

A Synthetic Route to the 126th Element: $Ba^{*141}+Yb173=Ch314$

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Abstract

In our previous papers [1-12], we predicted the 119-173th ideal extended elements, and illustrated the 126th element Ch314 should have the best relative stability among them and should be worthy to be synthesized preferentially. In this paper, we define the natural number axis (NNA) and the natural number coordinate system (NNCS), and suppose that in the world of nuclides, NNA and NNCS would be applicable, so in the world of nuclides the square root of 2, the square root of 3 and π would become rational numbers of 1.41, 1.73 and 3.14. Their relationships with nuclides and with the formula of the speed of light in atomic unites are exhibited to demonstrate this effect, the relative stability of U238 and U235 and the fission mode of U235 are explained, and finally we design a synthetic route to the 126th element, which is $Ba^{*141}+Yb173=Ch314$.

Keywords: natural number axis; natural number coordinate system; rational number and irrational number; elements and nuclides; the speed of light in atomic unites; stability of Uranium; fission of U235; synthetic route; the 126th element.

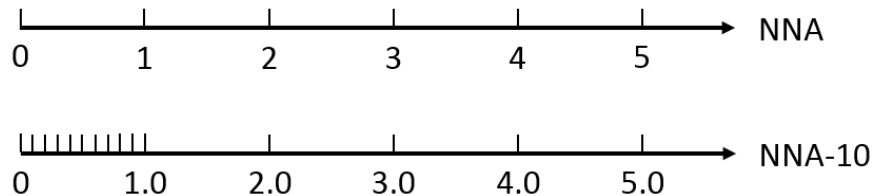
1. Introduction

We know modern sciences were derived from ancient Greek, which not only had the seeds of sciences, but also made the seeds sprouted. So its original philosophy and scientific concepts should not be negligible. A central belief of Pythagoreans was that "everything is number (rational number)". However, they found the square root of 2 which couldn't be expressed as a rational number, this led to the first crisis of mathematics, and later generations of mathematicians gave the solution of irrational number and real number. Here we give a real practical way to solve this problem.

2. Principles

Principle 1: Definition of the Natural Number Axis (NNA)

A natural number axis (NNA) is defined to be an axis with natural numbers sequentially located on it, but a specific natural number on it stands for a specific length of a line as follows (Fig. 1).



A dot (sub-unit) has a length \iff NNA

Fig. 1 A natural number axis (NNA) and a 10-parts divided natural number axis (NNA-10)

On a NNA, a specific number such as 2 stands for a length from 1 to 2 or 0 to 2. Most importantly, NNA is continuous with no need to add any irrational numbers on it. And the length between two adjacent natural numbers on a NNA is called a unit of the NNA. For example, a unit of the above NNA has a length of 1.

Every unit of a NNA can be divided to a number of sub-units, for example, 10 or 100 equal parts. And hence the corresponding divided NNA can be called NNA-10 or NNA-100. A unit of a NNA-10 has a length of 1.0 and a sub-unit of 0.1. A sub-unit of a NNA is defined as a dot of the NNA. A dot of a NNA has a length and even a width with a shape, and it can't be divided further. So if a place is located within a dot of a divided NNA, its value on this NNA must be the value of this dot no matter where it is exactly located in the dot. If a NNA-10 is amplified 10 times, its sub-unit will become a unit of a new NNA. So a dot with a length and a NNA with continuity are equivalent to each other.

Principle 2: A Square in a Natural Number Coordinate System with a Diagonal length of Rational Number

Use divided natural number axis x and y to compose a rectangular plane coordinate system which is called a natural number coordinate system (NNCS), and a square is located in this coordinate system. The line length of this square (l) is 1, and the line

width of this square (dl) is the sub-unite such as 0.1 or 0.01. Then the diagonal length of the square would be 1.4 or 1.41 in the form of rational number especially in this natural number coordinate system as follows (**Fig. 2** and **Fig. 3**).

