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SYSTEMATIC FRACTIONAL RELATIONSHIPS IN RADIOACTIVE DECAY MEASUREMENTS.

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TABLE 2. Parent radioactive nuclides found in nature

Nuclide		Percent abundance in nature	Half-period, years	Radioactive transitions observed[a]	Disintegration energy, MeV[a]
Atomic number, Z	Mass number, A				
19 K	40	0.0117	1.3×10^{9}	β^-, β^+, EC	β^- 1.3 – EC 1.5
34 Se	82	9.19	1.1×10^{20}	$\beta^- \beta^-$	3.0
37 Rb	87	27.83	4.8×10^{10}	β^-	0.3
48 Cd	113	12.2	9×10^{15}	β^-	0.3
49 In	115	95.77	5.1×10^{14}	β^-	0.5
52 Te	130	34.49	2×10^{21}	Growth of $^{130}_{54}Xe$[b]	1.6
57 La	138	0.089	1.1×10^{11}	β^-, EC	β^- 1.0 – EC 1.75
60 Nd	144	23.8	2.1×10^{15}	α	1.9
62 Sm	147	15.07	1.1×10^{11}	α	2.3
62 Sm	148	11.3	8×10^{15}	α	1.99
64 Gd	152	0.20	1.1×10^{14}	α	2.2
71 Lu	176	2.6	3.6×10^{10}	β^-, γ	0.6
72 Hf	174	0.16	2×10^{15}	α	2.5
75 Re	187	62.6	4×10^{10}	β^-	0.003
78 Pt	190	0.013	6×10^{11}	α	3.24
90 Th	232	100	1.4×10^{10}	α	4.08
92 U	235	0.715	7.0×10^{8}	α, SF	α 4.68
92 U	238	99.28	4.5×10^{9}	α, SF	α 4.27

[a] EC = electron capture. The EC energy is between ground states, but, in ^{138}La decay, 1.44 MeV of the EC energy goes to a gamma ray that feeds the ground state.

[b] Indirect evidence for $\beta^- \beta^-$ decay.

THE TABLE OF NUCLIDES.

Take a look at the table of parent radioactive nuclides. (Opposite) At first glance, there seems to be no particular order. Partly because the 'powers of ten' of the half times are cumbersome and distracting. They are IRRELEVANT to our discussion. Let us agree to IGNORE them! In fact, we shall hold the powers of ten in DISDAIN from now on; or ADJUST them to suit!

Looking more clearly and simply now at the nuclide table, it is seen that there are four 'one point ones'. (These will be discussed later.) There are also 2 twos, a four, a six, and an eight. These form a pattern, a sequence of numbers. Let's write them down.

2, 4, 6, 8

There's a start to getting some order in the nuclide table! Let's look for more order.

But first we must do a little tidying up!

K 40 HALF TIME.

This is given as 1.3 (Nuclide table) However, a published decay constant value of 5.8 would make the K 40 half time 1.2 (See below) We shall use this 1.2 value.

FOR MATHS BOFFINS. Half time = .693 / decay constant
Decay constant = .693 / half time

The '.693' rule.

ANOTHER SEQUENCE OF NUMBERS.

K 40 half time shall be 1.2 Lu 176 half time is 3.6 Rb 87 half time is 4.8

Hmm... 1.2 3.6 4.8 ... Is there a GAP in that sequence? Let's pop a 2.4 in there, so that we have.. 1.2 2.4 3.6 4.8

All these are multiples of 1.2 This is a 1.2 sequence. The 1.2 sequence sits quite comfortably along with the 2, 4, 6, 8 sequence.

'POWERS OF TEN' DISDAINED

But, notice carefully now, if we are to be unfailing in our disdain of 'powers of ten', then the 2 of the 2 4 6 8 sequence could be .2 And the 4 could be .4 and so on. So we can JOIN the two sequences of numbers together, like this.

.2 .4 .6 .8 1.2 2.4 3.6 4.8

So far, this looks like a NICE, NEAT sequence of half time values!

EXTENDING THE LIST.

So far, so good! Let's look a bit further at what we have left!

Looking at the bottom of the table of radioactive nuclides, and leaving U 238 aside for now, we see, reading up, a 7 and a 1.4 Or, adjusting the 'powers of ten', a 7 and a 14.

And further up the table is Nd 144, with a half time of 2.1 Or 21, if you will.

Another sequence of numbers.... 7, 14, 21

Let's tack these onto the sequence of numbers we have so far...

.2 .4 .6 .8 1.2 2.4 3.6 4.8 7 14 21

REFINING THE LIST.

