COLD NUCLEAR TRANSMUTATIONS

ATOMIC NUCLEI BINDING ENERGY FOR LIGHT NUCLEI

Philippe Hatt, independent researcher
E-mail : pcf.hatt@gmail.com

1. Several authors predict that alpha particle structures could be present in atomic nuclei. Convincing arguments of such structures are provided by systematics of the binding energies of the even-even nuclei with equal number of protons and neutrons.

2. The kind of binding energy existing within each alpha particle is a first question to consider. How to relate that binding energy to the deuterium binding energy, as well as to the tritium and He3 ones? As these exist before the alpha particle is constituted could they be found within the nucleus as substructures linking the nucleons of one alpha particle with the nucleons of another alpha particle?

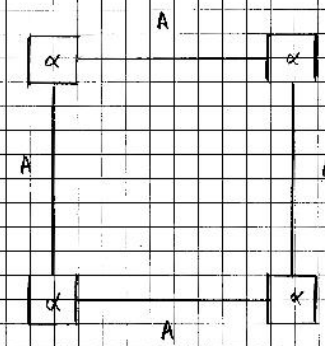
3. It will be shown in the following that the hypothesis of alpha structures in the n-alpha nuclei can indeed describe the binding energy systematics. In such an approach the system in its ground state behaves like a crystal, with stationary configuration and shape and with defined bond values between the various alpha particles. The examples provided are O16, Ne20, Mg24, Si28, S32, Ar36 and Ca40.

4. The hypothesis I developed founds its background in the structure of the neutron and the proton I proposed in my document posted on the internet one finds under www.philippehatt.com.