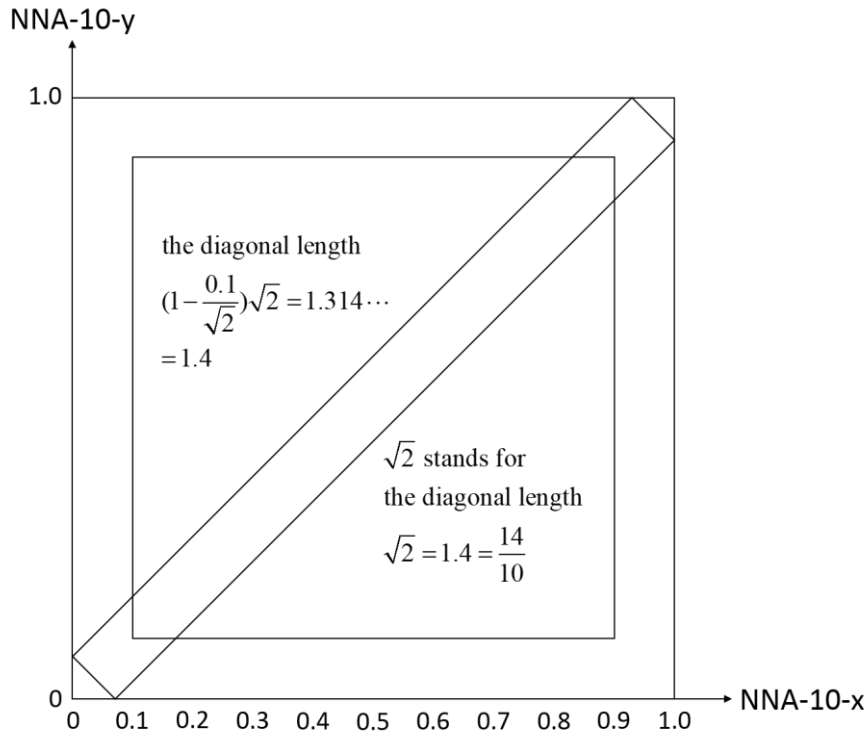


Fig. 2 A square in a natural number coordinate system (NNCS-10) with diagonal length of 1.4

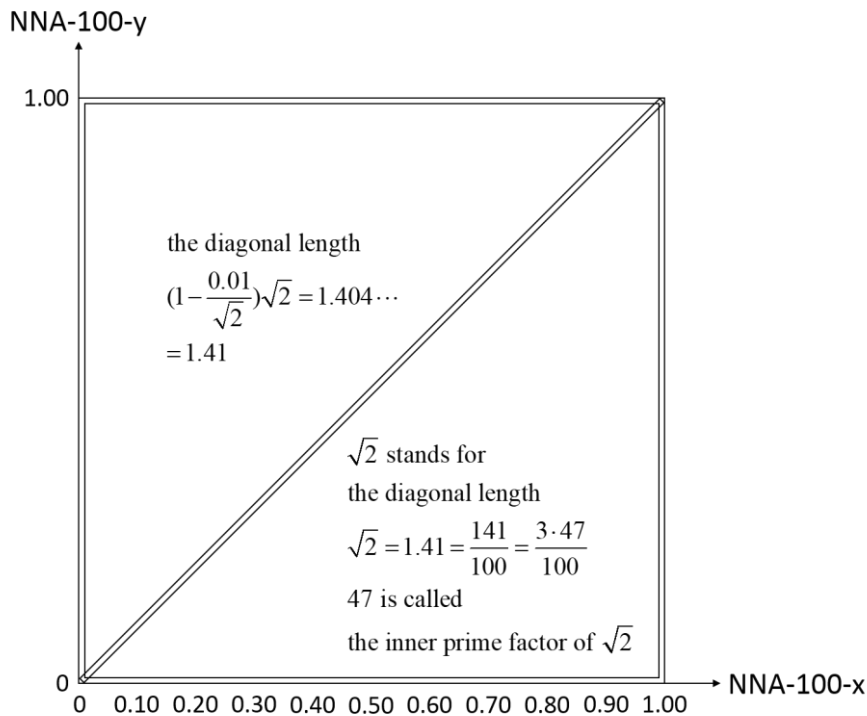


Fig. 3 A square in a natural number coordinate system (NNCS-100) with diagonal length of 1.41

So in a natural number coordinate system (NNCS), the diagonal length of a square should be a series of rational numbers according to the ratio of width to length of the square line (dl/l) as shown in **Table 1**.

