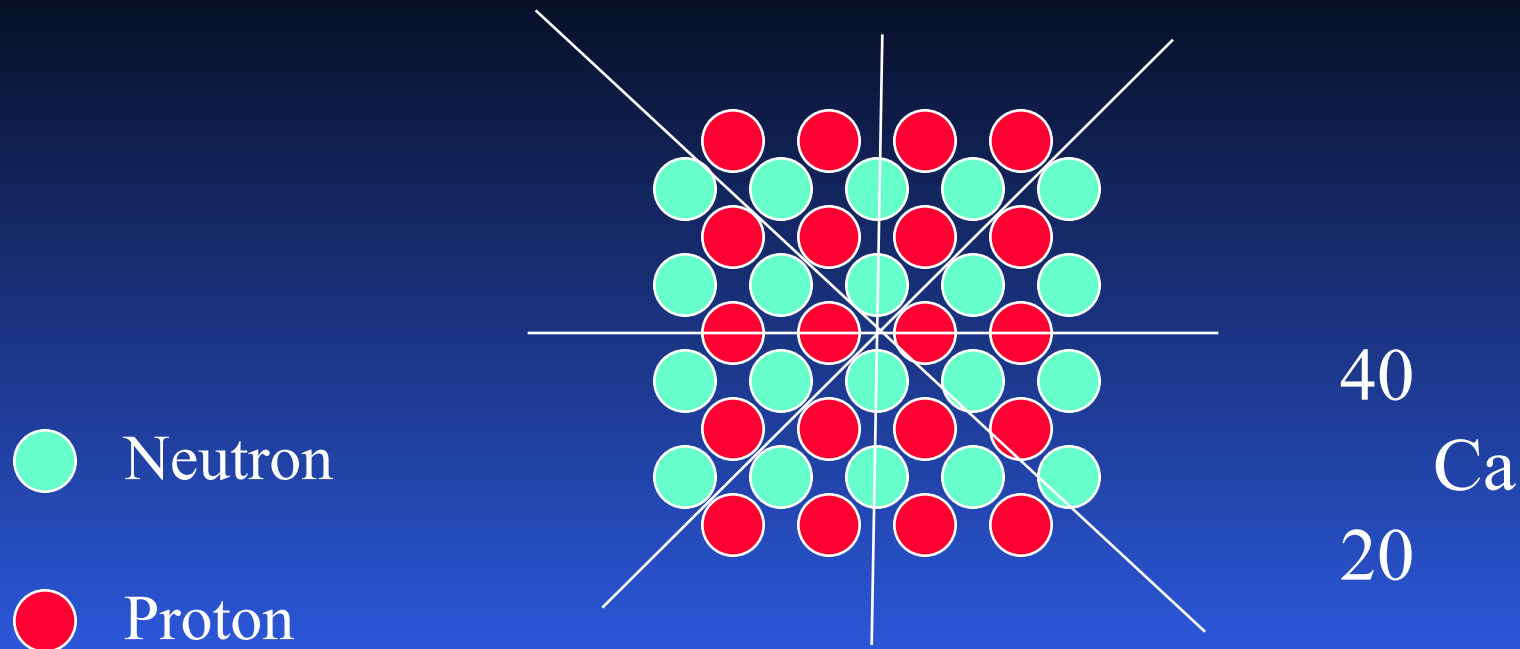
Neutron



Proton

Neon 22 has 8 additional (**non structural**) neutron sites that could be populated, resulting in Ne 30. To date the heaviest isotope of Ne that has been found is Ne 29 with a half life of .2 seconds.

The Structure of the Nucleus



Most abundant form of Ca, 96.94%. **Double mirror symmetry.**
Double Magic number Nuclei.

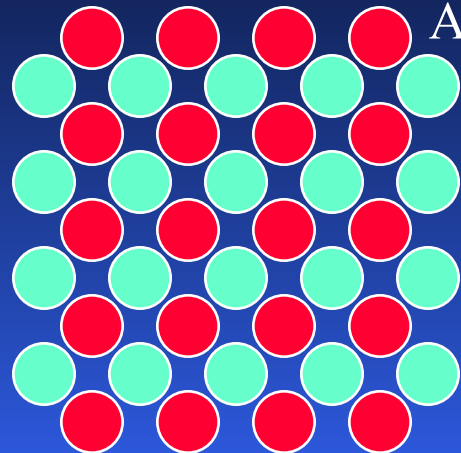
The Structure of the Nucleus



4

He

2



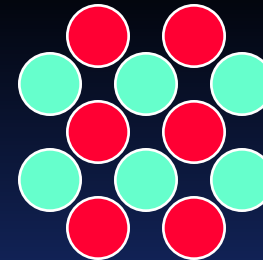
Abundance 99.9998%

40

Ca

20

Abundance 96.94%

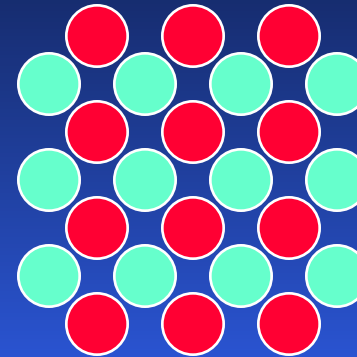


12

C

6

Abundance 98.93%



24

Mg

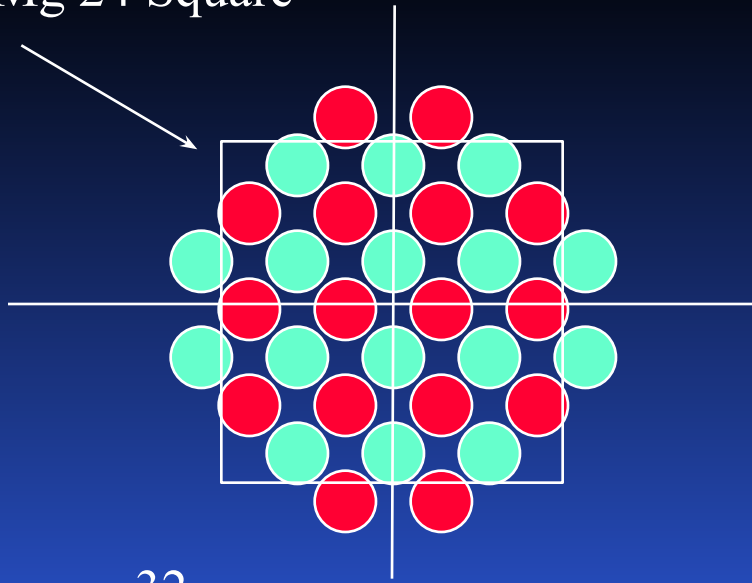
12

Abundance 79%

These 4 nuclear structures all follow the same pattern / symmetry. **They all have double mirror symmetry.** Two of these structures are double magic. The other two have high abundance's. Each of these nuclei are the most abundant form of their element.

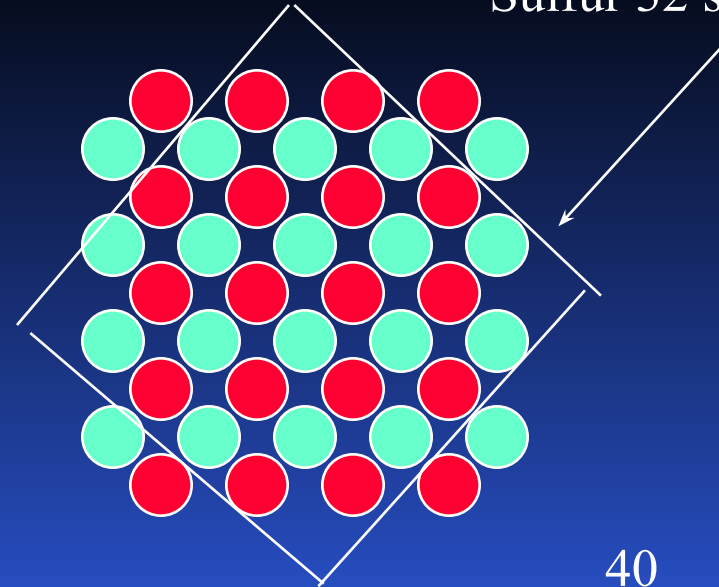
The Structure of the Nucleus

Mg 24 Square



32
S
16

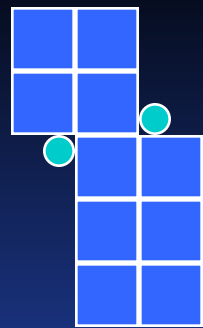
Sulfur 32 structure



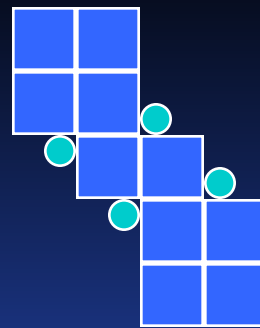
40
Ca
20

These 2 nuclear structures both have double mirror symmetry and are key nuclei for their abundance and stability. Fe 56 has the highest binding energy of any nucleus.

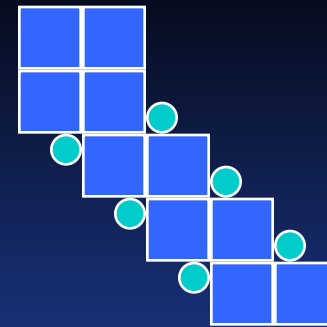
The Structure of the Nucleus



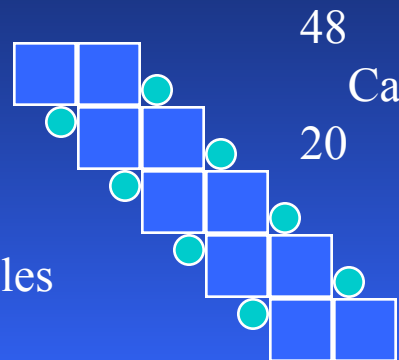
42
Ca
20
0.647%



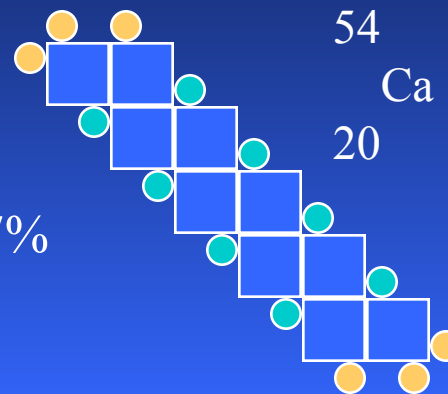
44
Ca
20
2.086%



46
Ca
20
0.004%



48
Ca
20
0.187%



54
Ca
20



2- Alpha Particles



non-structural neutron



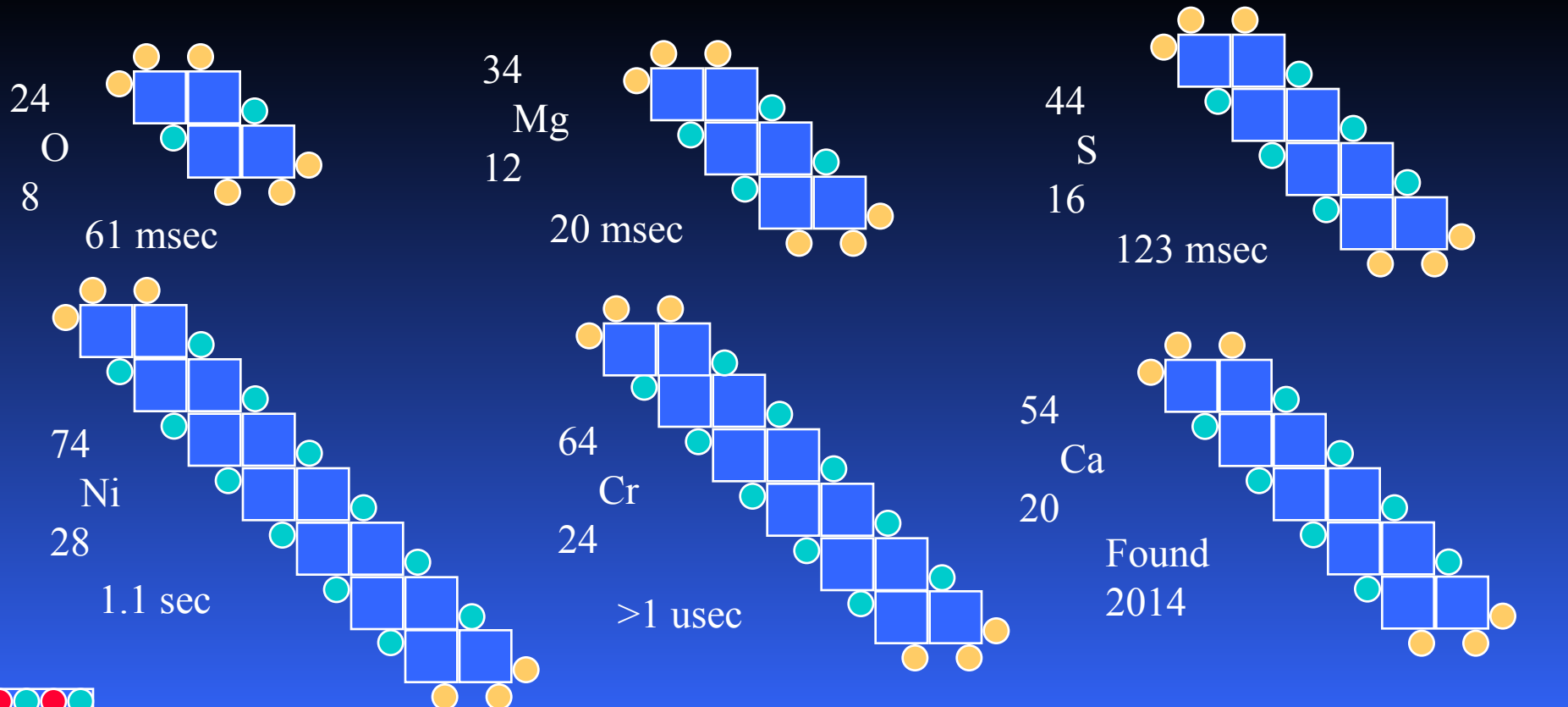
Neutron



Proton

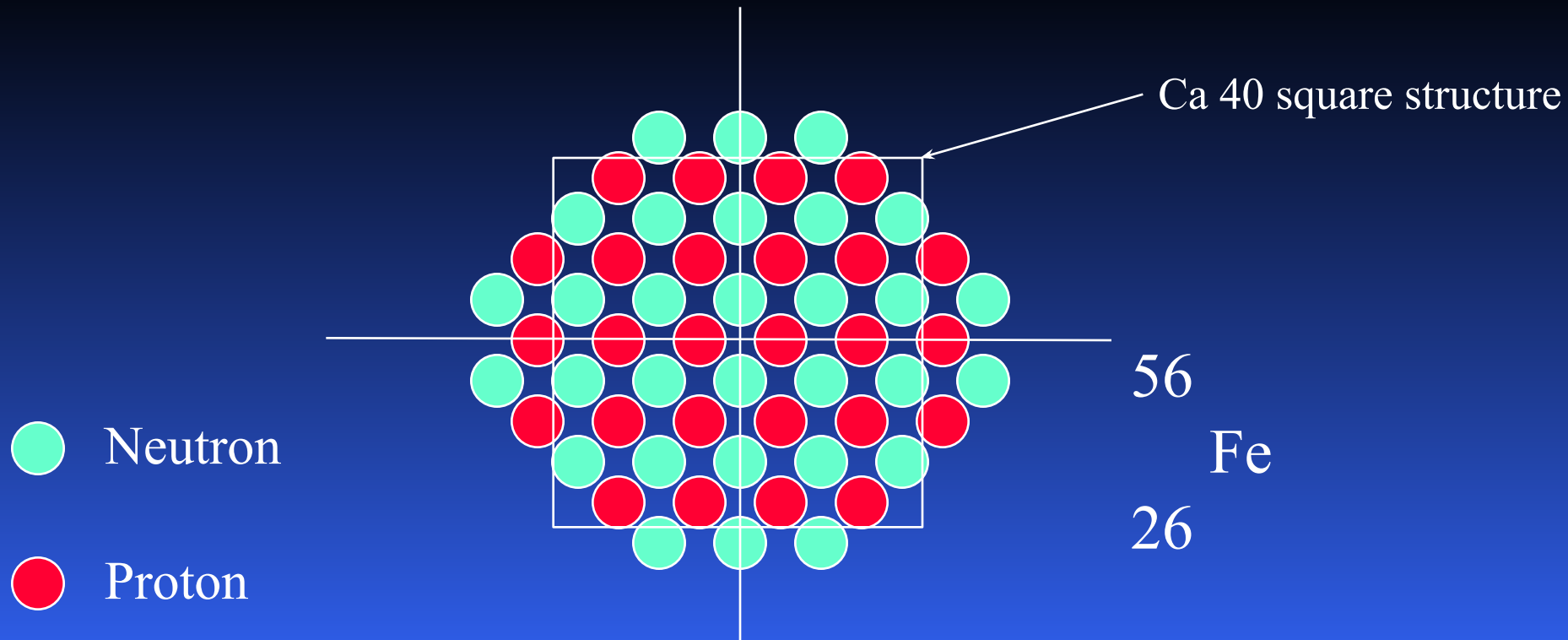
Starting with Ca 48 and filling six additional non-structural neutron sites gives Ca 54. To date the heaviest isotope of Ca that has been found is Ca 53 with a half life of 0.09 seconds.