$^{10}_{4}\alpha$ EB in MeV = 127,619 3

EB =

4 α	113,3000	MeV
2 NN	9,8730	
2 NP	4,4492	
	127,6222	MeV
	+0,0003	

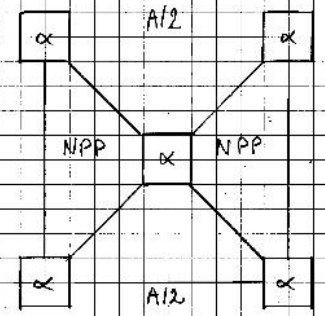


$EB = 4EB\alpha + 4A = 4EB\alpha + 25,75 = 127,6222$ MeV
$+0,0003$

$A = NN/2 + NP/2 = 6,4375$

$^{20}_{10}Ne$ 5 α E_B in MeV = 160.6448

E_B	5 α	141.6250	MeV
	0.5 NN	2.4683	
	0.5 NP	1.1123	
	2 NPP	15.4360	
		160.6416	MeV
		− 0.003	



$E_B = 5 E_B\alpha + A + 2 NPP = 5 E_B\alpha + 34.1875 =$

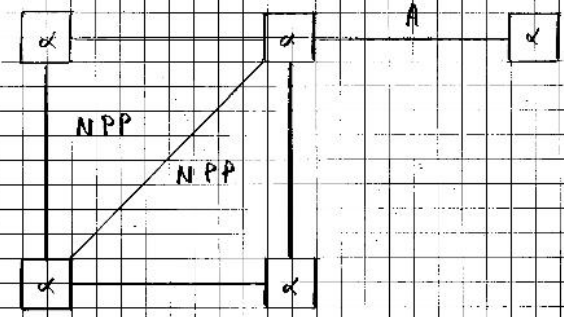
160.6416 MeV
− 0.003

$A = NN/2 + NP/2 = 6.4375$

$NPP = 13.875 = NN + 1.25 NP$

$^{20}_{10}Ne$ 5α E_B in MeV = 160,6448

E_B	5α		
	0,5 NN	14	16,2500 MeV
	0,5 NP		2,4683
	2 NPP		1,1123
		15	4,3600
		160	0,6416 MeV
			− 0,0003



$E_B = 5\,E_B\alpha + A + 2\,NPP = 5E_B\alpha + 34,1375 =$

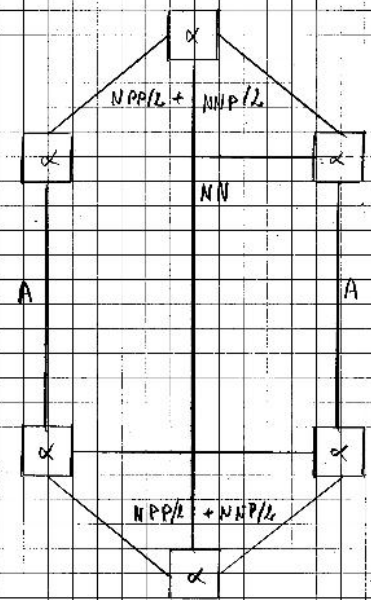
160,6415 MeV
− 0,0003

A = NN/2 + NP/2 = 6,4375

NPP = 13,875

$^{24}_{12}Mg$ 6α E_B in MeV = 198.2570

E_B	6α	169.9500	MeV
	2 NN	9.8730	
	NP	2.2246	
	NNP	8.4818	
	NPP	7.7180	
		198.2474	MeV