Table 1 The diagonal length of a square in a natural number coordinate system (NNCS)

NNCS	dl/l	Diagonal Length	Number	Rationality	Irrationality
NNCS-10	0.1	1.4			
NNCS-100	0.01	1.41	rational	decreasing	increasing
NNCS-1000	0.001	1.414			
NNCS-∞	1/∞	1.414.....	irrational		

We can define the following series numbers as $\sqrt{2}$ sequence:

$$\sqrt{2} \{1.4, 1.41, 1.414, \dots, 1.414\dots\}$$

$$dl/l \text{ increasing } \underbrace{\sqrt{2} \{1.4, 1.41, 1.414, \dots, 1.414\dots\}}_{\text{micro world}} \quad dl/l \text{ decreasing}$$

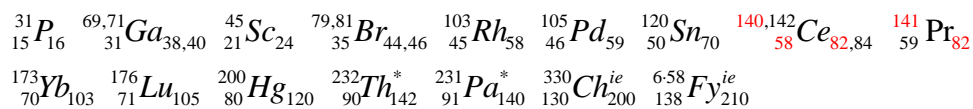
$$\text{micro world } \underbrace{\sqrt{2} \{1.4, 1.41, 1.414, \dots, 1.414\dots\}}_{\text{macro world}} \quad \text{macro world}$$

$$\text{rationality increasing } \underbrace{\sqrt{2} \{1.4, 1.41, 1.414, \dots, 1.414\dots\}}_{\text{irrationality increasing}}$$

3. The Square Root of 2 and its Relationships with Nuclides

We found that a 100-parts divided natural number coordinate system (NNCS-100) should be the applicable coordinate system in the world of nuclides because in the micro world the dl/l value of a line should not be too small or too large. It seems that the centesimal system is also applicable in the world of nuclides. And these are rules of nature or stipulated by God. So in the world of nuclides, the square root of 2 must be a rational number such as 141/100 or its good approximate rational ratios such as 140/99 or 82/58. The relationships between the square root of 2 and nuclides are shown as follows.

$$\sin \frac{\pi}{4} = \frac{\sqrt{2}}{2} = \frac{1.41}{2} = \frac{141}{2 \cdot 100} \approx \frac{140}{2 \cdot 99} \approx \frac{82}{2 \cdot 58}$$



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4. The Square Root of 3 and its Relationships with Nuclides

According to the above same reasons, in the world of nuclides, the square root of 3 must be a rational number such as 173/100 or its good approximate rational ratios such as 13/15 or 84/97. The relationships between the square root of 3 and nuclides are shown as follows.

$$\sin \frac{\pi}{3} = \frac{\sqrt{3}}{2} = \frac{1.73}{2} = \frac{173}{2 \cdot 100} \approx \frac{13}{15} \approx \frac{84}{97} \approx \frac{97}{112}$$

²⁷₁₃Al₁₄ ³¹₁₅P₁₆ ⁵⁶₂₆Fe₃₀ ⁹⁷₄₂Mo₅₅ ^{69,71}₃₁Ga_{38,40} ⁸⁴₃₆Kr₄₈ ⁸⁹₃₉Y₅₀ ¹⁰⁰₄₄Ru₅₆ ¹⁰³₄₅Rh₅₈ ¹¹²₄₈Cd₆₄
¹²⁰₅₀Sn₇₀ ¹⁴⁴₆₀Nd₈₄ ¹⁶³₆₆Dy₉₇ ¹⁶⁸₆₈Er₁₀₀ ¹⁷³₇₀Yb₁₀₃ ^{185,187}₇₅Re_{110,112} ²⁰⁰₈₀Hg₁₂₀ ²⁰⁹₈₄Po₁₂₅
¹³⁻¹⁹₉₇Bk₁₅₀* ²⁶²₁₀₃Lr₁₅₉* ¹⁵⁻¹⁹₁₁₂Cn₁₇₃* ²⁴⁻¹³₁₂₅Ch₁₈₇^{ie} ³³⁰₁₃₀Ch₂₀₀^{ie} ²⁻¹⁷³₁₃₇Fy₂₀₉^{ie} ¹⁵⁻²⁹₁₇₃Ch₂₆₂^{ie}