The Structure of the Nucleus



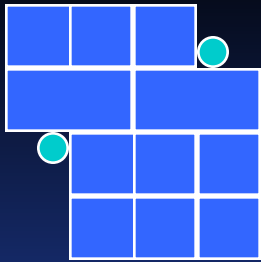
O 24, Mg 34, S44, Ca54, Cr 64, and Ni 74, are significantly more stable than the next heavier isotope. The nuclei are expected to have the same structure. They have a number of protons that is divisible by 4.

The Structure of the Nucleus

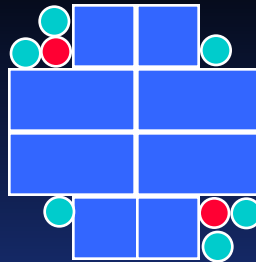


Most abundant form of Fe, 91.75%. Double mirror symmetry

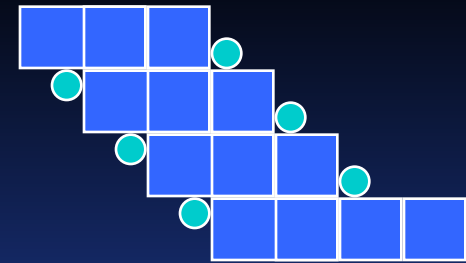
The Structure of the Nucleus



$^{54}_{26}\text{Fe}$ 5.84%



$^{56}_{26}\text{Fe}$ 91.75%



$^{58}_{26}\text{Fe}$

0.282 %

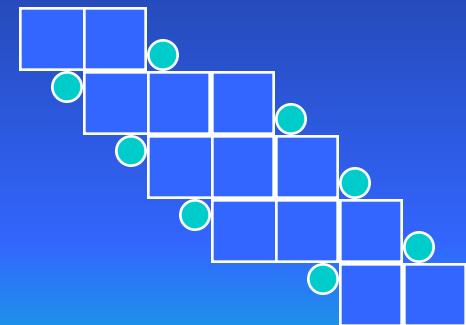


2- Alpha Particles

○ Neutron

● Proton

Different Forms of
stable Iron nuclei

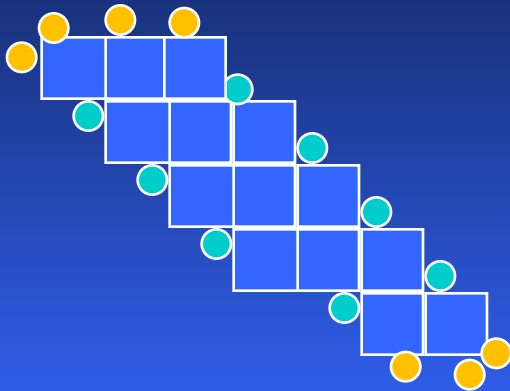


$^{60}_{26}\text{Fe}$

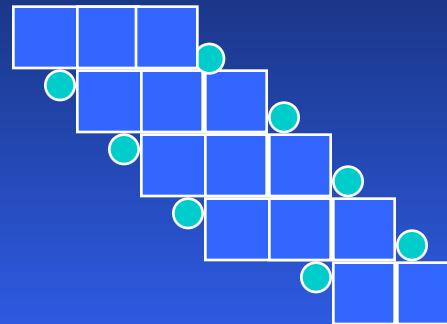
Half life = 1.5×10^{22} years

The Structure of the Nucleus

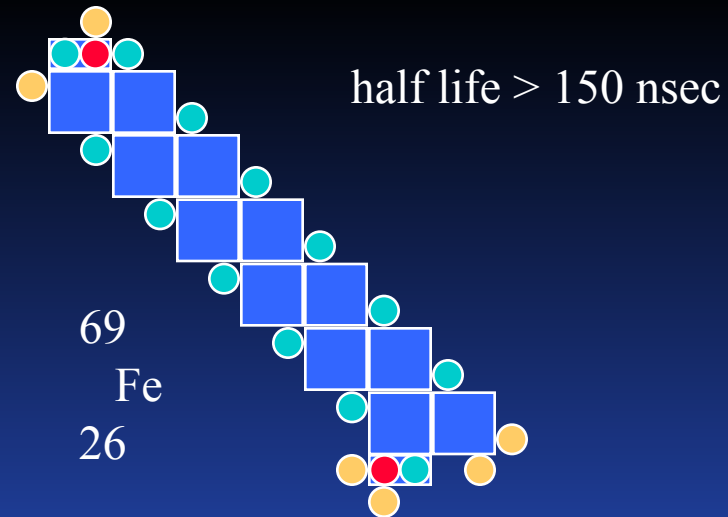
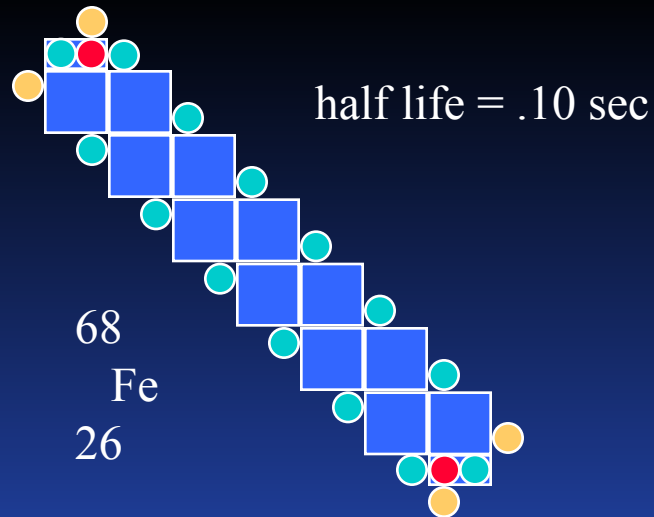
71
Ni
28



64
Ni
28



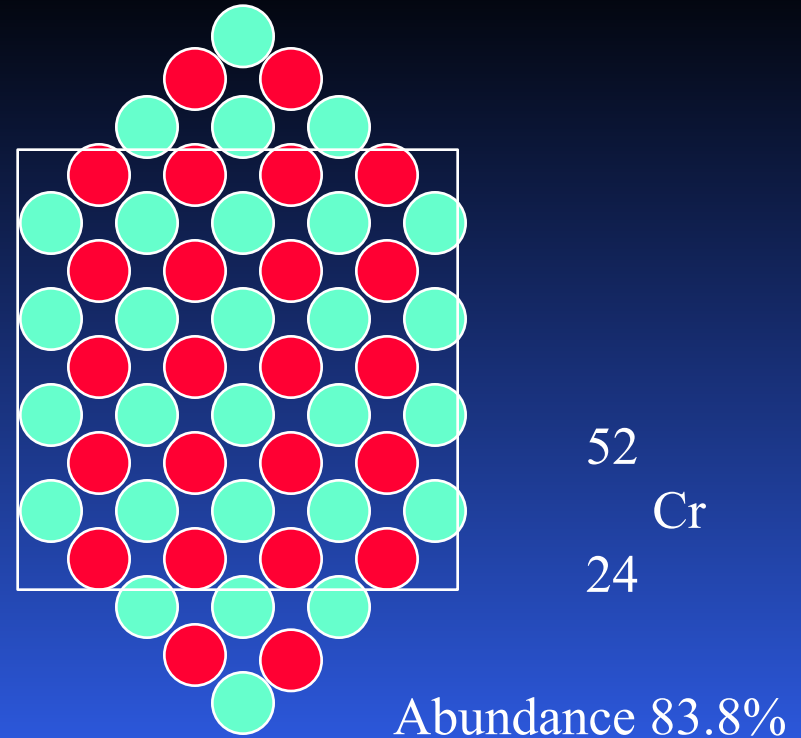
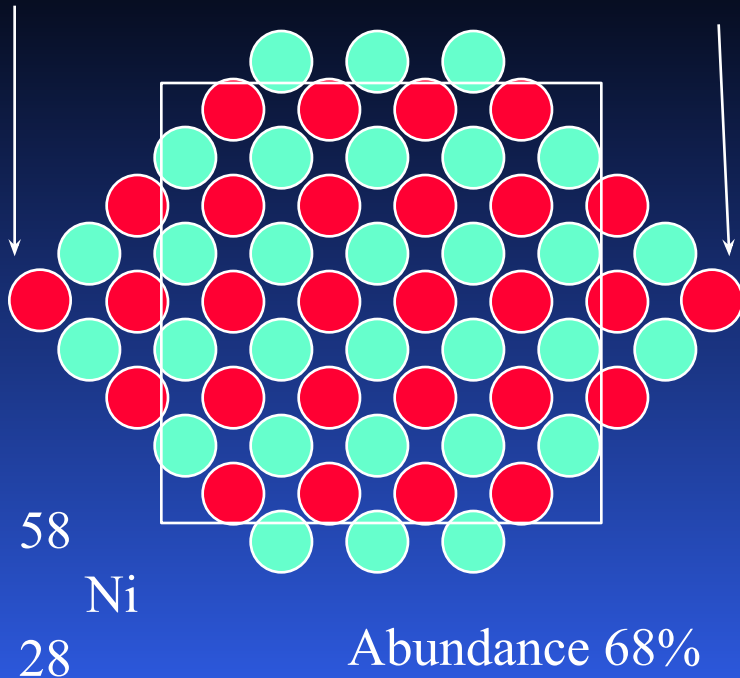
The Structure of the Nucleus



Fe 68 and Fe 69 are the last two isotopes of Fe. Notice that the structure of Fe 68 (or Ti 58) is a repeating structure of 3 neutrons followed by 2 protons. The structure at the bottom of Fe 69 above would also explain the nuclei of Ne 29, Si 39, Zn 79, and Se 89. Similarly if the splitting occurred at both ends that would explain Zn 80 and Se 90. Also the Fe 68 structure would predict that Ar 48 will eventually be found. All the above nuclei have one thing in common: their number of protons are $4(n + 1/2)$.

The Structure of the Nucleus

Fe 56 plus two extra protons



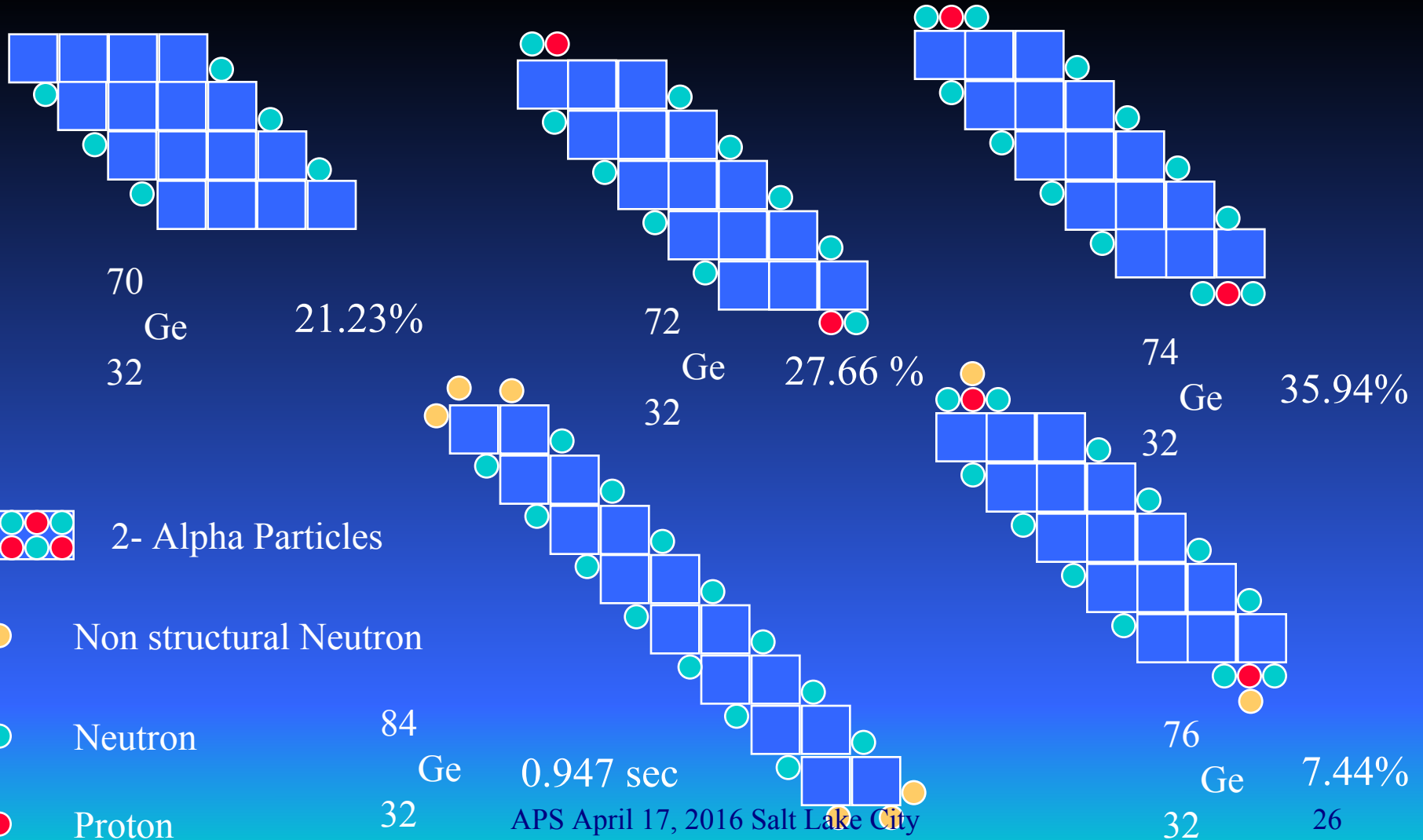
Both of these nuclei are the most abundant form of these elements.