		-0.0100	



$E_B = 6E_B\alpha + 2A + NN + NNP + NPP = 6E_B\alpha + 50.875 =$

198.2474 MeV
-0.0100

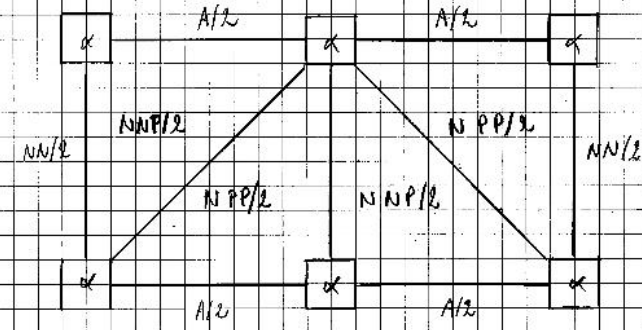
A = NN/2 + NP/2 = 6.4375 NN = 3.875

NPP = 13.875 NNP = 15.25 = 2NN + 1.25/2 NP

$^{24}_{12}Mg$ 6α E_B in MeV = 198,2570

E_B

6α	169,9500 MeV
2NN	9,8730
NP	2,2246
NNP	8,4818
NPP	7,7180
	198,2474 MeV
	-0,0100



$E_B = 6E_{B\alpha} + 2A + NN + NNP + NPP = 6E_{B\alpha} + 50,875 =$

198,2474 MeV

-0,0100

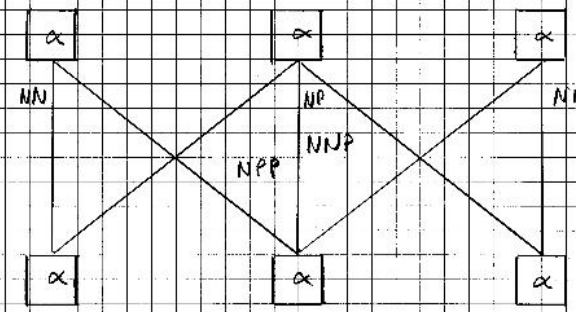
$A = NN/2 + NP/2 = 6,4375$

$NN = 8,875$

$NPP = 13,875$

$NNP = 15,25$

$^{24}_{12}Mg$ 6α E_B in MeV = 198,2570



$E_B = 6\,E_{B\alpha} + 2NN + NP + NNP + NPP =$

$6\,E_{B\alpha} + 50,875 = 198,2474$

$-0,010$

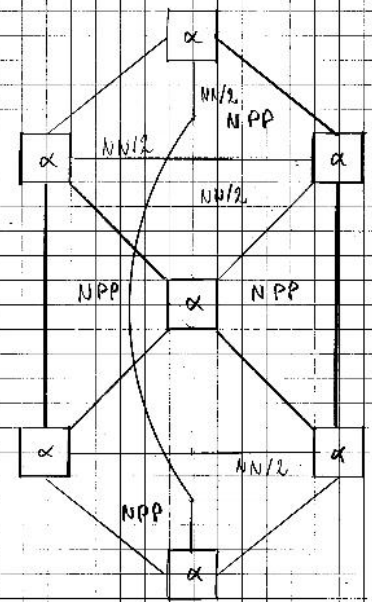
Remark: $2NN + NP = 2A + NN$

So the structure NN NP NN

equals A NN A

$^{28}_{14}Si$ 7 α Eb en MeV = 236.5368

Eb	7 α	198.2750	MeV	
	1.5 NN	7.4048		
	4 NPP	30.8720		
		236.5518	MeV	
		+0.015		



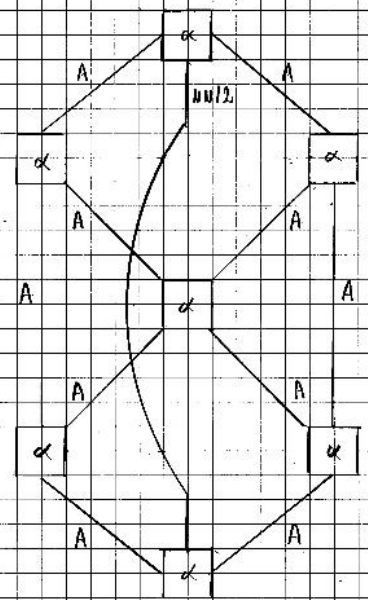
Eb = 7 Eb α + 1.5 NN + 4 NPP = 68.8125 =

