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Review Article

The structure of Atomic Nuclei

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Abstract

All nuclei of elements consist of successive chain of nuclei of helium. Stability of nuclei of helium is provided by an exchange by mesons between nucleons. Division of uranium 235U takes place in a chain where value of energy of separation of nucleus of helium 4He close to the zero.

Keywords : Successive chain of nuclei of helium or isotopes of nuclei of helium stability is provided by cooperation of nuclides.

Introduction

It is known that the number of nucleons in a nuclei is multiple four plays a large role at determination of properties of nucleus Foremost at the nuclei of containing an even number protons and neutrons spin of nucleus equal to the zero. To this group of elements belong helium 4He,carbon 12C,oxygen 16O.Beecause the nucleus of helium 4 He is the simples ,then it serves as basis for the construction of all anther nuclei. .

Substantive Provisions

Basis (by a brick) for formation of nuclei of elements is a nucleus of helium 4He or isotope nucleus of helium. All other nuclei of elements consist of successive chain of nuclei of helium. Why did the nucleus of helium become basis all other nuclei?

Appearance of fourth sector (proton or neutron) in the chart of tritium (3H) or chart of isotope of helium (3He) creates the complete structure of nucleus of helium. Thus sharply the size of binding energy grows to 28.296 MeV and binding energy on nuclide to 7.04 MeV. And no another way thus to increase the value of binding energy exists. Therefore the nucleus of helium becomes basis for all elements.

The nucleus of helium consists of two protons and two neutrons. A proton is a stable particle and neutron is unstable. How to provide stability of nucleus of helium? Stability of nucleus is provided by cooperation of protons and neutrons by means of π-mesons. We will consider one of variants of such cooperation. (Figure 1)

How do nucleus cooperate in a nucleus? They are constrained and cooperate all together. Protons and neutrons are difficult systems consisting of central part and cloud of the continuously emitted and taken in mesons. The proton P1 emits a π+meson and he is taken in by the neutron n1.The proton p2 emits the same π+meson, that is taken in by the neutron n2. And at same time neutrons emit π-0 mesons. That is taken in by protons .After an exchange of the mesons proton and neutron change by rotes. A proton becomes a neutron and former neutron by a proton. This cooperation recurs in the next loop. A current flows in the ring of helium, because the charge of 1e moves, that creates the magnetic field. This magnetic field helps the orientation of nucleus of helium in relation to other nuclei.

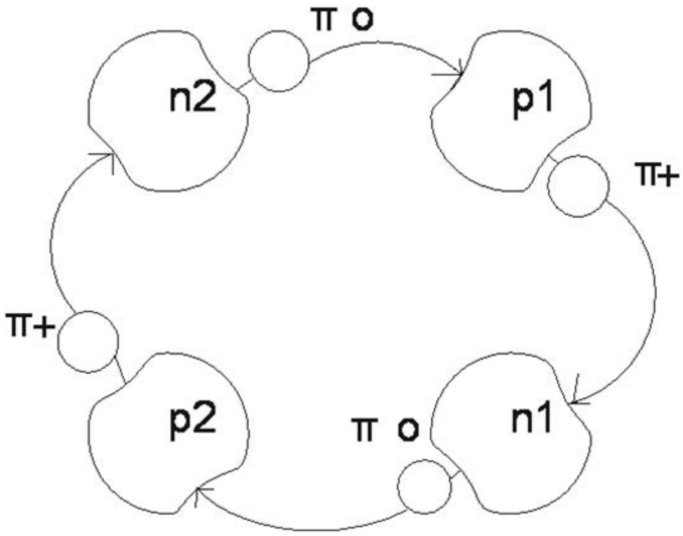


Figure 1.

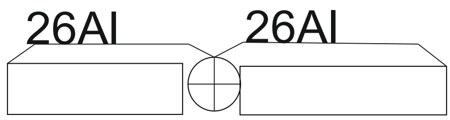
The nuclei of elements consist of chain of nuclei of helium that is bound by inter se binding energy of equal energy of separation of nucleus of helium. This connection come a true by a transmission between nuclei of part of energy. This cooperation connection ends with in nuclei. Why does this chain coagulate in a ball? Maybe she aims to occupy a minimum volume in space.

Why do the nuclei of all elements consist of a sequential chain of helium nuclei? We start by analyzing the helium core. We divide the helium core into two equal parts. To find the energy of separation of a part of the nucleus from the whole nucleus it is necessary to subtract from the binding energy of the whole nucleus the binding energy of its two parts. BE-binding energy, ES-energy of separation. ES (2H) (4He) =BE(4He)-BE(2H)-(BE2H)=28.296-2.225-2.225=23.846MeV. .