Notice, please, that 2.4, 3.6, and 4.8 are divisible by 1.2 To be totally CONSISTENT in the sequence of numbers, the next half time number, 7, should also be divisible by 1.2

Consider that the 7 in the radioactive nuclide table is ROUNDED OFF to only one significant figure. Could the 7 really be 7.2? This would mean that the 14 should be 14.4, and the 21 should be 21.6 So that the sequence of numbers should now read.....

.2 .4 .6 .8 1.2 2.4 3.6 4.8 7.2 14.4 21.6

This looks pretty good! Time to make a table of these values!

A TABLE OF RADIOACTIVE NUCLIDE HALF TIMES.

Here is our sequence of radiodecay half times listed below as a table.

21.6	
14.4	2/3 x 21.6
7.2	1/2 x 14.4
4.8	2/3 x 7.2
3.6	3/4 x 4.8
2.4	2/3 x 3.6
1.2	1/2 x 2.4
.8	2/3 x 1.2
.6	3/4 x .8
.4	2/3 x .6
.2	1/2 x .4
COLUMN 1	COLUMN 2

See that in column 2 the relationship of each column 1 value to the previous value is given as a fraction. For example:

14.4 is two thirds of 21.6

7.2 is one half of 14.4

and so on..

But note carefully that the fractions REPEAT in a SPECIAL ARRANGEMENT!

Two thirds, one half, two thirds, three quarters!

And then again...

Two thirds, one half, two thirds, three quarters!

And then...

Two thirds, one half... and the list ends at .2

EXTENDING THE LIST FURTHER.

But what say we don't stop at .2 but keep going? That is, keep up the repetition of...:

Two thirds, one half, two thirds, three quarters.

Then the bottom of the table would extend like this....

.4	2/3 x	.6
.2	1/2 x	.4
.13	2/3 x	.2
.1	3/4 x	.13

And the top of the list could be extended to, say, 86.4 Just by repeating the arrangement of fractions.

We might as well have the whole list. Here it is.

86.4	2/3 x	129.6
43.2	1/2 x	86.4
28.8	2/3 x	43.2
21.6	3/4 x	28.8
14.4	2/3 x	21.6
7.2	1/2 x	14.4
4.8	2/3 x	7.2
3.6	3/4 x	4.8
2.4	2/3 x	3.6
1.2	1/2 x	2.4
.8	2/3 x	1.2
.6	3/4 x	.8
.4	2/3 x	.6
.2	1/2 x	.4
.13	2/3 x	.2
.1	3/4 x	.13

And there we have it! A nice, orderly arrangement of half times.

DECAY CONSTANT VALUES.

Now we've settled the half time arrangements we'll have a look at the decay constants! We'll pick a half time value that's not off the planet, say, 28.8, and find the decay constant using the '0.693' rule.

So it's 0.693 divided by 28.8, which is .0241 to three significant figures. OR 2.41 because we are firm in our disdain of the 'powers of ten'. The 2.41 is easier to handle!

The 28.8 line on our table of values would then read...

Half Time	Fractional Relationship	Decay Constant
28.8	2/3 x 43.2	2.41

What about the 21.6 line? Because 21.6 is 3/4 less than 28.8, the decay constant will be 4/3 more than on the 28.8 line. (A bigger decay constant under the 0.693 conversion factor will make for the smaller 21.6 half time.) The 21.6 line will read...

21.6	3/4 x 28.8	4/3 x 2.41

And the 14.4 line will read...

14.4	2/3 x 21.6	3/2 x 4/3 x 2.41

And the 7.2 line will read...

7.2	1/2 x 14.4	2/1 x 3/2 x 4/3 x 2.41

...and so on.

We can continue this process all the way through the table, and then adjust the decay constant values by a power of ten to suit us.

The completed table of half times and decay constants is as follows...

TABLE 1a The 2.41 group of radioactive nuclides.
Note the decay constant of 2.41

Nuclide	Half Time	Fractional Relationship	Decay Constant
?	86.4	2/3 x 129.6	.03 x 2.41
?	43.2	1/2 x 86.4	.06 x 2.41
?	28.8	2/3 x 43.2	.1 x 2.41
Nd 144	21.6	3/4 x 28.8	.13 x 2.41
Th 232	14.4	2/3 x 21.6	.2 x 2.41
U 235	7.2	1/2 x 14.4	.4 x 2.41
Rb 87	4.8	2/3 x 7.2	.6 x 2.41
Lu 176	3.6	3/4 x 4.8	.8 x 2.41
?	(2.4)	2/3 x 3.6	1.2 x 2.41
K 40	1.2	1/2 x 2.4	2.4 x 2.41
Sm 148	.8	2/3 x 1.2	3.6 x 2.41
Pt 190	.6	3/4 x .8	4.8 x 2.41
Re 187	.4	2/3 x .6	7.2 x 2.41
Hf174/Te130	.2	1/2 x .4	14.4 x 2.41
?	.13	2/3 x .2	21.6 x 2.41
?	.1	3/4 x .13	28.8 x 2.41

ELEVEN DOWN, SEVEN TO GO!