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5. 2π and its Relationships with Nuclides

According to the above same reason, in the world of nuclides, 2π must be a rational number such as 4×157/100 or its good approximate rational ratios such as 44/7 or 10×71/113. The relationships between 2π and nuclides are shown as follows.

$$2\pi = 6.28 = \frac{4 \cdot 157}{100}, \quad 2\pi = \frac{2 \cdot 22}{7} = \frac{44}{7}, \quad 2\pi = \frac{2 \cdot 355}{113} = \frac{10 \cdot 71}{113}$$

¹⁴₇N₇ ²⁸₁₄Si₁₄ ^{48,49,50}₂₂Ti_{26,27,28} ⁵⁶₂₆Fe₃₀ ^{69,71}₃₁Ga_{38,40} ⁷⁵₃₃As₄₂ ^{86,87,88}₃₈Sr_{48,49,50} ¹⁰⁰₄₄Tm₅₆ ¹¹²₄₈Cd₆₄
^{113,115}₄₉In_{64,66} ^{119,120,122}₅₀Sn_{69,70,72} ^{136,137,138}₅₆Ba_{80,81,82} ¹⁵⁰₆₂Sm₈₈ ¹⁵⁷₆₄Gd₉₃ ¹⁶⁸₆₈Er₁₀₀ ¹⁶⁹₆₉Tm₁₀₀
^{175,176}₇₁Lu_{104,105} ^{185,11-17}₇₅Re_{110,112} ^{188,189}₇₆Os_{112,113} ²⁰⁹₈₃Bi₁₂₆* ²⁰⁹₈₄Po₁₂₅* ²⁻¹¹³₈₈Ra₁₃₈* ²⁵⁷₁₀₀Fm₁₅₇*
²⁸⁵₁₁₂Cn₁₇₃* ^{4-71,22-13}₁₁₃Nh_{171,173}^{ie} ³¹²₁₂₅Ch₁₁₇^{ie} ²⁻¹⁵⁷₁₂₆Ch_{4,47}^{ie} ²⁻¹⁷³₁₃₇Fy₂₀₉^{ie} ²²⁻¹⁷₁₄₈Ch_{2,113}^{ie} ⁴⁰⁰₁₅₇Ch₂₄₃^{ie} ⁶⁻⁷¹₁₆₉Ch₂₅₇^{ie}

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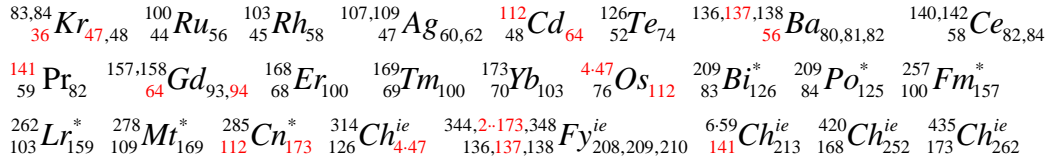
6. The Formula of the Speed of Light in Atomic Unites and its Relationships with the square roots of 2 and 3

In our previous papers [1, 2, 4, 7], we gave the formula of the speed of light in atomic unites as follows, and we found that there were 141=3×47 and 173 factors in the formula which should correspond to the square roots of 2 and 3.

$$c_{au} = \frac{c}{v_e} = \sqrt{112 \times \left(168 - \frac{1}{3} + \frac{1}{12 \cdot 47} - \frac{1}{14 \cdot 112 \cdot (2 \cdot 173 + 1)} \right)} = 137.035999074626$$