Ni 58 & Cr 52 shows evidence that the protons want to spread out.

Neutron

Proton

The Structure of the Nucleus



The Structure of the Nucleus

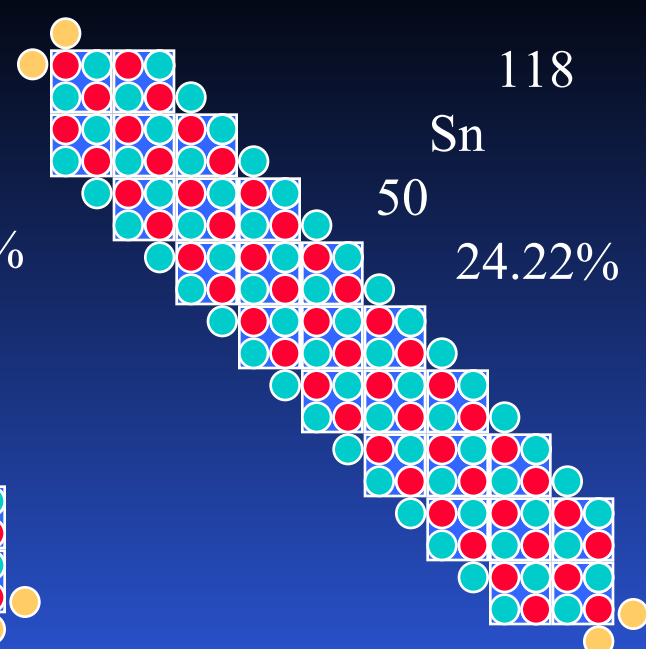
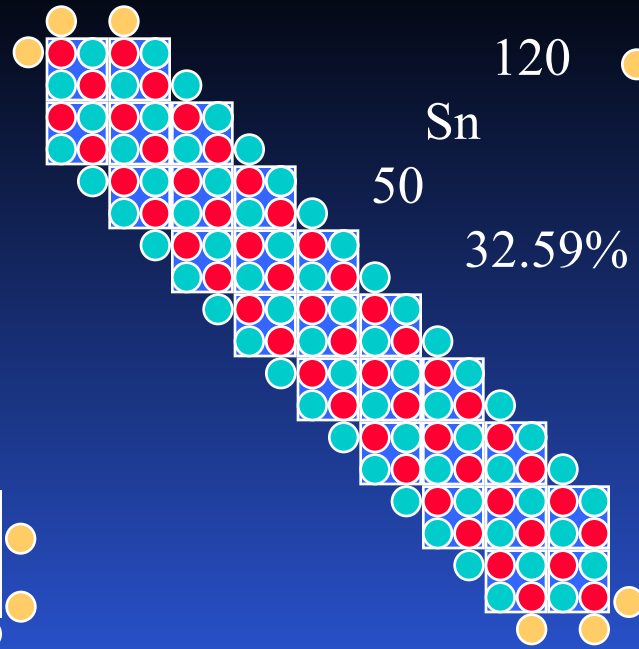
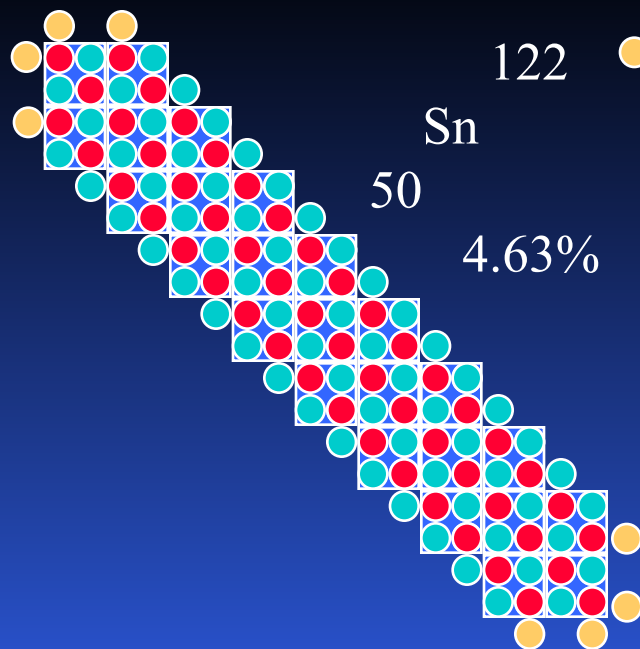


3- Alpha Particles

● Non Structural Neutron

● Neutron

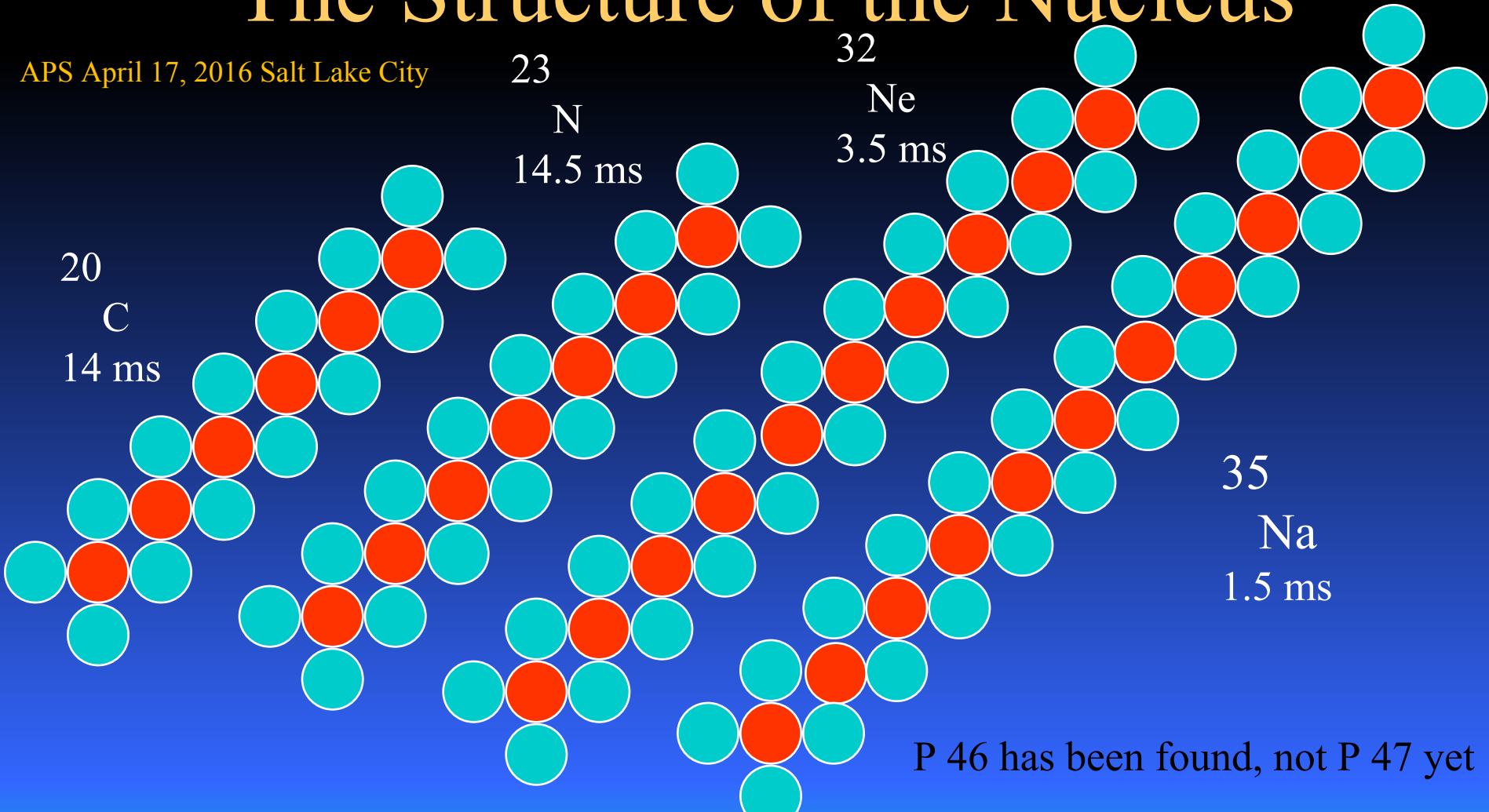
● Proton



Sn 120 is the most abundant form of Sn. Subtract two non structural neutrons and you get Sn 118, 24.22% abundance, Subtract two more non structural neutrons and you get Sn 116, abundance 14.54%, subtract the last two non structural neutrons= Sn 114, abundance .65%. By the time we get to Sn we significant evidence that the protons want to spread out.

The Structure of the Nucleus

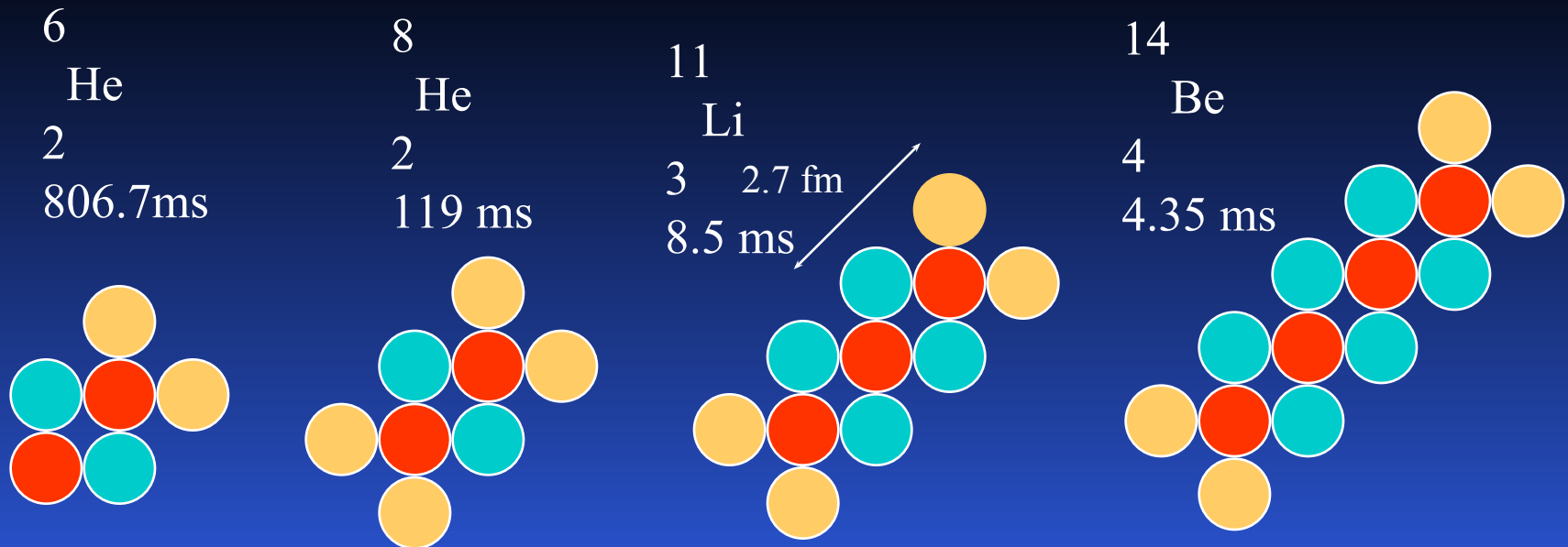
APS April 17, 2016 Salt Lake City



C 20, N 23, O 26, F 29, Ne 32, Na 35, Mg 38, Al 41, Si 44, also fits this pattern.
With a few controversial exceptions all except Carbon are the heaviest known isotope.

The Structure of the Nucleus

Known Halo Nuclei

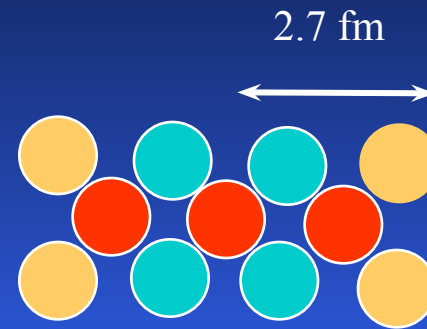
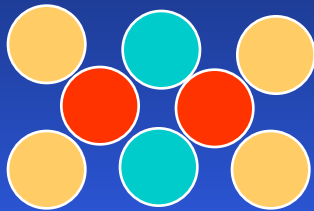


He 6, He 8, Li 11, Be 12 and Be 14 are known as the Halo Nuclei, it is known that two loosely bound neutrons are tied to the core of the nuclei. In these nuclei the mass and charge radii may differ by large amounts. The density distribution shows an extended neutron tail at low density. Li 11 extends farther out than current models can explain. B 17, also believed to be a halo nucleus, fits this pattern. Reference: D.N. Poenaru and W. Greiner pg 139. and proceedings of ENAM 98.