Next, we will study the 52Fe core .To analyze the 52Fe core we will use the same principle as for the helium core. Although this method is applicable with restrictions for the 52Fe the following factors are not taken into sccount: 1) the shape of the nucleus 2) the influence of a positive charge. Divide the 52FE core into two equal parts.

1).ES(26Al)(52Fe)=BE(52Fe)-BE(26AL)-BE(26Al)=447.705-211.892-211.892=23.921MeV

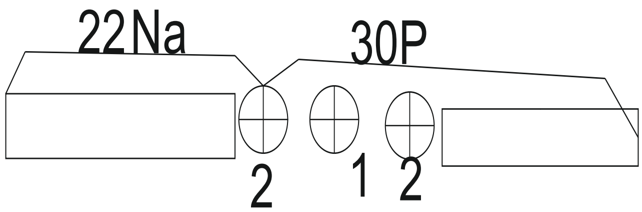
We obtained a value almost equal to the value of the division of the helium nucleus into two parts We assume that the helium nucleus is located in the center of the 52Fe nucleus. (Figure 2)



2).Next, we divide the 52Fe core into unequal parts. One part is 26Na and the second part is 30P.

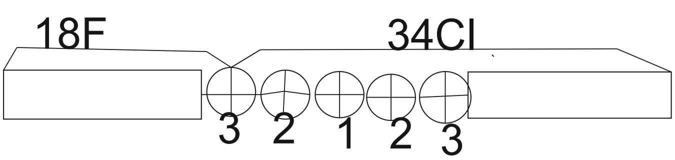
ES (22Na) (52Fe)=BE(52Fe)-BE(22Na)-BE(30P)=447.705-174.148-250.409=23.148

Again, a value comparable to the fission of the helium nucleus was obtained. In this case we have a division into two parts 22Na and 30P.One fission point is located to the left of the center of the nucleus and the second to the right of the center Thus , we already have three parts of the 52Fe nucleus consisting of helium nuclei.. (Figure 3)



3). Now we divide the 52Fe core into two parts consisting of 18F and 34Cl.

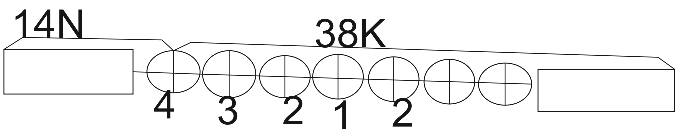
ES (18F) (52Fe)=BE(52Fe)-BE(18F)-BE(34CL)=447.705-137372-285.568=24.765MeV (Figure 4)



Now already have five parts of the 52Fe nucleus.

4). Let us do four more calculations similar to those done above.

ES (14N)(52Fe)=BE9(52Fe)-BE(14N)-BE(38K)=447.705-104.661-320.650=22.394MeV (Figure 5)

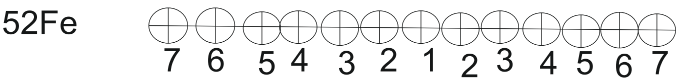


5). ES (10B) (52Fe)=BE(52Fe)-BE(10B)-BE(42Sc)=447.705-64.753-354.692=28.260MeV

6).ES (6Li) (52Fe)=BE(52Fe)-BE(6Li)-BE(46V)=447.705-31.995-390.365=25.345MeV

7).ES (2H) (52Fe)=BE(52Fe)-BE(2H)=BE(50Mn)=447.705-2.225-426.640=18.840MeV

Thus, we got all 13 helium nuclei that make up the 52Fe nucleus. (Figure 6)



BE (52Fe) =13x28.296+(-

0.092)+7.367+7.162+4.725+9.322+9.985+6,947+6.641+7.050+5.125+7.696+7.937=447.705Me (Figure 6) (Table 1)

Why are the 235U uranium nucleus divided and the 238U nucleus not divided? Where is the fission point? The uranium nucleus consists of 46 helium nuclei or helium nuclei isotopes. They are interconnected by the binding energy which we traditionally call the separation energy ES(a) or ES(a+n)or ES(a+2n).The magnitude of this energy depends on the following factors:1)the magnitude of Z 2)the type of helium nucleus 3) the magnitude of the Coulomb energy. (Figure 7) (Table 2 and Table 3).

Table1 shows the formation scheme of the 235U and 238U isotopes. It is known that the 235U isotope is divided into two parts and the 238U isotope is not divided. What is the difference?

Let us consider in more detail. Tabl.2 (part of Tabl1) shows the path to the sequential formation of the a uranium element from Z54 to Z64.Prior to A131 the formation of the 235U and 238U isotopes proceeds along the same branch. Starting with A131 the isotope paths diverge Isotope 235U goes along the branches A131 A136 A140 A14 ,A15 ,A156 and further along the left branch to the end.