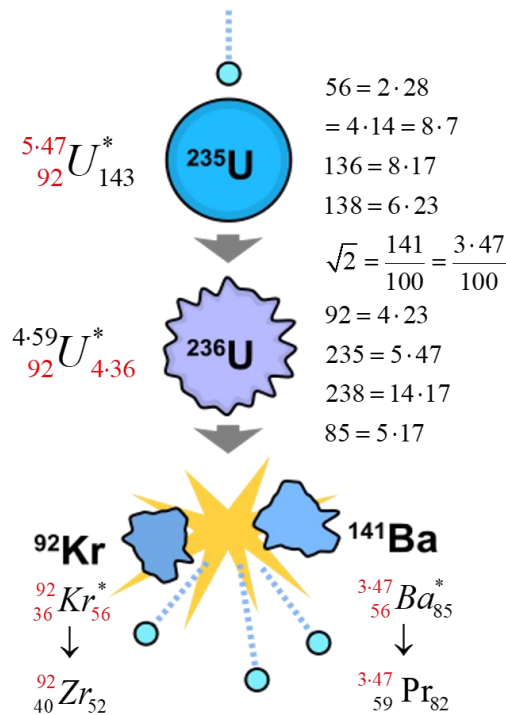
c : the speed of light in vacuum

v_e : the line speed of the ground state electron of H atom in Bohr model



7. Explanations to the Relative Stability of Uranium (U238 and U235) and the Fission mode of U235

We know that the 92th element Uranium has two main relatively stable isotopes, i.e., U238 with radioactive half-life of $4.468(3)\times 10^9$ y and U235 with half-life of $7.04(1)\times 10^8$ y. Their half-lives are close to the age of the earth, so there are U238 and U235 naturally existing in the earth with natural abundance of 99.28% and 0.71% respectively. U235 is important for both nuclear reactors and nuclear weapons because it is the only isotope existing in nature to any appreciable extent that is fissile, that is, can be broken apart by thermal neutrons. U238 is also important because it absorbs neutrons to produce a radioactive isotope that subsequently decays to Pu239, which is also fissile and hence important to nuclear reactors [13]. We here try to explain the relative stability of U238 and U235 and the fission mode of U235 (Fig. 4).



Stable numbers are marked in red
 Fission of U235 and its Explanations

Fig. 4 Fission of U235 and its Explanations

Some stable numbers in the world of nuclides:

56 = 2 · 28 = 4 · 14 = 8 · 7: the most stable number in nuclides;

136 137 138: the numbers related to the fine-structure constant α ,

so 136 137 138 are called the fine-structure constant numbers,

136 = 8 · 17, 138 = 6 · 23, 17 23 are called the inner prime factors of 136 138;

92 = 4 · 23, so 92 is related to the fine-structure constant number 138;

238 = 14 · 17, so 238 is related to the most stable number 56 and

the fine-structure constant number 136;

85 = 5 · 17, so 85 is related to the fine-structure constant number 136;

141: the number related to $\sqrt{2}$ or $\sin \frac{\pi}{4} = \frac{\sqrt{2}}{2} = \frac{141}{2 \cdot 100} = \frac{3 \cdot 47}{2 \cdot 100}$,

47 is called the inner prime factor of $\sqrt{2}$;

235 = 4 · 47, so 235 is related to $\sqrt{2}$, but should be less stable than 141;

36: a number related to the fine-structure constant α because:

$$\alpha_1 = \frac{36}{7 \cdot e^2 \frac{e^2}{\left(\frac{2}{1}\right)^3} \frac{e^2}{\left(\frac{3}{2}\right)^5} \frac{e^2}{\left(\frac{4}{3}\right)^7} \dots \frac{e^2}{\left(\frac{113}{112}\right)^{225}}} \frac{1}{112 + \frac{1}{75^2}} = 1/137.035999037435;$$

48 = 2 · 24 = 2 · 8 · 3, so 48 is also a stable number;

144 = 4 · 36 = 3 · 48, so 144 is also a stable number;

146: ${}_{146}^{370}\text{Ch}_{224}^{ie}$, 146 = 2 · 73, 224 = 2 · 112 = 4 · 56, so 146 is also a stable number.

