Part 5

Chapters 11 to 13

Philippe Hatt

CHAPTER 11

**HAFNIUM AND TANTALUM, TUNGSTEN AND RHENIUM,
OSMIUM AND IRIDIUM, PLATINUM AND GOLD**

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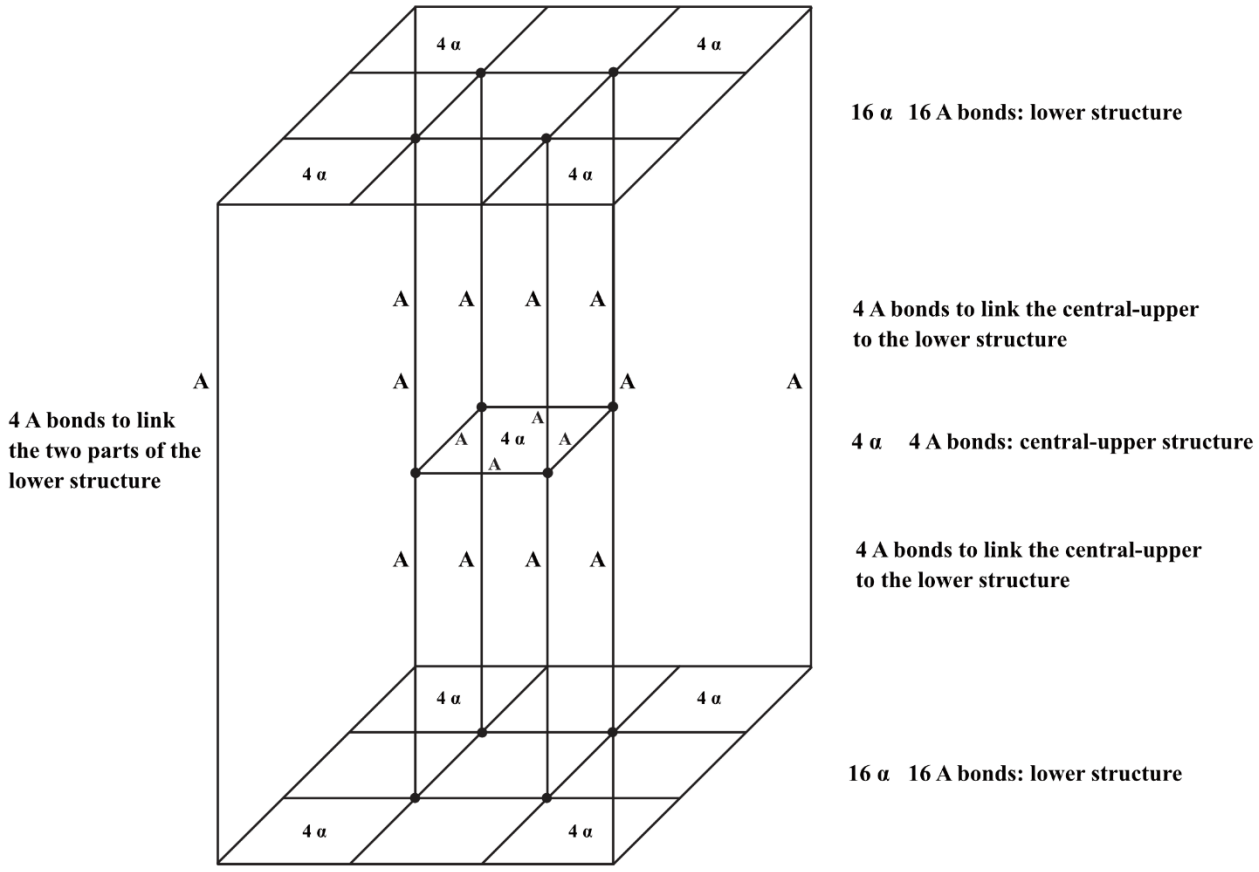
1. Core structure of Hafnium (72 Hf) and Tantalum (73 Ta)

After the Lanthanides series there is Hafnium with 36 α in its core. There are 6 stable isotopes of Hafnium, Hf 180 being the most common in nature. Tantalum has also 36 α in its core, Ta 181 being the isotope with 99.99% occurrence.
The 36 α core structure is different from that of the former Lanthanide ones.
There are three substructures linked (16 α – 4 α – 16 α) together in the following way.

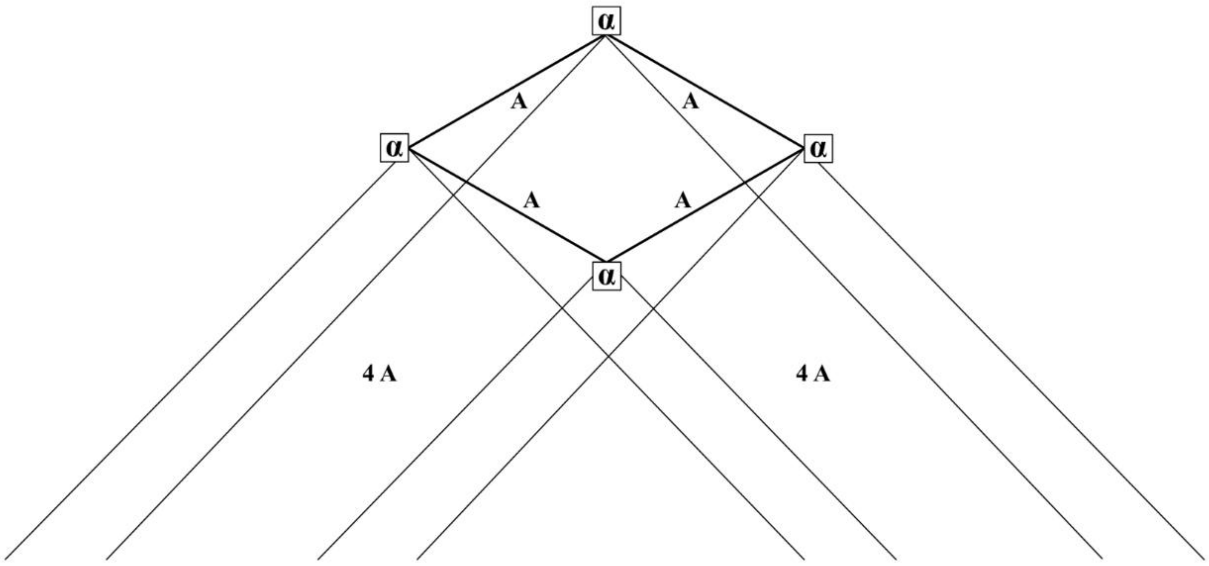
Figure 1



In total 48 A bonds, i.e. (24 NN + 24 NP) bonds.
So, the core structure is constituted with 36 α and 48 A bonds.
This figure is detailed in the following figures 1 bis and 1 ter.

Figure 1 bis

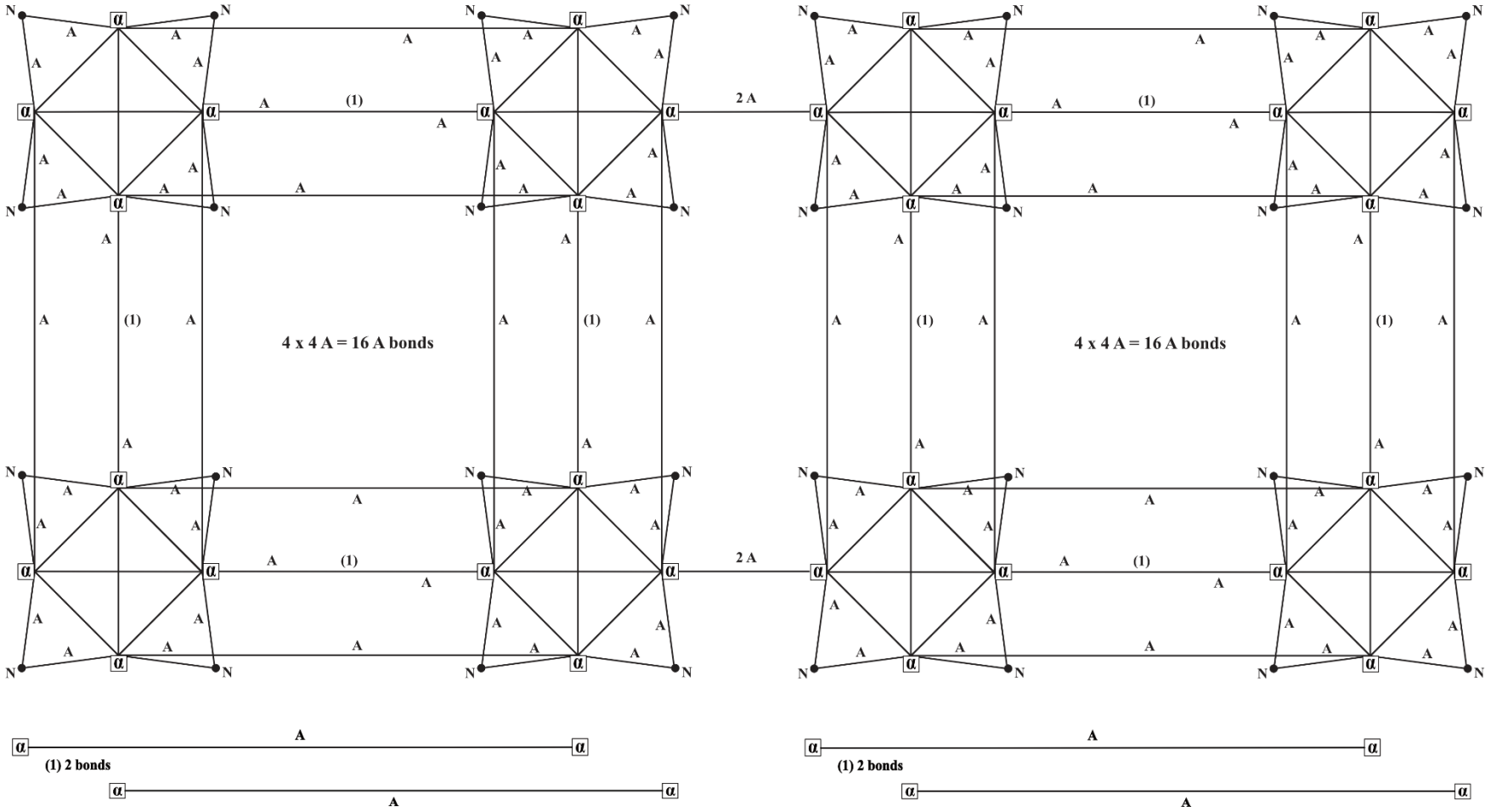
Hf – Central-upper structure



These twice four A bonds are linking the four α particles of the central-upper structure to twice four α particles of the lower structure.

Figure 1 ter

Hf - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with mainly 2A bonds. They are also linked together with the 2 x 16A bonds of the lower structure. Also, the two parts of the lower structure are linked together with 2 x 2 A bonds.

2. Binding energy of Hafnium and Tantalum

Summary table of the N and P supplementary binding energy of all stable Hf and Ta nuclides.

Nucleus	N	P	NN	NP	NNP	NPP	NP (P)	NPP (P)
Hf 174	30	0	29.5	30	0	0	0	
Hf 176	32	0	30.5	31	0	1	0	
Hf 177	33	0	32	34	0	0	0	
Hf 178	34	0	34	33	0	0	0	
Hf 179	35	0	34	34	0	0.5	0	
Hf 180	36	0	33	34	1	1	0	
Ta 180	35	1	33	34	1	0	1	0.5
Ta 181	36	1	35.5	35.5	0.5	0	1	0

In case of Hf 174 the lower structure is not completely saturated: only 30 N supplementary are binding with the α particles. Out of these 30 N, 29 are bound with 2 A (NN + NP) the last one is bound with NN/2 and NP bonds or (A + NP/2) bond (figures 2 and 2 bis).

In case of Hf 176 the lower structure is saturated with 32 N supplementary bound with 32 α particles. Out of these 32 N, 30 are bound with 2 A bonds, 1 with 1 NPP bond, the last one with (A + NP/2) bond as the last one of Hf 174 (figures 3 and 3 bis).

In case of Hf 177, the lower structure is completely saturated with 32 x 2A bonds.
The central-upper structure has one N supplementary bound with 2 NP bonds to 2 α particles (figures 4 and 4 bis).

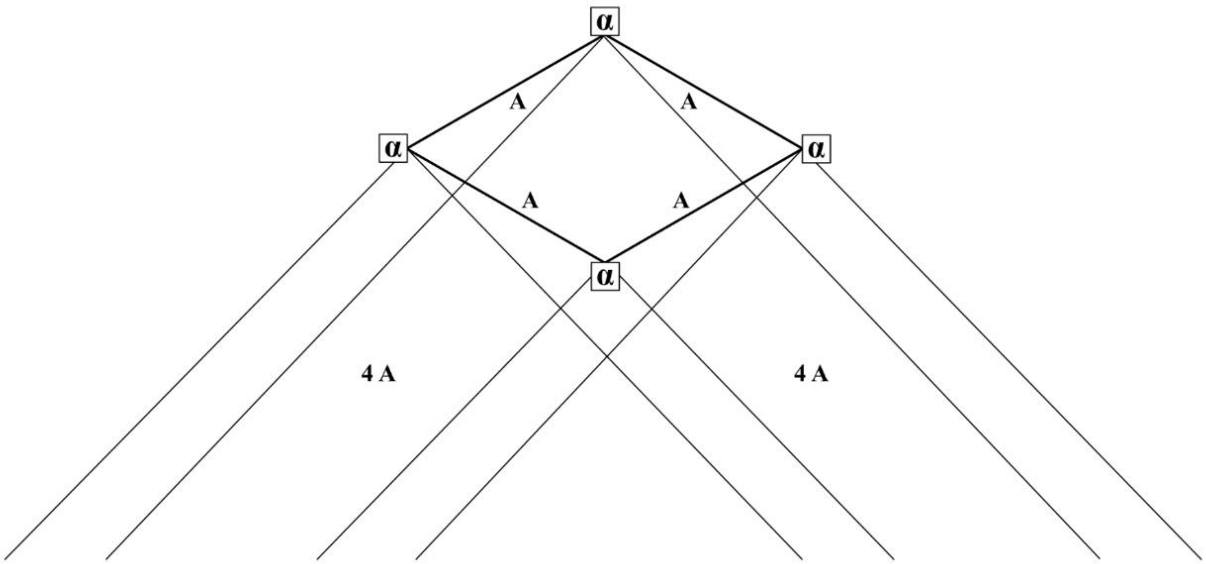
In case of Hf 178, 179, and 180, the central-upper structure is progressively saturated with N supplementary bound with 2 A bonds or others. The lower structure is completely saturated with 32 x 2 A bonds (figures 5 to 7 bis).

Hf 180 has 32 x 2 A bonds (lower structure) and 1 NNP, 1 NPP, 2 A, and 1 NP bonds for 4 N supplementary on the central-upper structure.
Comparing Hf 180 and Ta 180, the only difference is that 1 N of Hf 180 bound with 1 NPP bond is replaced with 1 P of Ta 180 bound alternately with 1 NPP and 2 NP i.e. (NPP/2 + NP) bonds (figures 8 and 8 bis).

In case of Ta 181, 4 N supplementary are bound to the 4 α particles with 3 x 2 A bonds and (A + NNP/2) bonds. The last N supplementary is bound to the P with one NP bond (figures 9 and 9 bis).

Figure 2

Hf 174 – Central-upper structure



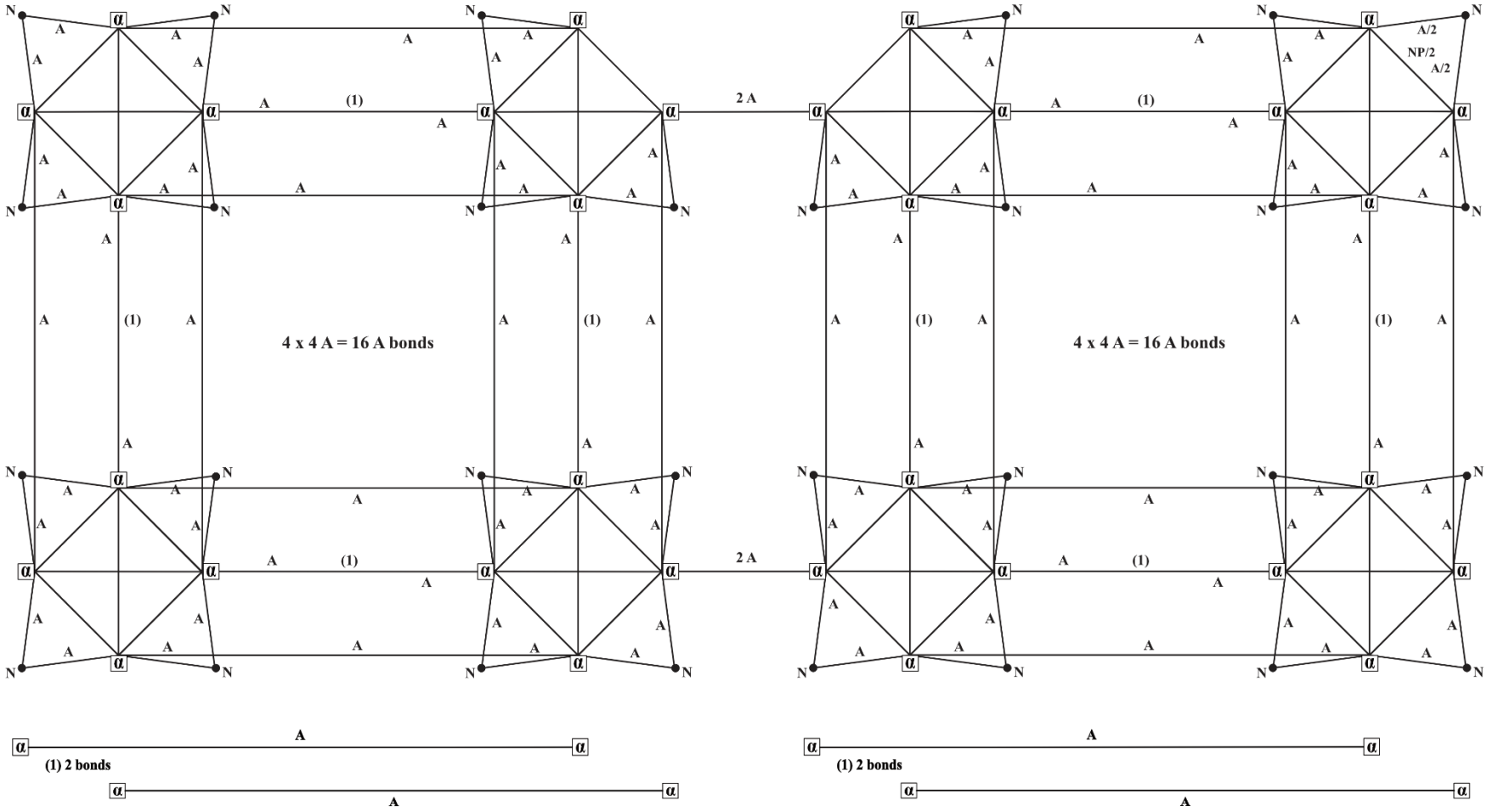
These twice four A bonds are linking the four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{174}_{72}$**Hf** Nat. abundance: 0.2% 36 α, 30 N suppl. E_B in MeV = 1,403.9247 MeV

	E_B	36 α	x	28.325	1,019.7000 MeV
		24	x	4.9365	118.4760
Core		24	x	2.2246	53.3904
30 N suppl.		29.5	x	4.9365	145.6268
		30	x	2.2246	66.7380
					1,403.9312 MeV
					+ 0.007

Figure 2 bis

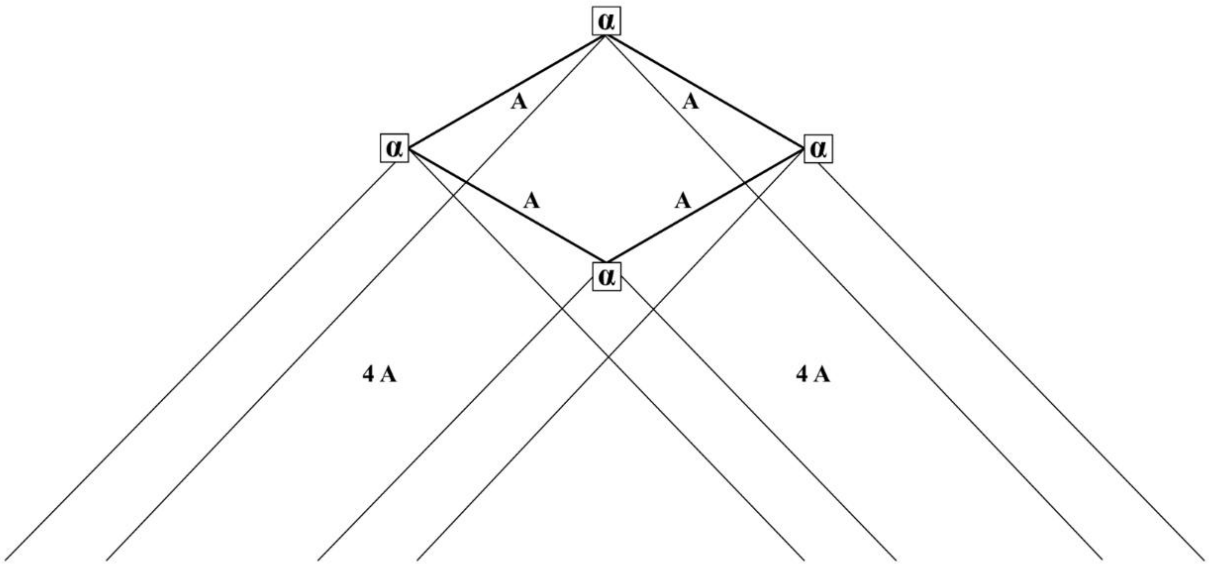
Hf 174 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with either 2A bonds or other bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 3

Hf 176 – Central-upper structure



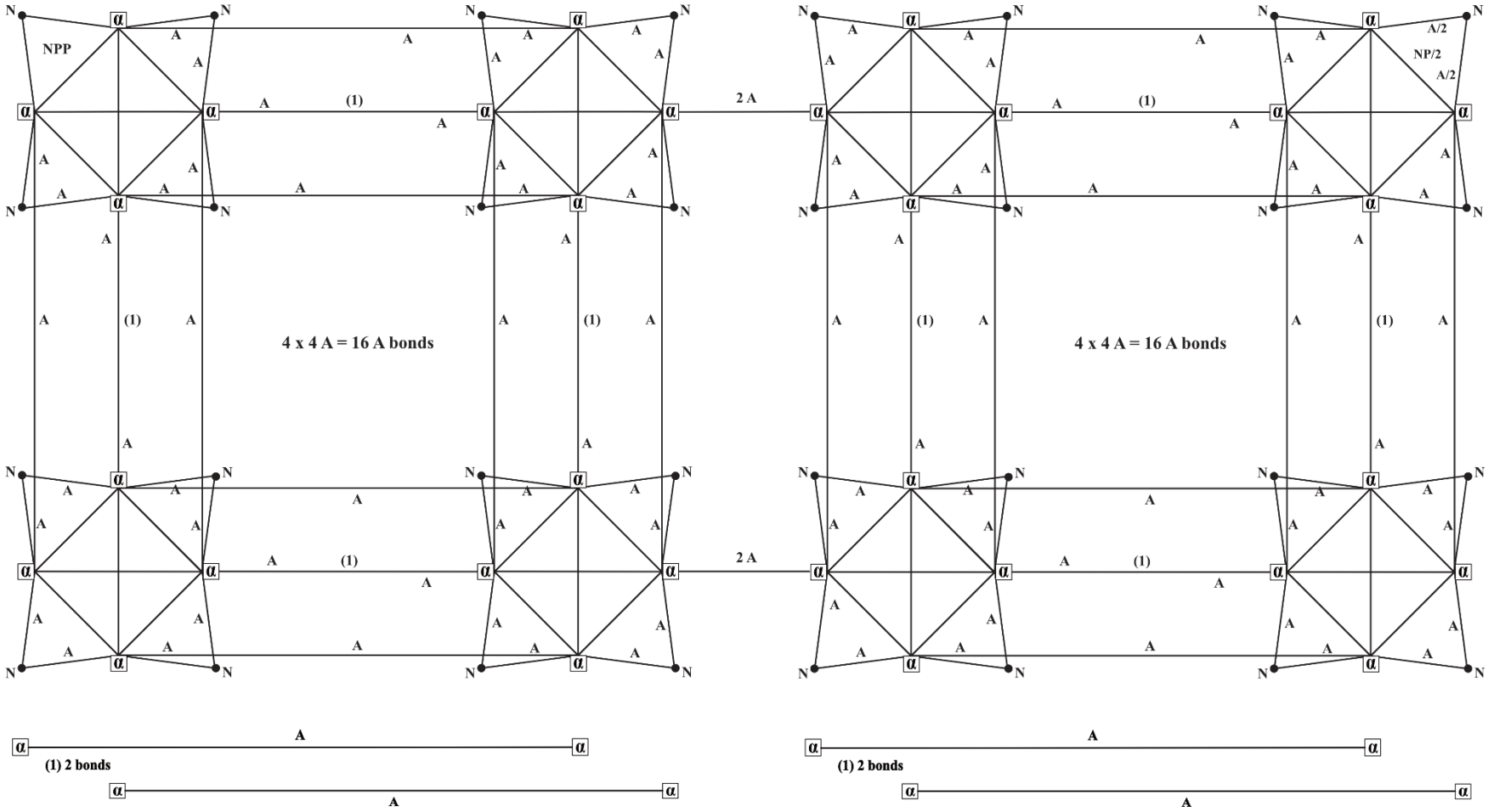
These twice four A bonds are linking the four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{176}_{72}$**Hf** Nat. abundance: 5.2% 36 α, 32 N suppl. E_B in MeV = 1,418.7992 MeV