The Structure of the Nucleus

Halo Nuclei

^8_2He
119 ms



$^{11}_3\text{Li}$
8.7 ms

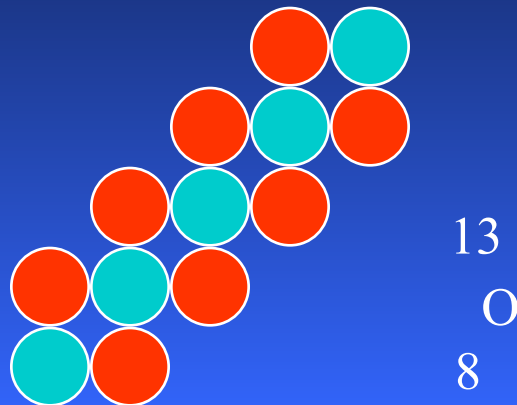
The Structure of the Nucleus

Semi stable structures along the proton drip line

half life = 53.29 days

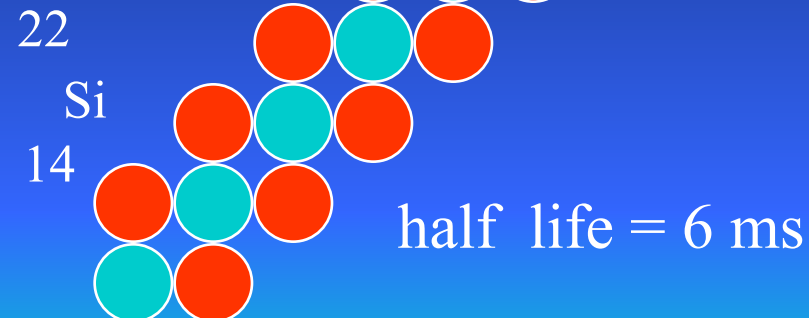
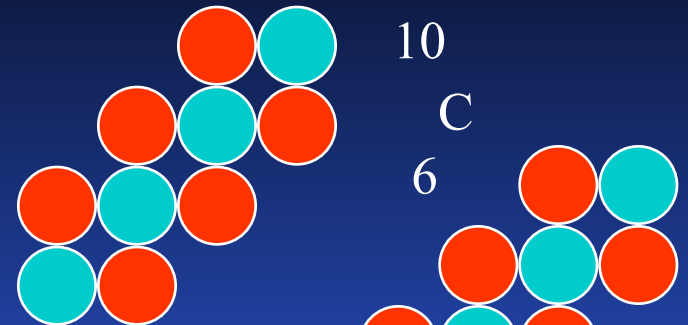


Ne 16 and Mg 19 exists and fit this pattern, their half lives should be between 6-8 ms.



half life = 8.58 ms

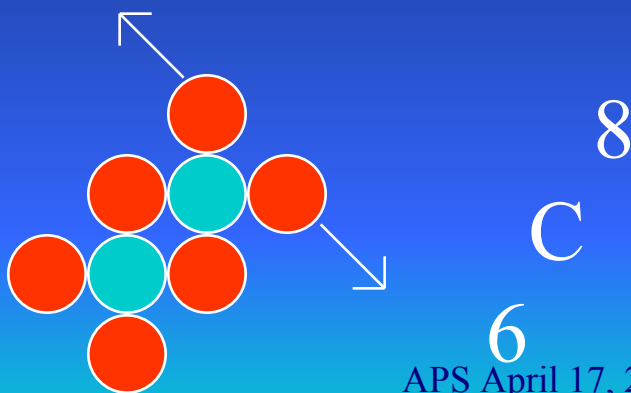
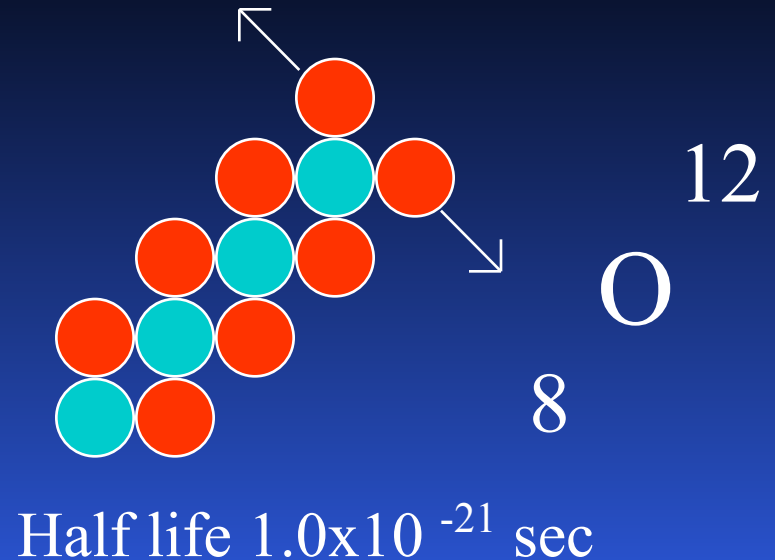
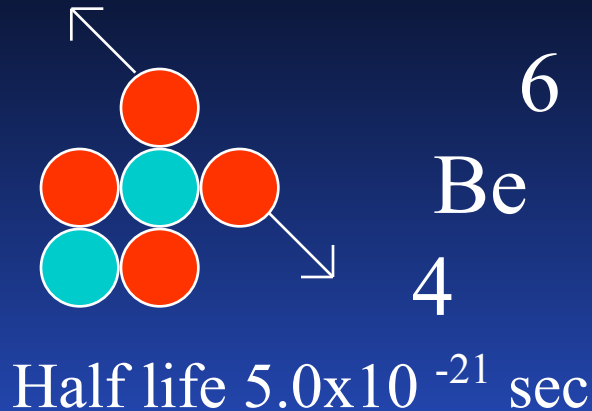
half life = 19.255 seconds



half life = 6 ms

The Structure of the Nucleus

Very unstable structures that decay by double proton emission

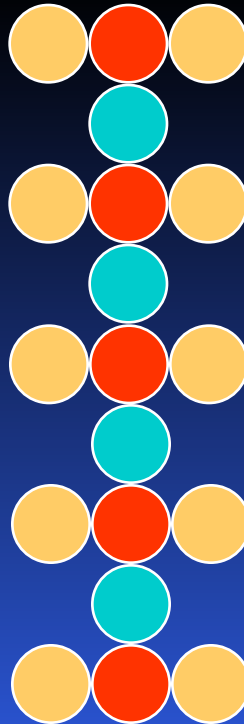


The Structure of the Nucleus



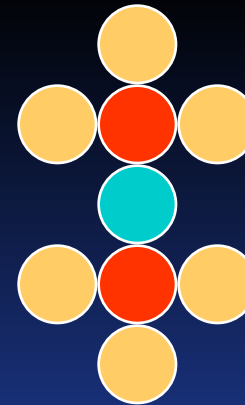
5
H
1

half life $\sim 1 \times 10^{-21}$ sec



19
B
5

half life = ??

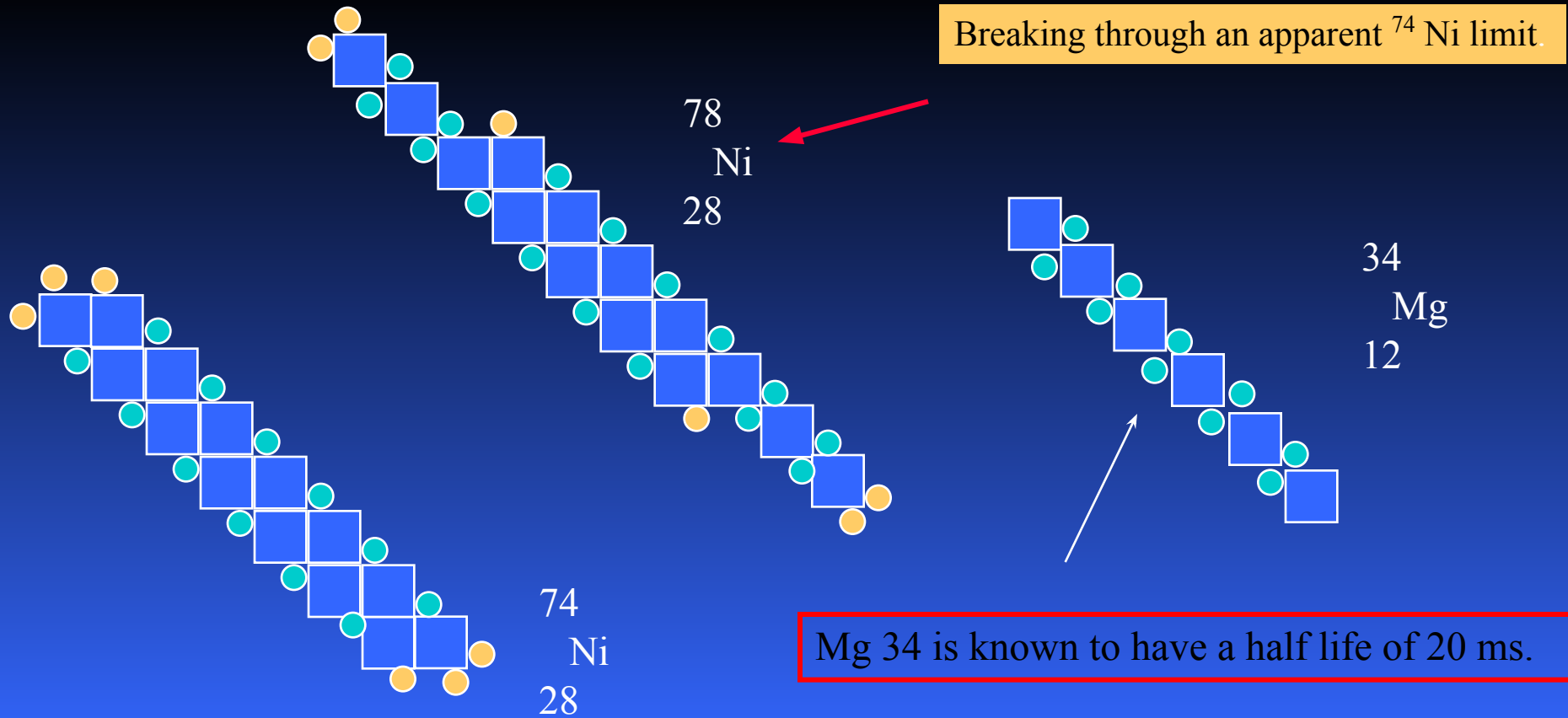


9
He
2

half life = 2×10^{-21} sec

He 10 does not have a bound state. B19 is the last isotope of Boron.
Predictions: Hydrogen 6 will be found to be an unbound nuclei.

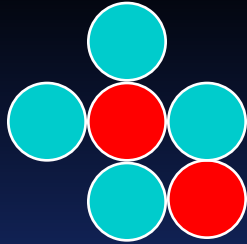
The Structure of the Nucleus



Ni 76 is believed to have a half live
> 150 ns. Ni 78 half life is not known.

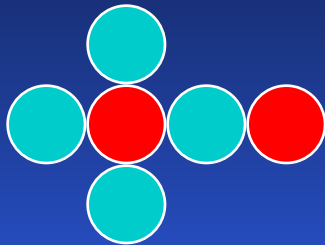
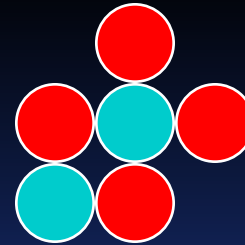
The Structure of the Nucleus

⁶He
4

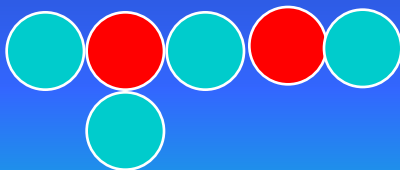
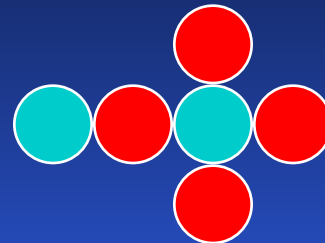


Ground state

⁶Be
4



First excited state



Second excited state



The Structure of the Nucleus

$$\begin{aligned}\mu &= I(A) = (e_q f) \pi r^2 \\ &= \frac{1}{2} (e_q v_q r) I(A) = \\ \mu_{\text{proton}} &= \frac{2(2/3) f \pi r_p^2}{I(A)}\end{aligned}$$

Since this model assumes the frequency of rotation of the proton and neutron are the same, we get.

$$\begin{aligned}\mu_{\text{proton}} / \mu_{\text{neutron}} &= -2 \\ &= (r_p / r_n)^2 \\ r_n / r_p &= \\ \{2(.96623707) / 1.41060761\}^{1/2} &= \\ 1.1704523 &\end{aligned}$$

Therefore the velocity of the dn quark in the neutron is 1.17045 the velocity of the up quark in the proton.

The Structure of the Nucleus

It is generally accepted that the Binding energy difference between the mirror nuclei of ${}^3\text{He}$ and ${}^3\text{H}$ is due to Coulomb repulsion between the two protons.

Blatt, Weisskoff, Theoretical Nuclear Physics, 52, p 204

$$\begin{aligned} \text{BE}({}^3\text{H}) &= \text{mass}({}^3\text{H}) - m_e - m_p - 2m_n = \\ 8.48183 \text{ Mev} \\ \text{BE}({}^3\text{He}) &= \text{mass}({}^3\text{He}) - 2m_e - 2m_p - m_n = \\ 7.71809 \text{ Mev} \\ \text{BE}({}^3\text{H}) - \text{BE}({}^3\text{He}) &= .76374 \text{ Mev} \end{aligned}$$

$$\begin{aligned} \text{Coulomb energy in } {}^3\text{He} &= \Delta \text{BE} = .76374 \text{ Mev} \\ &= 6e^2/5R_c \end{aligned}$$

R_c = separation distance between the two protons in ${}^3\text{He}$.
 $R_c = 2.262 \text{ fm}$. If we assume the structure is linear, and the neutron is between the two protons and 1.1704523 times larger, we get $r_p = .5211 \text{ fm}$ and $r_n = .6099 \text{ fm}$

Structure of the Nucleus

$$\mu_{proton} \equiv \frac{2e_{quark} \cdot v_{up, quarks} \cdot r_{proton}}{2}$$

$$v_{up, quarks} \equiv \frac{2\mu_{proton}}{2e_{up, quark} \cdot r_{proton}}$$

$$v_{up, quarks} \equiv \frac{2(1.41060761 \times 10^{-26} J / T)}{2(2 / 3)(1.602095^{-19} C) \cdot 0.5211 \text{ fm}}$$

$$v_{up, quark, in, proton} \equiv 2.53447 \times 10^8 m / s \equiv 0.8454c$$

$$v_{dn, quarks, in, neutron} \equiv 1.1704523 \cdot v_{up, quarks} \equiv 0.9895c$$

The Structure of the Nucleus

$$m_{\text{proton}} = 1836.1 m_e = m_{\text{dn quark}} +$$

$$\sqrt{1 - \frac{2 m_{\text{up}}^2}{\text{quark}^2}} \text{quark} v_{\text{up}}$$

$$m_{\text{neutron}} = 1838.6 m_e = m_{\text{up quark}} +$$

$$\sqrt{1 - \frac{2 m_{\text{dn}}^2}{\text{quark}^2}} \text{quark} v_{\text{dn}}$$

Plugging $v_{\text{up}} = 0.8454c$ and $v_{\text{dn}} = 0.9895c$ into the above 2 equations, we get two equations with two unknowns (mass of up and dn quarks). This give a mass of the up quark of 463.8 mass electrons and the dn quark of 99 mass electrons. **This results in the up quark (orbiting inside the proton) having a deBroglie wavelength of 3.30 fm, which when divided by 2π corresponds to a radius of .526 fm, which is 1% different than the .5211 fm initially**

The Structure of the Nucleus

Iterating until the DeBrolie wavelength of the up quark in the proton exactly matches the radius of the proton we get:

Radius: Proton = 0.519406×10^{-15} meters
Neutron = $0.6079394 \times 10^{-15}$ meters

Velocity: 2 - up Quarks in Proton = .848123 speed of light
2 - dn Quarks in Neutron = .992685 speed of light

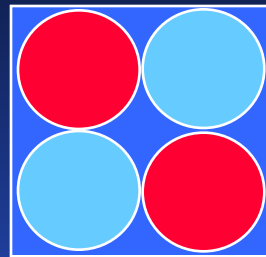
Mass: *up Quark mass = 237.31 MeV*
dn Quark mass = 42.39 MeV

The sum of the mass of the calculated up and dn quark meeting at the perimeter of the helium nucleus between the neutron and the proton adds up to 279.7 MeV, Which is almost exactly the mass of two pi mesons ($139.6 \text{ MeV} \times 2 = 279.2 \text{ MeV}$). Since the nuclear force as been explained as the exchange of TWO pi mesons this may also have some significance in supporting this theory.