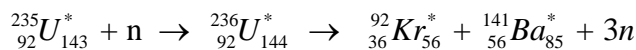
Explanations to the relative stability of U238 and U235:

${}_{92}^{238}\text{U}_{146}^*$ with three stable numbers: 92 = 4 · 23, 238 = 14 · 17 and 146 = 2 · 73;

${}_{92}^{235}\text{U}_{143}^*$ with two stable numbers: 92 = 4 · 23, 235 = 5 · 47

the stability of these numbers should decrease in the above sequences

Explanations to the fission mode of U235:



in the first step, 144 is more stable than 143, and 236 = 4 · 59 with relative stability,

so there is energy releasing and make the nucleus of ${}_{92}^{236}\text{U}_{144}^*$ in metastable state;

in the second step, the first step released energy brokes the nucleus of ${}_{92}^{236}\text{U}_{144}^*$

to two pieces along with 3 neutrons;

${}_{36}^{92}\text{Kr}_{56}^*$ has stable numbers 56, 36 and 92;

${}_{56}^{141}\text{Ba}_{85}^*$ has stable numbers 56, 141 and 85 = 5 · 17;

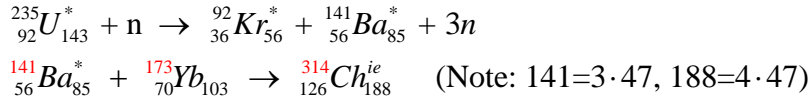
so they are relatively stable products.

This should be the total and exact image of U235's fission.

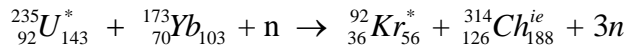
Naturally existing radioactive elements Uranium (U235 and U238) and Thorium (Th232) in the earth decay to Lead (Pb) finally and release energy, and this is very important for the core of the earth to maintain high temperature, autorotation and production of the magnetic field of the earth, and hence to protect the life on the earth.

8. A Synthetic Route to the 126th Element: $Ba^*141+Yb173=Ch314$

In our previous papers [1-12], we predicted the ideal extended elements from 119th to 173th, and illustrated the 126th element would have the best stability among these elements and should be worthy to be synthesized preferentially. So based on our analysis for the stability of some key numbers such as 141, 173 and 314, we design the following synthetic route to the 126th element Ch314.

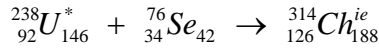


Total reaction:

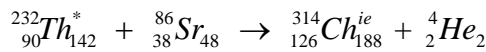
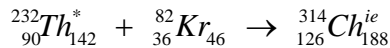
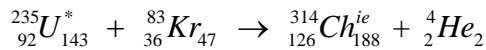
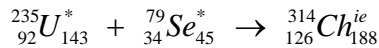
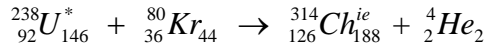


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Or other routes:



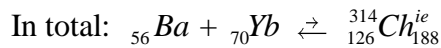
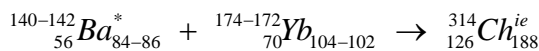
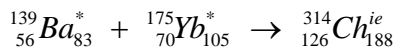
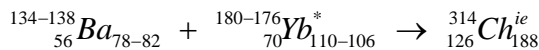
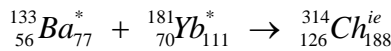
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However, U^* and Th^* are easy to break, so the first route should be the best.

A Series of synthetic routes to ${}_{126}^{314}Ch^{ie}$:



${}_{126}^{314}Ch^{ie}$ should be produced in the supernova explosions but soon decays out.