	E_B	36 α	x	28.325	1,019.7000	MeV
		24	x	4.9365	118.4760	
	Core	24	x	2.2246	53.3904	
	32 N suppl.	30.5	x	4.9365	150.5633	
		31	x	2.2246	68.9626	
		1	x	7.7180	7.7180	
					1,418.8103	MeV
					+ 0.011	

Figure 3 bis

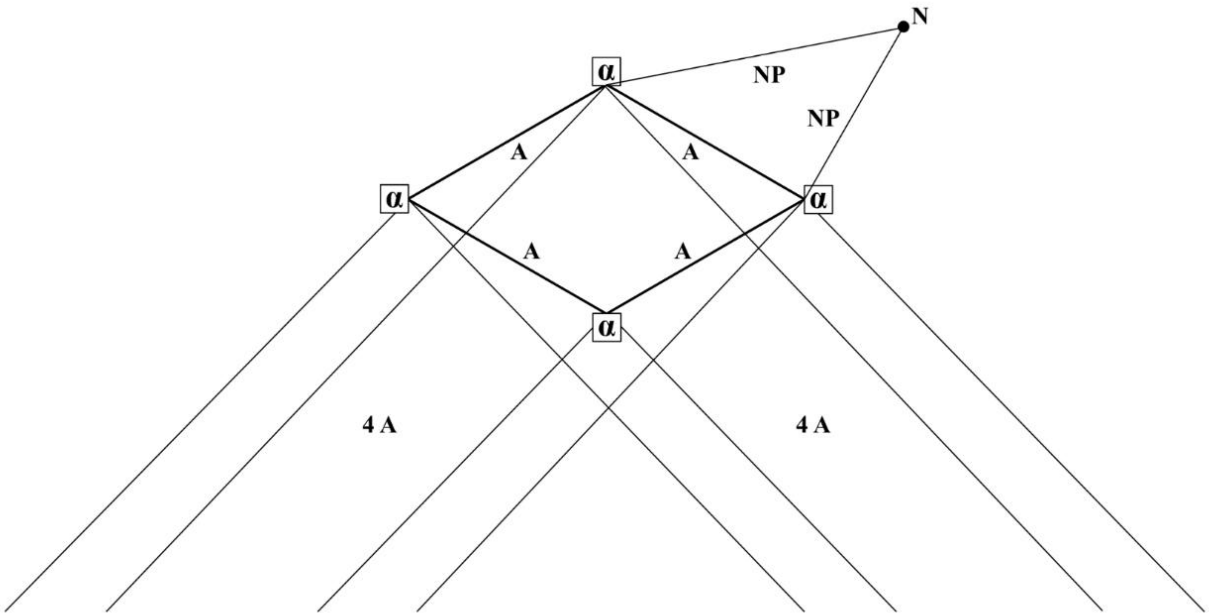
Hf 176 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with either 2A bonds or other bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 4

Hf 177 – Central-upper structure



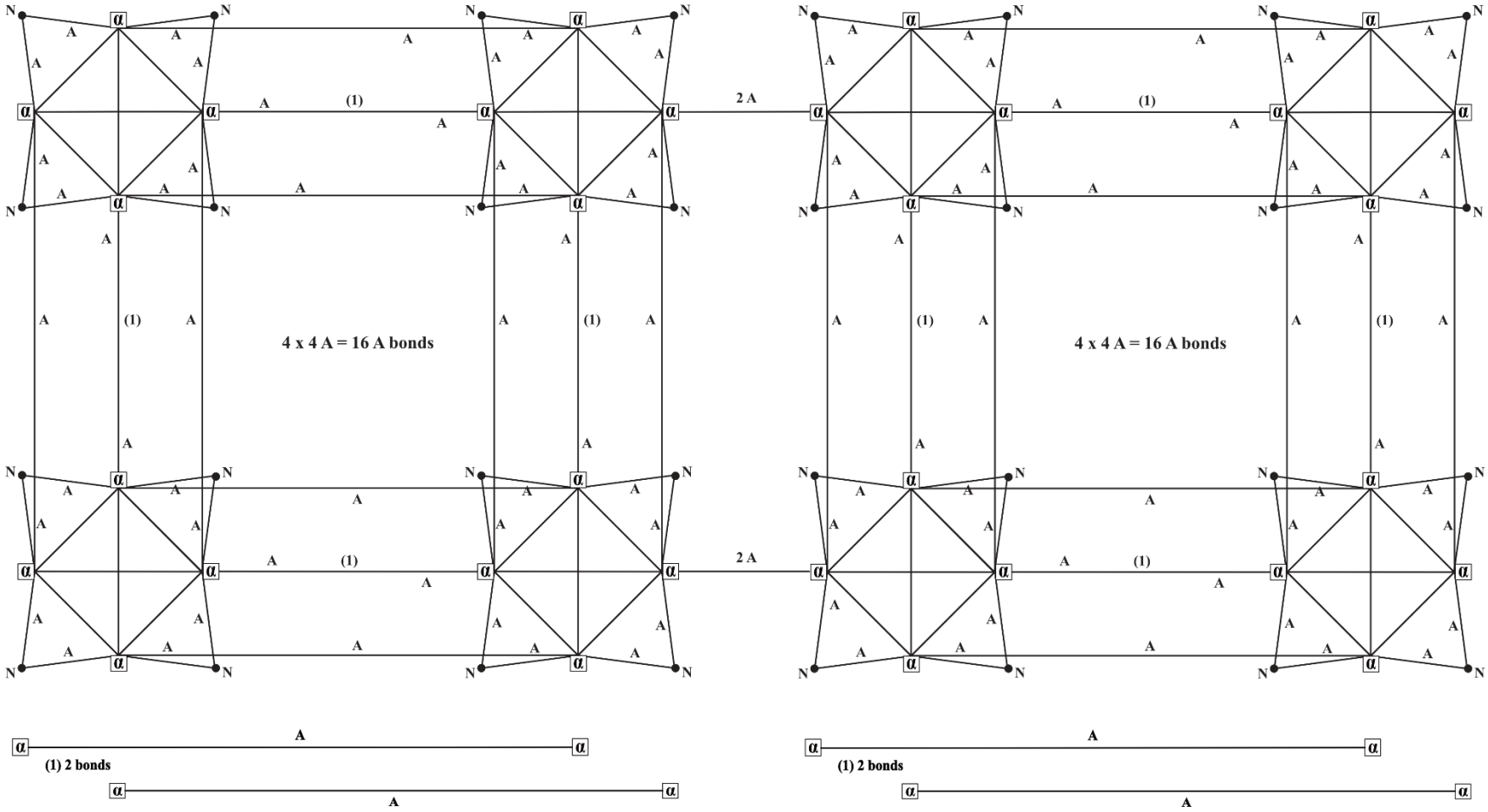
These twice four A bonds are linking the four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{177}_{72}$**Hf** Nat. abundance: 18.5% 36 α, 33 N suppl. E_B in MeV = 1,425.1748 MeV

	E_B	36 α	x	28.325	1,019.7000	MeV
		24	x	4.9365	118.4760	
Core		24	x	2.2246	53.3904	
33 N suppl.		32	x	4.9365	157.9680	
		34	x	2.2246	75.6364	
					1,425.1708	MeV
					- 0.004	

Figure 4 bis

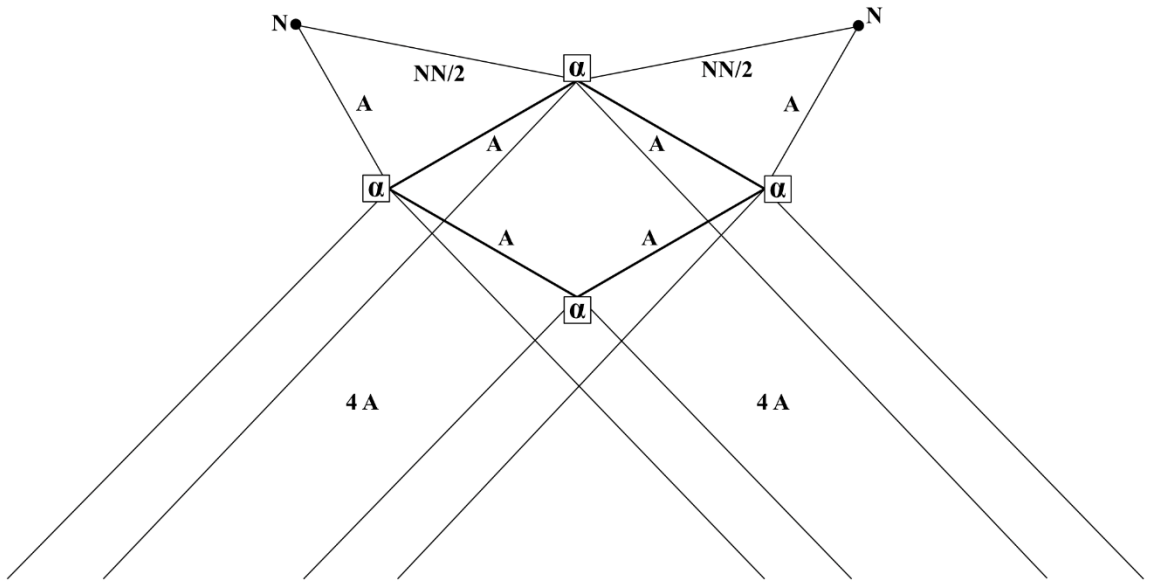
Hf 177 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 5

Hf 178 – Central-upper structure



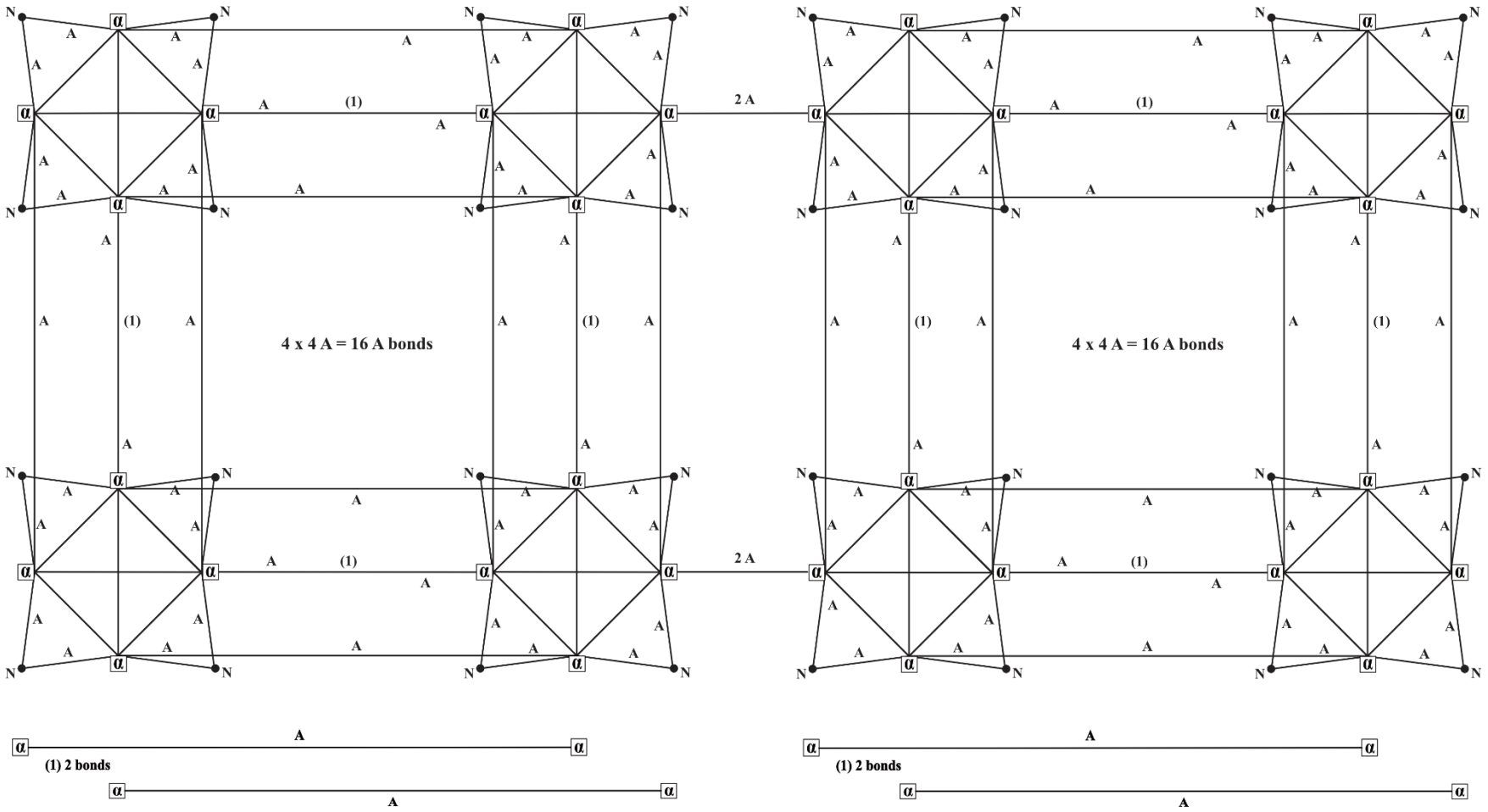
These twice four A bonds are linking the four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{178}_{72}$**Hf** Nat. abundance: 27.1% 36 α, 34 N suppl. E_B in MeV = 1,432.8007 MeV

	E_B	36 α	x	28.325	1,019.7000	MeV
		24	x	4.9365	118.4760	
Core		24	x	2.2246	53.3904	
34 N suppl.		34	x	4.9365	167.8410	
		33	x	2.2246	73.4118	
					1,432.8192	MeV
					+ 0.019	

Figure 5 bis

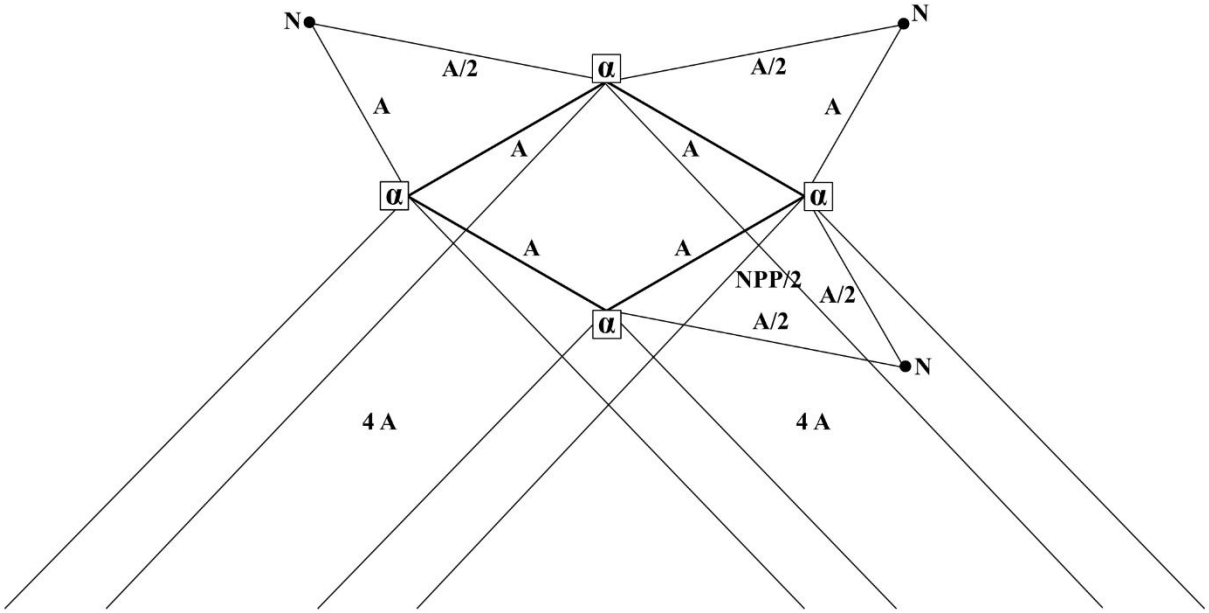
Hf 178 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 6

Hf 179 – Central-upper structure



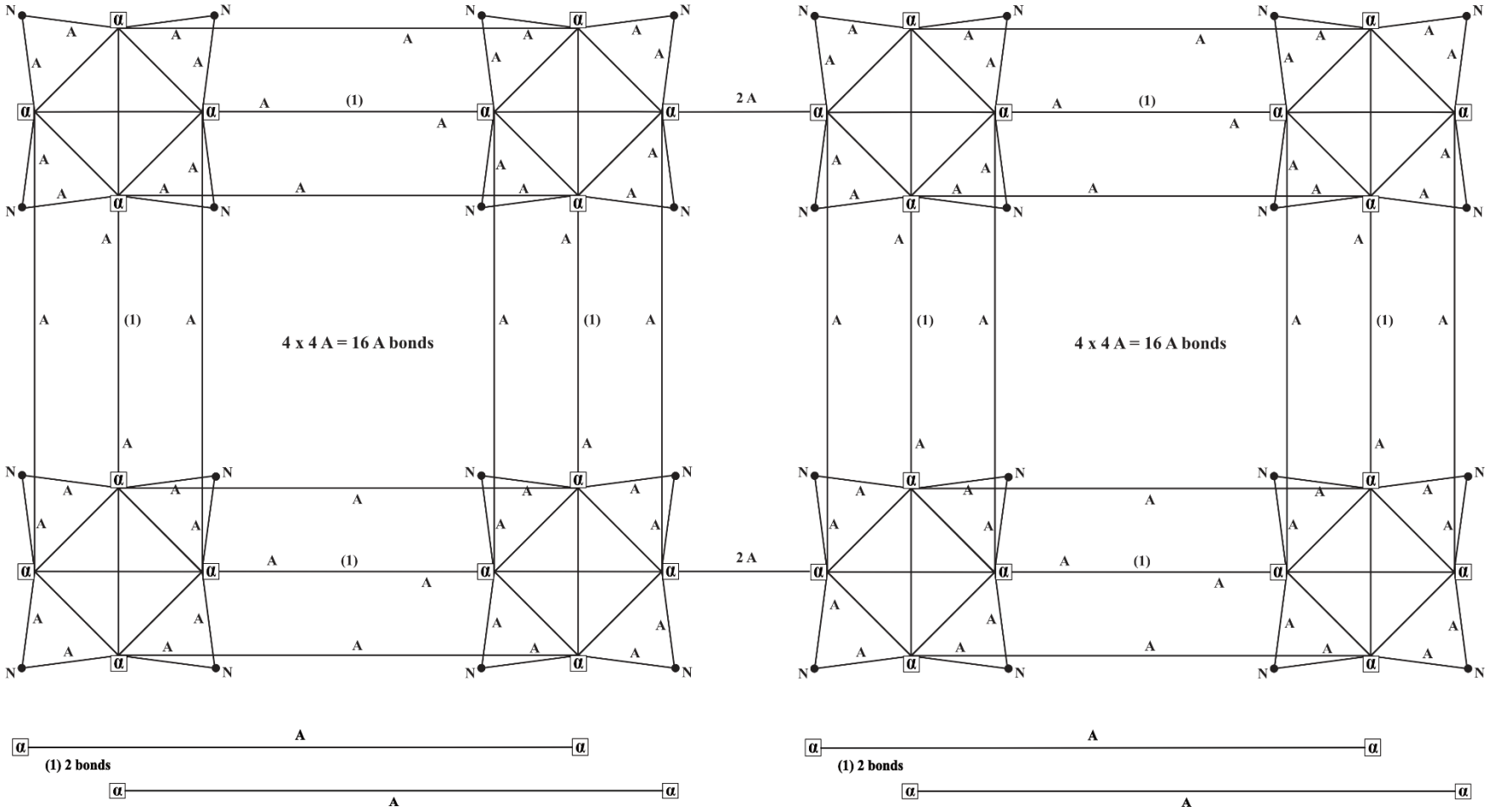
These twice four A bonds are linking the four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{179}_{72}$**Hf** Nat. abundance: 13.8% 36 α, 35 N suppl. E_B in MeV = 1,438.8997 MeV

	E_B	36 α	x	28.325	1,019.7000	MeV
		24	x	4.9365	118.4760	
	Core	24	x	2.2246	53.3904	
	35 N suppl.	34	x	4.9365	167.8410	
		34	x	2.2246	75.6364	
		0.5	x	7.7180	3.8590	
					1,438.9028	MeV
					+ 0.003	

Figure 6 bis

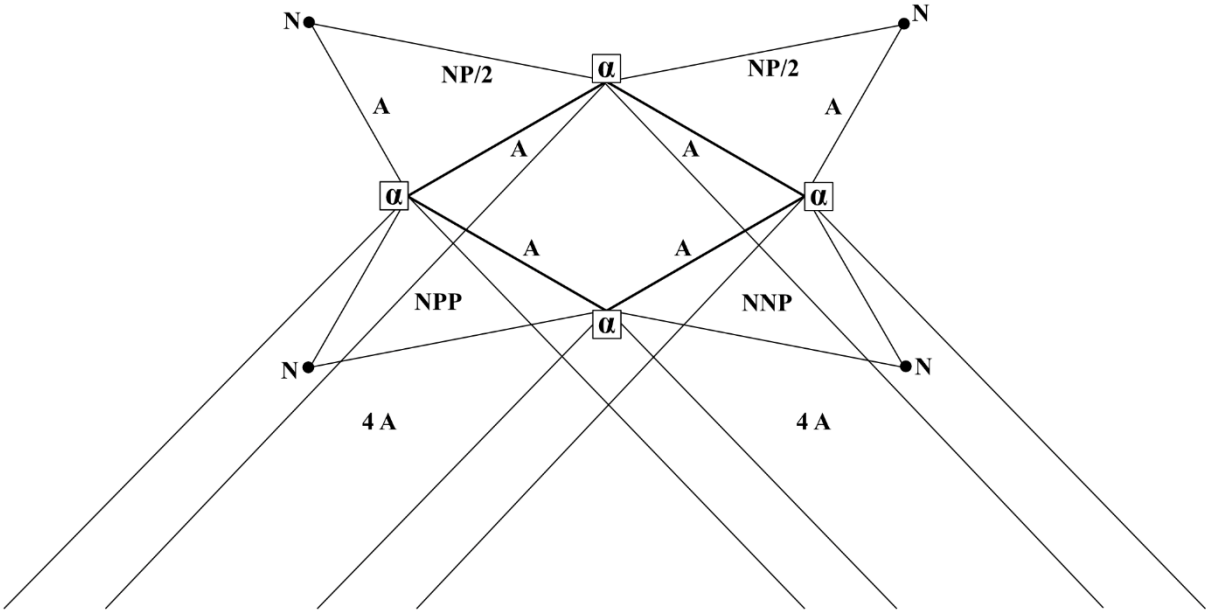
Hf 179 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 7