236.5518 MeV
+0.015

NN = 8.875 NPP = 13.875

$^{88}_{14}Si$ 7α E_B in MeV = 236.5368

E_B	7α	198.2750 MeV
	5.5NN	27.1508
	5NP	11.1230
		236.5488 MeV
		+0.012



$E_B = 7 E_B\alpha + 10 A + 0.5 NN = 7 E_B\alpha + 68.8125 =$

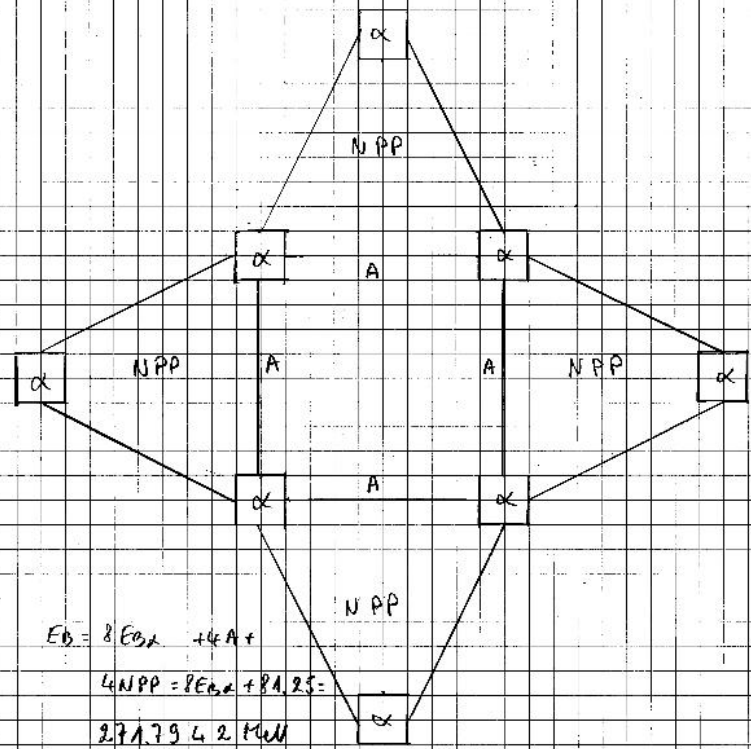
236.5488 MeV
+0.012

$A = NN/2 + NP/2 = 64.375$

$NN = 8.875$

$^{32}_{16}S$ 8α Ee in MeV = 271,7801

EB	8α	226,6000	MeV
	2NN	9,8730	
	2NP	4,4492	
	4NPP	30,8720	
		271,7942	MeV
		+0,0144	



$E_B = 8E_{B\alpha} + 4A +$

$4NPP = 8E_{B\alpha} + 81,25 =$

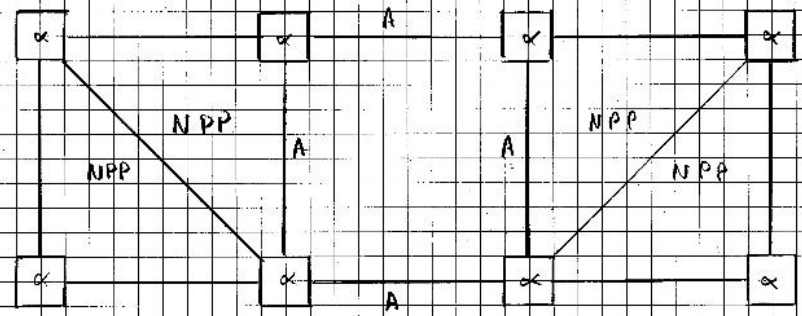
271,7942 MeV
+0,0144

$A = NN/2 + NP/2 = 6,4375$ $NPP = 13,875$

$^{32}_{16}S$ 8α

