The logarithmic spiral of beta-stable odd isotopes
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Логарифмическая спираль бета-стабильных нечетных изотопов
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Abstract: *this research is a mathematical description of the line of beta-stability isotopes with use of a parametrical form of the equation of a logarithmic spiral. It gives the chance to prove Praut's hypothesis that hydrogen is primary matter of which by a nucleosynthesis atoms of all other elements were formed. Conducted the analogy is the result of this study with the processes which are developing in nature by the properties of the logarithmic spiral.*

Аннотация: *данное исследование является математическим описанием линии бета-стабильности изотопов с использованием параметрической формы уравнения логарифмической спирали. Это дает возможность обосновать гипотезу Праута о том, что водород является первичной материей, из которой путём нуклеосинтеза образовались атомы всех других элементов. Проведена аналогия результата данного исследования с процессами, которые развиваются в природе по свойствам логарифмической спирали.*

Keywords: *logarithmic spiral, odd isotopes, deuteron-cluster structure, binding neutron.*
Ключевые слова: *логарифмическая спираль, нечетные изотопы, дейтрон-кластерная структура, связывающий нейтрон.*

Introduction

This research is a continuation of "Statistical analysis of stable and long-lived isotopes using deuteron cluster" [1].It presents the Hydrogen model of atomic nucleus in which nucleus consists of deuterium nucleus and definite numbers of neutrons which bond deuterons in a unified structure. The specialty of this model is that the hydrogen is considered as a primary matter and atoms of other elements are formed from it by nucleosynthesis.

The idea of hydrogen being primary matter for all elements was proposed at the beginning of 19^{th}century. In his evaluation John Dalton assumed that atomic mass of hydrogen is equal to 1, andtherefore atomic masses of all elements in his table are integers. After study of Dalton's table of atomicmasses in 1815-1816 years, William Prout came to a conclusion that all elements ultimately consist ofhydrogen and atomic masses differ as they consist of different number of hydrogen atoms. This standpoint is known as Prout hypothesis [2, 3]. Deviations from integrality were considered by Pratt as measuring errors. Further the most precise determinations of atomic masses did not confirm this position and Pratt's ideas were not been developed.

But Josef Mattauch in 1934, states that if two adjacent elements on the periodic table have isotopes of the same mass number, one of these isotopes must be radioactive. Two nuclides that have the same mass number (isobars) can both be stable only if their atomic numbers differ by more than one [4]. A Mattauch isobar rule nevertheless indicates a continuous sequence in the structure of atomic nuclei. In order to develop this idea in the Hydrogen model the atomic mass of hydrogen was taken as 2 [1] which corresponds to the mass of its isotope deuterium.

Analysis

If the weight of any isotope divided into deuteron clusters which are quantitatively equal to the charge of the nucleus, it gets to deuteron-cluster structure with a certain number of neutrons in the residue, which is supposed to link these clusters into a single structure [1].

Table 1. The deuteron- cluster structure of odd stable and long-lived isotopes

1	**p** **1D** **H**								
2	**3D** **3D+1n** **Li**						**5D** **5D+1n** **B**	**7D** **7D+1n** **N**	**9D+1n** **F**
3	**11D+1n** **Na**						**13D+1n** **Al**	**15D+1n** **P**	**17D+1n** **17D+3n** **Cl**
4	**19D+1n** **19D+3n** **K**	**21D+3n** **Sc**	**23D+5n** **V**	**25D+5n** **Mn**	**27D+5n** **Co**	**29D+5n** **29D+7n** **Cu**	**31D+7n** **31D+9n** **Ga**	**33D+9n** **As**	**35D+9n** **35D+11n** **Br**
5	**37D+11n** **Rb**	**39D+11n** **Y**	**41D+11n** **Nb**	**43D+11n** **43D+12n** **43D+13n** **Tc**	**45D+13n** **Rh**	**47D+13n** **47D+15n** **Ag**	**49D+15n** **49D+17n** **In**	**51D+19n** **51D+21n** **Sb**	**53D+21** **I**
6	**55D+23n** **Cs**	**57D+25n** **La**	**59D+23n** **Pr**	**61D+23n** **61D+24n** **61D+25n** **Pm**	**63D+25n** **63D+27n** **Eu**	**65D+29n** **Tb**	**67D+31n** **Ho**	**69D+31n** **Tm**	**71D+33n** **Lu**
			73D+35n **Ta**	**75D+35n** **75D+37n** **Re**	**77D+37n** **77D+39n** **Ir**	**79D+39n** **Au**	**81D+41n** **81D+43n** **Tl**	**83D+43n** **Bi**	**85D+39n** **85D+40n** **85D+41n** **At**
7	**87D+49n** **Fr**	**89D+49n** **Ac**	**91D+49n** **Pa**	**93D+51n** **Np**	**95D+51n** **95D+53n** **Am**	**97D+53n** **Bk**	***99D+55*** ***99D+57*** ***Es***	***101D+57*** ***Md***	***103D+53*** ***103D+55*** ***Lr***
			105D+63 ***Db***	***107D+65*** ***Bh***	***109D+65*** ***109D+67*** ***Mt***	***111D+67*** ***Rg***	***113D+69*** ***113D+71*** ***Uut***	***115D+71*** ***Uup***	***117D+67*** ***117D+69*** ***Uus***