Hf 180 – Central-upper structure



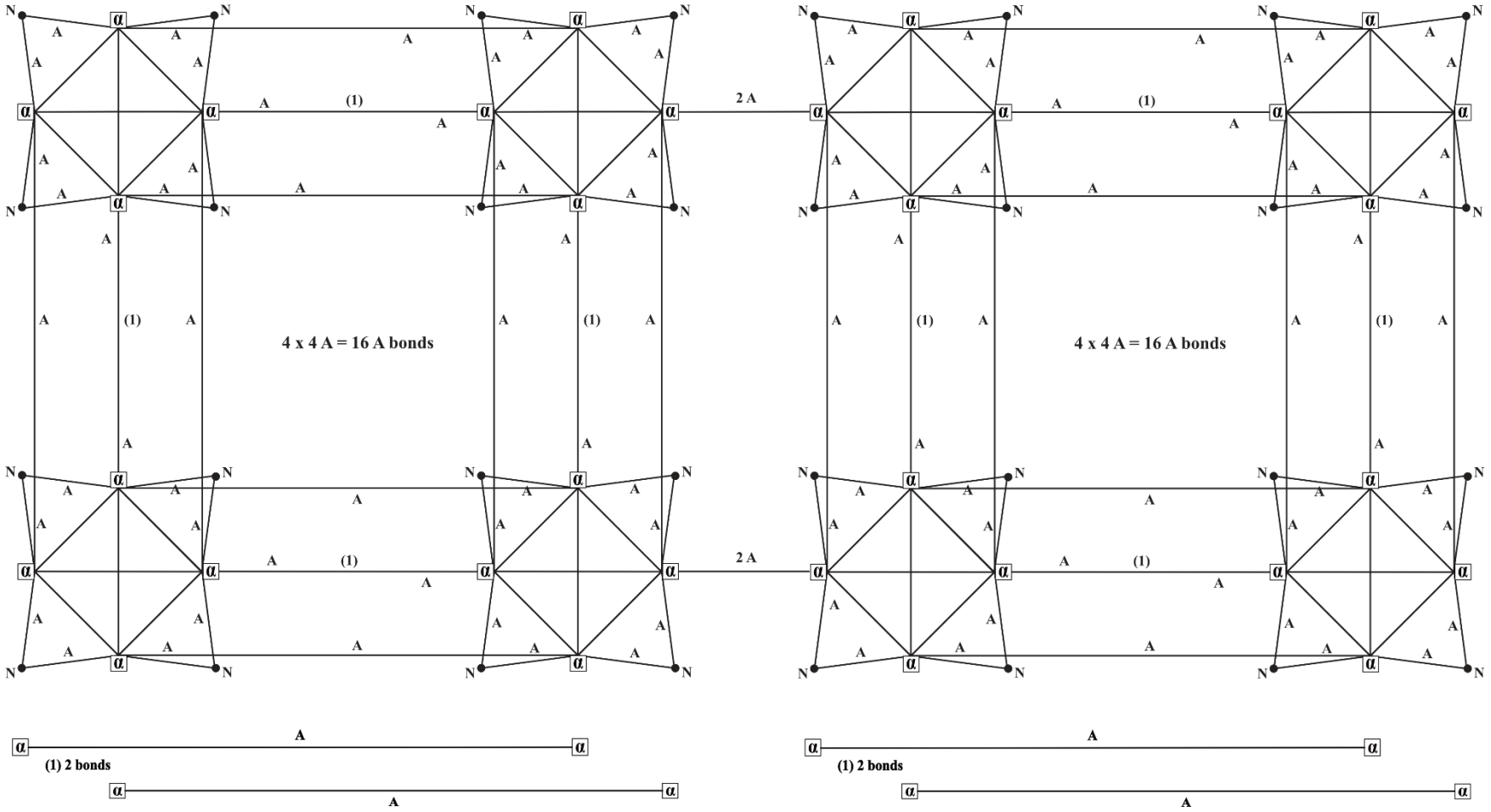
These twice four A bonds are linking the four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{180}_{72}$**Hf** Nat. abundance: 35.2% 36 α, 36 N suppl. E_B in MeV = 1,446.2874 MeV

E_B	36 α	x	28.325	1,019.7000	MeV
	24	x	4.9365	118.4760	
Core	24	x	2.2246	53.3904	
.	33	x	4.9365	162.9045	
36 N suppl	34	x	2.2246	75.6364	
	1	x	8.4818	8.4818	
	1	x	7.7180	7.7180	
				1,446.3071	MeV
				+ 0.020	

Figure 7 bis

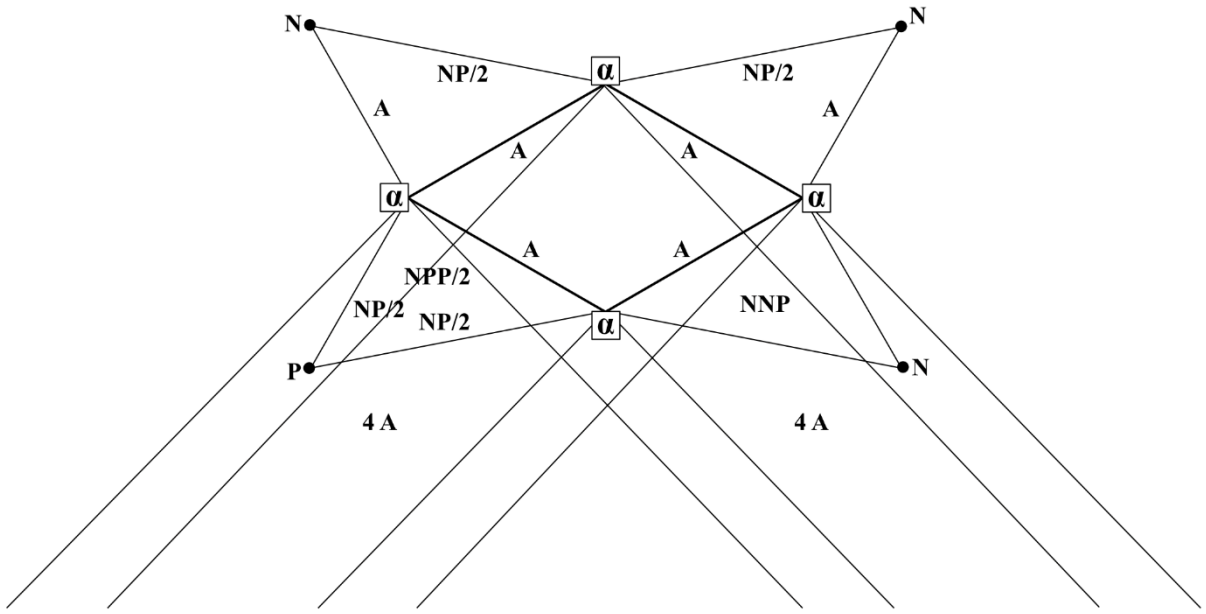
Hf 180 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 8

Ta 180 – Central-upper structure



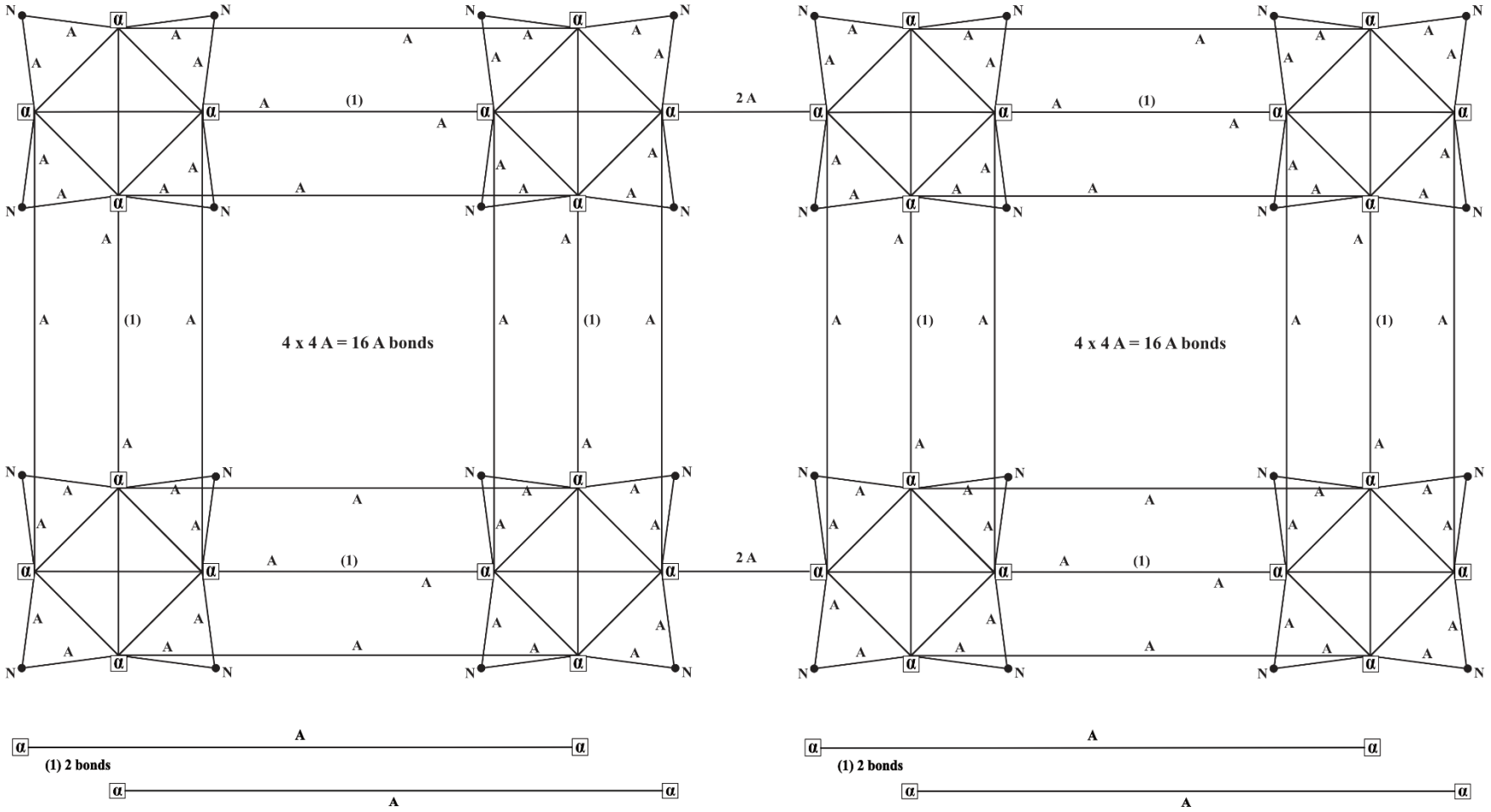
These twice four A bonds are linking the four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{180}_{73}$**Ta** Nat. abundance: 0.012% 36 α, 35N, 1P suppl. E_B in MeV = 1,444.6586 MeV

	E_B	36 α	x	28.325	1,019.7000	MeV
		24	x	4.9365	118.4760	
Core		24	x	2.2246	53.3904	
.		33	x	4.9365	162.9045	
35 N, 1 P suppl		35	x	2.2246	77.8610	
		1	x	8.4818	8.4818	
		0.5	x	7.7180	3.8590	
					1,444.6727	MeV
					+ 0.014	

Figure 8 bis

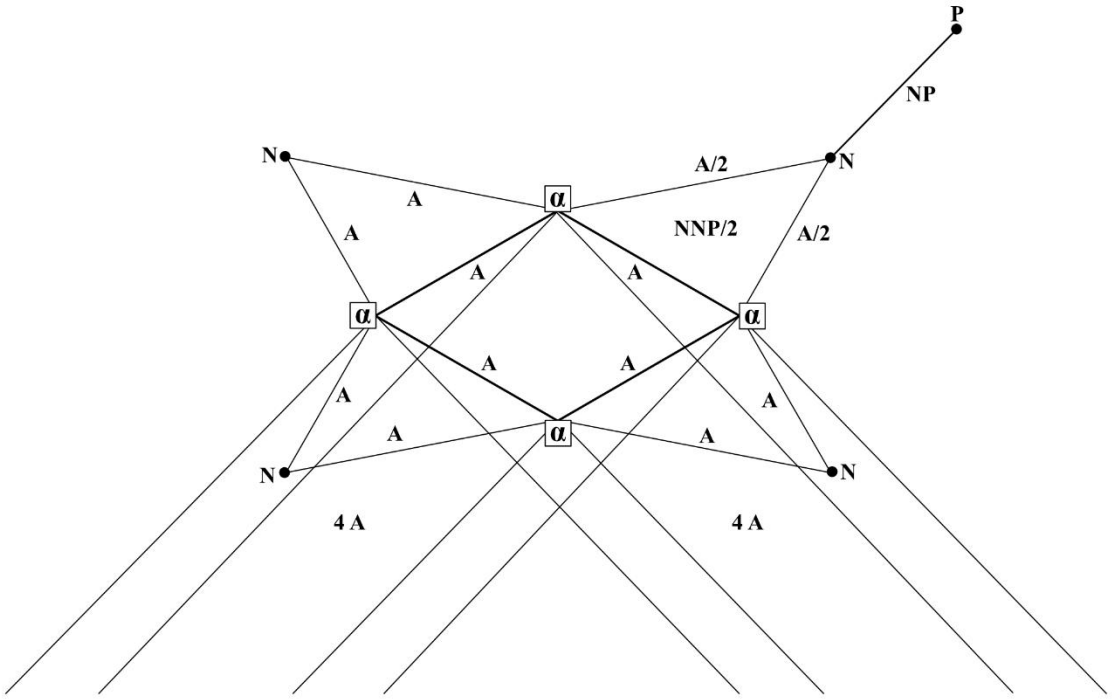
Ta 180 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 9

Ta 181 – Central-upper structure



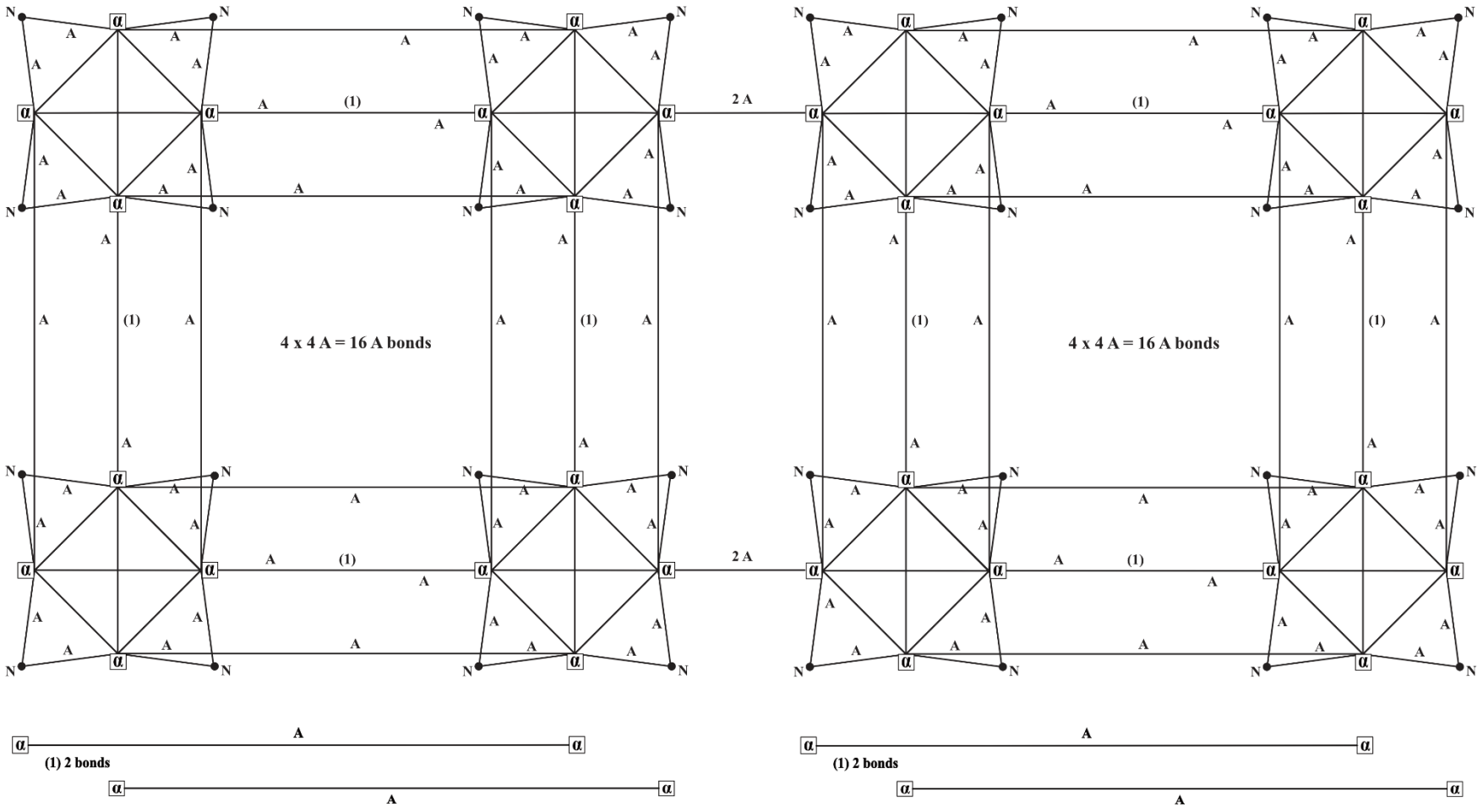
These twice four A bonds are linking the four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{181}_{73}$**Ta** Nat. abundance: 99.988% 36 α, 36N, 1P suppl. E_B in MeV = 1,452.2354 MeV

	E_B	36 α	x	28.325	1,019.7000	MeV
		24	x	4.9365	118.4760	
Core		24	x	2.2246	53.3904	
.		35.5	x	4.9365	175.2458	
36 N, 1 P suppl		36.5	x	2.2246	81.1979	
		0.5	x	8.4818	4.2409	
					1,452.2510	MeV
					+ 0.016	

Figure 9 bis

Ta 181 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

3. Core structure of Tungsten (74 W) and Rhenium (75 Re)

These two elements have the following core structure: 37 α particles linked with 46 A (23 NN + 23 NP). There are three substructures (16 α – 5 α – 16 α) linked together in the following way.

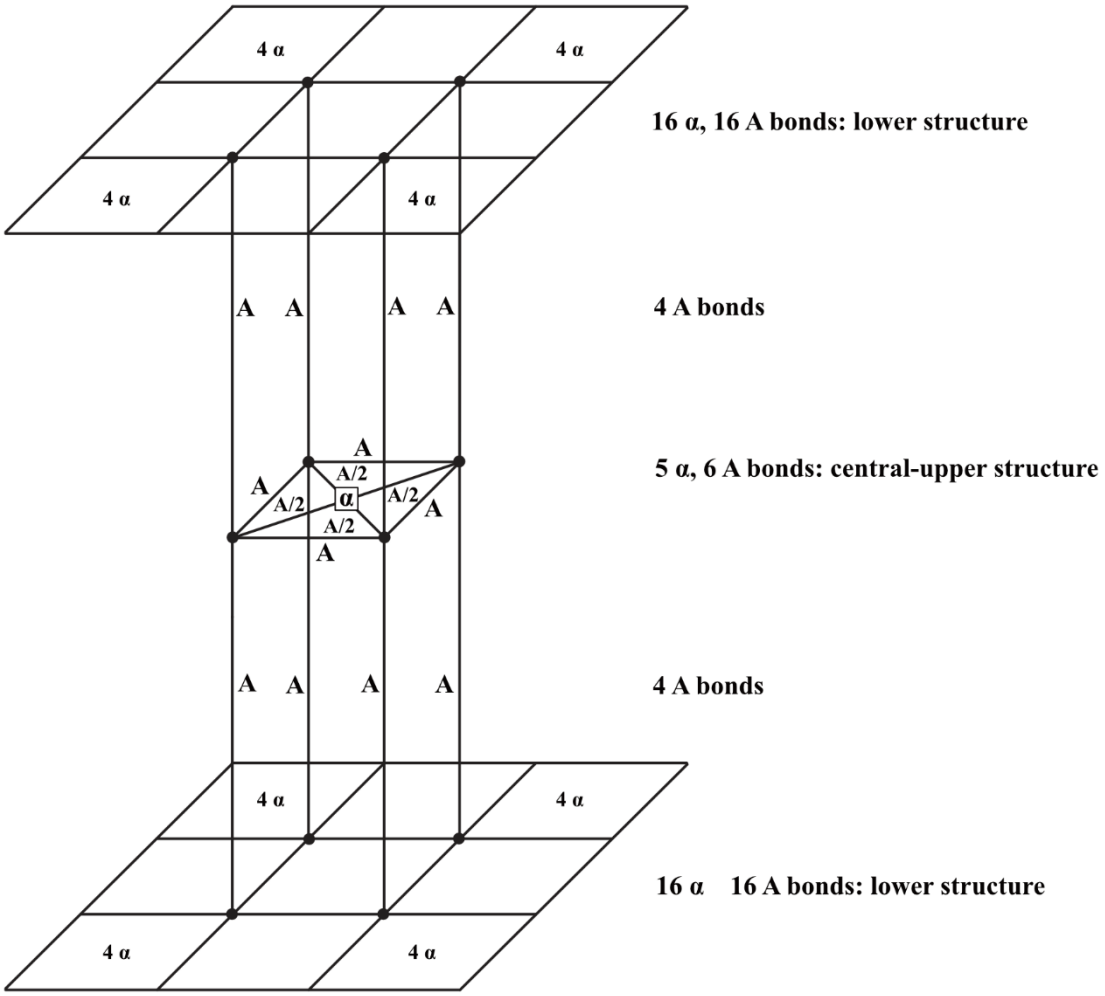
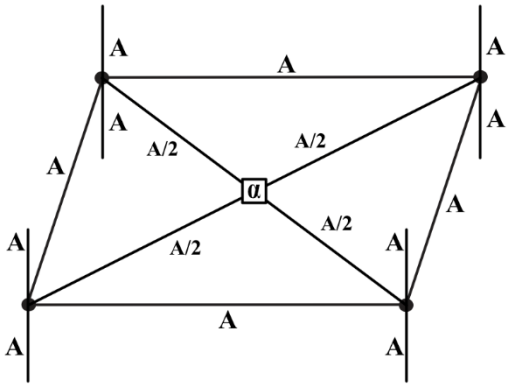


Figure 1

W 180 – Central-upper structure



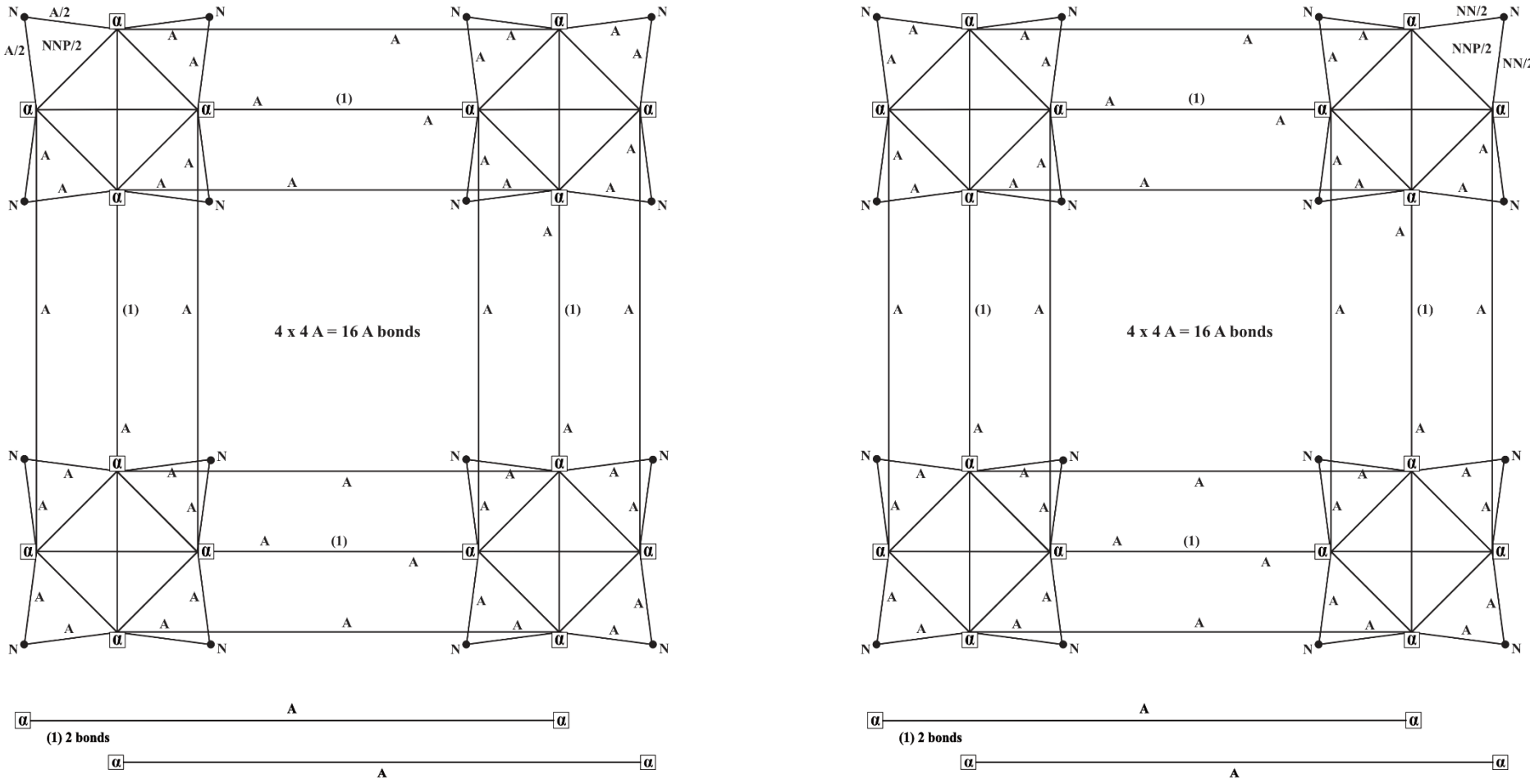
These 4 x 2 A bonds are linking the central-upper structure to twice four α particles of the lower structure.