Period of Revolution = 1.283533×10^{-23} seconds

The Structure of the Nucleus

Unit cell size = 1.12735 fm
“diameter” of He nucleus = 2.255 fm

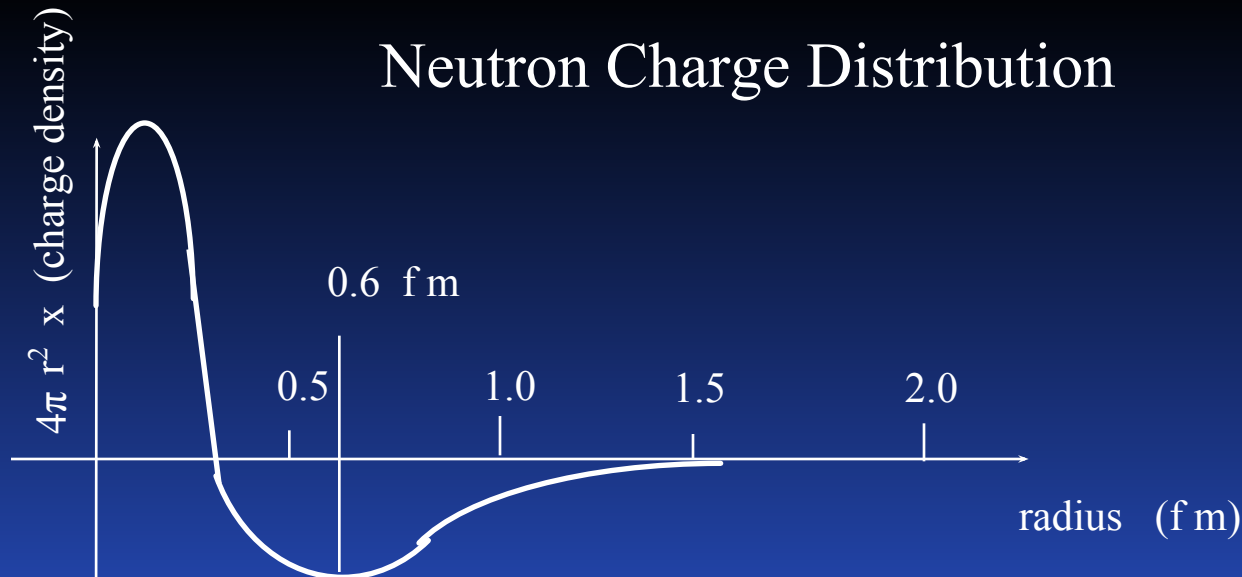


←→
2.255 fm

This model predicts a size and charge distribution of the neutron that agrees with electron scattering, pg 687 Modern Atomic and Nuclear Physics, F. Yang and J.H. Hamilton, 1996 McGraw Hill. (see text) This model predicts a size of the proton that agrees with many nuclear physics texts, namely 0.45 fm to 0.65 fm. Note that the linear extrapolation of the 3D model predicts a size of 1.23 fm for the proton, which is too big.

The Structure of the Nucleus

Neutron Charge Distribution



Charge Distribution for the neutron as determined by electron scattering

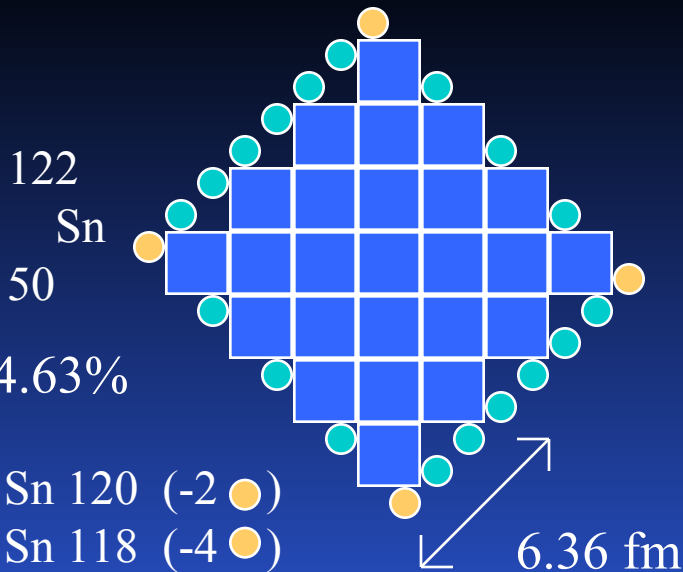
Reference: Pg 687, Figure 14.19, Fujia Yang and Joseph H. Hamilton,
“Modern Atomic and Nuclear Physics, McGraw-Hill, 1996.

Quote from that text: “The neutron charge distribution with an inner positive charge and outer layer of negative charge is consistent with its negative magnetic moment”

Additional references: R.M. Littauer, H.F. Schopper, R.R. Wilson “Structure of the Proton and Neutron, Physical Review Letters, Vol7, no.4 page 144.

The Structure of the Nucleus

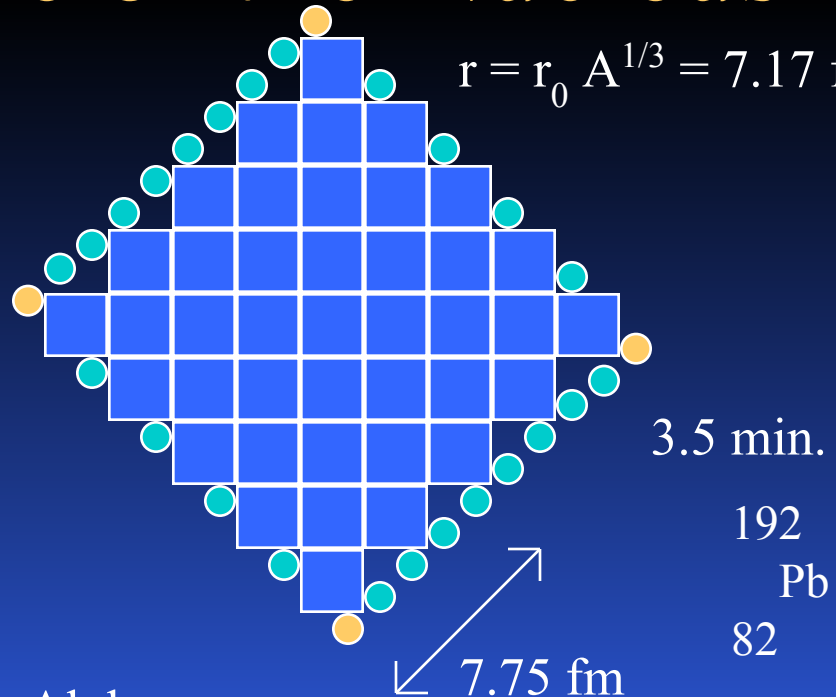
$$r = r_0 A^{1/3} = 1.23 A^{1/3} = 6.10 \text{ fm}$$



1
3
5
7
5
3
1
--
25

41 Alphas

$$r = r_0 A^{1/3} = 7.17 \text{ fm}$$



7.75 fm



2- Alphas

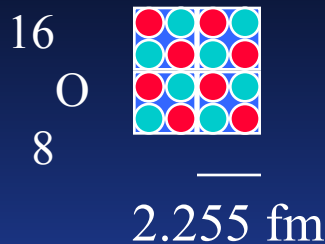
- non-structural neutron
- Neutron
- Proton

Notice that the above diamond structures give consecutive magic numbers. The Sn structure is stable because square structures of Sn are stable, on the other hand the above structure of Pb is not as stable. Since this model has derived the size of a Helium nucleus as 2.255 fm this can be used to calculate the size of the above structures, and good agreement is found with established values.

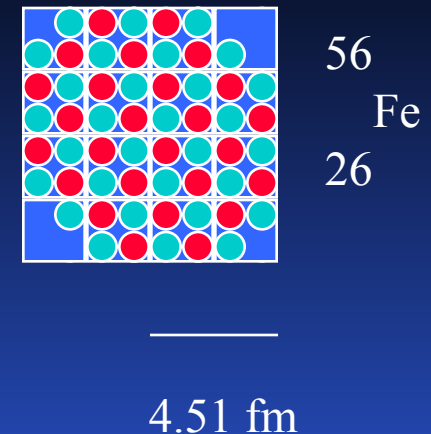
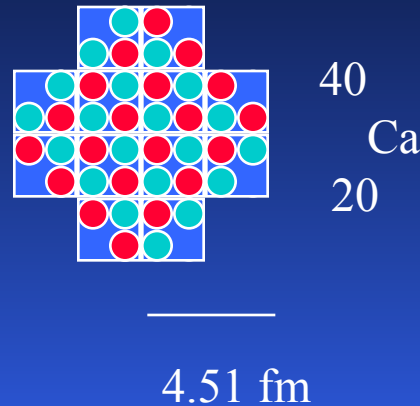
The Structure of the Nucleus

$$r = r_0 A^{1/3} = 1.23 A^{1/3} = 3.10 \text{ fm}$$

$$r = r_0 A^{1/3} = 4.71 \text{ fm}$$



$$r = r_0 A^{1/3} = 4.21 \text{ fm}$$



1- Alpha

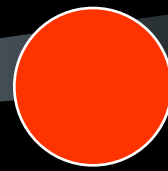


Neutron

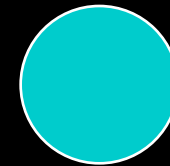


Proton

Notice that the above structures of O 16, Ca 40, and Fe 56 give good agreement to the accepted size of these structures. This model has derived the size of a Helium nucleus as 2.255 fm and this can be used to compare against the accepted size of these nuclei.

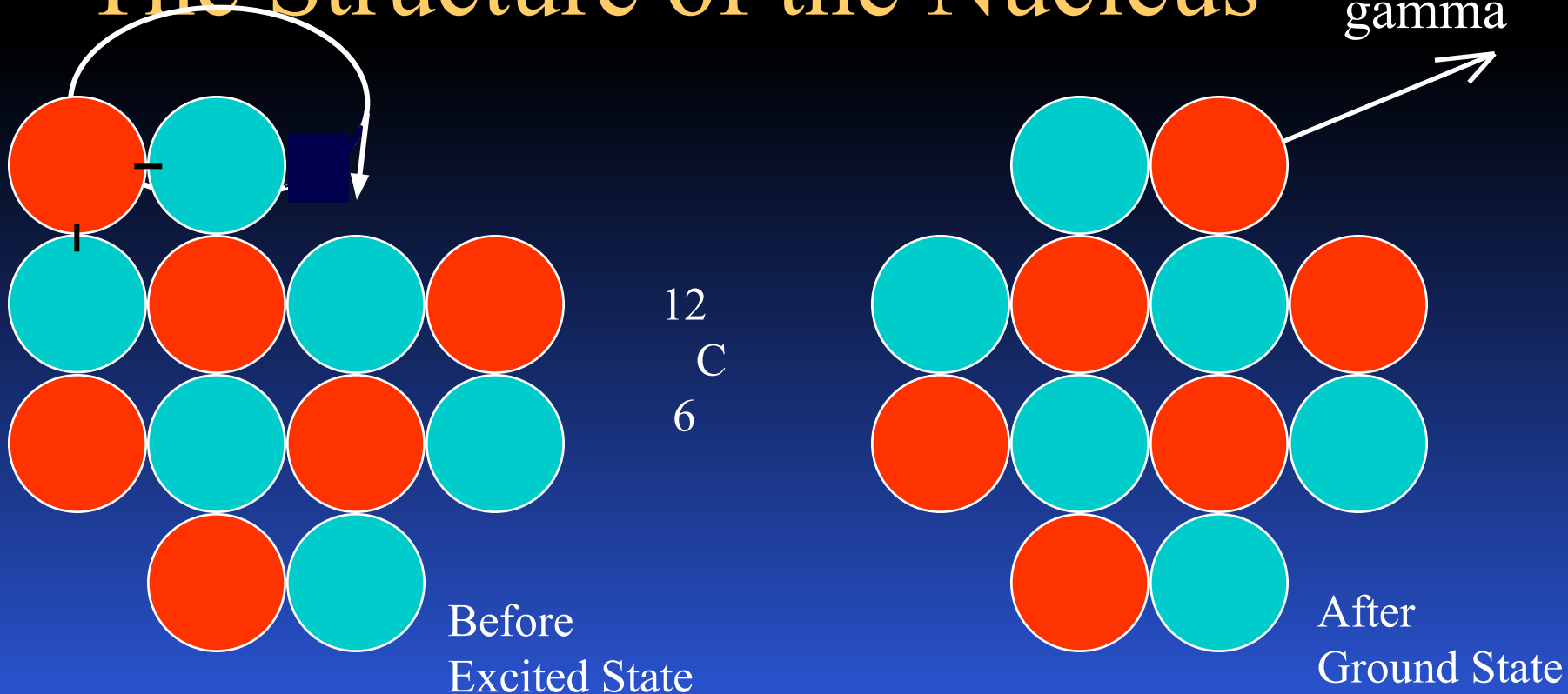


Proton



Neutron

The Structure of the Nucleus



Gamma emission is represented by a shift of one proton around an adjacent neutron position (depicted above). Beta (-) emission is the shift of one neutron one lattice position (into a proton position).

Structure of the Nucleus

What reasons can account for the different structures above and below Pb?

If the Uranium nuclei are really linear, then they are shorter by a factor of the square root of 2 than they would be if they were diagonal. This would mean that the structure has extra stored up potential energy in the form of repulsion of all those protons. Because the structure has just as many bonds (4) at any point along the structure, it should be just as strong a structure as Pb, just that it contain that potential energy of all the repelling protons. Therefore it is like a compressed

spring waiting for an alpha decay to make the structure unstable resulting in it expanding to the diagonal size of the Pb nuclei. It would be expected that this would explain the back bending of I vs ω for the yrast states of Dy 156 and other such nuclei. Also it would explain why each emission is the same in energy and why the number of steps in these spectrum is approximately the same number as the number of steps in this model.