For elements with nuclear charge *99-117* deuteron-cluster structure is calculated based on the periodicity of cluster structures in atomic nuclei [1] by adding 14 neutrons, to the deuteron-cluster structure of downstream elements, which binding the clusters.

Using mathematical expressions (1.0) and (2.0) we construct a logarithmic spiral:

$$x(t) = r\cos t = ae^{bt}\cos t\,, \qquad (1.0)$$

$$y(t) = r\sin t = ae^{bt}\sin t\,, \qquad (2.0)$$

Where **t** - the angle of deviation from the zero point, **r** - radius vector of the point. The **e** being the base of natural logarithms, and **a** and **b** being arbitrary positive real constants.

*Table 2: **a** - factor responsible for the distance between the coils, **b** - factor responsible for the density of coils of spiral.*

a	0.05
b	0.25

Table 3: Parameters of logarithmic spiral

Binding neutron	Angle (t)	x	y	Isotopes
0	-0.1396263	0.04781488	-0.006719943	**2H**
0	-0.1396263	0.04781488	-0.006719943	**6Li**
1	0	0.05	0	**7Li**
0	-0.1396263	0.04781488	-0.006719943	**10B**
1	0	0.05	0	**11B**
0	-0.1396263	0.04781488	-0.006719943	**14N**
1	0	0.05	0	**15N**
1	0	0.05	0	**19F**
1	0	0.05	0	**23Na**
1	0	0.05	0	**27Al**
1	0	0.05	0	**31P**
1	0	0.05	0	**35Cl**
3	0.27925268	0.05153842	0.014778405	**37Cl**
1	0	0.05	0	**39K**
3	0.27925268	0.05153842	0.014778405	**41K**
3	0.27925268	0.05153842	0.014778405	**45Sc**
5	0.55850536	0.04875615	0.030466226	**51V**
5	0.55850536	0.04875615	0.030466226	**55Mn**
5	0.55850536	0.04875615	0.030466226	**59Co**
5	0.55850536	0.04875615	0.030466226	**63Cu**
7	0.83775804	0.04125146	0.045814388	**65Cu**
7	0.83775804	0.04125146	0.045814388	**69Ga**
9	1.11701072	0.02897943	0.05941664	**71Ga**
9	1.11701072	0.02897943	0.05941664	**75As**
9	1.11701072	0.02897943	0.05941664	**79Br**
11	1.3962634	0.01230942	0.069810193	**81Br**
11	1.3962634	0.01230942	0.069810193	**85Rb**
11	1.3962634	0.01230942	0.069810193	**89Y**
11	1.3962634	0.01230942	0.069810193	**93Nb**
				Tc
13	1.67551608	-0.0079455	0.075596415	**103Rh**
13	1.67551608	-0.0079455	0.075596415	**107Ag**
15	1.95476876	-0.0305339	0.075573961	**109Ag**
15	1.95476876	-0.0305339	0.075573961	**113In**
17	2.23402144	-0.0538106	0.068874418	**115In**
19	2.51327412	-0.0758233	0.055088882	**121Sb**
21	2.7925268	-0.0944388	0.034372921	**123Sb**