$^{180}_{74}$W Nat. abundance: 0.1% 37 α, 32 N suppl. E_B in MeV = 1,444.5796 MeV

	E_B	37 α	x	28.325	1,048.0250 MeV
		23	x	4.9365	113.5395
Core		23	x	2.2246	51.1658
.		31.5	x	4.9365	155.4998
32 N suppl		30.5	x	2.2246	67.8503
		1	x	8.4818	8.4818
					1,444.5622 MeV
					- 0.017

Figure 1 bis

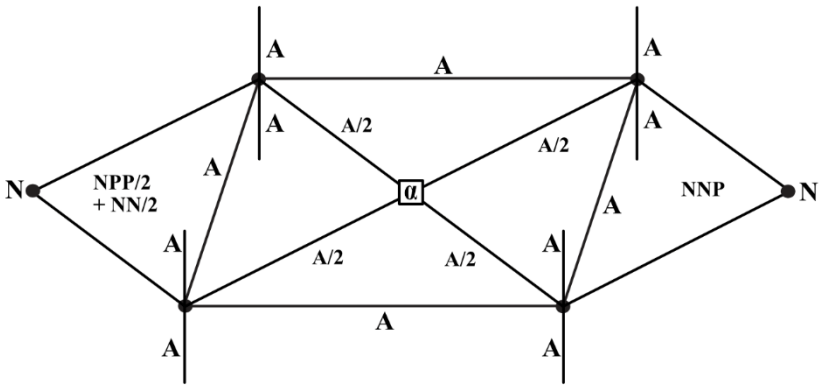
W 180 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds or (NNP/2 + A) and (NNP/2 + NN) bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 2

W 182 – Central-upper structure



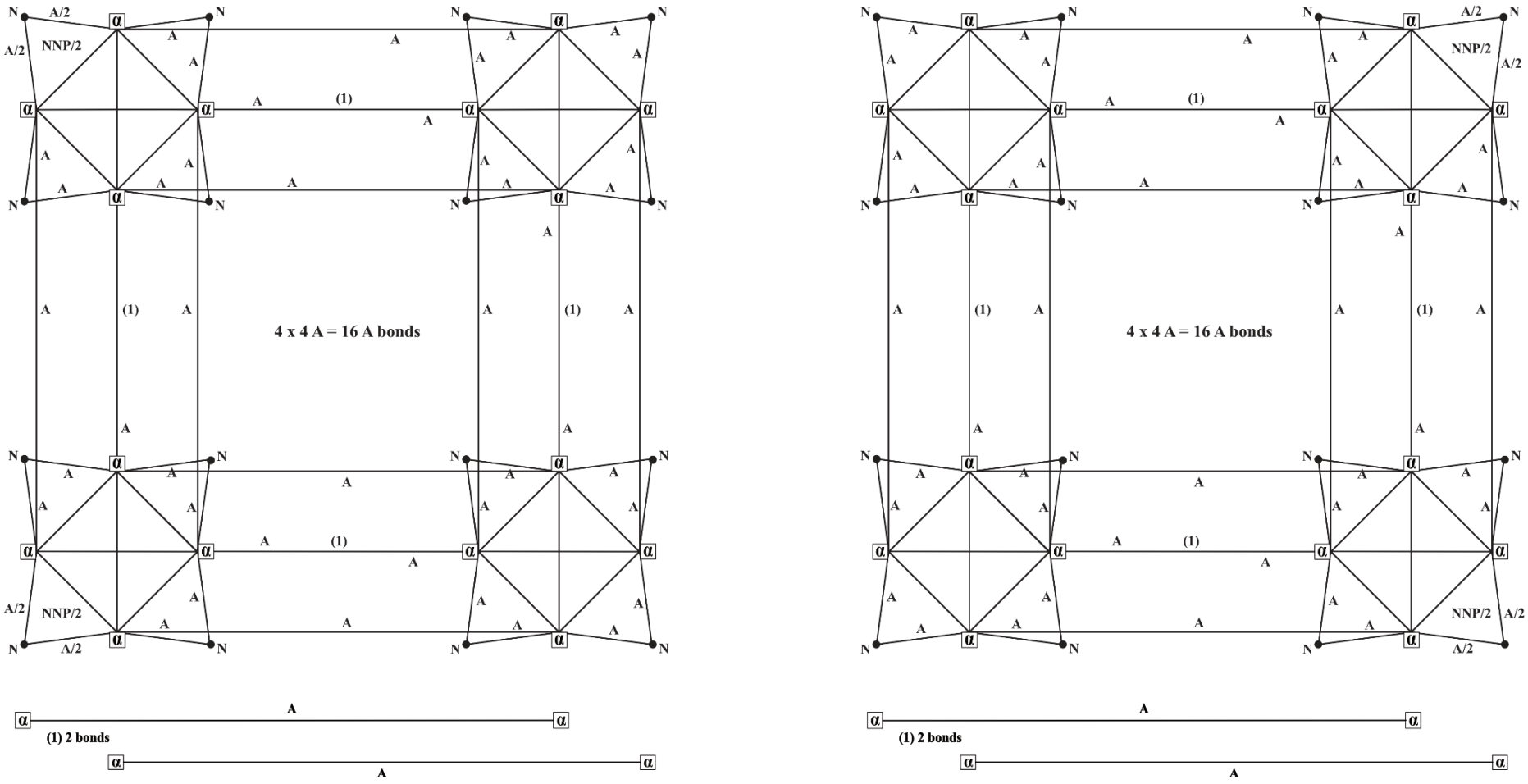
These 4 x 2 A bonds are linking the central-upper structure to twice four α particles of the lower structure.

$^{182}_{74}$W Nat. abundance: 26.3% 37 α, 34 N suppl. E_B in MeV = 1,459.3321 MeV

	E_B	37 α	x	28.325	1,048.0250	MeV
		23	x	4.9365	113.5395	
Core		23	x	2.2246	51.1658	
.		30.5	x	4.9365	150.5633	
34 N suppl		30	x	2.2246	66.7380	
		3	x	8.4818	25.4454	
		0.5	x	7.7180	3.8590	
					1,459.3360	MeV
					+ 0.004	

Figure 2 bis

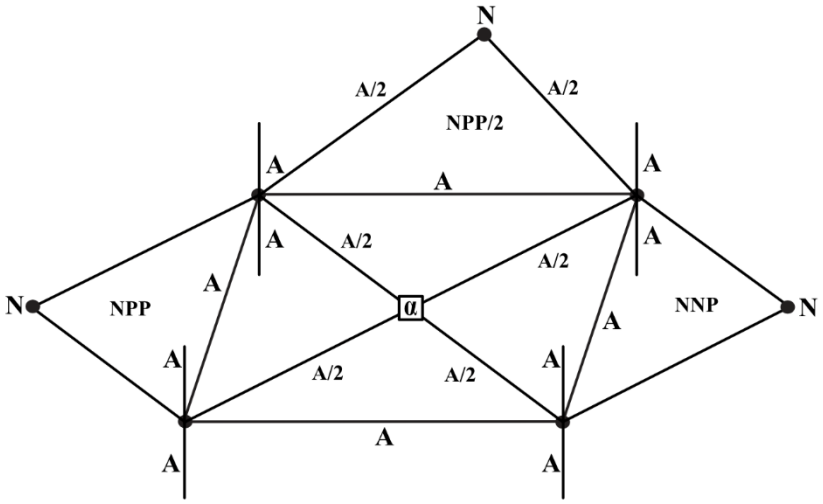
W 182 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds and (NNP/2 + A) bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 3

W 183 – Central-upper structure



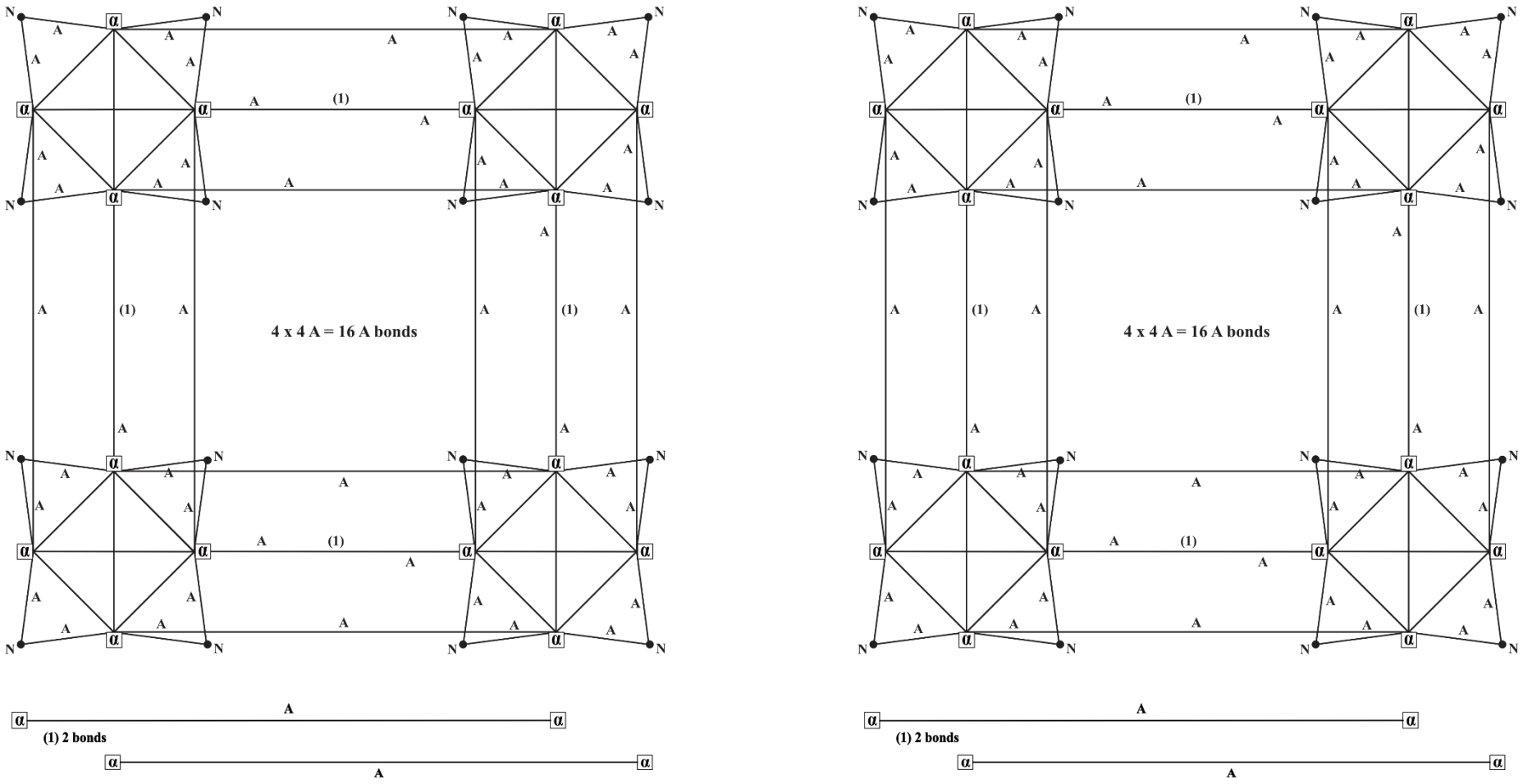
These 4 x 2 A bonds are linking the central-upper structure to twice four α particles of the lower structure.

$^{183}_{74}W$ Nat. abundance: 14.3% 37 α, 35 N suppl. E_B in MeV = 1,465.5229 MeV

	E_B	37 α	x	28.325	1,048.0250 MeV
		23	x	4.9365	113.5395
Core		23	x	2.2246	51.1658
.		32.5	x	4.9365	160.4363
35 N suppl		32.5	x	2.2246	72.2995
		1	x	8.4818	8.4818
		1.5	x	7.7180	11.5770
					1,465.5249 MeV
					+ 0.002

Figure 3 bis

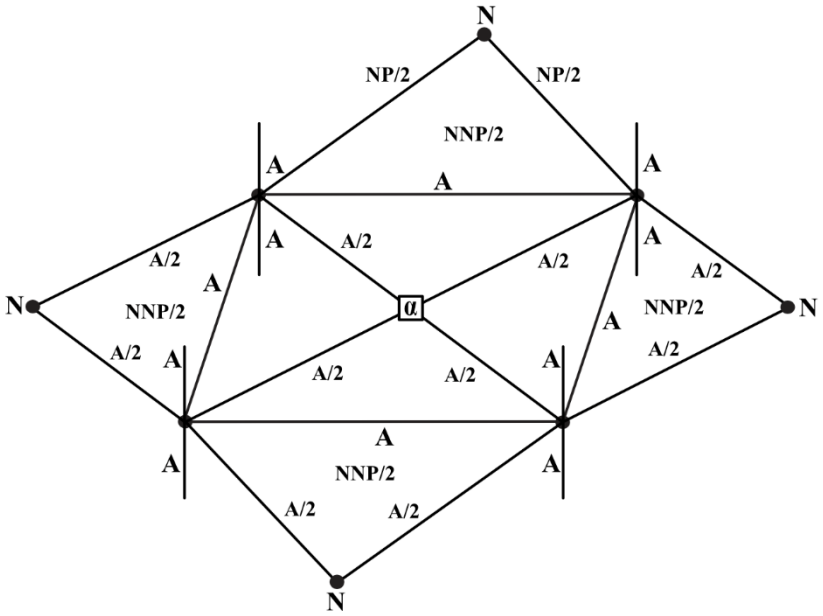
W 183 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 4

W 184 – Central-upper structure



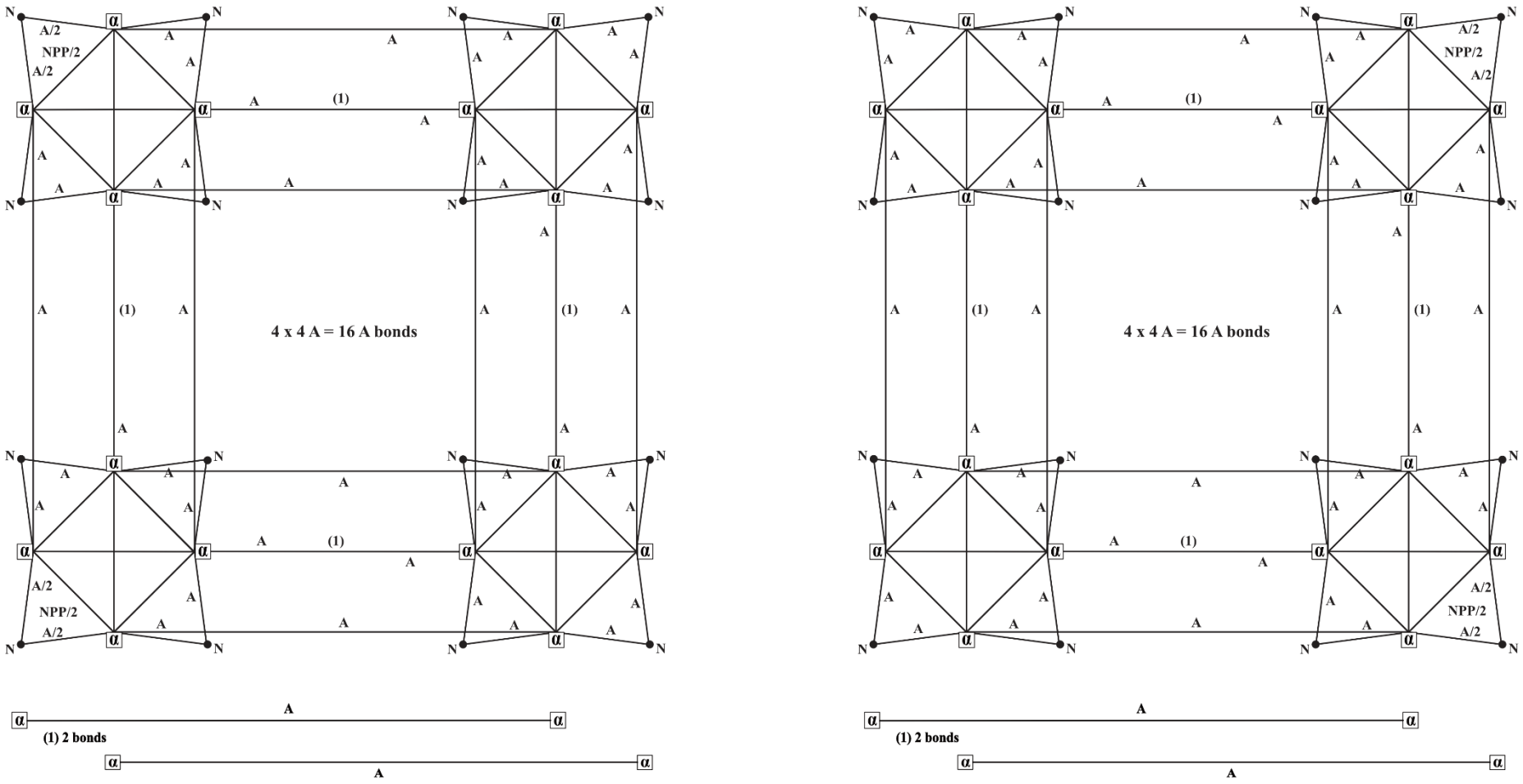
These 4 x 2 A bonds are linking the central-upper structure to twice four α particles of the lower structure.

$^{184}_{74}$W Nat. abundance: 30.7% 37 α, 36 N suppl. EB in MeV = 1,472.9342 MeV

	EB	37 α	x	28.325	1,048.0250	MeV
		23	x	4.9365	113.5395	
Core		23	x	2.2246	51.1658	
.		31.5	x	4.9365	155.4998	
36 N suppl		32.5	x	2.2246	72.2995	
		2	x	8.4818	16.9636	
		2	x	7.7180	15.4360	
					1,472.9292	MeV
					- 0.005	

Figure 4 bis

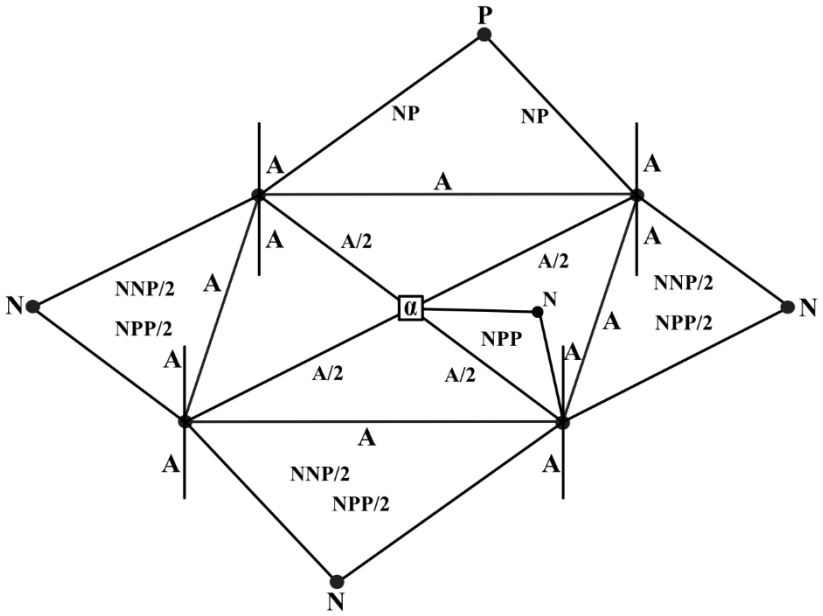
W 184 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds and (NPP/2 + A) bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 5

Re185 – Central-upper structure



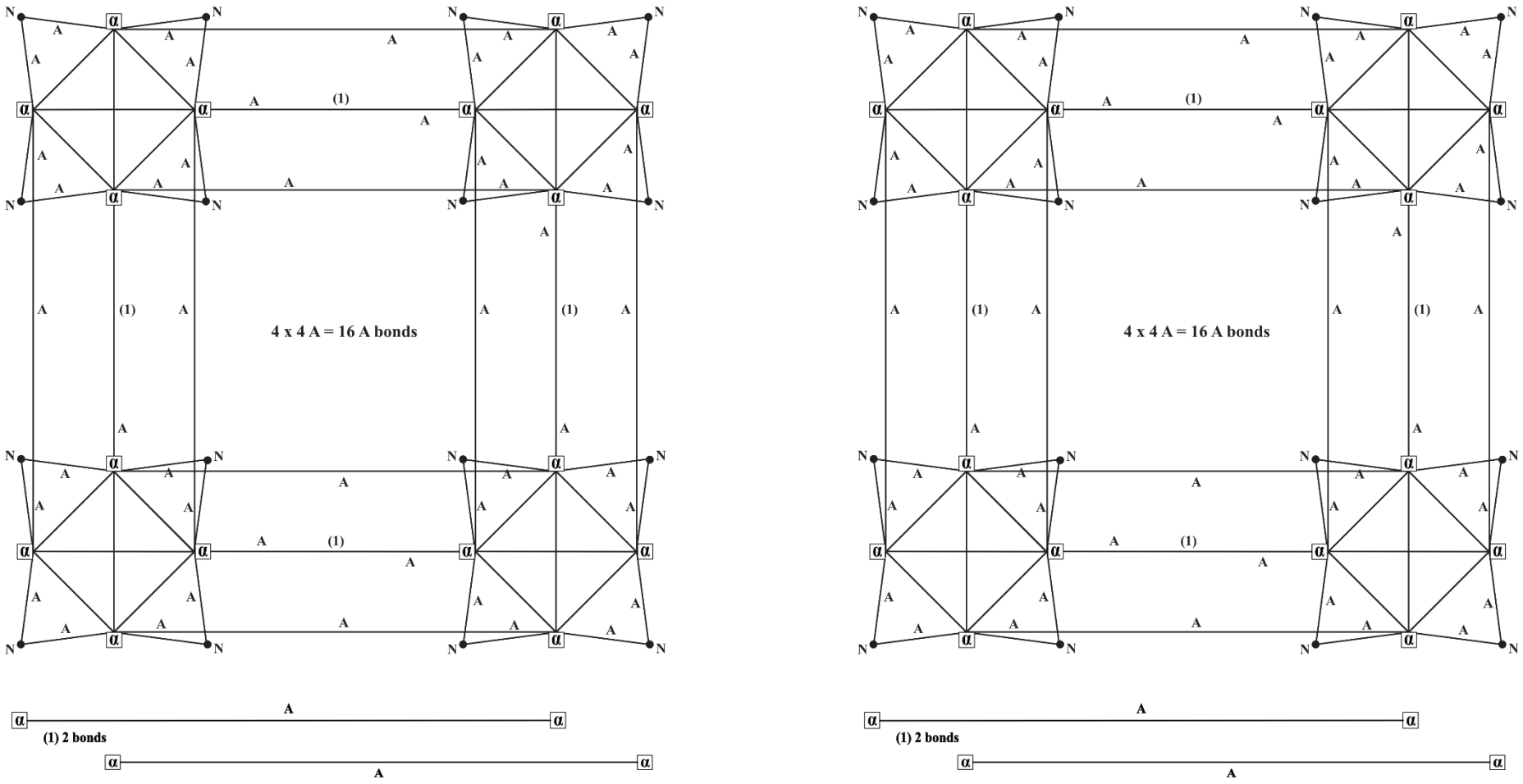
These 4 x 2 A bonds are linking the central-upper structure to twice four α particles of the lower structure.