E_B 4n MeV = 271.7801

E_B	8α	2.266000 MeV
	2NN	9.8730
	2NP	4.4492
	4NPP	30.8720
		271.7942 MeV
		+0.014

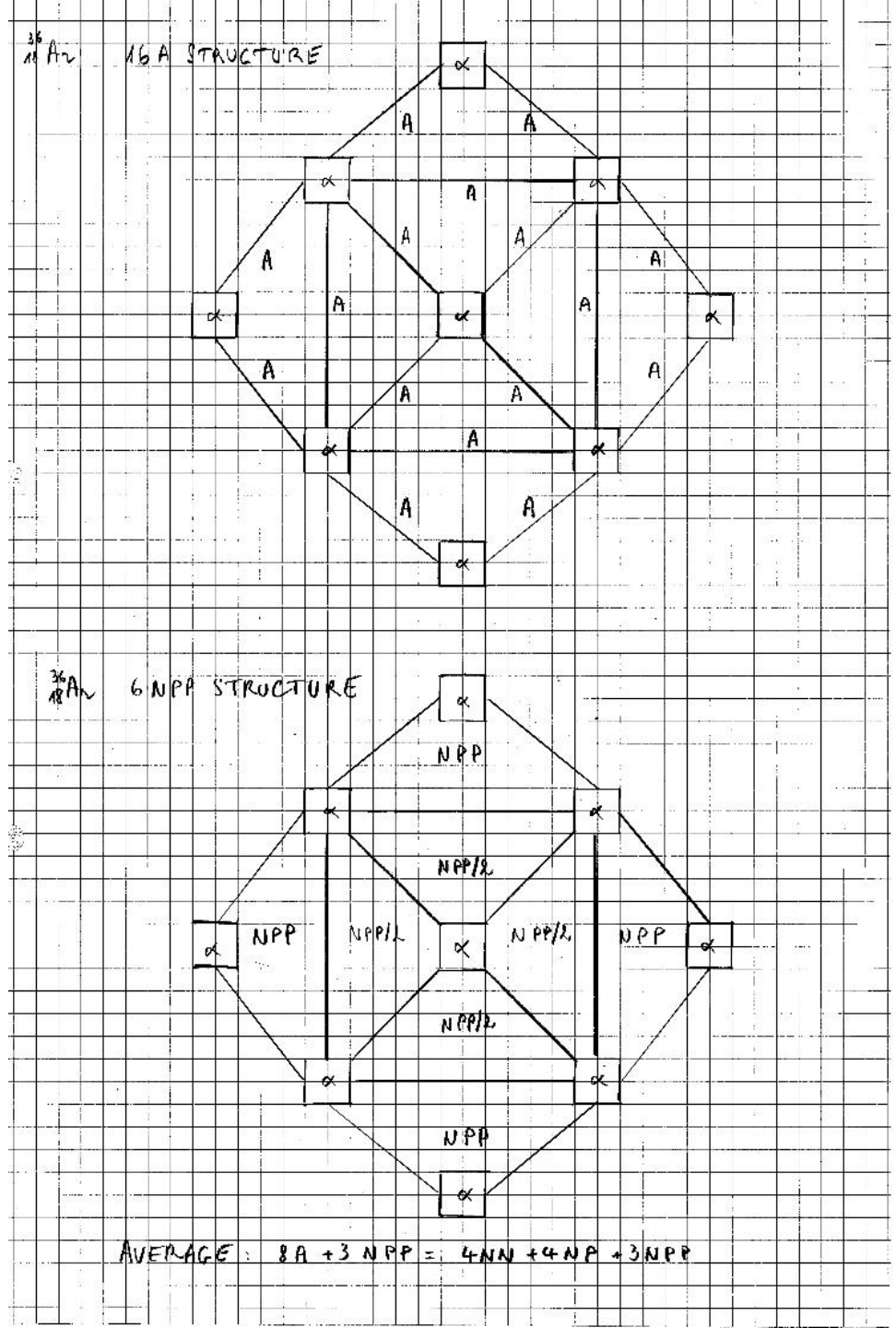


$E_B = 8E_B\alpha + 4A + 4NPP = 8E_B\alpha + 81.25 =$

271.7942 MeV
+0.014

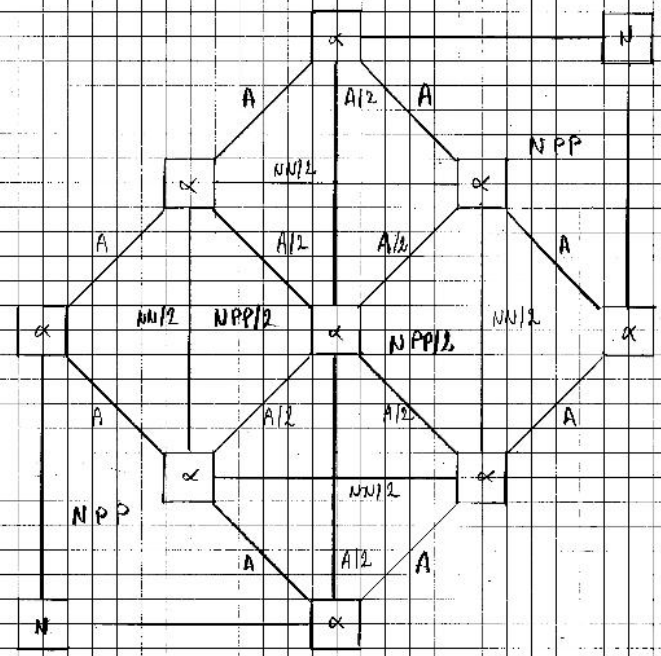
$A = NN/2 + NP/2 = 6.4375$

$NPP = 13.875$


16A STRUCTURE
A
6NPP STRUCTURE
NPP
NPP/2
AVERAGE: 8A + 3 NPP = 4NN + 4NP + 3NPP

$^{39}_{17}Ar$ 9α, 2N E_B in MeV = 327,3426

E_B 9 α 254,9250 MeV
7,5 NN 38,0238
5,5 NP 12,2353
3 NPP 23,1540
327,3381 MeV
− 0,005



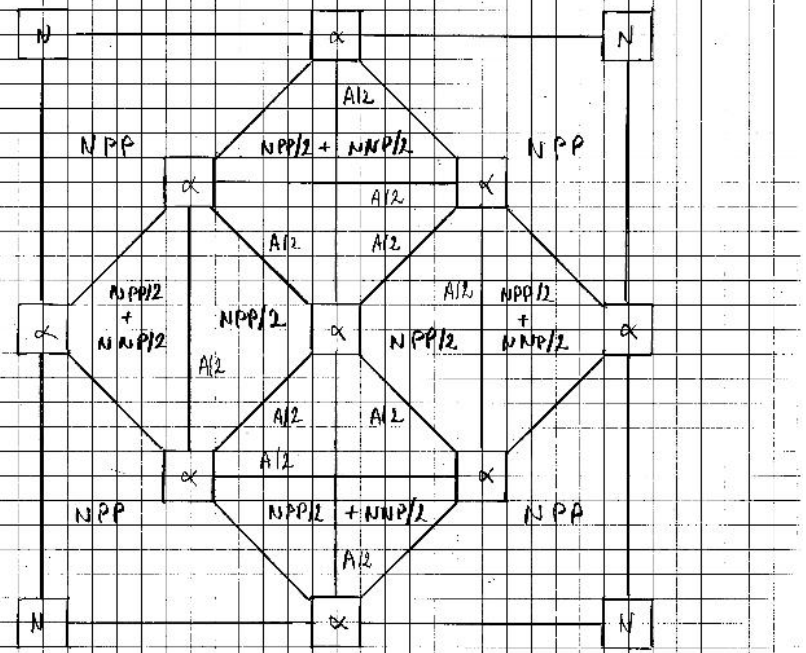
E_B = 9 E_B α + 11 A + 2 NN + 3 NPP = 9 E_B α + 130,1875 =

327,3381 MeV