21	2.7925268	-0.0944388	0.034372921	**127I**
23	3.07177948	-0.1075041	0.007517419	**133Cs**
23	3.07177948	-0.1075041	0.007517419	**139La**
23	3.07177948	-0.1075041	0.007517419	**141Pr**
				Pm
25	3.35103216	-0.1130337	-0.024026063	**151Eu**
27	3.63028484	-0.1094103	-0.058174474	**153Eu**
29	3.90953752	-0.0955821	-0.092302597	**159Tb**
31	4.1887902	-0.0712413	-0.123393634	**165Ho**
31	4.1887902	-0.0712413	-0.123393634	**169Tm**
33	4.46804289	-0.0369621	-0.148246932	**175Lu**
35	4.74729557	0.00571769	-0.16373308	**181Ta**
35	4.74729557	0.00571769	-0.16373308	**185Re**
37	5.02654825	0.05428788	-0.167080925	**187Re**
37	5.02654825	0.05428788	-0.167080925	**191Ir**
39	5.30580093	0.10534203	-0.156175978	**193Ir**
39	5.30580093	0.10534203	-0.156175978	**197Au**
41	5.58505361	0.15474387	-0.129845526	**203Tl**
43	5.86430629	0.19788329	-0.088103319	**205Tl**
42	5.72467995	0.17739432	-0.110848275	**206Pb**
43	5.86430629	0.19788329	-0.088103319	**209Bi**
				At
49	6.70206433	0.24398749	0.108630228	**223Fr**
49	6.70206433	0.24398749	0.108630228	**227Ac**
49	6.70206433	0.24398749	0.108630228	**231Pa**
51	6.98131701	0.21938697	0.184087527	**237Np**
51	6.98131701	0.21938697	0.184087527	**241Am**
53	7.26056969	0.17172677	0.254595402	**243Am**
53	7.26056969	0.17172677	0.254595402	**247Bk**
54	7.40019603	0.1394049	0.285822403	**238U**
55	7.53982237	0.10176025	0.313185857	***253Es***
57	7.81907505	0.01232351	0.352899181	***255Es***
57	7.81907505	0.01232351	0.352899181	***259Md***
				Lr
63	8.65683309	-0.3131899	0.30244401	***273Db***
65	8.93608577	-0.4122191	0.219180786	***279Bh***
65	8.93608577	-0.4122191	0.219180786	***283Mt***
67	9.21533845	-0.4896853	0.104085821	***285Mt***
67	9.21533845	-0.4896853	0.104085821	***289Rg***
69	9.49459113	-0.5355166	-0.037446968	***295Uut***

70	9.63421747	-0.5437462	-0.115576832	***298Fl***
71	9.77384381	-0.5409255	-0.196880769	***297Uut***
71	9.77384381	-0.5409255	-0.196880769	***301Uup***

Binding neutrons of odd isotopes were taken for the making a logarithmic spiral, which are shown in *Table 1*.After entering the values from *Table 3* on the two-dimensional coordinate system, we obtain a logarithmic spiral, which is shown in *Figure 2*. It should be noted that the binding neutron from the deuteron-cluster structure of technetium, promethium, astatine and lawrencium were not used in the making of the spiral.