At the A136 A140 transition the binding energy between helium nuclei becomes 1.629MeV and at theA140,A144 transition the binding energy becomes negative ES(a)=-1.012MeV. This is the transition which is a weak point and causes the division of the 235U isotopes. The formation of 238U isotope proceeds along the path

A131,A137,A142,A147 A152,A157,A162,A167 and further along the right branch to A238. There are no net places in this branch.The second variant of the formation of these isotopes in Tabl.3.Prior to A137 the formation 0f 235U and 238U isotopes proceeds along the same branch. Beginning with A137 the isotope paths diverge. The 238U isotope follows the same path and the 235U isotope follows the A137 A141 A146 A151, A156 path and further along the previous branch to the end. There is a weak point in the transition between A137 and A141. The binding energy between the helium nuclei here is 0.144MeV .The second variant of the formation of the 235U nucleus is more likely. This is the place where the chain can be broken into two parts by a thermal nutron.

Conclusion

Dividing of uranium by two parts making 2/3 basic nucleus takes place the break of successive chain of nucleus where a value ES (a) approaches a zero.

Table 1. Formation of Nuclei of 235U and 238U

92	184	U	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235			238
90	180															229			232	5.710	
88	176													223			226		4.538		
86	172											217			220		8.501				
84	168									211			214			6.253					
82	164							205			208			10.998							
80	160					199			202			12.650									54
78	156			193			196			10.636					48	49	50	51	52	53	
76	152	187			190			10.591										187			190
74	148	35	36	37	38	39	40	41	42	43	44	45	46	47		181			184		
72	144														176		178		9.180		
70	140													171	172			5.770			
68	136												166	167		6.500					
66	132											161	162			9.454		35	36	37	38
64	128										156	157				9..359					
62	124								150	151	152					5.036					
60	120						144		146	147						5.006					
58	116						140	141	142							8.606					
56	112						136	137								16.763					
54	108					131										16.792					
52	104			125												16.550					
50	100	119														20.699					119
48	96															18.200			113		
46	92		20	21	22	23	24	25	26	27	28	29	30	31	32		107	ES(a+2n) = 18.07			
44	88														101		ES (a+n) =9.666				
42	84													96		2.761					
40	80													92		2.198					
38	76													88		7.916					
36	72													84		ES(α+n) =17.904					
34	68												79		22.220						
32	64										73		21.013								
30	50								67		ES(α+2n) =21.254										
28	56						61		ES(α+n) =15.005												
26	52					56			7.614												
24	48					52			7.696												
22	44					48			5.125												
20	40					44		ES(α)=7.050													
18	36					40		ES(a+2n)		=26.033											
16	32			34				ES(α+2n) =15.302													
14	28	28			9.985																
12	24	24			9.322																
10	20	20			4.730																
8	16	16			7.162																
6	12	12			7.367																
4	8	8			ES(α)=0.092																
Z	2Z	n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

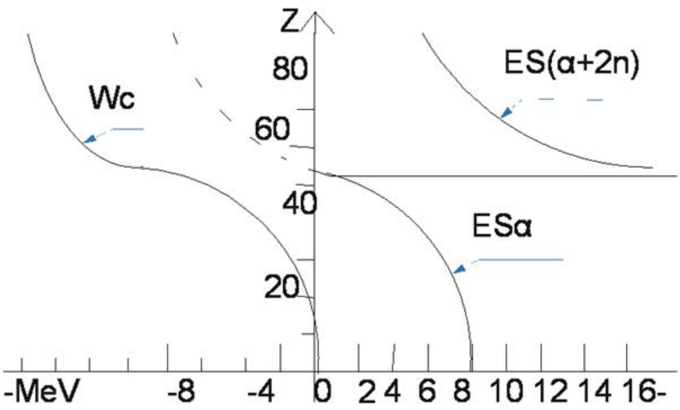


Figure 7.

Table 2.

64 ES (a+2n) =13.080						156	157	ES (a+1n) =7.403MeV
62 ES (a+2n) =10.900				150		152		ES (a+1n) =8.003
60 ES (a) = -1.012		144			147			ES (a+1n) =5.006
58 ES (a) =1.629b		140		142				ES (a+1n) =8.606
56 ES (a+n) =11.401		136	137					ES (a+2n) =16.388MeV
54	131							

Table 3.

64 ES (a+n) = 9.366					156	167	ES (a+1n) =7.403MeV
62 ES (a+n) =5.003				151	152		ES (a+1n) =8.003
60 ES (a+n) =6.880			146	147			ES (a+1n) =5.008
58 ES (a) =0.144		141	142				ES (a+1n) =8.206
56 ES (a+2n) =16.388		137					ES (a+2n) =16.388MeV
54	131						

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