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We know: $\sin \frac{\pi}{4} = \frac{\sqrt{2}}{2} \approx \frac{1.41}{2}$, $\sin \frac{\pi}{3} = \frac{\sqrt{3}}{2} \approx \frac{1.73}{2}$

and $1.41+1.73=3.14$, $\pi \approx 3.14$, so: $\sqrt{2}+\sqrt{3} \approx \pi$

However, in the world of nuclides, especially when a centesimal natural number coordinate system (NNCS-100) is applicable, the above \approx should become $=$, So in the world of nuclides:

$$\sqrt{2}+\sqrt{3} = \pi, \text{ or } \frac{\sqrt{2}}{2} + \frac{\sqrt{3}}{2} = \frac{\pi}{2},$$

or $\sin \frac{\pi}{4} + \sin \frac{\pi}{3} = \frac{\pi}{2}$ (its geometric meaning is shown in Fig. 5)

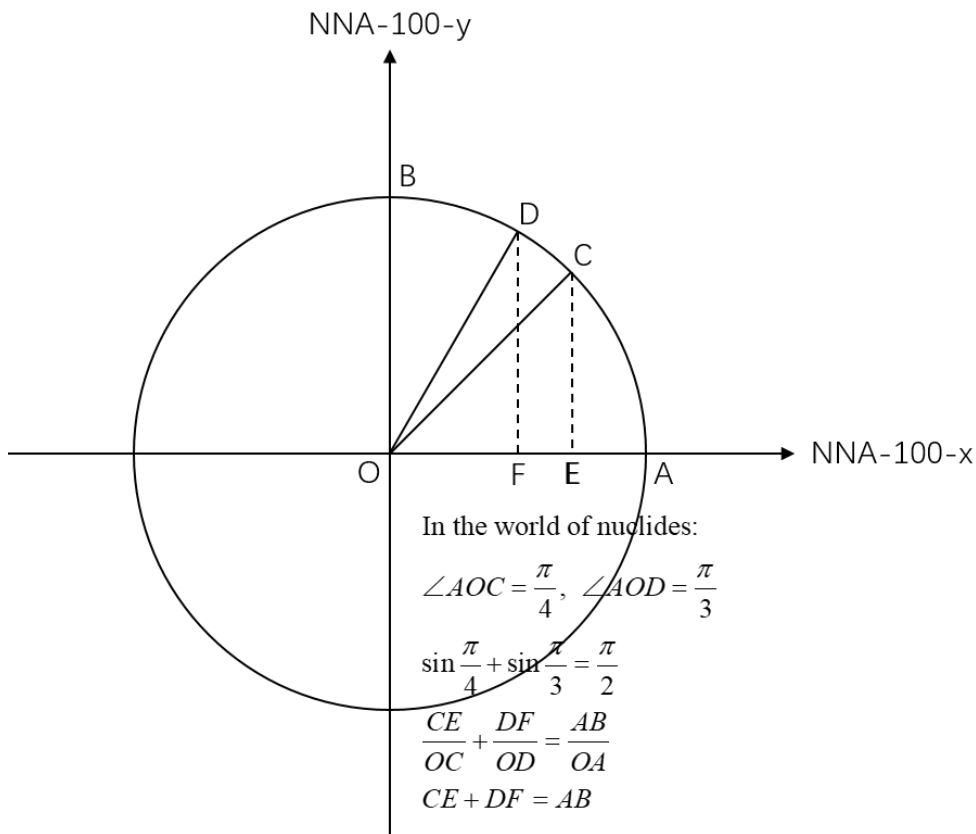


Fig. 5 In the world of nuclides the square root of 2 plus the square root of 3 is equal to π

9. Discussions and Conclusions

It seems in sub-atomic world such as the world of nuclides, God (or the natural rules) prefers the natural number axis (NNA), the natural number coordinate system (NNCS) and the centesimal system, and hence some typical irrational numbers such as the square roots of 2, the square root of 3 and π become rational numbers 1.41, 1.73 and

3.14 respectively in the world of nuclides. One typical proof of these preferences is that the most relatively stable isotope of the 100th element Fm has 157 ($157=314/2$) neutrons in its nucleus. And we apply these principles to design a synthetic route to the 126th element: $Ba^{*141}+Yb^{173}=Ch^{314}$, which corresponds to the formula of the square root of 2 plus the square root of 3 being equal to π in the world of nuclides.