$^{185}_{75}$**Re** Nat. abundance: 37.4% 37 α, 36 N, 1 P suppl. E_B in MeV = 1,478.3367 MeV

	E_B	37 α	x	28.325	1,048.0250	MeV
		23	x	4.9365	113.5395	
Core		23	x	2.2246	51.1658	
.		32	x	4.9365	157.9680	
36 N suppl.		34	x	2.2246	75.6364	
1 P suppl.		1.5	x	8.4818	12.7227	
		2.5	x	7.7180	19.2950	
					1,478.3524	MeV
					+ 0.016	

Figure 5 bis

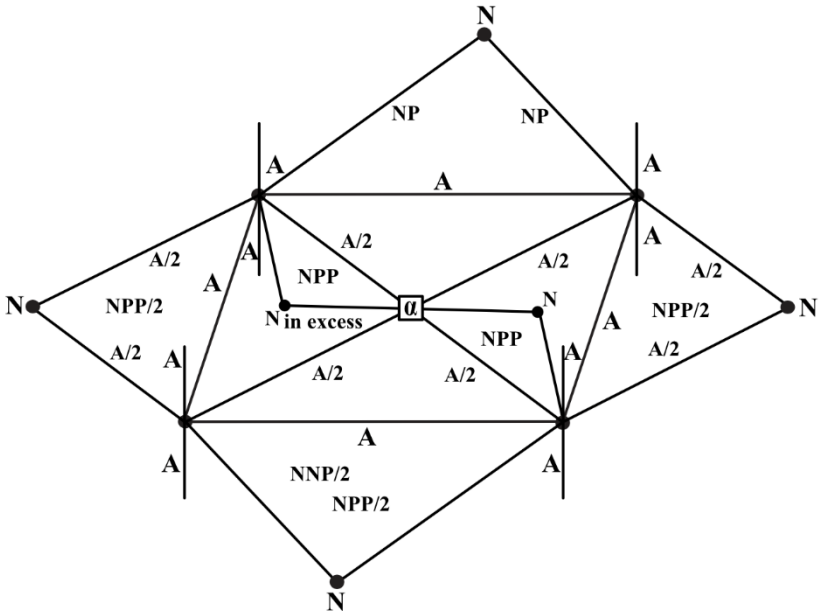
Re 185 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 6

W 186 – Central-upper structure



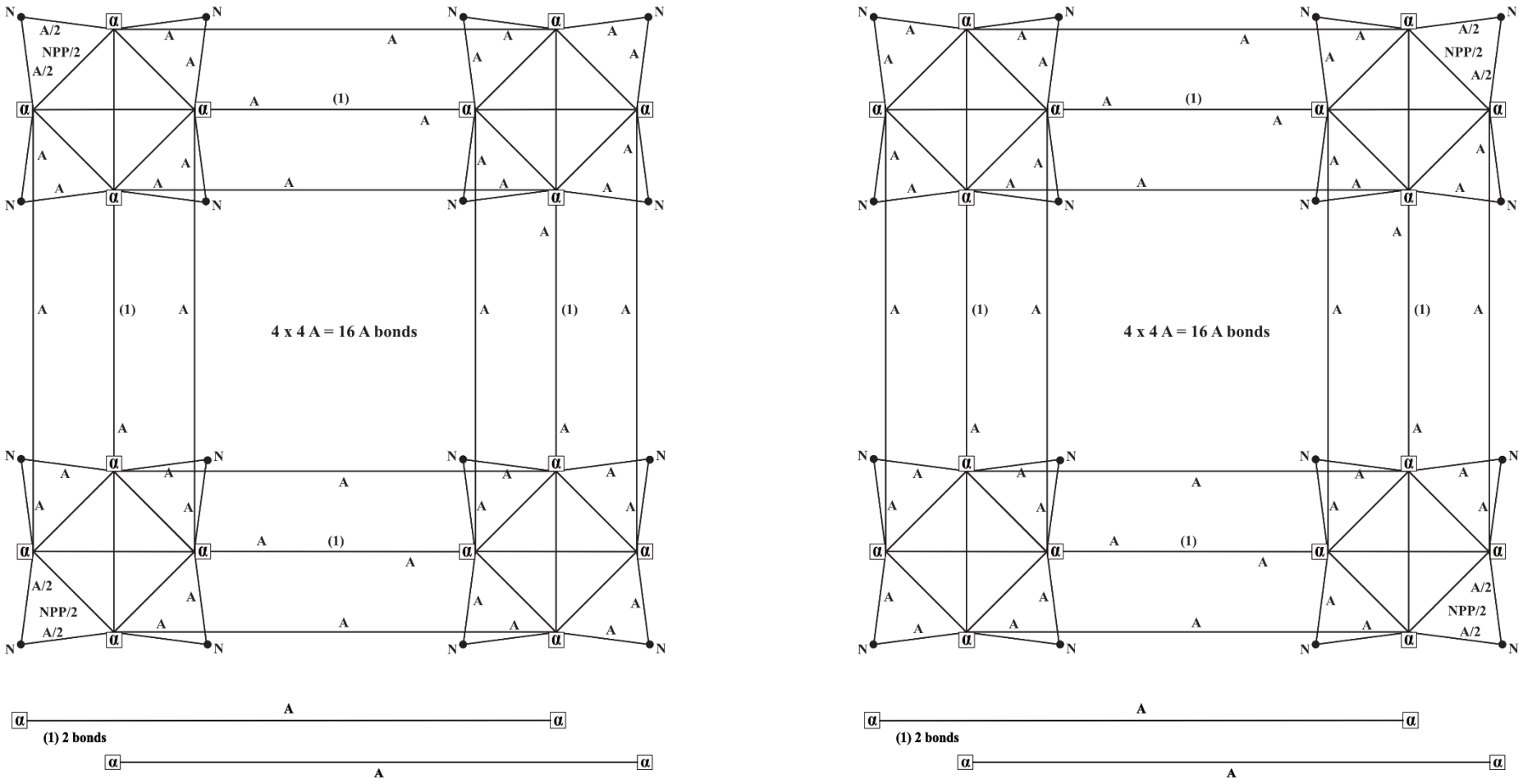
These 4 x 2 A bonds are linking the central-upper structure to twice four α particles of the lower structure.

$^{186}_{74}$W Nat. abundance: 28.6% 37 α, 37 N suppl, 1 N in excess E_B in MeV = 1,485.8798 MeV

	E_B	37 α	x	28.325	1,048.0250	MeV
		23	x	4.9365	113.5395	
Core		23	x	2.2246	51.1658	
.		31	x	4.9365	153.0315	
37 N suppl.		33	x	2.2246	73.4118	
1 N in excess.		0.5	x	8.4818	4.2409	
		5.5	x	7.7180	42.4490	
					1,485.8635	MeV
					- 0.016	

Figure 6 bis

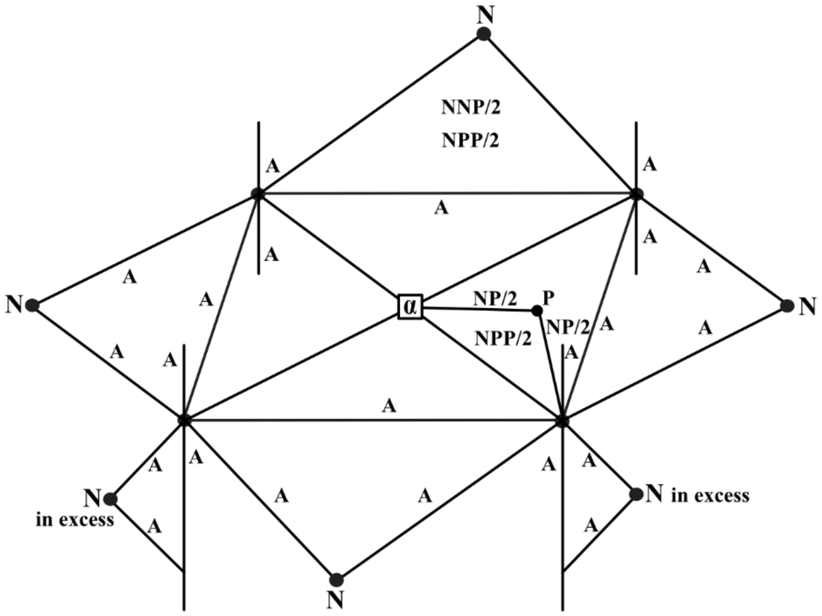
W 186 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds and (NPP/2 + A) bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 7

Re 187 – Central-upper structure

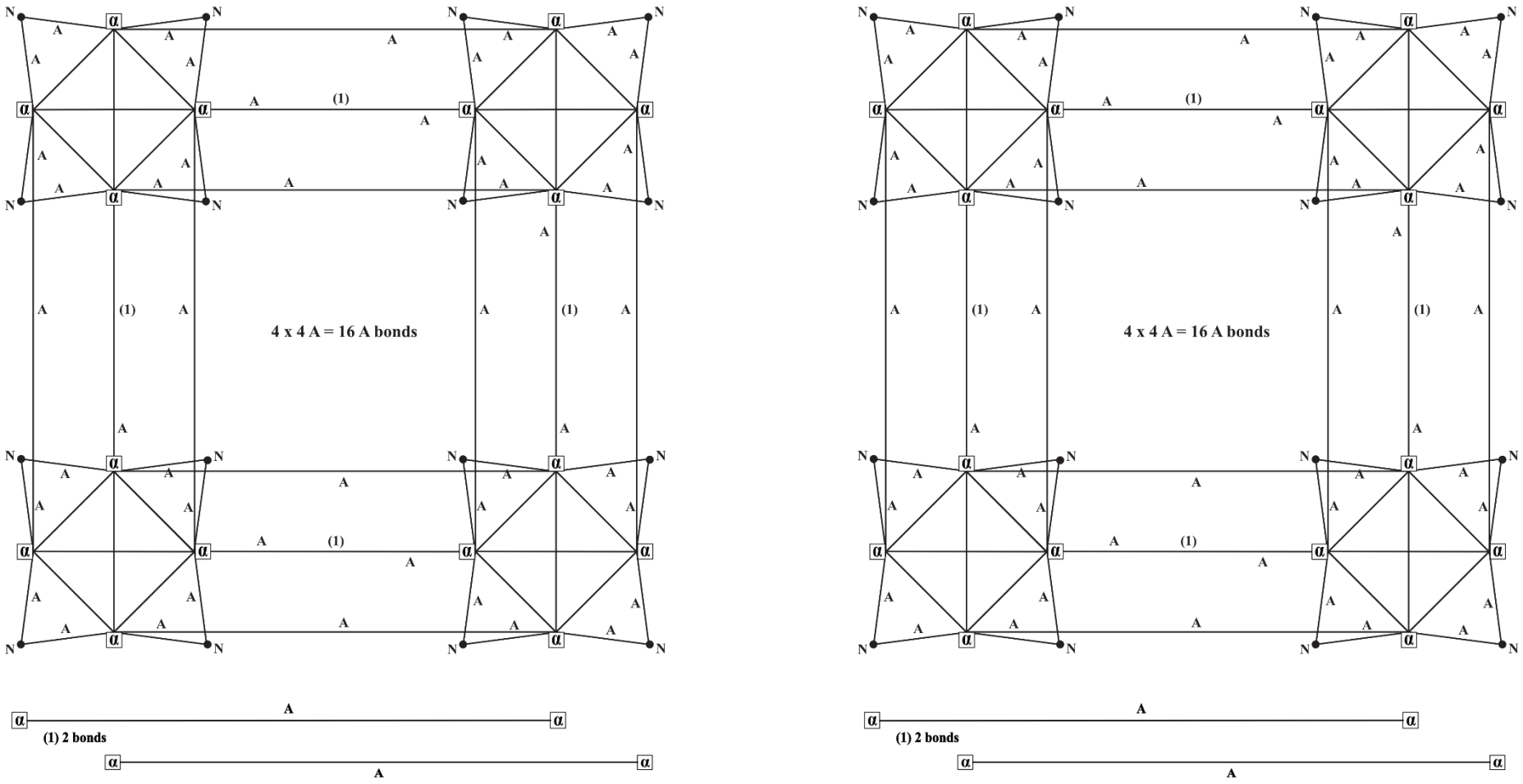


These 4 x 2 A bonds are linking the central-upper structure to twice four α particles of the lower structure.

$^{187}_{75}$**Re**	Nat. abundance: 62.6 %	37 α, 36 N, 1 P suppl. 2 N in excess		EB in MeV = 1,491.8768	MeV	
	EB	37 α	x	28.325	1,048.0250	MeV
		23	x	4.9365	113.5395	
Core		23	x	2.2246	51.1658	
.		37	x	4.9365	182.6505	
36 N, 1 P suppl.		38	x	2.2246	84.5348	
2 N in excess.		0.5	x	8.4818	4.2409	
		1	x	7.7180	7.7180	
					1,491.8745	MeV
					- 0.002	

Figure 7 bis

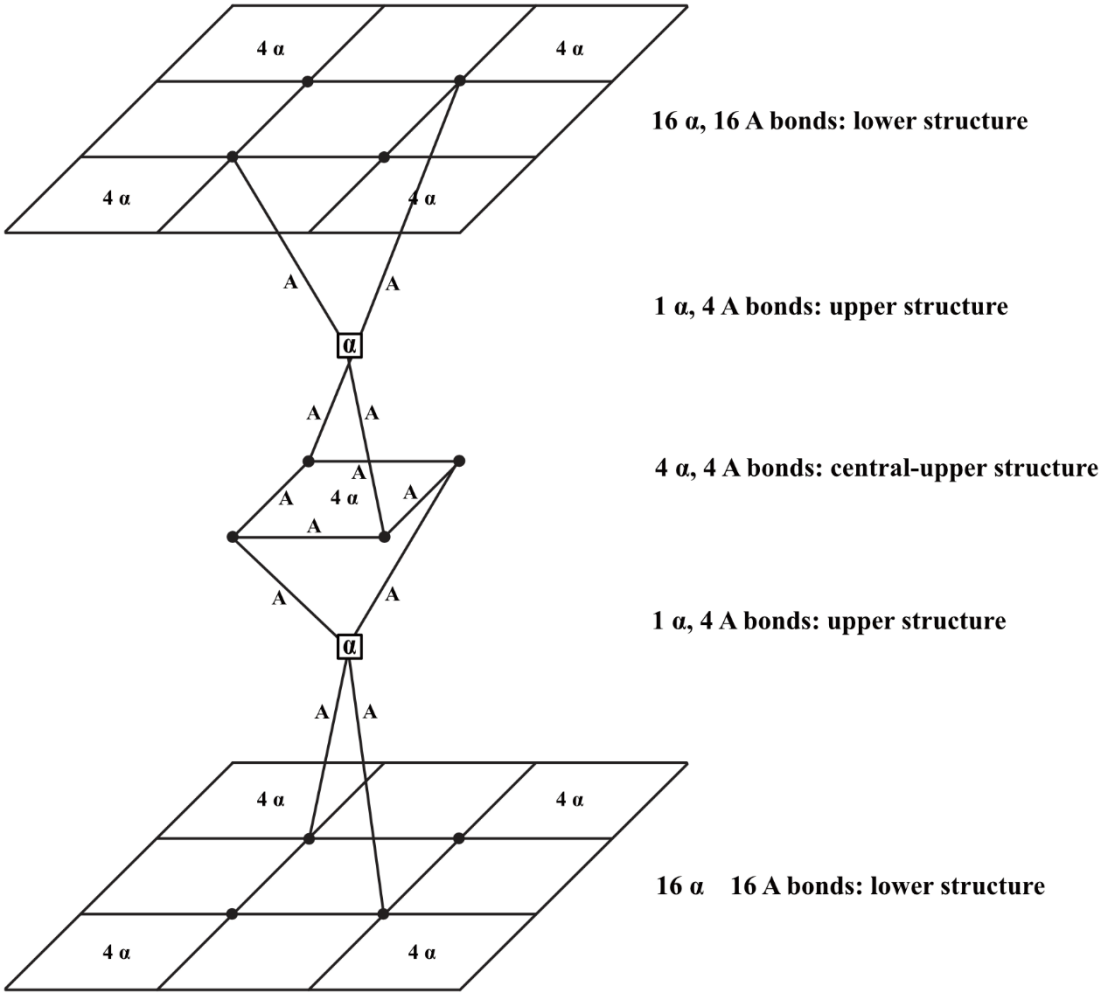
Re 187 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

4. Core structure of Osmium (76 Os) and Iridium (77 Ir)

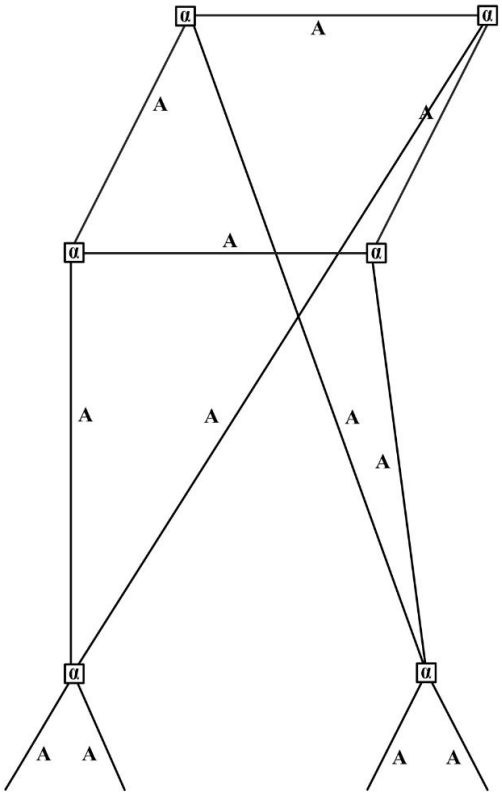
This structure contains 38 α linked together with 44 A bonds. These bonds are also consolidated with the N supplementary bonds which are progressively replacing the direct A bonds and closing the gaps of the α structure.



In total 44 A bonds. So the core is constituted with 38α and 44 A bonds.

Figure 1

Os 184 – Central-upper structure



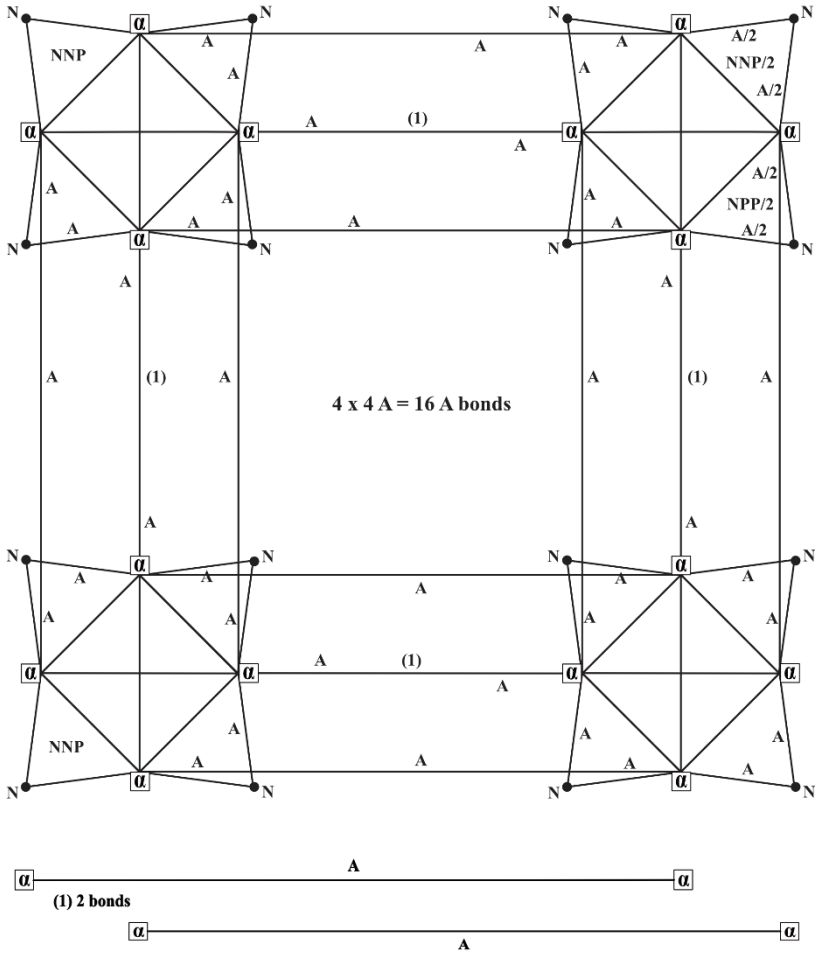
These twice four A bonds are linking the six α particles of the central-upper structure to twice two α particles of the lower structure.

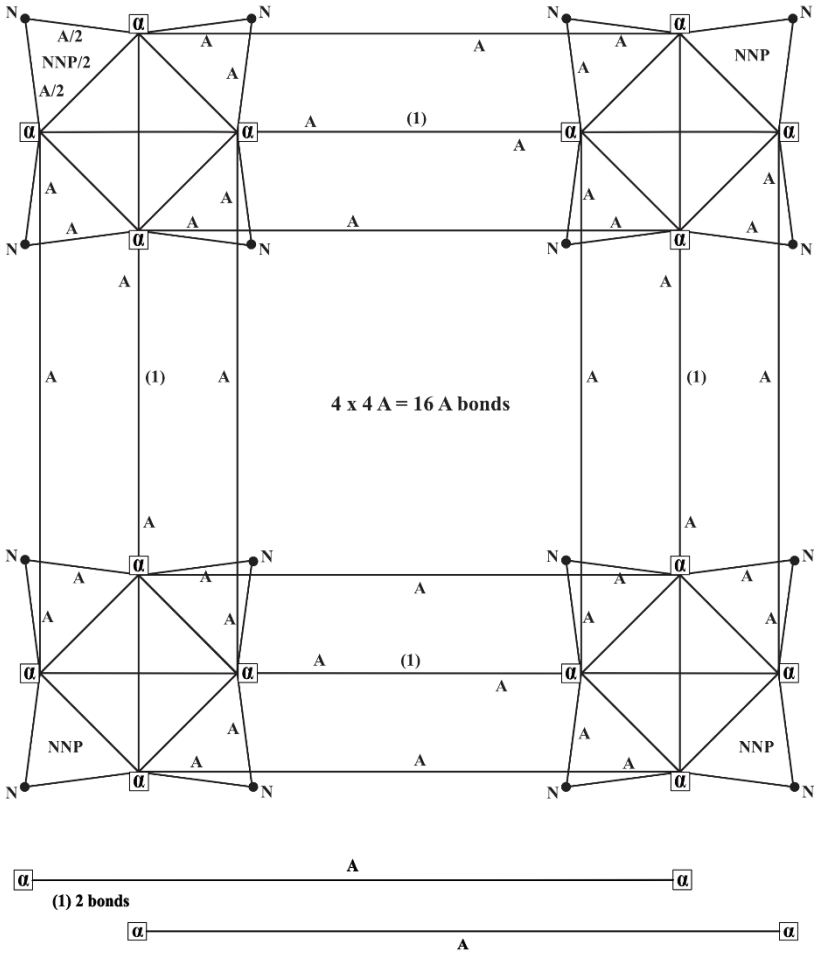
$^{184}_{76}$**Os** Nat. abundance: 0.1 % 38 α, 32 N suppl. E_B in MeV = 1,469.9166 MeV

	E_B	38 α	x	28.325	1,076.3500	MeV
		22	x	4.9365	108,6030	
Core		22	x	2.2246	48.9412	
.		26.5	x	4.9365	130.8173	
32 N suppl.		26.5	x	2.2246	58.9519	
.		5	x	8.4818	42.4090	
		0.5	x	7.7180	3.8580	
					1,469.9304	MeV
					+ 0.014	

Figure 1 bis

Os 184 - Lower structure

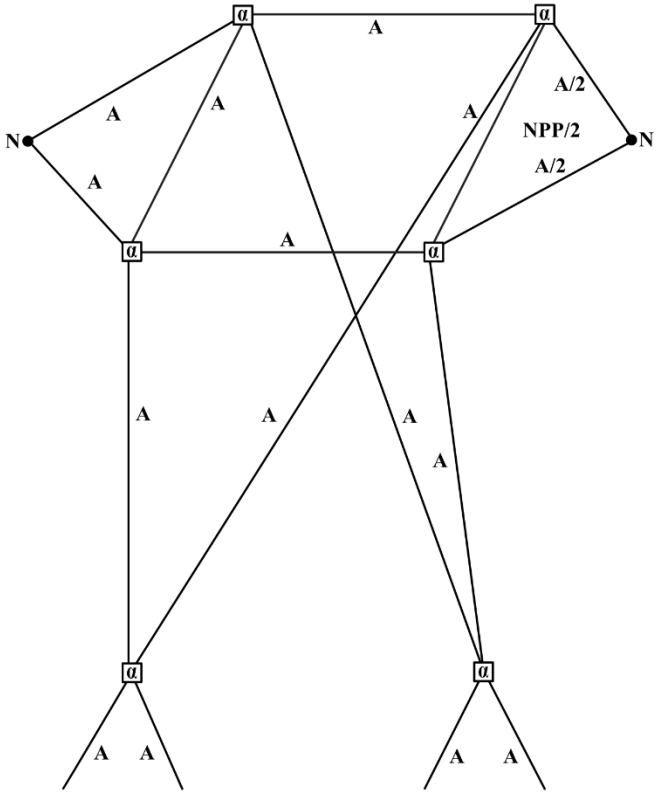




Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds or NNP and NPP bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 2

Os 186 – Central-upper structure



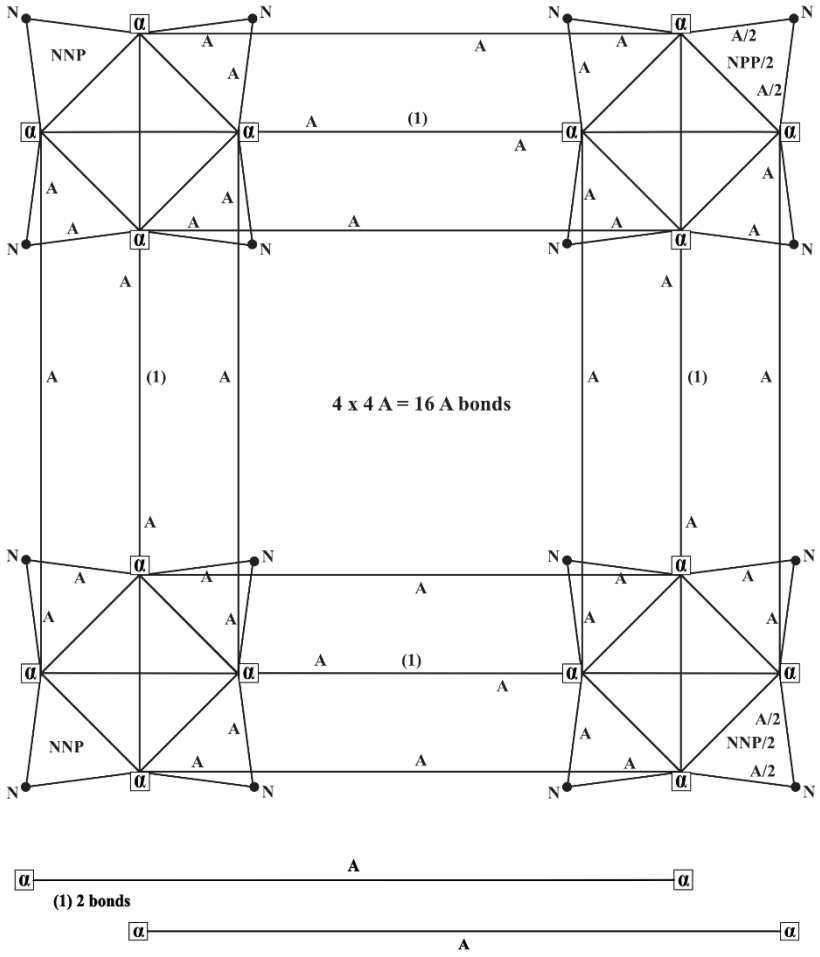
These twice four A bonds are linking the six α particles of the central-upper structure to twice two α particles of the lower structure.