The Structure of the Nucleus

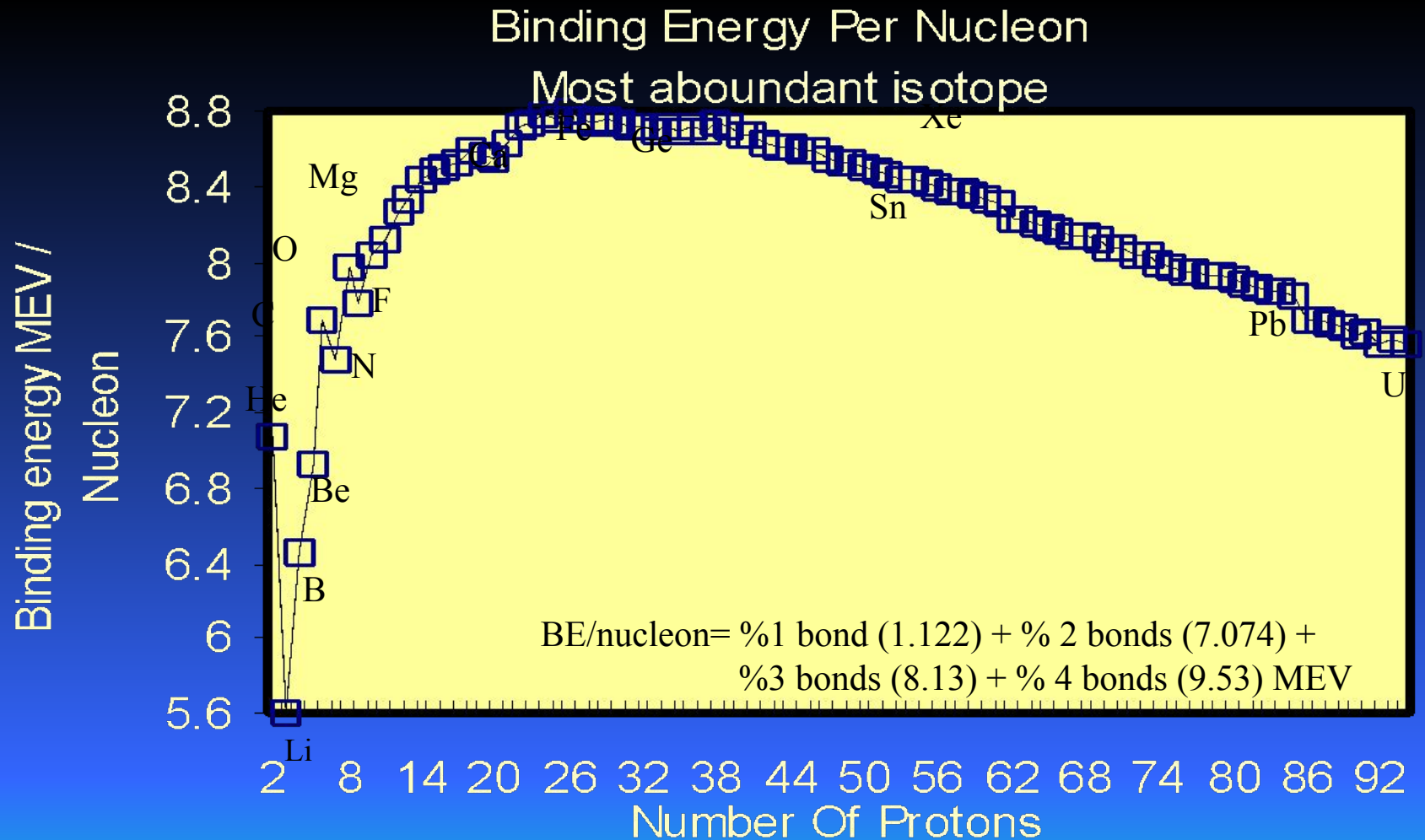
Mass difference of the $\Phi(1020)$ and $\omega(782)$

The mass difference between the $\Phi(1020)$ meson and the $\omega(782)$ meson is 237.47 ± 0.13 MeV based upon the previous data from the Particle Data Group. What is interesting is that this difference is almost exactly that of the predicted mass of the up quark in the CBM model.

237.31 MeV

Why these two mesons are significant is that since they are the lowest excited state of the π meson, we know their masses better than the higher excited states and we know that all the quantum numbers of both of these mesons are the same and they are composed only of up and down quarks. It must be more than just coincidence that this mass difference is in agreement with this model's mass of the up quark.

The Structure of the Nucleus*



The Structure of the Nucleus

The CBM Model of the Nucleus Explains

- Central Force term (center quarks) and the Stronger Tensor Term (orbiting quarks)
- Why the volume of the nucleus is mostly empty (flat structure)
- Why the force is repulsive at $r < 0.5$ fm (size of the proton, incompressible)
- Why there is a neutron skin of about 0.1 fm on many nuclei (see structures)
- Saturation of the binding energy at Fe 56 (highest % of 4 nearest neighbors)
- Explains the exact magnetic moments of the nucleons, especially the neutron
- Why the nucleus can have only half integer spins (flat; up or down)
- Prime number proton nuclei have only one stable form (2D symmetry operator)
- The size of key square nuclei agree well with accepted values
- Explains Gamma and Beta emission as nucleon and lattice shifting movement
- Does a good job of explaining most of the Magic numbers (4,8,50,82)
- Thermal neutrons react with nuclei (better able to align to flat structure)
- It explains the linear alpha chains recently discovered such as Mg 24
- It does not have a problem with the spin crisis of the proton.

Basic finding

The mass of the quarks in any generation and its associated lepton (-e) are related by the geometric mean:

Sq rt (mass of electron **times** the mass of the up like quark) = mass of the down like quark.

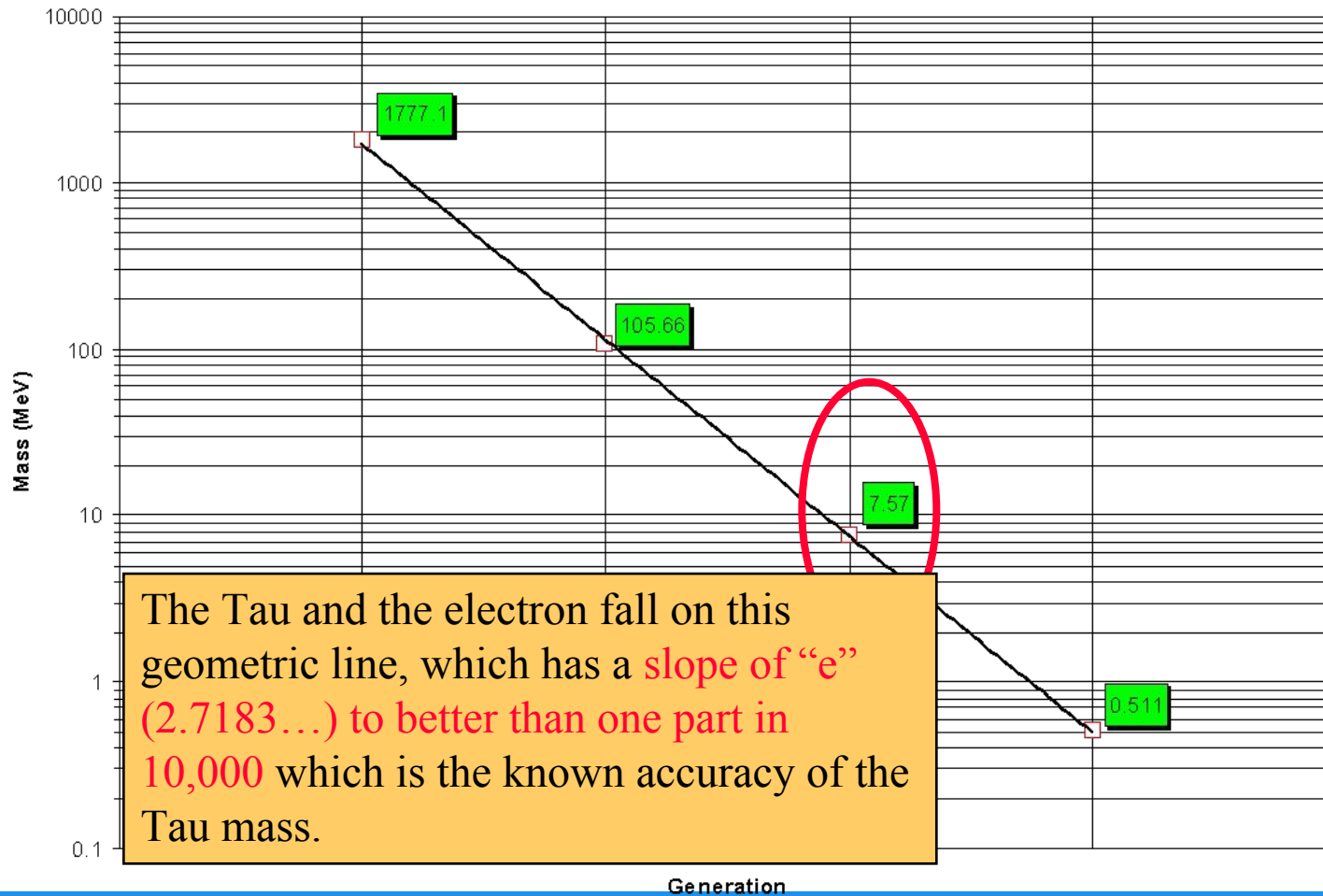
$$M_d = \sqrt{M_u \times M_e}$$

Also: the mass of any consecutive quarks of the same type (up like or dn like) are related by the geometric mean.

$$M_{X1} = \sqrt{M_{X-1} \times M_{X+1}}$$

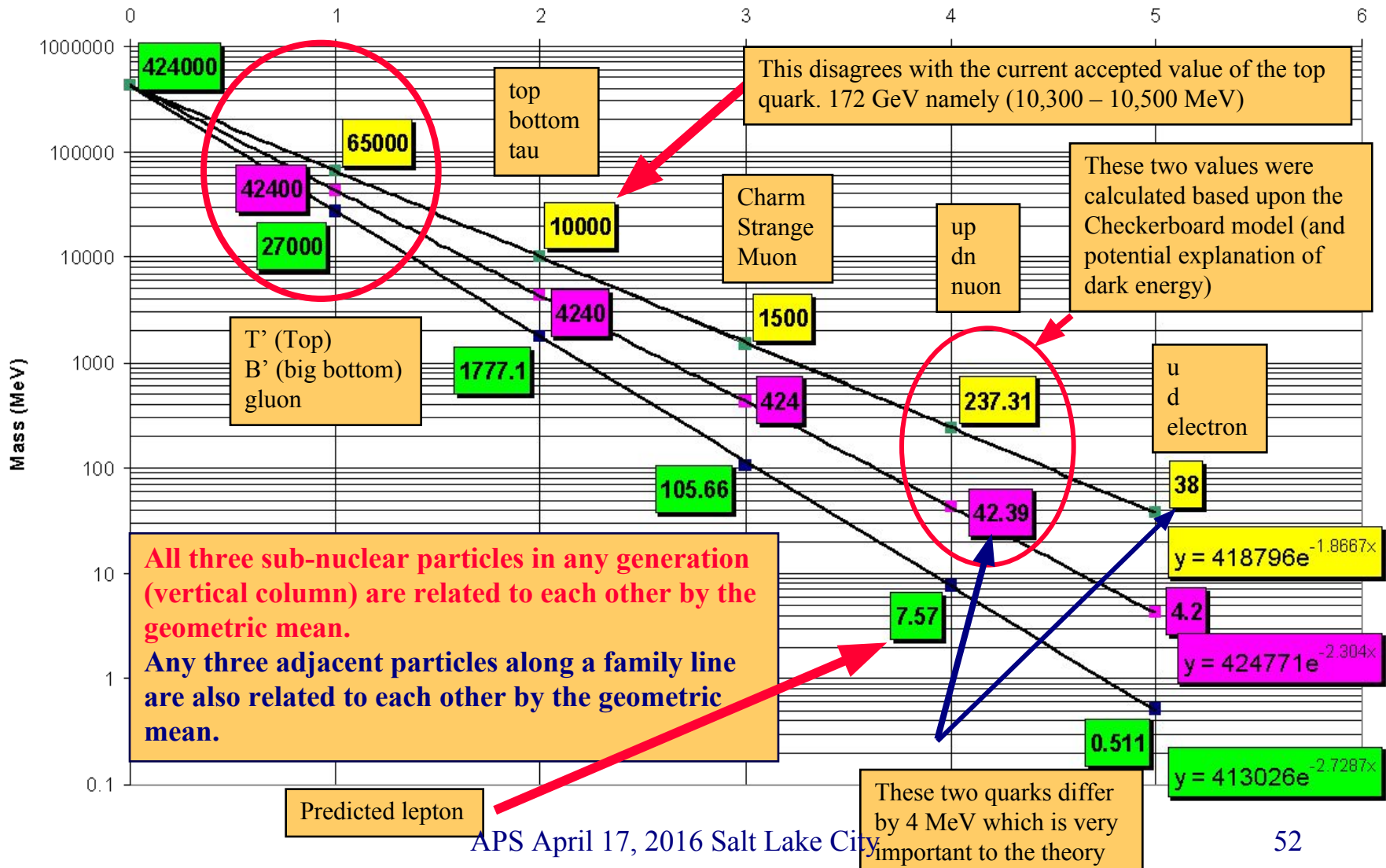
Where X = u, d, or electron family

Mass MeV vs. Generation Number
Figure 1



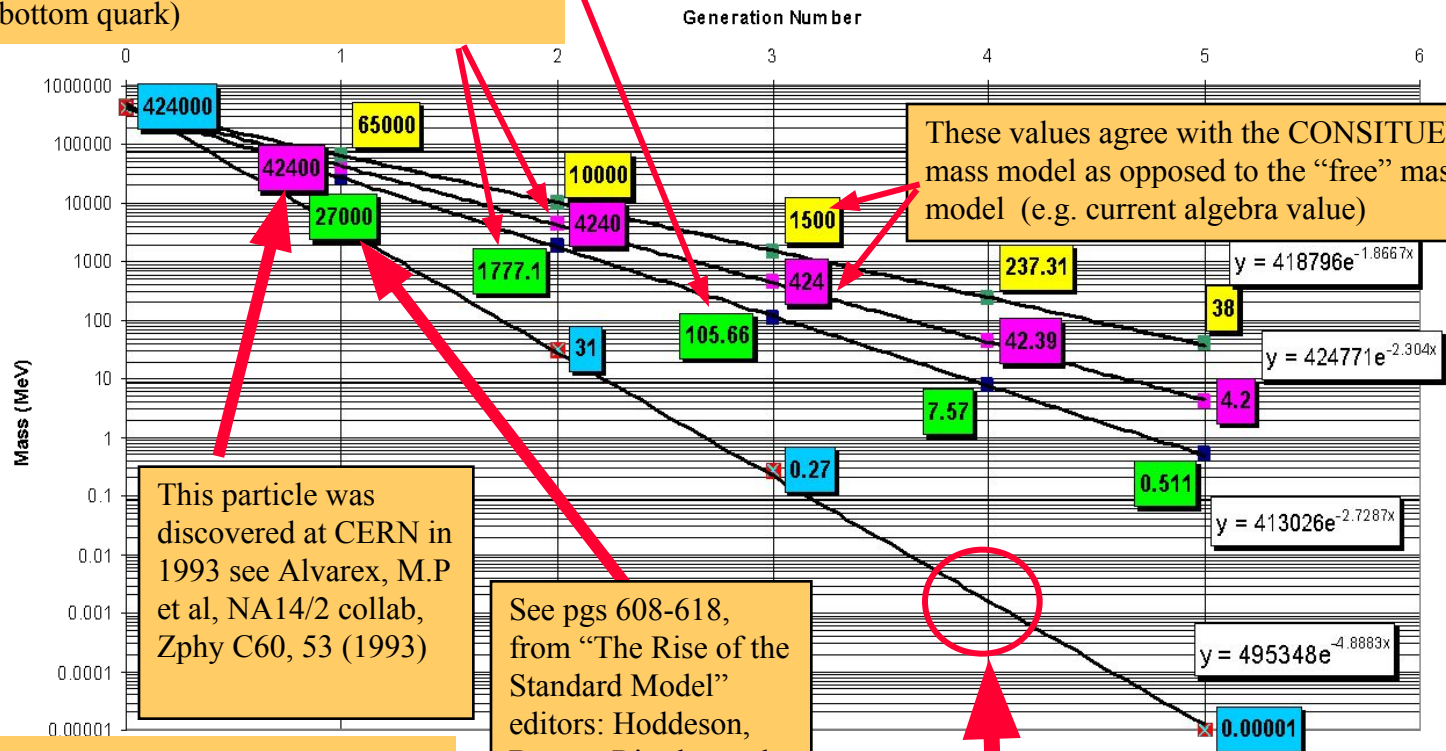
Masses of Sub-Nuclear Particles

Figure 2.
Generation Number



These three particles agree exactly with the standard model (the muon, tau and the bottom quark)

Masses of Sub-Nuclear Particles
Figure 3.