− 0,005

A = NN/2 + NP/2 = 6,4375 NN = 8,875 NPP = 13,875

$^{40}_{18}Ar$ 9α $4N$ E_{bin} MeV = 343,8104

E_B	9α	254,9250	MeV
	2,5NN	12,3413	
	2,5NP	5,5615	
	2NNP	16,9636	
	7NPP	54,0260	
		343,8174	MeV
		+0,007	



$E_0 = 9E_{B\alpha} + 5A + 2NNP + 7NPP = 9E_{B\alpha} + 159,8125 =$

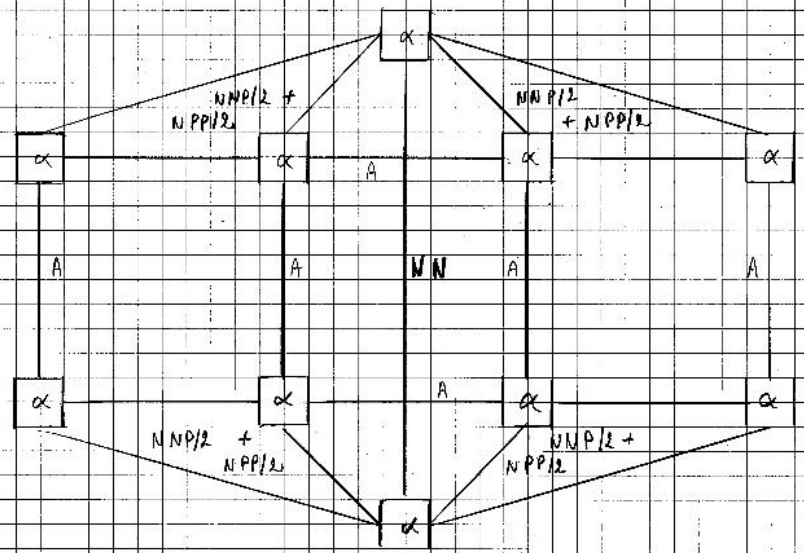
343,8174 MeV
+0,007

$A = NN/2 + NP/2 = 6,4375$ $NNP = 15,25$ $NPP = 13,875$

$^{40}_{20}Ca$ 10 α E_B in MeV = 342,052 2

E_B

10 α	283,250 0	MeV
4 NN	19,746 0	
3 NP	6,673 8	
2 NNP	16,963 6	
2 NPP	15,436 0	
	342,069 4	MeV
	+0,017	



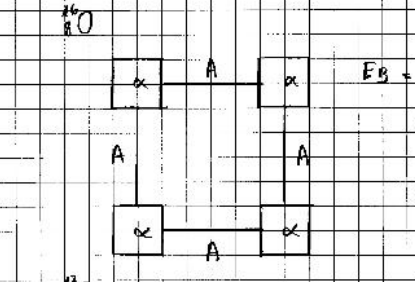
E_B = 10 E_B α + 6 A + NN + 2 NNP + 2 NPP =