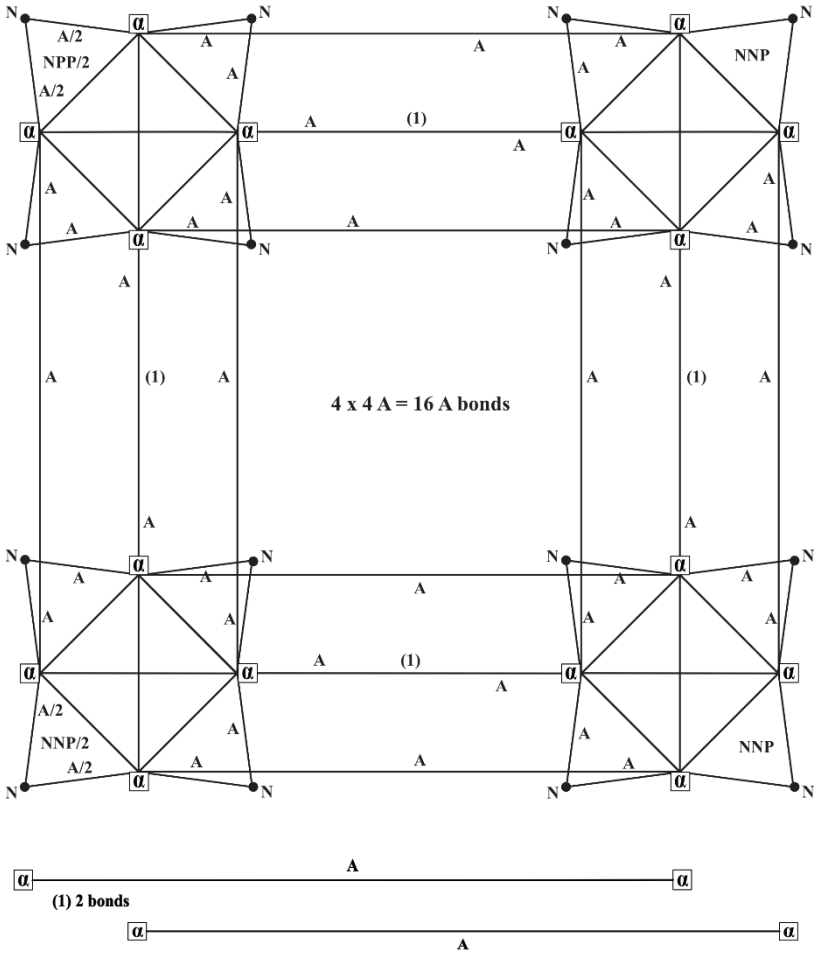
$^{186}_{76}$**Os** Nat. abundance: 1.58 % 38 α, 34 N suppl. E_B in MeV = 1,484.8066 MeV

	E_B	38 α	x	28.325	1,076.3500	MeV
		22	x	4.9365	108,6030	
Core		22	x	2.2246	48.9412	
.		27.5	x	4.9365	135.7538	
34 N suppl.		27.5	x	2.2246	61.1765	
.		5	x	8.4818	42.4090	
		1.5	x	7.7180	11.5770	
					1,484.8105	MeV
					+ 0.004	

Figure 2 bis

Os 186 - Lower structure

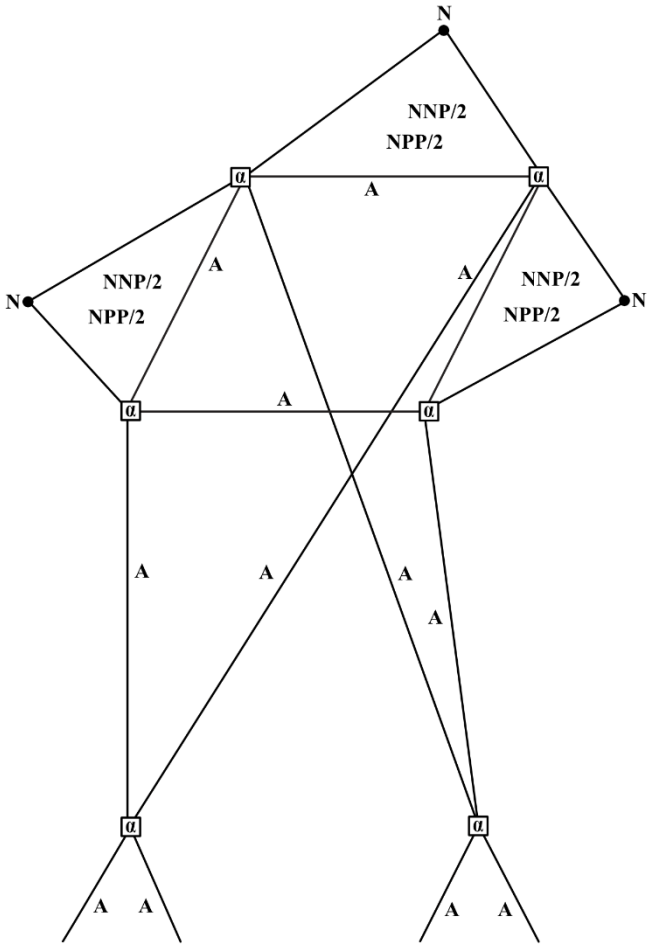




Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds or NNP and NPP bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 3

Os 187 – Central-upper structure



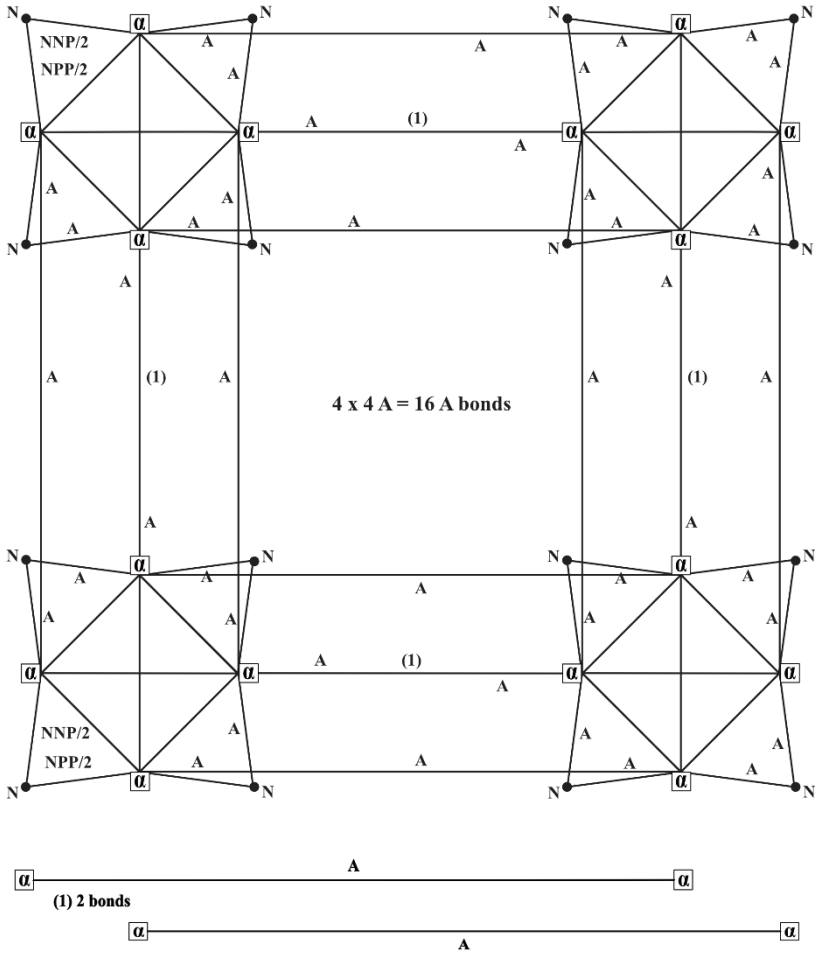
These twice four A bonds are linking the six α particles of the central-upper structure to twice two α particles of the lower structure.

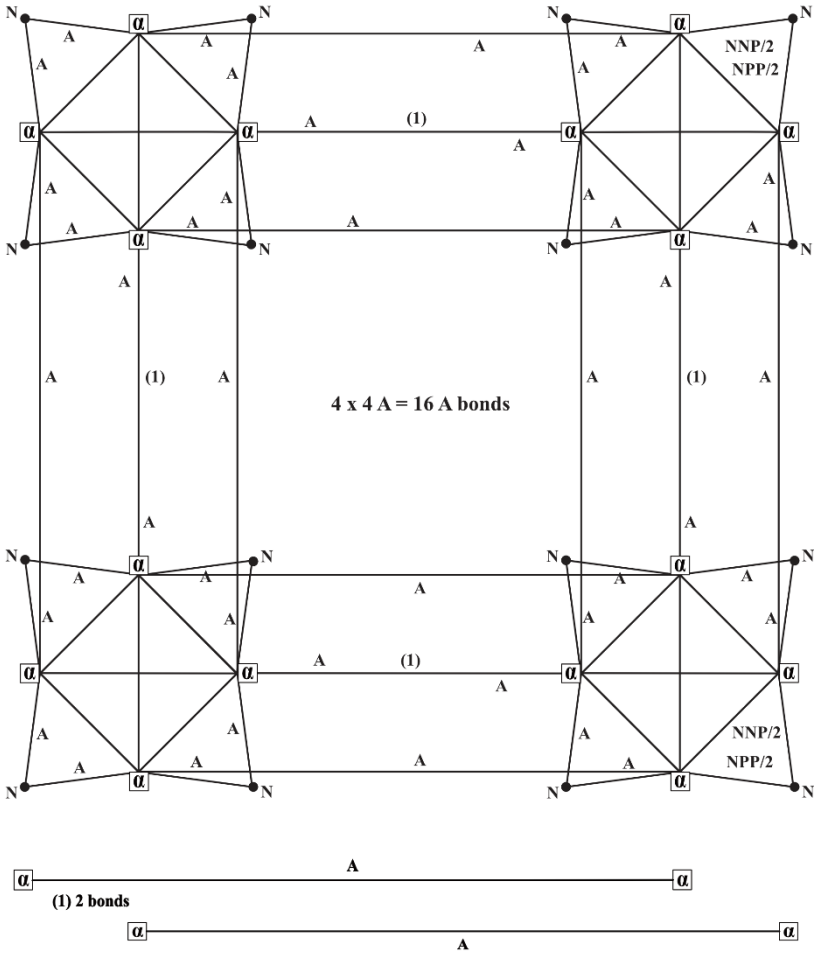
$^{187}_{76}$**Os** Nat. abundance: 1.6 % 38 α, 35 N suppl. E_B in MeV = 1,491.0969 MeV

	E_B	38 α	x	28.325	1,076.3500	MeV
		22	x	4.9365	108,6030	
		22	x	2.2246	48.9412	
Core						
.		28	x	4.9365	138.2220	
35 N suppl.		28	x	2.2246	62.2888	
.		3.5	x	8.4818	29.6863	
		3.5	x	7.7180	27.0130	
					1,491.1043	MeV
					+ 0.008	

Figure 3 bis

Os 187 - Lower structure

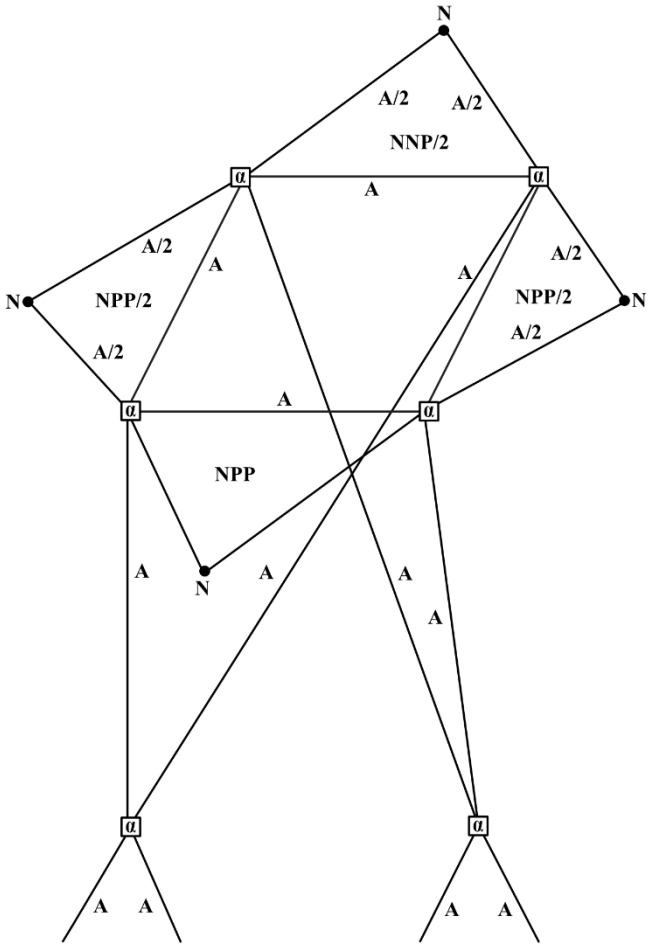




Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds or NNP and NPP bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 4

Os 188 – Central-upper structure



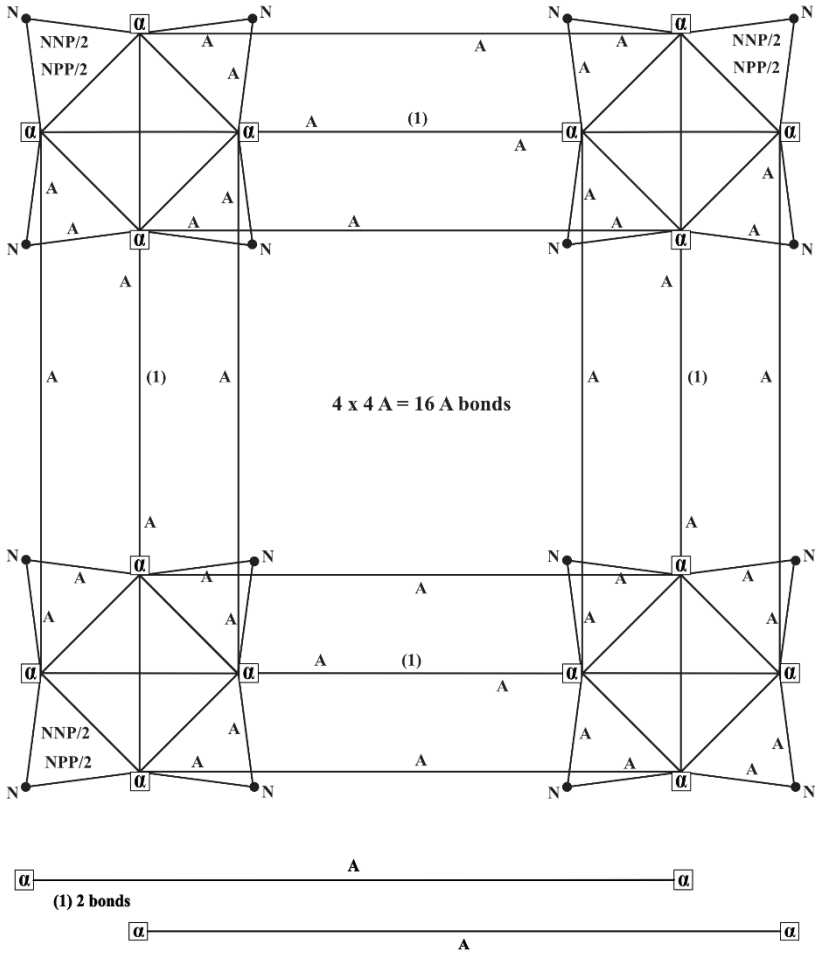
These twice four A bonds are linking the six α particles of the central-upper structure to twice two α particles of the lower structure.

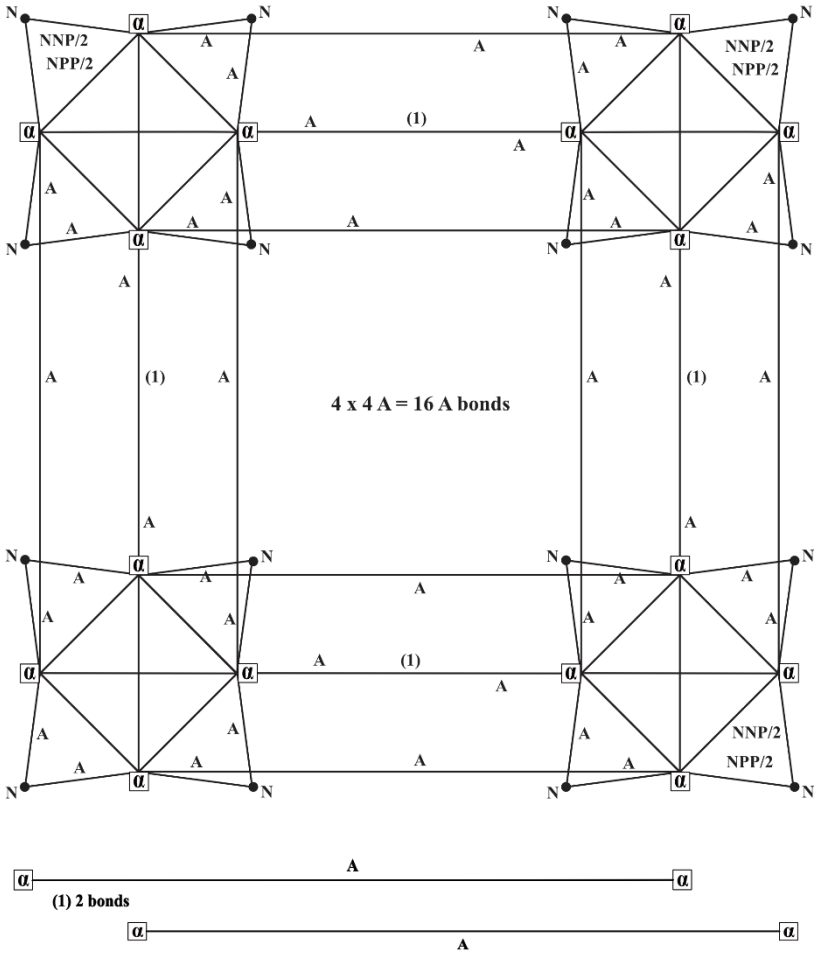
$^{188}_{76}$**Os** Nat. abundance: 13.3 % 38 α, 36 N suppl. E_B in MeV = 1,499.0864 MeV

	E_B	38 α	x	28.325	1,076.3500	MeV
		22	x	4.9365	108,6030	
Core		22	x	2.2246	48.9412	
.		27.5	x	4.9365	135.7538	
36 N suppl.		27.5	x	2.2246	61.1765	
.		3.5	x	8.4818	29.6863	
		5	x	7.7180	38.5900	
					1,499.1008	MeV
					+ 0.014	

Figure 4 bis

Os 188 - Lower structure

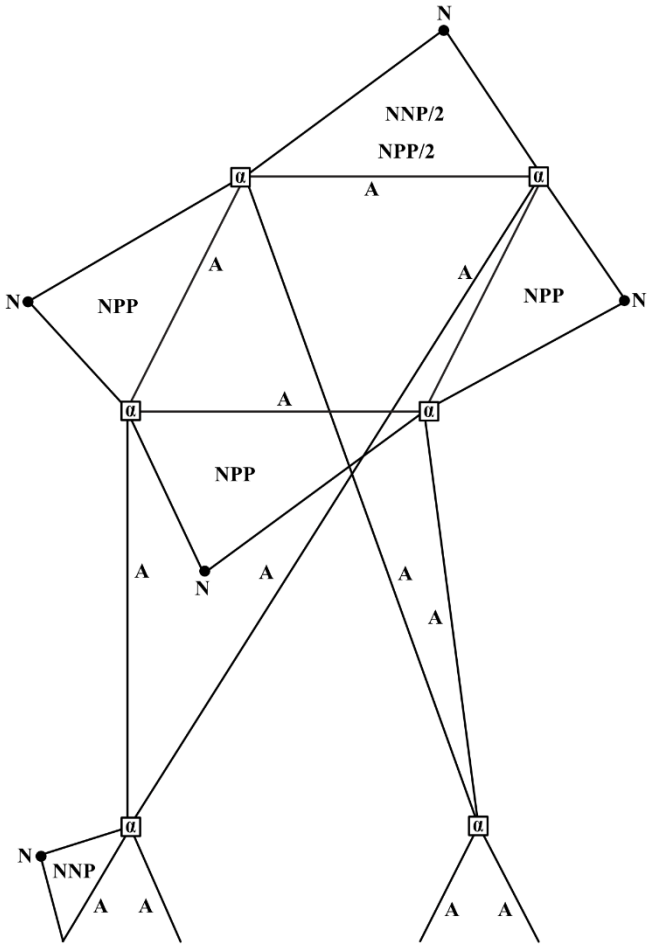




Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds or NNP and NPP bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 5

Os 189 – Central-upper structure



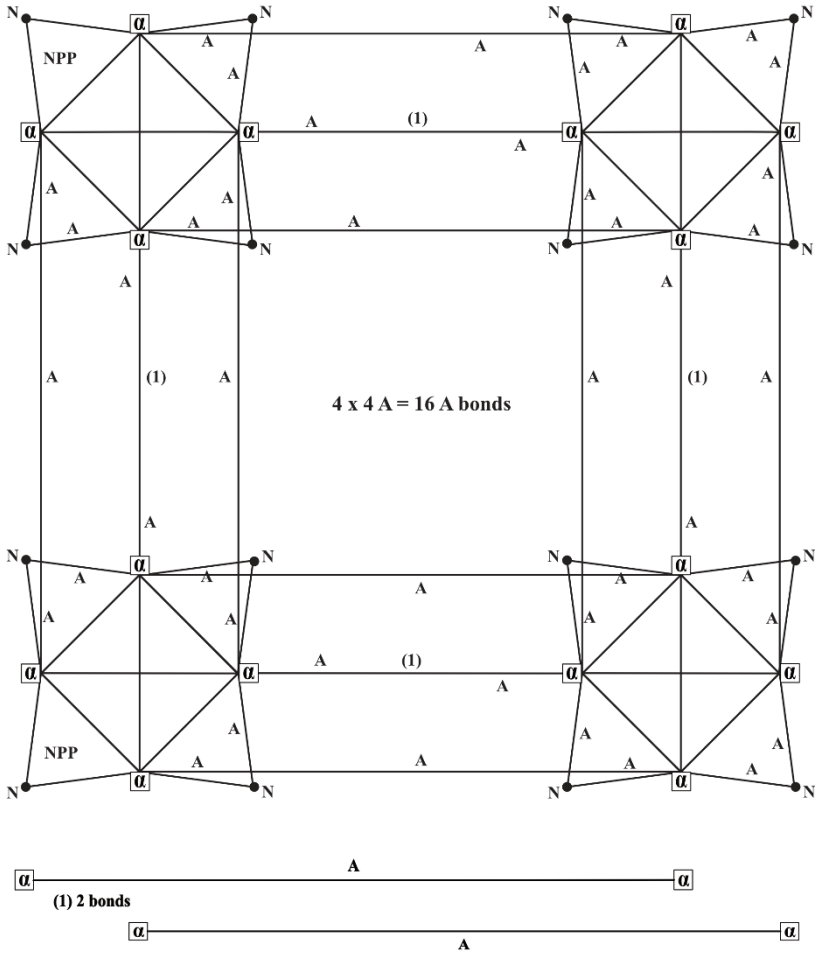
These twice four A bonds are linking the six α particles of the central-upper structure to twice two α particles of the lower structure.