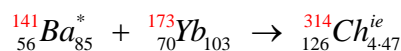
How about the situations in our ordinary world? The floors of a room or a road or a plaza paved with tiles are examples of NNA and NNCS. A road in the eyes of taxi drivers is a NNA because he can only take fees according to the natural numbers of kilometers or miles, he can't take fees according to the irrational numbers such as the square root of 2 or π . If we analyze more intensively, we can put a 1 km milestone on a road and assume the milestone itself has a length of 1 meter, then if we put 1000 such milestones within the distance of 0-1 km, this distance will become a continuous natural number axis with 1 m unit. In addition, we should remember that a milestone stands for a distance and there should be no milestone with no length itself or every dot must have a size and even a shape.

So, we can conclude this paper with the following statement which is reported to be said by German mathematician and logician Leopold Kronecker (1823-1891): God created the natural numbers, all the rest are work of man.

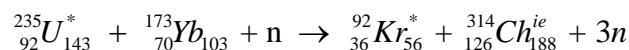
10. Supplements

Supplement 1: Research Methods Concerning 126Ch314

(1) Synthesis of 126Ch314



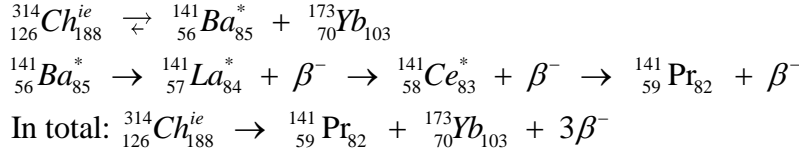
or



or other sythetic routes

(2) Investigations of the Abundances of Pr and Yb in the Universe

A recent paper [14, 15] reported the element Yb in stars is mainly originated from the supernova explosions. If future investigations also reveal the element Pr mainly has the same origination and the abundances of Pr and Yb in the universe are correlated. Then it hints they should have a mother element such as 126Ch314 as follows.



And

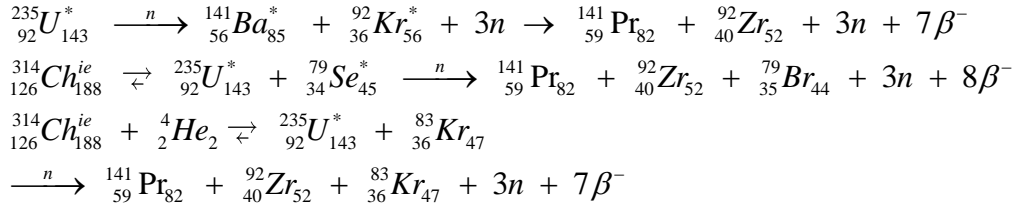


Table 2 Abundances of Pr and Yb in the sun and in the solar system [13, 16].

Elements	Abundances	
	In the sun	In the solar system
59Pr141	1.4×10^{-7}	1.7×10^{-7}
70Yb173	5.5×10^{-8}	4.0×10^{-8}

Note: Atom mole fraction relative to Si = 1.

It should be reasonable that the abundance of 59Pr141 is a little more than that of 70Yb173 in the sun and in the solar system (**Table 2**), one reason should be that there are more routes to produce 59Pr141 than 70Yb173 as shown above, and another reason should be that 70Yb173 is heavier than 59Pr141.

(3) Investigations of the Amounts of Yb and Pr in the minerals

If Pr and Yb have a mother element 126Ch314, their amounts in their relevant minerals should be correlated or even there is still 126Ch314 remained in the minerals.

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Appendix I: Research and Writing History

Section	Page	Writing Period	Location	Version
whole paper	1-9	2022/8/1-5	Chengdu	viXra:2208.0020v1
whole paper	1-11	2022/8/1-8	Chengdu	viXra:2208.0020v2
whole paper	1-11	2022/8/1-8, 23	Chengdu	viXra:2208.0020v3
whole paper	1-12	2022/8/1-8, 23, 10/10-11	Chengdu	viXra:2208.0020v4

Note: date was recorded according to Beijing Time.