10 E_B α + 105,75 = 342,069 4

+0,017

A = NN/2 + NP/2 NN = 8,875 NNP = 15,25 NPP = 13,875

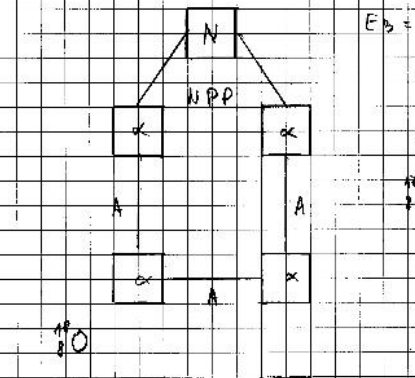
FROM O16 TO F19



$E_B = 4E_{B\alpha} + 4A = 4E_{B\alpha} + 25.75 =$

$127.6223\ MeV$
± 0.0103

$A = NM/2 + NP/2 = 6.4375$

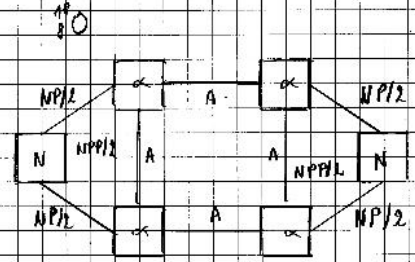


$E_B = 4E_{B\alpha} + 3A + NPP = 4E_{B\alpha} + 33.1875 =$

$131.7596\ MeV$
-0.003

$33.1875 = 25.75 + 13.875 - 6.4375$

$^{17}_{8}O = {}^{16}_{8}O - A + NPP$

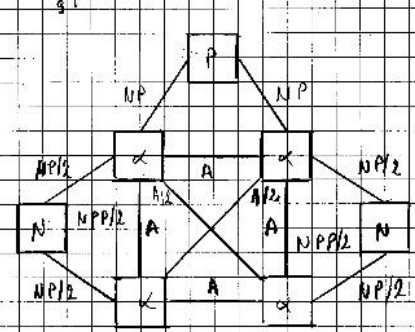


$E_B = 4E_{B\alpha} + 4A + 2NP + NPP =$

$4E_{B\alpha} + 47.625 = 139.7894\ MeV$
-0.018

$47.625 = 33.1875 + 6.4375 + 8$

$^{19}_{8}O = {}^{17}_{8}O + A + 2NP = {}^{16}_{8}O + NPP + 2NP$



$E_B = 4E_{B\alpha} + 5A + 4NP + NPP =$

$4E_{B\alpha} + 62.0625 = 147.8192\ MeV$
± 0.018

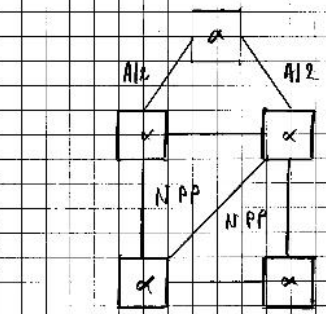
$62.0625 = 47.625 + 6.4375 + 8$

$^{19}_{9}F = {}^{16}_{8}O + A + 2NP$

$O16 = 4A + 4E_{B\alpha}$ $\quad F19 = 5A + 4NP + NPP + 4E_{B\alpha}$

FROM $^{20}_{10}Ne$ TO $^{23}_{11}Na$

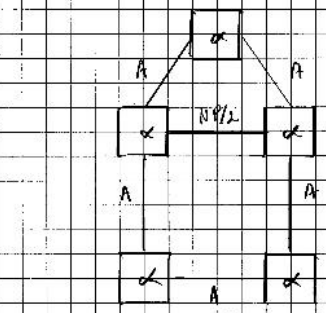
$^{20}_{10}Ne$



$E_B = 5E_{B\alpha} + A + 2NPP = 5E_{B\alpha} + 34,1875 =$

$160,6415$ MeV
$-0,003$

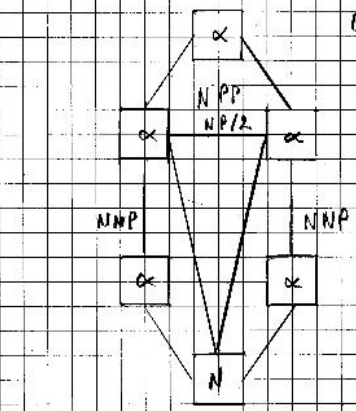
$^{20}_{10}Ne$ Variant



$E_B = 5E_{B\alpha} + 5A + 0,5NP = 5E_{B\alpha} + 34,1875 =$

$160,6401$ MeV
$-0,005$

$^{24}_{10}Ne$



$E_B = 5E_{B\alpha} + 0,5NP + 2NNP + NPP =$

$5E_{B\alpha} + 46,375 = 167,4189$ MeV
$+0,013$

$46,375 = 34,1875 + 12,1875 =$

$34,1875 + 6,4375 + 5,75 =$

$34,1875 + A + 1 + 2 \times 2,375 =$

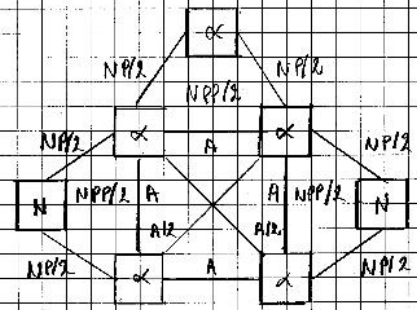