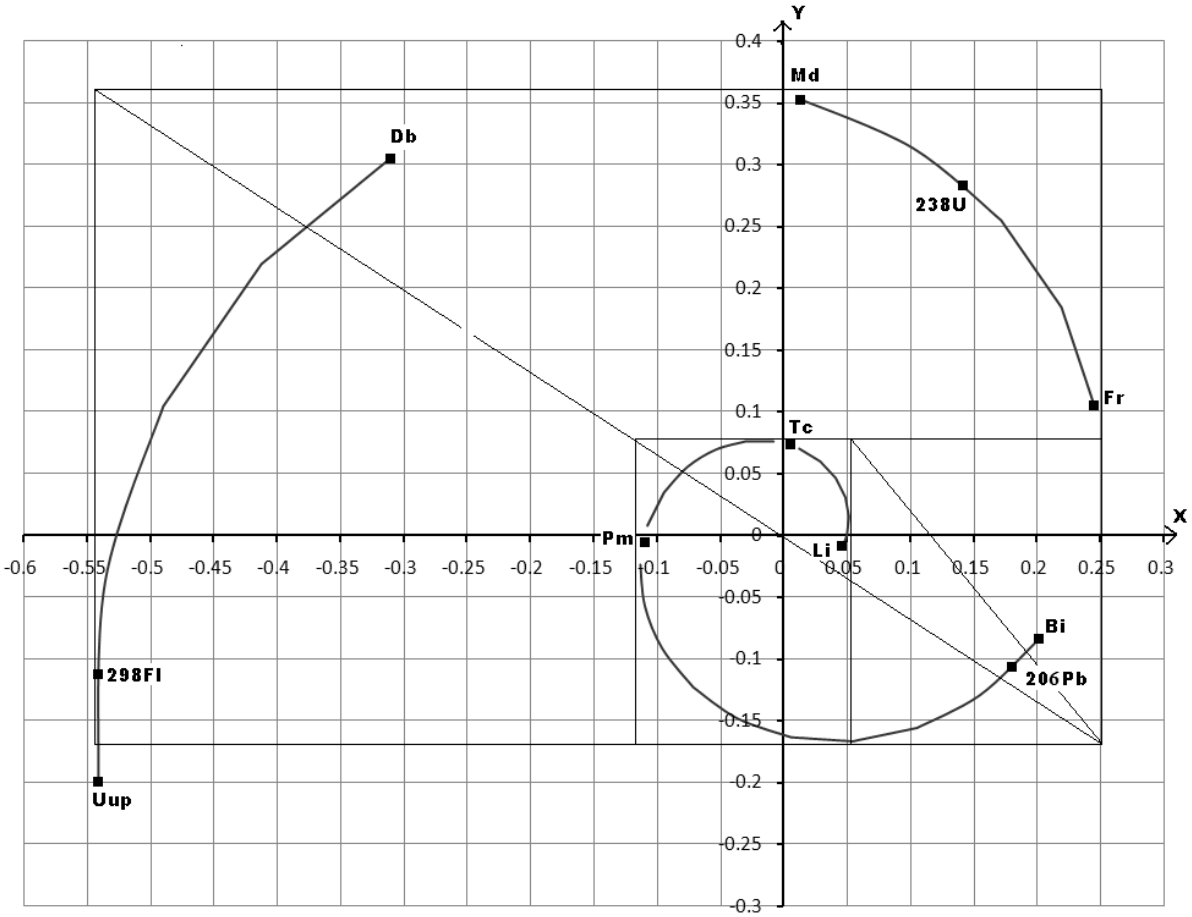

Fig. 2. The logarithmic spiral of odd isotopes actually describes the line of beta stability.

As it is known technetium and promethium have no stable isotopes and they come before lead in the periodic table of elements, and astatine is the next odd element after isotope ^{209}Bi, which is considered until some time [5] the hardest of naturally occurring element between stable isotopes. It is noteworthy that the value of technetium, promethium, astatine and lawrencium intersect abscissa and ordinate of logarithmic spiral. Hydrogen model shows that for doubly magic isotope 298Fl [6] the clusters neutrons ratio is equal to the value of the golden ratio.

298Fl = 114Deuteron cluster + 70 binding neutron = 114 / 70 = 1.6285... Golden ratio = 1.6180...

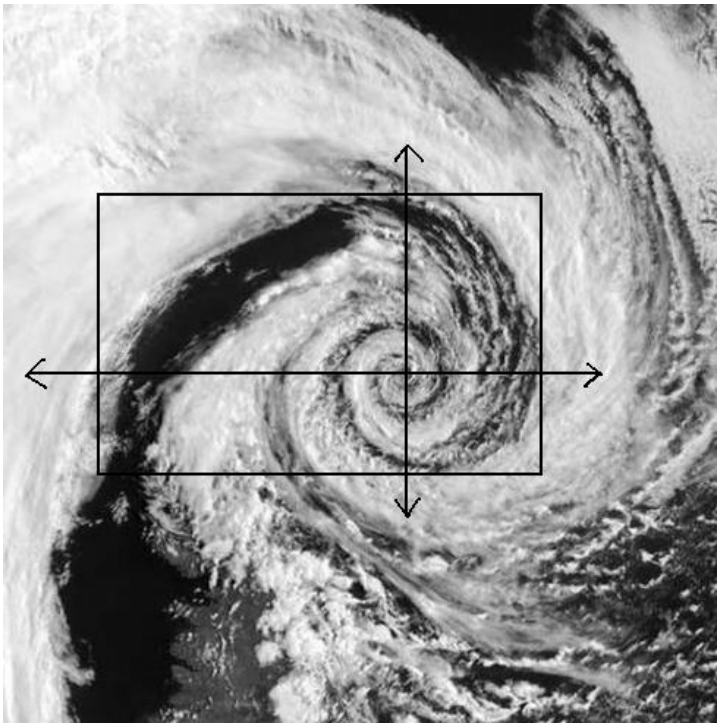

Fig. 3.The atmospheric depression which has arisen on the southwest coast of Iceland on September 4, 2003. (Satellite picture)