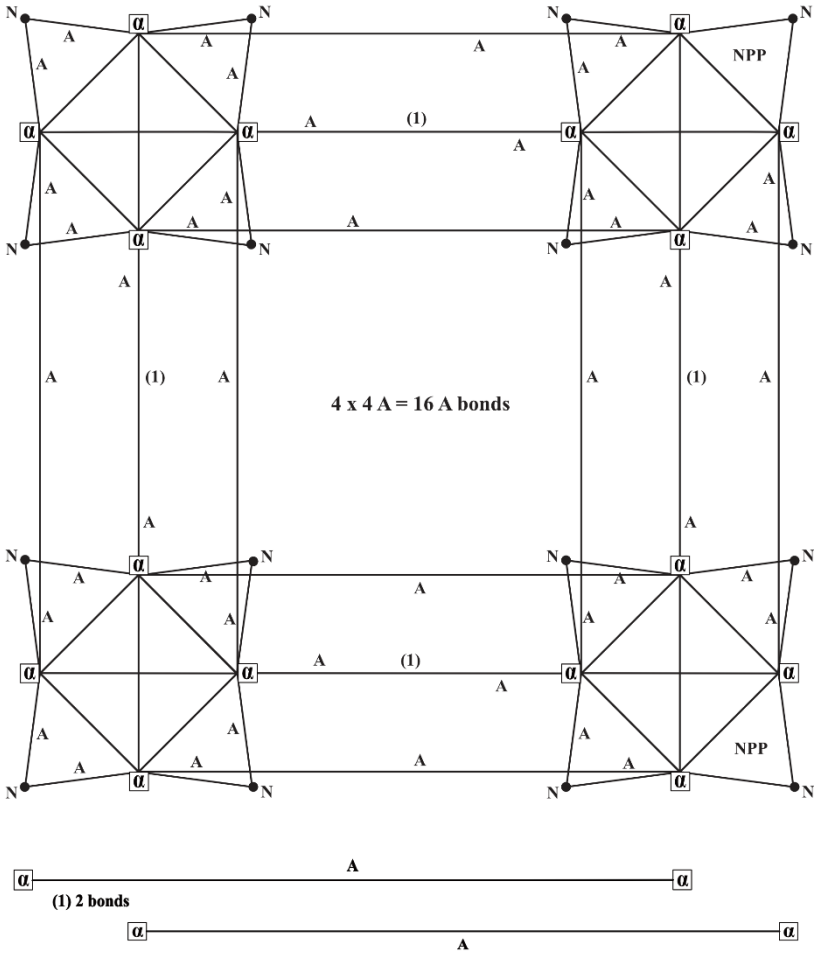
$^{189}_{76}$**Os** Nat. abundance: 16.1 % 38 α, 37 N suppl. E_B in MeV = 1,505.0074 MeV

	E_B	38 α	x	28.325	1,076.3500	MeV
		22	x	4.9365	108,6030	
Core		22	x	2.2246	48.9412	
.		28	x	4.9365	138.2220	
37 N suppl.		28	x	2.2246	62.2888	
.		1.5	x	8.4818	12.7227	
		7.5	x	7.7180	57.8850	
					1,505.0127	MeV
					+ 0.005	

Figure 5 bis

Os 189 - Lower structure

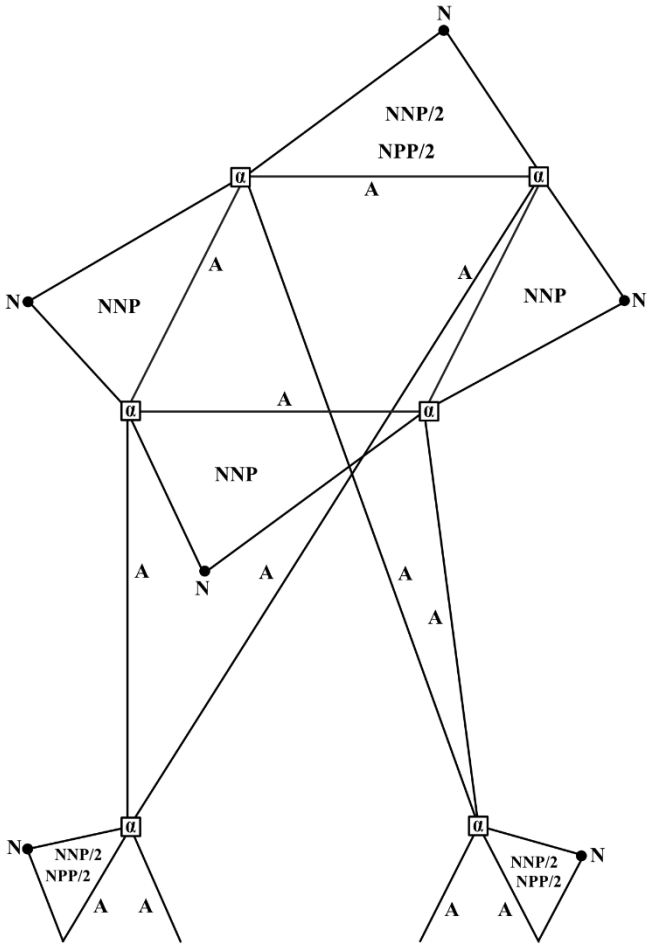




Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds or NPP bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 6

Os 190 – Central-upper structure



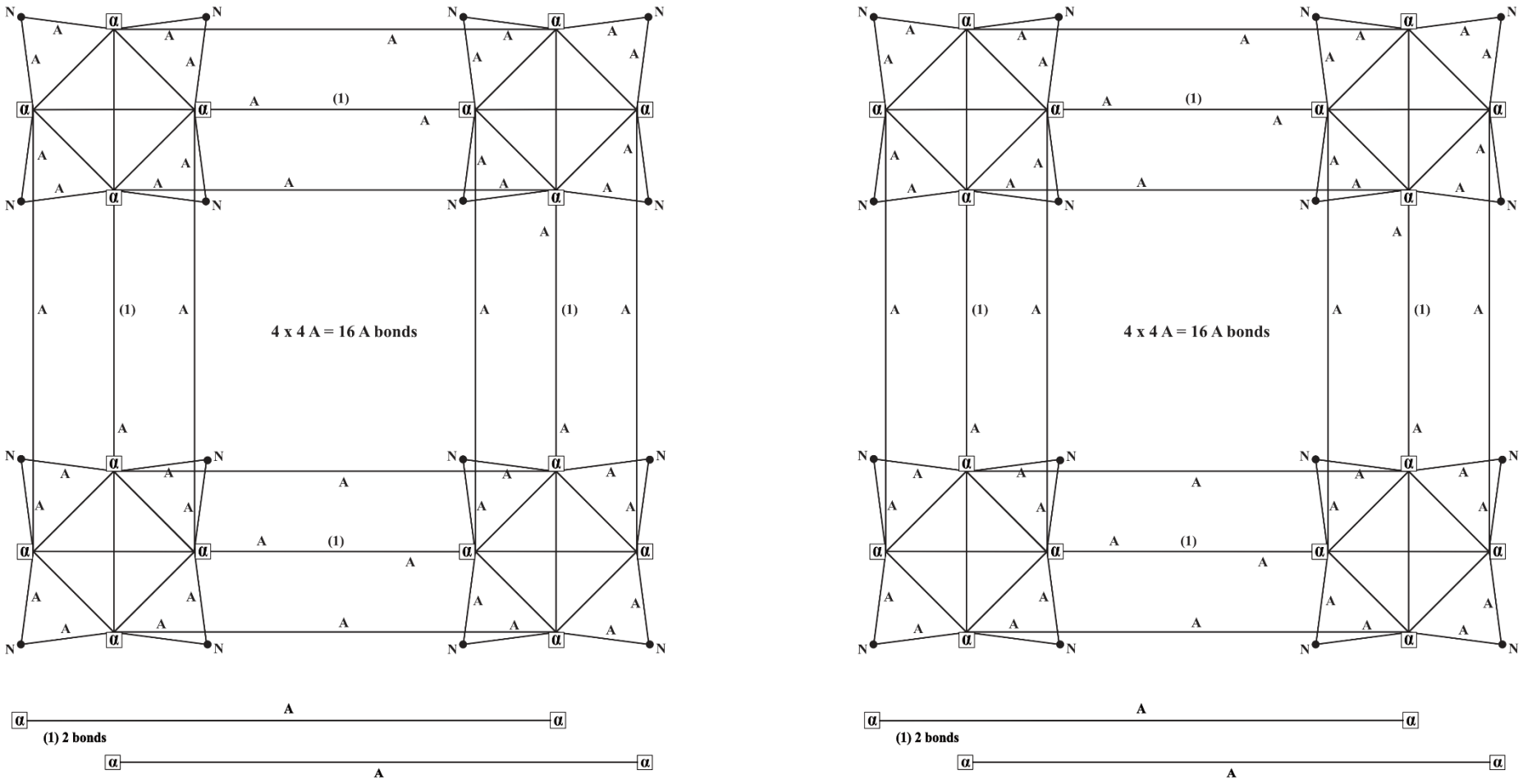
These twice four A bonds are linking the six α particles of the central-upper structure to twice two α particles of the lower structure.

$^{190}_{76}$**Os** Nat. abundance: 26.4 % 38 α, 38 N suppl. E_B in MeV = 1,512.7998 MeV

	E_B	38 α	x	28.325	1,076.3500	MeV
		22	x	4.9365	108,6030	
Core		22	x	2.2246	48.9412	
.		32	x	4.9365	157.9680	
38 N suppl.		32	x	2.2246	71.1872	
.		4.5	x	8.4818	38.1681	
		1.5	x	7.7180	11.5770	
					1,512.7945	MeV
					- 0.005	

Figure 6 bis

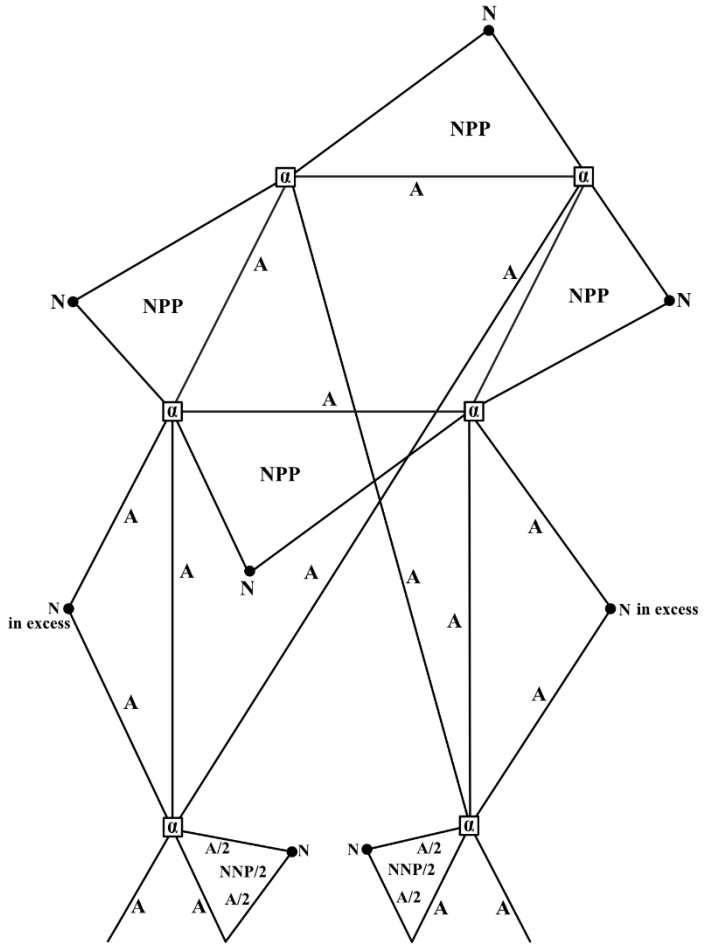
Os 190 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 7

Os 192 – Central-upper structure

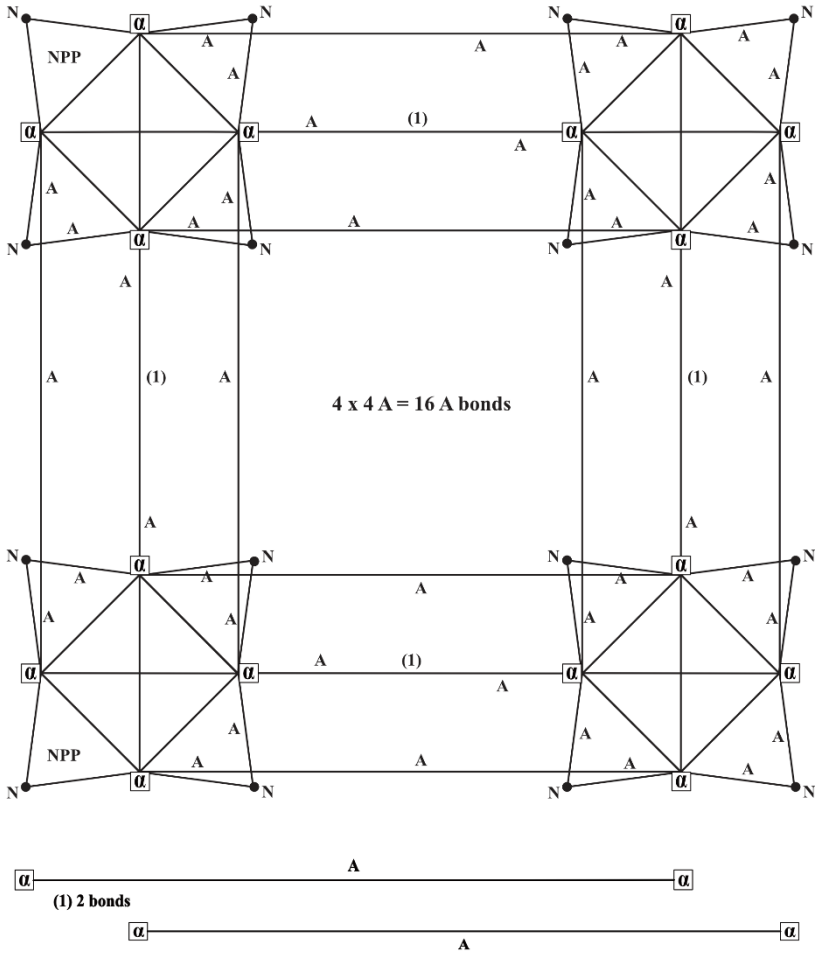


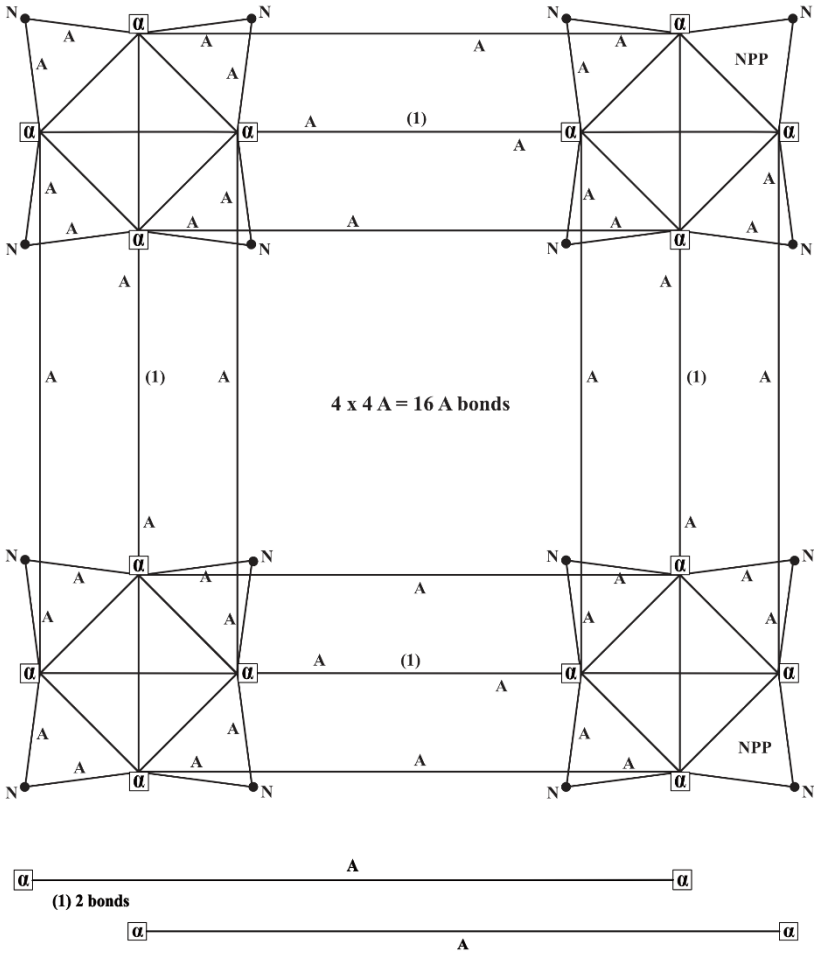
These twice four A bonds are linking the six α particles of the central-upper structure to twice two α particles of the lower structure.

$^{192}_{76}$Os	Nat. abundance: 41 %			38 α, 38 N suppl. 2 N in excess	E_B in MeV = 1,526.1168	MeV
	E_B	38 α	x	28.325	1,076.3500	MeV
		22	x	4.9365	108,6030	
Core		22	x	2.2246	48.9412	
.		31	x	4.9365	153.0315	
38 N suppl.		31	x	2.2246	68.9626	
2 N in excess		1	x	8.4818	8.4818	
		8	x	7.7180	61.7440	
					1,526.1141	MeV
					- 0.002	

Figure 7 bis

Os 192 - Lower structure

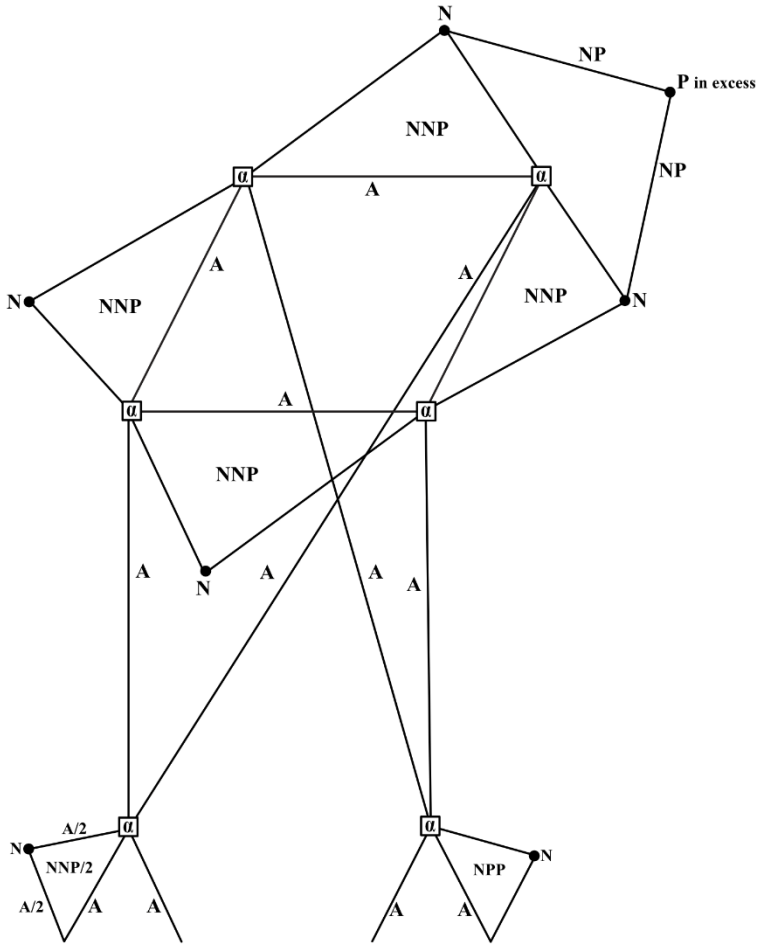




Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds or NPP bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 8

Ir 191 – Central-upper structure

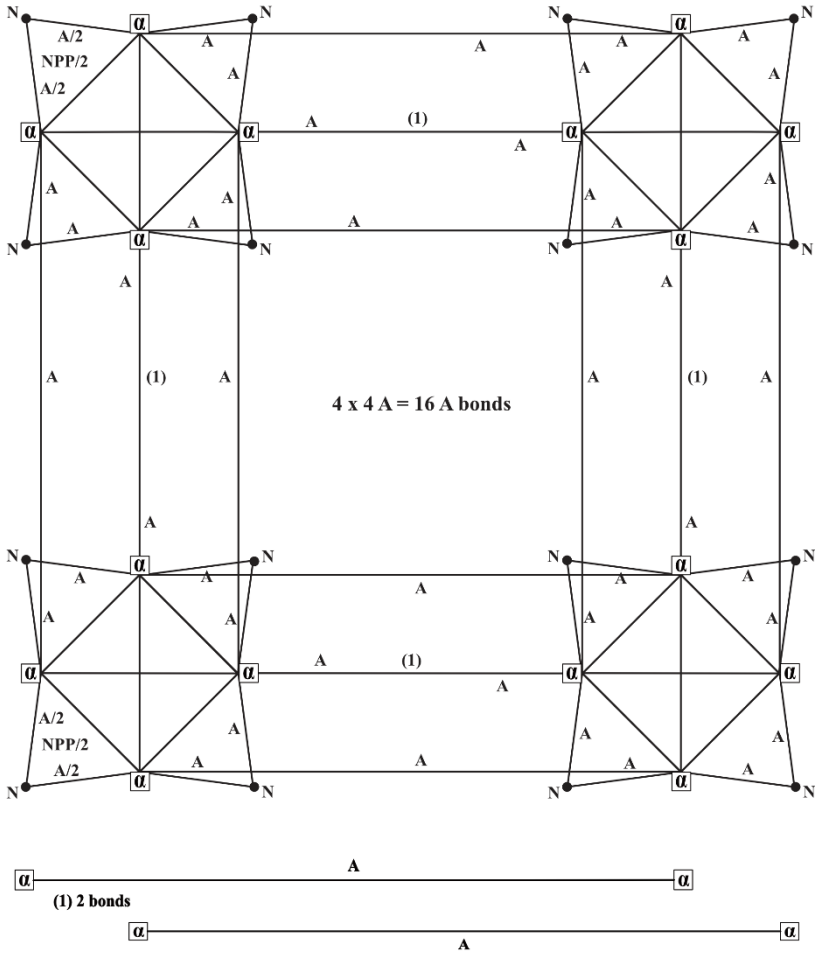


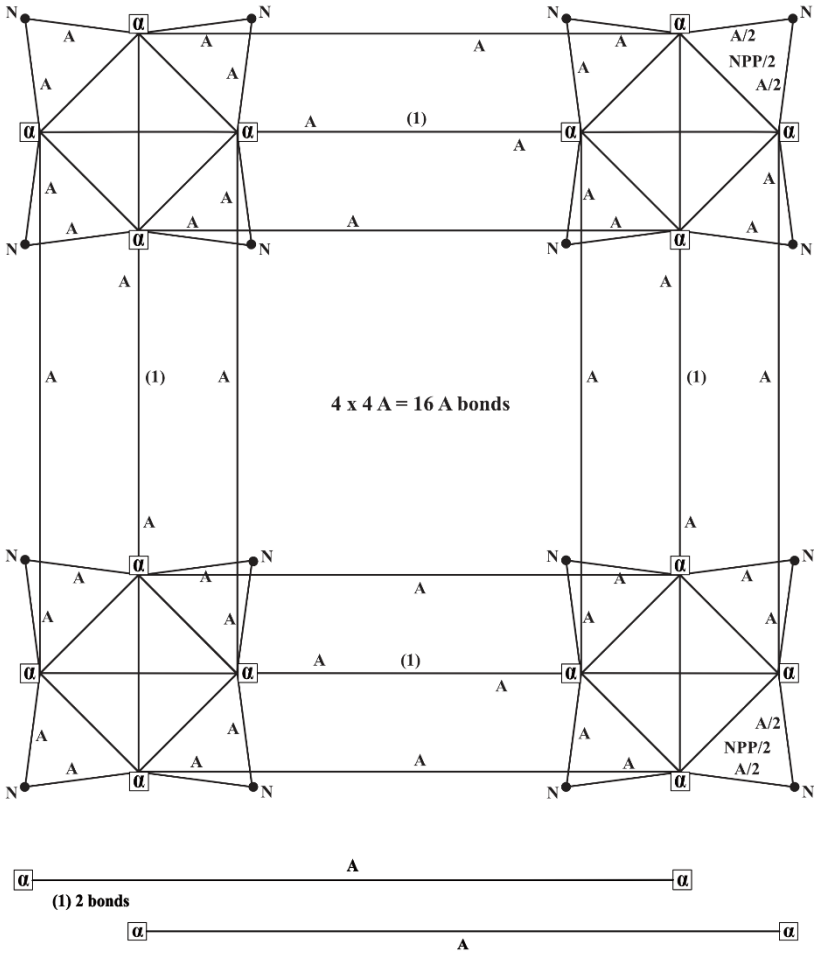
These twice four A bonds are linking the six α particles of the central-upper structure to twice two α particles of the lower structure.