$0,5NP + 6A + 1 + 2 \times 2,375$

$2A + 1 = 13,875 = NPP$

$2A + 2,375 = 15,25 = NNP$

$E_B\,^{24}_{10}Ne = 0,5NP + 2NNP + NPP$
$+ 5E_{B\alpha}$

$^{22}_{10}Ne$



$E_B = 5E_B\alpha + 5A + 3NP + 1.5NPP =$

$5E_B\alpha + 65 = 177.7786\ MeV \pm 0.009$

$65 = 34.1875 + 30.8125 =$

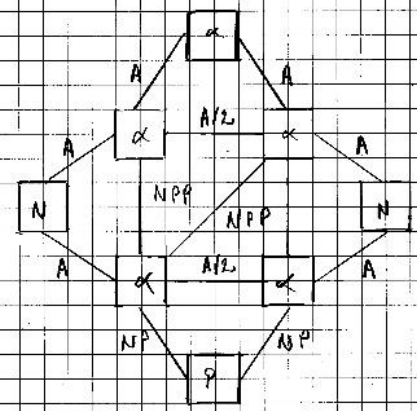
$5A + 32.8125$

$32.8125 = (1.5 \cdot 13.875) +$

$(3.4) = 1.5NPP + 3NP$

$E_B\ {}^{22}_{10}Ne = 5A + 1.5NPP + 3NP + 5E_B\alpha$

$^{23}_{11}Na$



$E_B = 5E_B\alpha + 7A + 2NP + 2NPP =$

$5E_B\alpha + 80.8125 =$

$186.5741\ MeV \pm 0.010$

$80.8125 = 65 + 15.8125 =$

$65 + 8.875 + 0.5 \cdot 13.875 =$

$5A + 3NP + NN + 1.5NPP +$

$0.5NPP = 7A + 2NP + 2NPP$

$E_B\ {}^{23}_{11}Na = 7A + 2NP + 2NPP + 5E_B\alpha$

$Ne\ 20 = 2NPP + A + 5E_B\alpha$

$Na\ 23 = 2NPP + 7A + 2NP + 5E_B\alpha$

5. According to the hypothesis developed above the nuclei of the various elements are constituted out of α particles and other nucleons grouped in order to form sub nuclei bound together by four types of bonds, NN, NP, NNP, NPP.

6. The binding energies of Deuterium (NP), Tritium (NNP), He3 (NPP) and NN are linked together through the following equations:
EB Tritium (NNP) = 2NN – 1.25/2 NP
EB He3 (NPP) = NN + 1.25 NP
2 NN being the neutronic part of the binding energy of α particle.

7. One can now start the study of all other nuclei. It will be shown that bonds like α particle ones or H2(NP), H3(NNP), He3(NPP) ones are sufficient to explain the binding energy values of all nuclei, which pleads for the predominance of the α particle in the structure of the nuclei.