There are 18 parent radioactive nuclides found in nature. (See list opposite page 1)

Only 11 of the 18 parent radioactive nuclides can be fitted to table 1a (See page 7)

The remaining 7 are....

Nuclide	Half time
U 238	* 4.6
In 115	5.1
Cd 113	** 9
Se82 La138 Sm147 Gd152	1.1

See that... 1.1 x 1/2.41 = 4.6

1.1 x 4.6 = 5.1

4.6 / 5.1 = 0.9 i.e. 9/10

5.1 / 4.6 = 1.1 i.e. 10/9

This means that the half times can be rewritten using only the terms 10/9, 9/10, and 1/2.41

Nuclide	Half time
U 238	10/9 x 1/2.41
In 115	10/9 x 10/9 x 1/2.41
Cd 113	9/10
Se 82 etc.	10/9

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* The published decay constant for U 238 is 1.5 So half time 4.6, not 4.5 listed opposite page 1 See K40 comments on page 1.

** Or 0.9 It doesn't matter. 'Powers of ten disdained.

The decay constants for the fractional half times can be found by using a trick of the trade....

Decay constant = .693 / half time

$$.693 = 10/9 \times 1/2.41 \times 1.5$$

TABLE 1b The 1.5 group of radioactive nuclides. Note the decay constant of 1.5

Nuclide	Half Time	Fractional Half Time	Decay Constant
U 238	4.6	$\frac{10}{9} \times \frac{1}{2.41}$	1.5
In 115	5.1	$\frac{10}{9} \times \frac{10}{9} \times \frac{1}{2.41}$	$\frac{9}{10} \times 1.5$
Cd 113	9	$\frac{9}{10}$	$\frac{10}{9} \times \frac{10}{9} \times 1.5 \times \frac{1}{2.41}$
Se 82 La 138 Sm 147 Gd 152	1.11	$\frac{10}{9}$	$1.5 \times \frac{1}{2.41}$

Note. It should be noted here that 2.41 is rounded up from 2.406... You may use 2.406... in tables 1a, 1b, and the possible table 1c which follows.

CARBON 14 Part of a 1.11 group? Others? Decay constant of 1.11?

C 14	5.6	$1.5 \times \frac{9}{10} \times \frac{1}{2.41}$	$\frac{10}{9} \times \frac{10}{9}$

REDSHIFTS AND RADIO ACTIVITY.

The numbers 2.406, 1.5, and 10/9 are found in astronomy in the study of redshifts.

- Bill Tifft, Univ of Arizona, says redshifts are QUANTIZED (in jumps of) 72.144 km/sec. This is .0002406 of the standardised 299,792 km/sec speed of light. Looking at table 1a, decay constant of 2.406 (see note bottom page 9) means redshifts are more likely to be about DECAY OF LIGHT, not 'galaxies moving away'. BIG BANG NOW SERIOUSLY IN QUESTION!

- Fred Hoyle discussed a natural limit to redshift observations at 1.35 billion light years out. Still a limit today. Redshift 'speeds' rocket up beyond. 'Recession speed' at 1.35 billion light years out is

$$900 \times 72.144 \text{ km/sec}$$
$$(900 \times .0002406 \times \text{light speed})$$

$$1.35 \text{ billion light years} / 900 = 1.5 \text{ million}$$

See the CONSTANT 1.5 AVERAGING per .0002406
Compare the 1.5 and the 1/2.41 (per .0002406) in table 1b, page 9.

- There may be lots of 1.35 limits, bigger and smaller than 1.35 billion, and these might add, so that...

e.g.
$$1.35\text{x}10^9 + 1.35\text{x}10^8 + 1.35\text{x}10^7 + \ldots$$
$$= 1.35\text{x}10^9 \text{ x } 10/9$$

Compare the 10/9 value in tables 1b and 1c

EDITOR'S COMMENTS That's it for now. For more on the SPEED OF LIGHT see www.lollo.org.nz
As always, regards from the lollo team,
Mrs H, Inky, Sparrow, and Bill.

POST SCRIPT: The precise theoretical value of Bill Tifft's Quantum Number is $1.5 / \ln 2 \times 10/9$
(Powers of ten disdained)