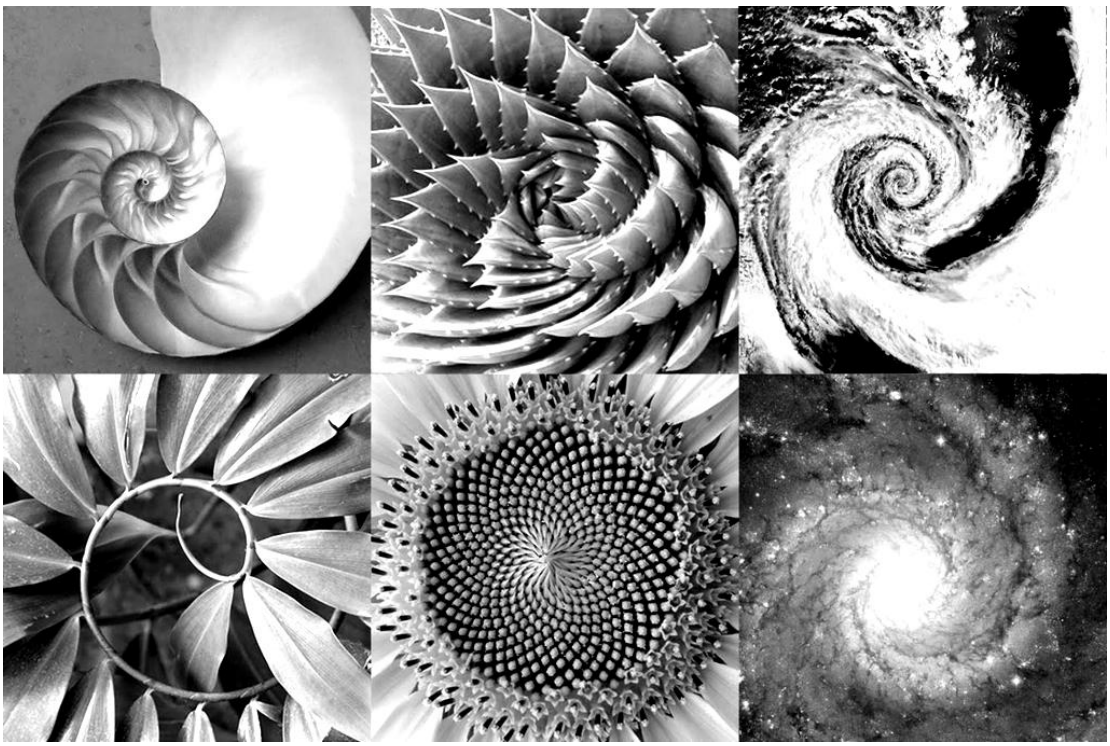

Fig. 4. Examples of logarithmic spirals occurring in nature: in plants, spiral galaxies, in atmospheric air flow, etc.

Conclusion

The size of logarithmic helix turns increases gradually, but their shape remains constant. The increase of radius by circle length unit is constant. As a result of this feature the logarithmic helix appears in definite growing forms such as shell of mollusks, sunflower cap, spirals of cyclones and galaxies. Analysis of connection neutrons of odd elements deuteron-cluster structures also shows the regularity of growth and repeatability of atom features. In fact, logarithmic helix describes the power hole in which the energy transforms into mass (matter). The center of cyclones or galaxies in the place where the above mentioned power hole is collated with the general energy background. Energy entering into the power hole gradually transforms into

more bound matter form, but as it goes to the center of the helix it reaches the maximum of bonding and then the reversed process of transformation of mass (matter) into energy takes place.

Figures 3 and 4 show examples in which the processes occur in nature on a logarithmic spiral. Having drawn an analogy with the Figure 2, it can be concluded that the physical processes that are mathematically described by a logarithmic spiral in nature are the same for the micro- and macrocosm. Such a physical process is the periodicity. Periodic law is universal for the Universe.

References

1. *Isayev R.* Statistical analysis of stable and long-lived isotopes using deuteron cluster // Problems of modern science and education, 2015. Vol. 10 (52), p. 10-16.
2. *William Prout* (1815). On the relation between the specific gravities of bodies in their gaseous state and the weights of their atoms. Annals of Philosophy, 6: 321–330.
3. *William Prout* (1816). Correction of a mistake in the essay on the relation between the specific gravities of bodies in their gaseous state and the weights of their atoms. AnnalsofPhilosophy,7: 111–113.
4. *Thyssen, Pieter; Binnemans, Koen*; (2011). Handbook on the Physics and Chemistry of Rare Earths. Elsevier. Vol. 41, p. 66.
5. *Pierre de Marcillac, Noël Coron, Gérard Dambier, Jacques Leblanc, and Jean-Pierre Moalic* (April 2003). «Experimental detection of α-particles from the radioactive decay of natural bismuth» // Nature 422 (6934), p.876–878.
6. *Fricke, Burkhard.* "Superheavy elements: a prediction of their chemical and physical properties". Recent Impact of Physics on Inorganic Chemistry 21, 1975, P. 93.