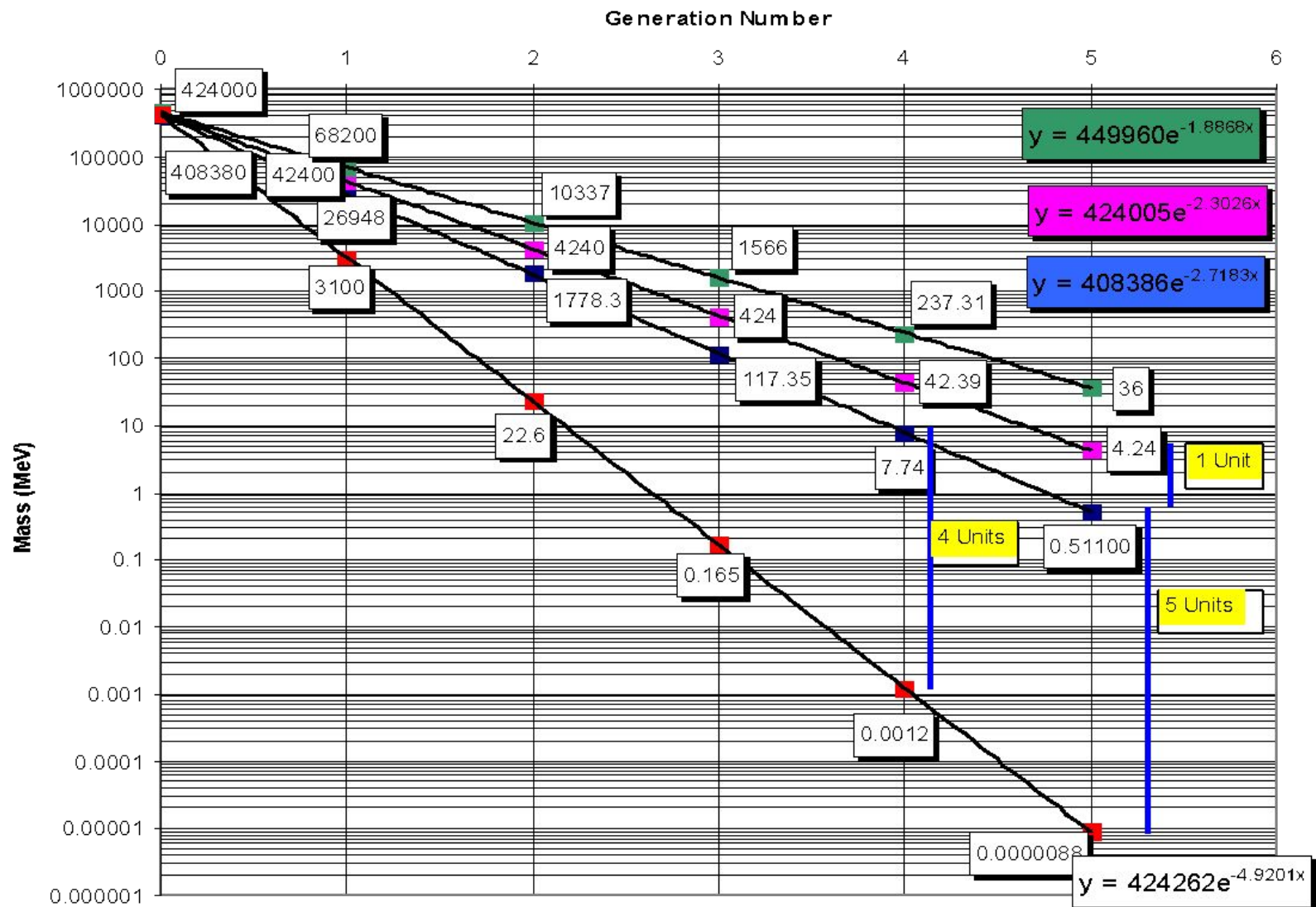


This particle was discovered at CERN in 1993 see Alvarex, M.P et al, NA14/2 collab, Zphy C60, 53 (1993)

In 1983-84 CERN found evidence for a top quark (t b) between 30 to 50 MeV. Could this have been (tB’)? G. Arnison Physics Letters, Vol 147B Nov 15th 1984.

See pgs 608-618, from “The Rise of the Standard Model” editors: Hoddeson, Brown, Riordan and Dresden. Reports the finding of a 27 GeV event.

Opening for a “Simpson” like neutrino see Flam, F. :Science **257**, 1044 (1992) (or Sterile neutrino)



Misc particles

The mass of two T' quarks plus one B' (baryon) would = 172.4 GeV

The mass of one T' and one anti T' (meson) would = 130 GeV

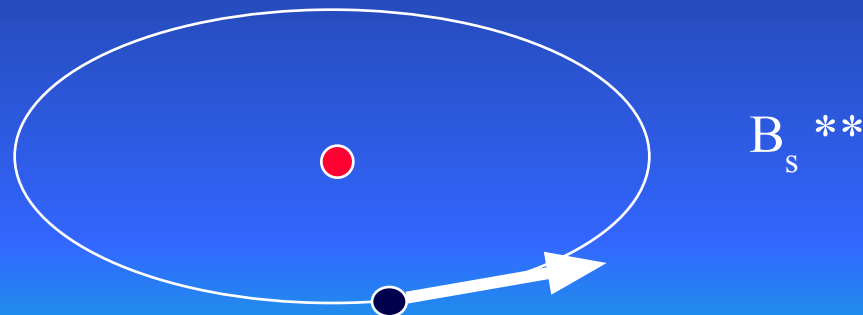
The mass of one T' and one anti B' (meson) would = 107.4 GeV

The mass of one B' and one anti B' (meson) would = 84 GeV

The mass difference between the Z and W boson is = 10.3 GeV (std model),
Which is what I believe is the mass of the top quark.

Notice on the Fermi lab today web page

Fermi lab Today March 6th 2006 “Particles called B mesons are composed of an anti bottom quark and a second quark of different types. When the second is light such as an up, down or strange quark – the two particle system behaves somewhat like an atom with the heavier quark playing the role of the nucleus at the atom’s center, and the lighter quark (up, down, or strange) the role of the electron orbiting the nucleus.” “Analysis of the 1 fb dataset has also led to the first direct observation of a strange quark spinning around an anti b in an orbitally excited state, a composite state known as B_s^{**} (appearing as a bump in the second graphic below)”



Pythagorean Means (A,H and G)

A Arithmetic Mean = $(x_1 + x_2 + x_3 \dots x_n) / n$

Medial (middle value of a distribution)

Mode (value with the most frequent occurrence)

H Harmonic Mean = $n / (1/x_1 + 1/x_2 + 1/x_3 \dots 1/x_n)$

G Geometric Mean = n th root of $(x_1 * x_2 * x_3 \dots x_n)$

Q Quadratic Mean (RMS) see Wikipedia for geometric construction.

RSM is also called Radius of Gyration, and used in AC circuits.

Example: calculate the central tendencies of : 20 21 23 23 25 29 32 33

H = 24.95

G = 25.34

A = 25.75 Median = 24 and Mode = 23

Q = 26.17 = $\text{sq root} (1/n (x_1^2 + x_2^2 + x_3^2 \dots + x_n^2))$ about 5% > H in this example

Relationship: $H < G < A < Q$ (general rule)

H and A are each others reciprocal dual.

G is its own reciprocal dual. $G (1/x_1 \dots 1/x_n) = 1 / G (x_1 \dots x_n)$

For two elements (x_1 and x_2) then $G = \text{root} (A * H)$ or $H = G^2 / A$

One can view the G (of say 11 numbers) as the equivalent side of a hypercube

That give the equivalent volume of the 11 dimensional solid.

Geometric means

The $G(1, 2, 4) = 2$ (1,2,4 is a geometric progression) 2 is the G of (1 and 4)

$G(1, 4, 16) = 4$ (1, 4, 16 is the square of the previous line) 4 is the G of (1 and 16)

$G(1, 8, 64) = 8$ (1, 8, 64 is the cube of 1,2,4 and also is a geometric progression)

The power of any geometric progression is also geometric.

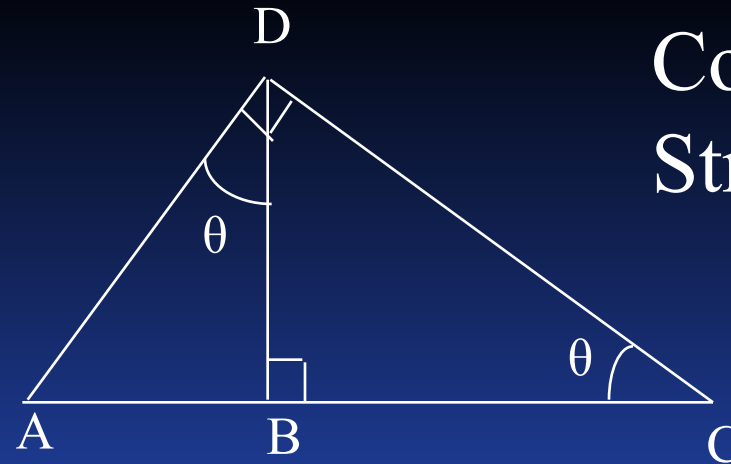
In Physics we know that mass is proportion to volume ($\frac{4}{3} \pi r^3$)

Therefore if the MASS of quarks follows a pattern of geometric progression then one would expect that the RADIUS would also be geometric based upon the logic above.

Since the CBM predicts that the masses of the quarks and leptons are related by the geometric mean then I suspect that the radii of the quarks and leptons are also geometric and related to the cube root of the mass with the appropriate assignment of a scale factor.

I believe that scale factor results in the electron radius being 7.0 atto meters about 100X smaller than the proton and neutron. The muon would be 6.12 times bigger than the electron based upon the above logic and the curves later in the presentation.

SNEP masses explained



Connection with
String Theory

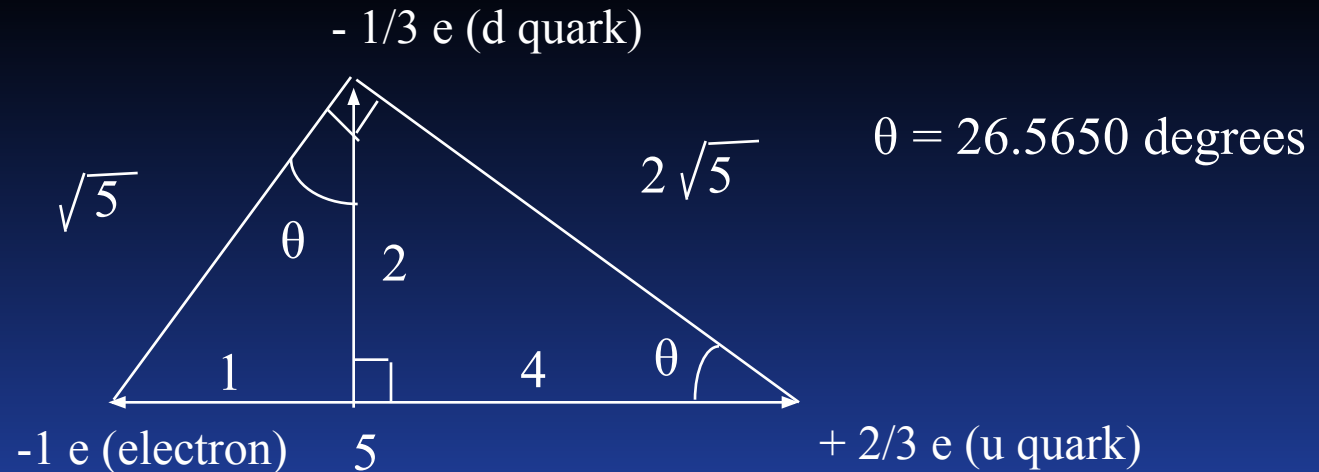
Three similar right triangles (ADC, DBC, ABD) This figure has the following properties, independent of the value of the angle θ .

1. The line segment BD is equal to the geometric mean of line segment AB, BC.

Ratio	AB	BD	BC
1:2:4	1	2	4
4:6:9	4	6	9
9:12:16	9	12	16

3:4:5 Right Triangle

SNEP masses explained



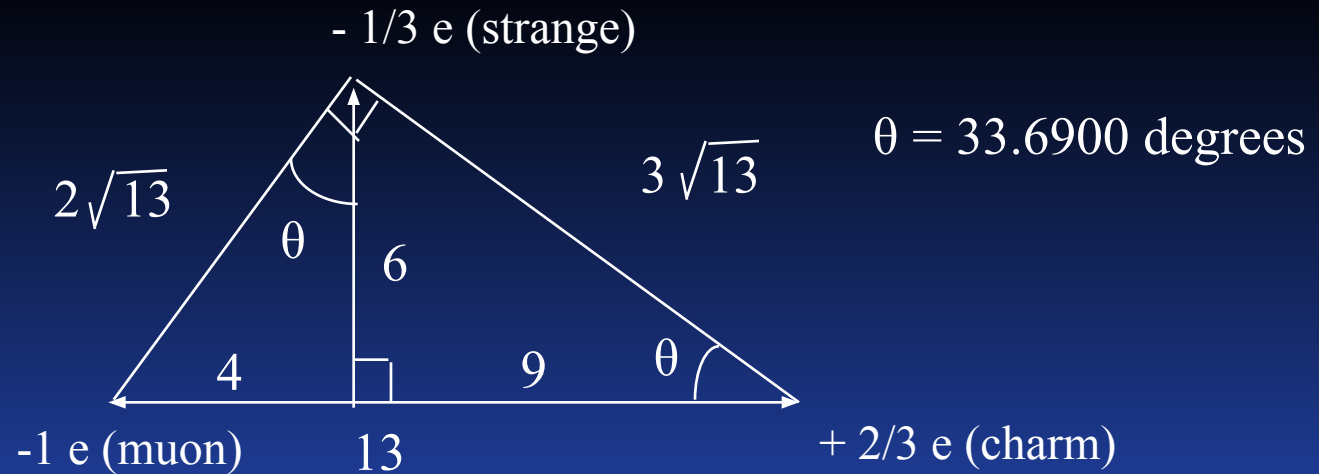
This example gives you the **Relative Ratio** of the Radii of the electron Generation.

The Relative ratio of the electron to the d quark and the d quark relative to the radii of the u quark is 0.50

	Ratio	AB	BD	BC
Electron Generation	1:2:4	1	2	4
Muon Generation	4:6:9	4	6	9
Tau Generation	9:12:16	9	12	16

3:4:5 Right Triangle

SNEP masses explained



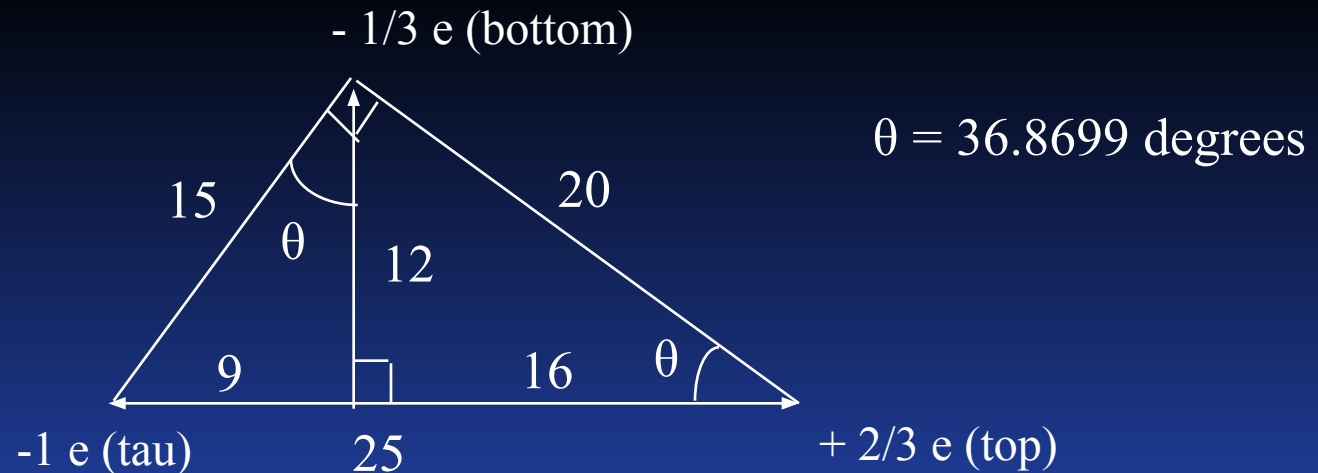
This example gives you the **Relative Ratio** of the Radii of the Muon Generation.

The Relative ratio of the muon to the strange quark and the strange relative to the radii of the charm quark is 0.666...

	Ratio	AB	BD	BC
Electron Generation	1:2:4	1	2	4
Muon Generation	4:6:9	4	6	9
Tau Generation	9:12:16	9	12	16

3:4:5 Right Triangle

SNEP masses explained



This example gives you the **Relative Ratio** of the Radii of the Tau Generation.

The Relative ratio of the Tau to the Bottom quark and the Bottom relative to the radii of the Top quark is 0.75

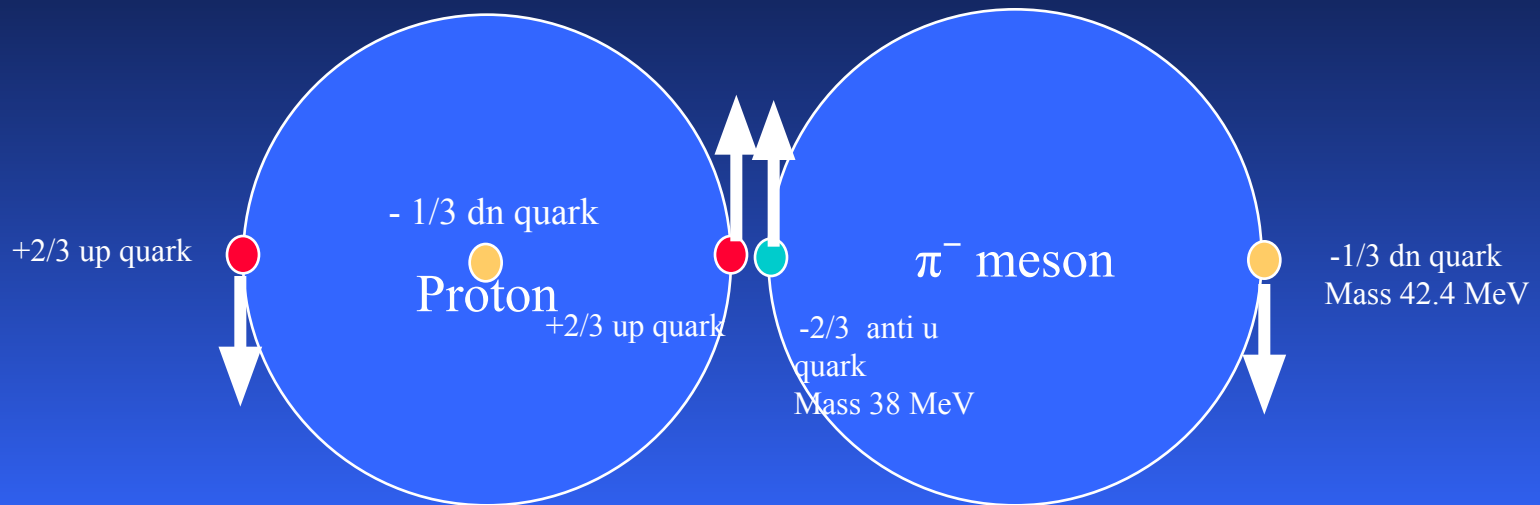
	Ratio	AB	BD	BC
Electron Generation	1:2:4	1	2	4
Muon Generation	4:6:9	4	6	9
Tau Generation	9:12:16	9	12	16

3:4:5 Right Triangle

Rational for the mass of the π meson

Assumption: the period of rotation of π meson and proton are the same

- 1 The speed of the up quarks in the proton are 84.8123% c. ($\gamma = 1.8875$)
2. Assume initially that the meson and proton are the same size. 0.5194 fm
3. Adjust the speed of the quarks in the meson so that the speed gives you The mass of the meson. In this case this results in a decrease the size of the meson.



Resulting speed of the quarks in the π meson = 81.7% c ($\gamma = 1.736$)

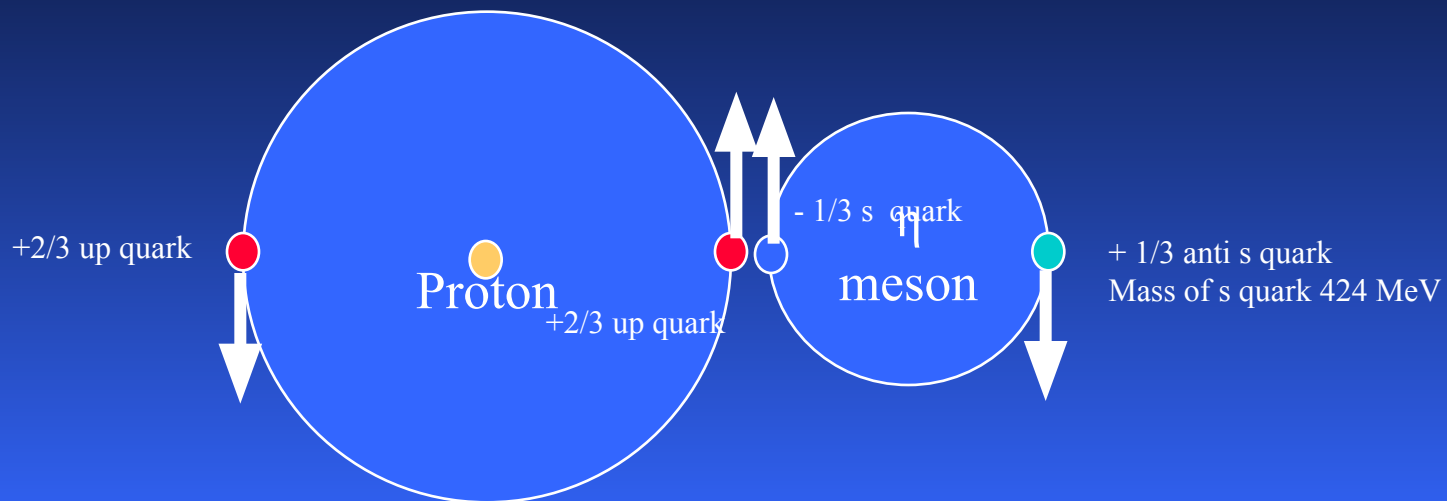
$(38 + 42.4) 1.736 = 139.57$ ($.817/.848 * .5194 = 0.500$)

Resulting size of the π meson = 0.500 fm (accepted value 0.46-0.56 fm)

Rational for the mass of the η (957) meson

Assumption: the period of rotation of η meson is that of the proton.

- 1 The speed of the up quarks in the proton are 84.8% c.
2. Period of rotation in the proton = $2\pi (0.5194 \text{ fm}) / 0.848 c = 1.283 \cdot 10^{-23} \text{ sec}$
3. Adjust the speed of the s quarks in the η meson so that the speed gives you The mass of the η meson. In this case this results in a decrease the size of the meson.



Resulting speed of the s quarks in the η meson = 46.4% c ($\gamma = 1.129$)
 $957.77 \text{ MeV} / 848 \text{ MeV} = 1.129$ ($46.4/84.8$) * $0.5194 = 0.285 \text{ fm}$
 Resulting size of the η meson = 0.285 fm (accepted value $0.275 \pm 0.02 \text{ fm}$)

New Revelation

- Some speculate the size of an electron is about 7.0 atto meters. 7×10^{-18} meters (about 100x smaller than proton)
- My speculation: The density of the electron (& all quarks) is about one TeV per fm³
- My speculation: All the Quarks have the same density, different radii.
- My speculation: Black holes have the same density as quarks/electrons. If this is true then:
 - The radius of BH in the Milky Way is 90 miles
 - The radius of the BH in Andromeda is 1000 miles.
 - (black holes are not singularities)

Relative size of the proton and neutron

Recently I learned from work done by J.A. Nolen, J.P. Schiffer, and N. Williams in the late 60's "The neutron radius of 208 Pb" 1968. that they determined that the radius of the neutron was larger than the proton by 0.07 ± 0.03 fm.

Since my theory predicts the radius of the neutron as 0.607939 fm and

The size of the proton as 0.519406 fm

r_n / r_p 1.170452

That difference is 0.0885 fm

Well within the range of 0.04 to 0.10 fm.

The accepted RMS value of the proton is 0.8779 ± 0.0094 fm

One of the reasons that Nuclear Physicist have problems with this model is because

The RMS radius is significantly larger than what the Checkerboard theory predicts.

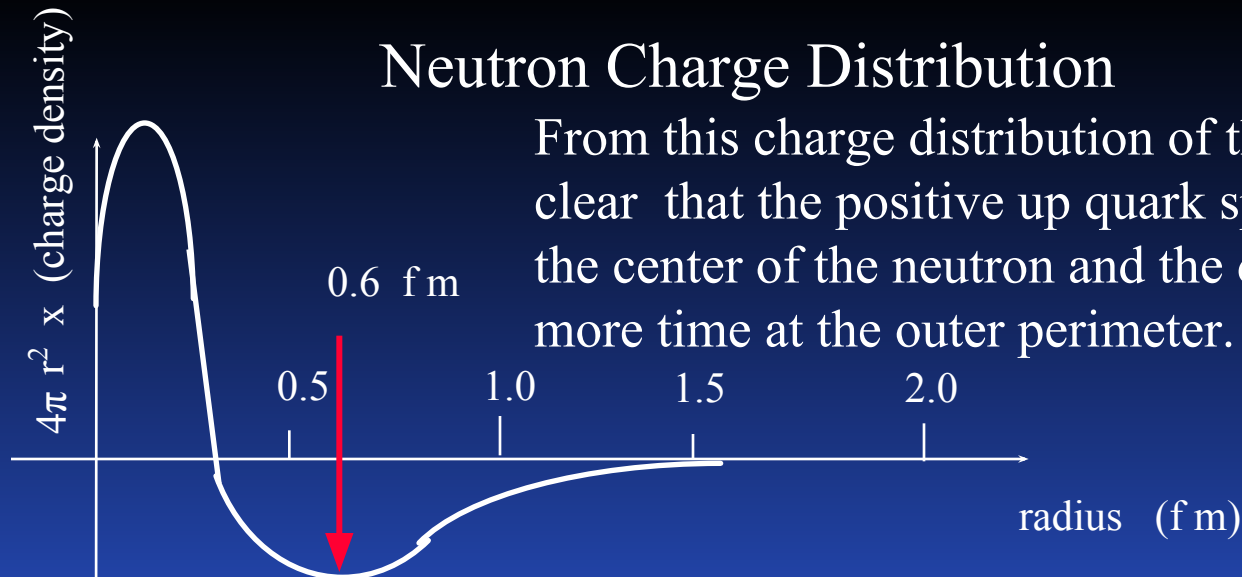
Why is the RMS value of the proton so large? What does an RMS value represent?

Why does the muon RMS value = 0.84184 ± 0.00067 ?

Is the proton a perfect sphere or is it oblate or even bagel shaped as indicated in 2003.

The Structure of the Nucleus

Neutron Charge Distribution



From this charge distribution of the neutron it is clear that the positive up quark spends more time in the center of the neutron and the dn quarks spend more time at the outer perimeter.

Charge Distribution for the neutron as determined by electron scattering

Reference: Pg 687, Figure 14.19, Fujia Yang and Joseph H. Hamilton,
“Modern Atomic and Nuclear Physics, McGraw-Hill, 1996.

Quote from that text: “The neutron charge distribution with an inner positive charge and outer layer of negative charge is consistent with its negative magnetic moment”

Additional references: R.M. Littauer, H.F. Schopper, R.R. Wilson “Structure of the Proton and Neutron, Physical Review Letters, Vol7, no.4 page 144.

Who is Theodore M. Lach

- B.S. Physics 1968 U of I M.S. Physics 1969 U of I
- 1969 Sept Joined AT&T as Dev Engineer in Thin Film Hybrids.
Clean Room design, D.I. Water system design Eng.
Hybrid IC manufacturing 4ESS FA packs
- 1975 MS Material Sc. Northwestern Thesis under direction of D.L. Johnson
Ceramic material specialist
- 1976 Registered Prof. Eng of Ill.
- 1978 R&D Member of Technical Staff AT&T Teletype (IC packaging)
- 1980 R&D MTS mask making and fab room design.
- 1982 Senior R&D MTS (IC wafer fabrication, mask making, projection exposers and steppers)
- 1985 5ESS component Reliability MTS
- 1987 5ESS circuit pack and system Reliability
- 1995 Distinguished MTS 5ESS Reliability
- 2000 Consulting MTS Switching Division and core Enterprise
- 2001 Home Land Security NRIC -6 Lucent Representative for Hardware
- 2002 Bell Labs Fellow
- 2006 Alcatel-Lucent Fellow and Life member of ALU Technical Academy
- 2007 ATCAv2 and other core Enterprise products such as Telica servers and wireless Packet switches.
- 2012 Retired after 42.5 years in AT&T, Western Electric, Teletype, Bell Labs, Lucent, Alcatel-Lucent

Ted's areas of Reliability

IC reliability, bipolar, CMOS, GaN, memory, integrated Circuits, FPGA ...

JEDEC representative to 14.1, 14.2, and 14.3)

Resistors, Capacitors, inductors, and all other passives (IEC representative)

Connector Reliability, gold thickness effects, socket reliability, constriction resistance

Power modules, RF power amplifiers, high voltage IC's, ...

Disk Drives, Tape drives, toggle switches, ...

Circuit pack level reliability, over 20,000,000 packs in the field many over 25 yr.

ESD expert: Human Body Model, Charge Device Model, Machine Model,...

Tin Whiskers, mediation techniques.

PWB failure modes: Solder joint fatigue, Hygroscopic dust, pad cratering...

Corrosion failure modes. High sulfur content environments.

IC failure modes: Electromigration, TDDB, hot carriers, NBTI, Moisture Sensitivity

Fire Resistance, Fire initiation, Earthquake resistance, Temp and Humidity stds.

System Reliability, fault tolerant, redundancy, RAID, Hamming ...

Hybrid metallization failures (TC bond failures), Al₂O₃ micro pore clusters.

Noise in Thin Film resistors. Step coverage, Alignment and Overlap allowances.

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