$^{191}_{77}$Ir	Nat. abundance: 37.3 %		38 α, 38 N suppl. 1 P in excess		EB in MeV = 1,518.0896	MeV
	EB	38 α	x	28.325	1,076.3500	MeV
		22	x	4.9365	108,6030	
Core		22	x	2.2246	48.9412	
.		30.5	x	4.9365	150.5633	
38 N suppl.		32.5	x	2.2246	72.2995	
1 P in excess		4.5	x	8.4818	38.1681	
		3	x	7.7180	23.1540	
					1,518.0791	MeV
					- 0.010	

Figure 8 bis

Ir 191 - Lower structure

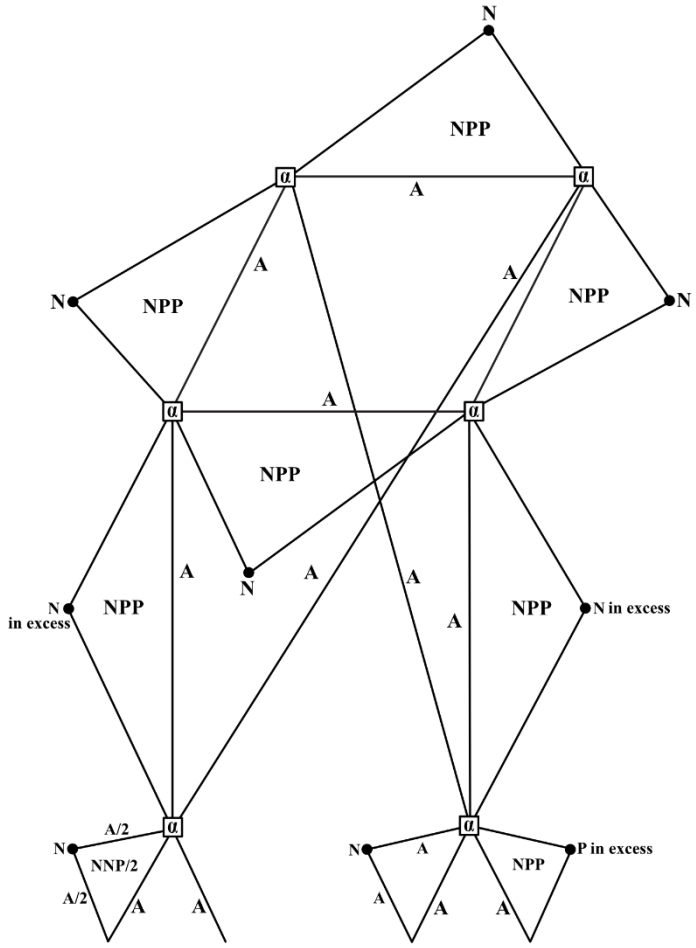




Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds or NPP bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 9

Ir 193 – Central-upper structure



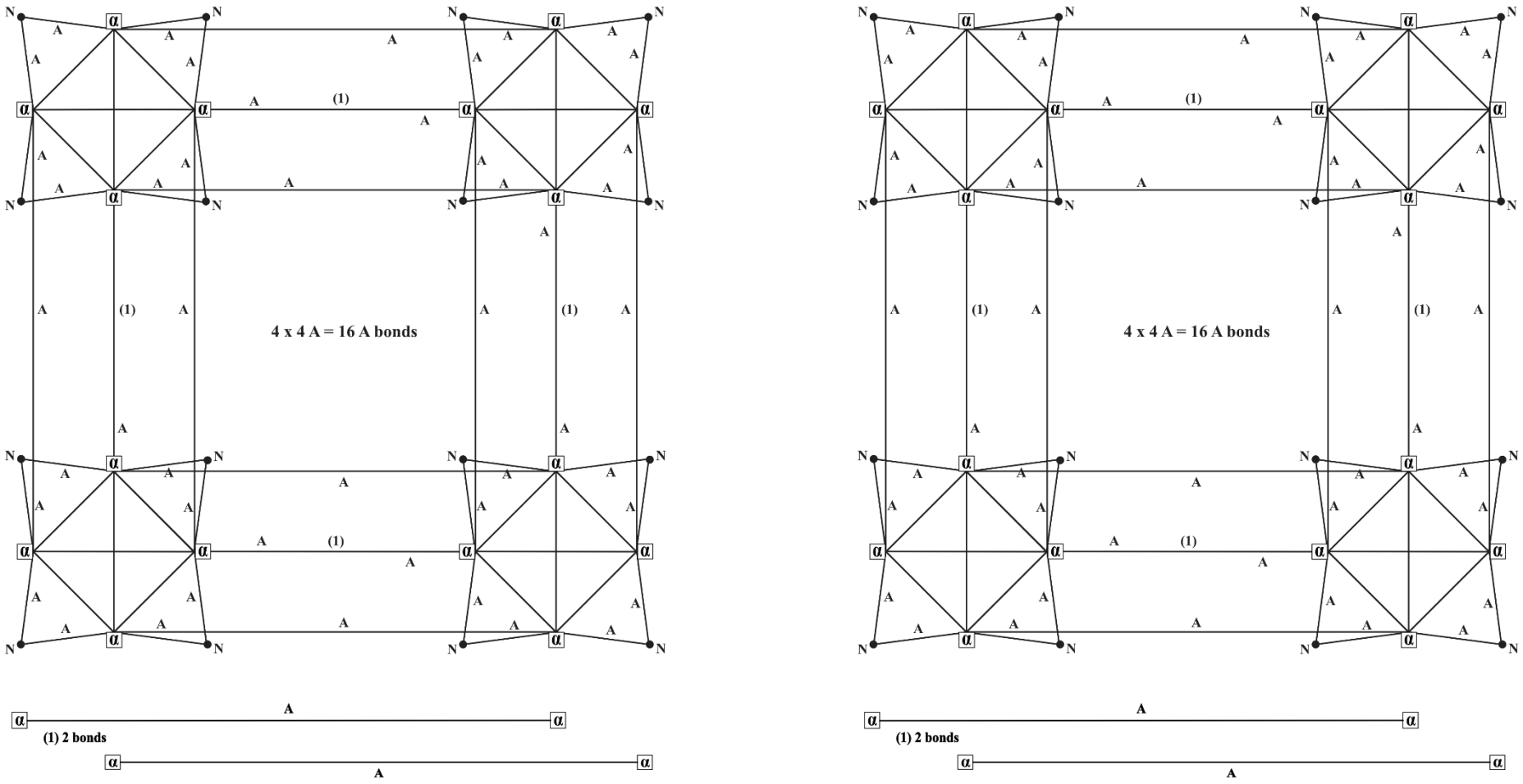
These twice four A bonds are linking the six α particles of the central-upper structure to twice two α particles of the lower structure.

$^{193}_{77}$**Ir** Nat. abundance: 62.7 % 38 α, 38 N suppl. 2 N, 1 P in excess E_B in MeV = 1,532.0597 MeV

	E_B	38 α	x	28.325	1,076.3500	MeV
		22	x	4.9365	108,6030	
Core		22	x	2.2246	48.9412	
.		33.5	x	4.9365	165.3728	
38 N suppl.		33.5	x	2.2246	74.5241	
2 N, 1 P in excess		0.5	x	8.4818	4.2409	
		7	x	7.7180	54.0260	
					1,532.0580	MeV
					- 0.001	

Figure 9 bis

Ir 193 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

5. Core structure of Platinum (78 Pt) and Gold (79 Au)

(see chapter 9 point 2 and figures 9 to 15 bis)

CHAPTER 12

MERCURY AND THALLIUM

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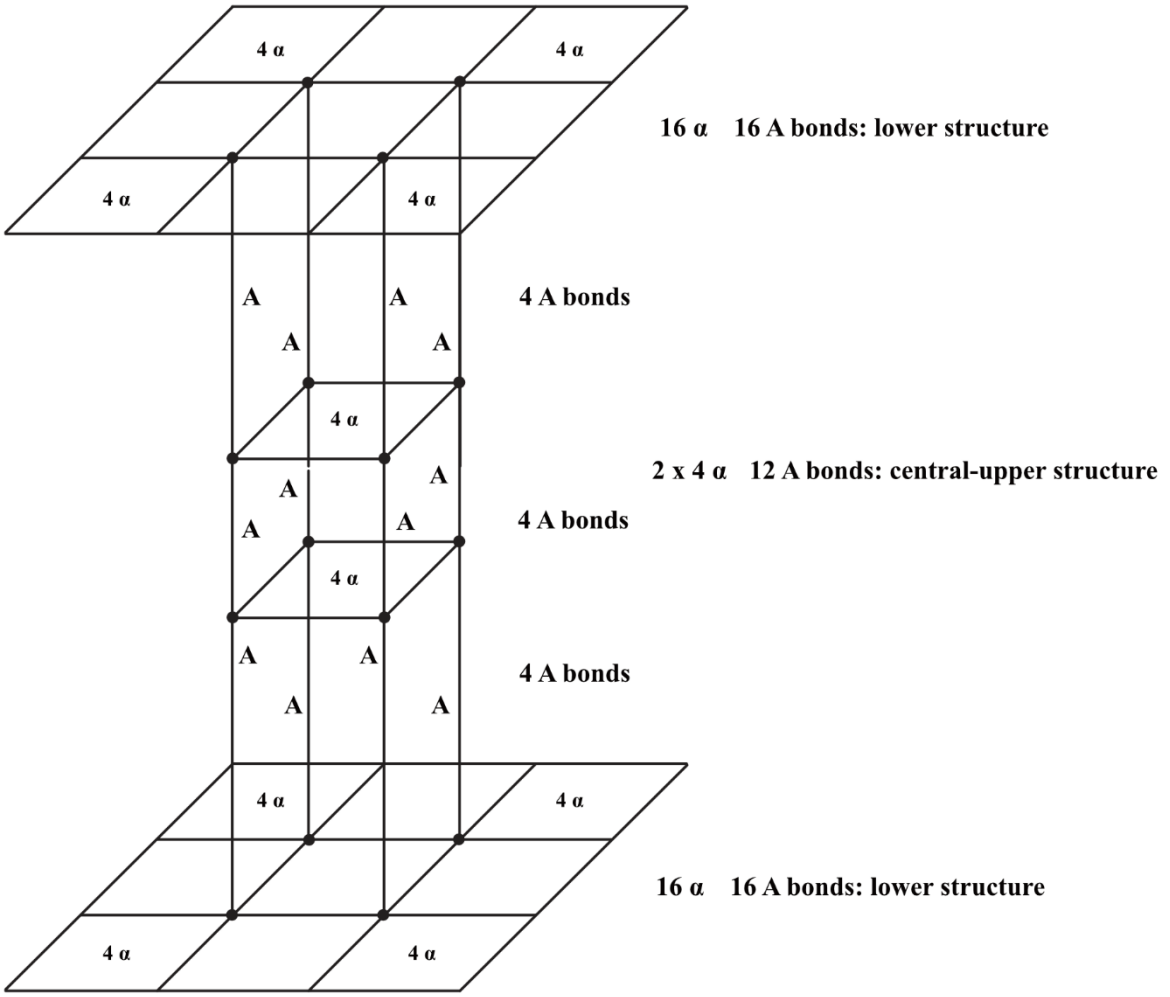
1. Core structure of Mercury (80 Hg) and Thallium (81 Tl)

The core structure of 80 Hg and 81 Tl is based on a lower structure constituted with 2 x 16 α particles and a central-upper structure with 2 x 4 α particles.



In total there are 40 α particles and 44 A bonds.

2. Binding energy of Mercury and Thallium

Summary table of the N and P supplementary binding energy of all stable Hg and Tl nuclides.

Nucleus	N	P	NN	NP	NNP	NPP	NP (P)
Hg 196	36	0	31.5	31.5	0.5	4	
Hg 198	38	0	32.5	32.5	1	4.5	
Hg 199	39	0	33	33	0	6	
Hg 200	40	0	32.5	32.5	0	7.5	
Hg 201	41	0	36.5	36.5	1	3.5	
Hg 202	42	0	38.5	38.5	2.5	1	
Tl 203	42	1	33.5	33.5	0.5	8	2
Hg 204	44	0	40	40	1	3	
Tl 205	44	1	38.5	38.5	2.5	3	2

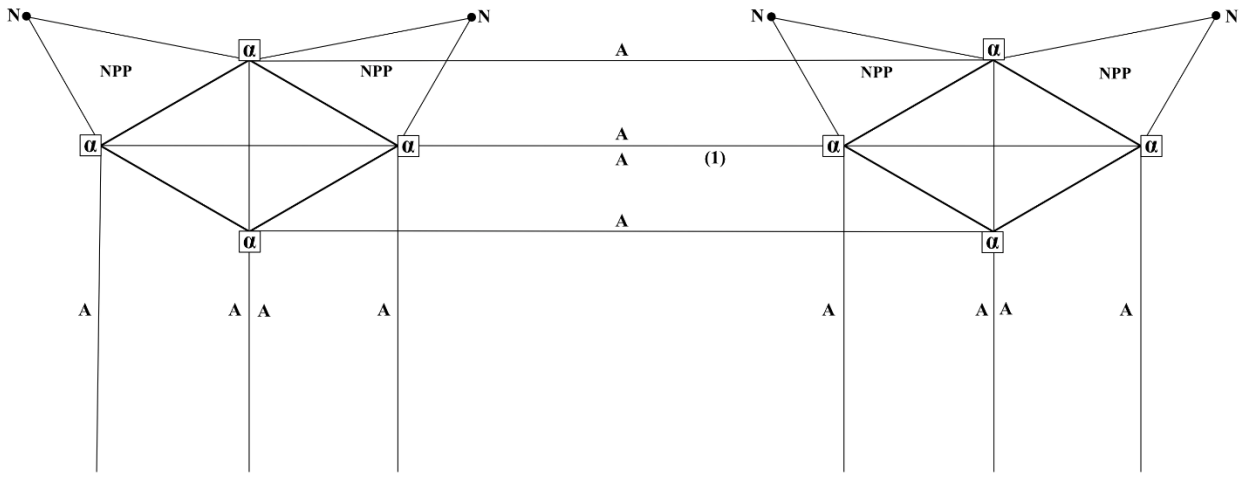
The lower structures of all these nuclides are saturated with 32 N supplementary bound to 32 α particles with 32 x 2 A bonds (except for Hg 196), where there are 31 x 2 A bonds and 1 (A + NNP/2) bond (figures 1 and 1 bis).

The α particles of the upper structures are bonded with 2 A bonds, NNP or NPP bonds (see figures 1 to 9 bis).

Comparing Hg 196 and Hg 198, there are 2 bonds more: 2 A and NNP/2 + NPP/2.
Comparing Hg 198 and Hg 199, there is one bond more (NPP). Also, one NNP is modified into (A + NPP/2).
Comparing Hg 198 and Hg 200, 2 NPP are added, and 1 NNP is modified into NPP.
Comparing Hg 199 and Hg 200, 1 NPP is added, and 1 A is modified into NPP/2.
Comparing Hg 200 and Hg 201, 1 NNP is added, also 4 NPP are modified into 4 x 2 A.
Comparing Hg 201 and Hg 202, 1 NNP is added. Also, 2.5 NPP are modified into 0.5 NNP and 2 x 2 A bonds.
Comparing Hg 202 and Tl 203, 5 x 2 A and 2 NNP are modified into 7 NPP, also 2 NP are added.
Comparing Tl 203 and Hg 204, 1 x 2 A are added. Also, 4.5 NPP are modified into 4.5 x 2 A, 2 NP into 2 A bonds, and NPP/2 into NNP/2.
Comparing Hg 204 and Tl 205, 2 NP are added, and 1.5 x 2 A bonds are modified into 1.5 NNP bonds.
Notice also that 2 NPP and 2 NP are added to Hg 202 to obtain Tl 205.

Figure 1

Hg 196 – Central-upper structure



(1) 2 A bonds

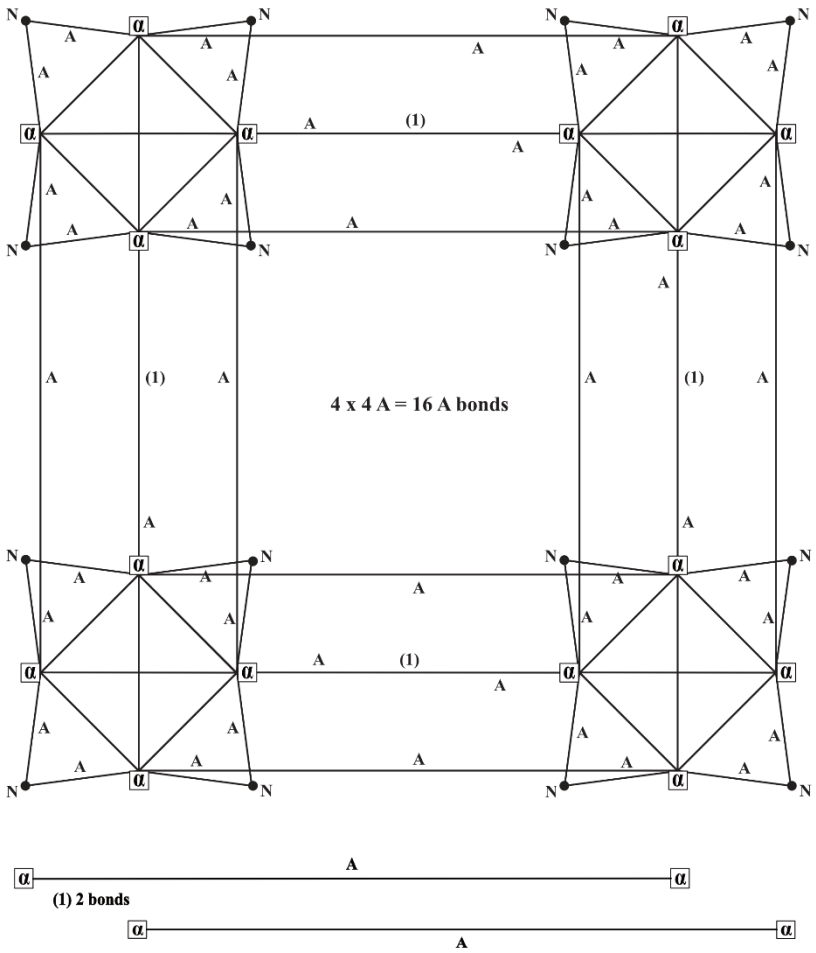
These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

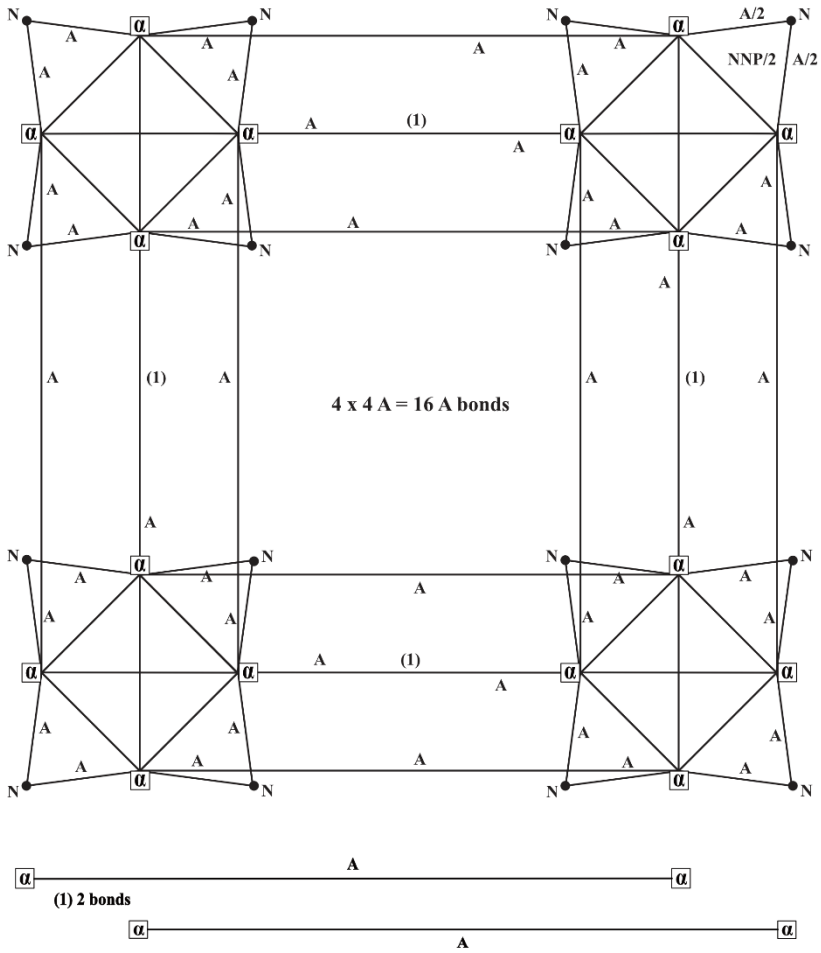
$^{196}_{80}$**Hg** Nat. abundance: 0.2% 40 α, 36N suppl. E_B in MeV = 1,551.2163 MeV

	E_B	40 α	x	28.325	1,133.0000	MeV
		22	x	4.9365	108.6030	
Core		22	x	2.2246	48.9412	
.		31.5	x	4.9365	155.4998	
36 N suppl		31.5	x	2.2246	70.0749	
		0.5	x	8.4818	4.2409	
		4	x	7.7180	30.8720	
					1,551.2318	MeV
					+ 0.015	

Figure 1 bis

Hg 196 - Lower structure

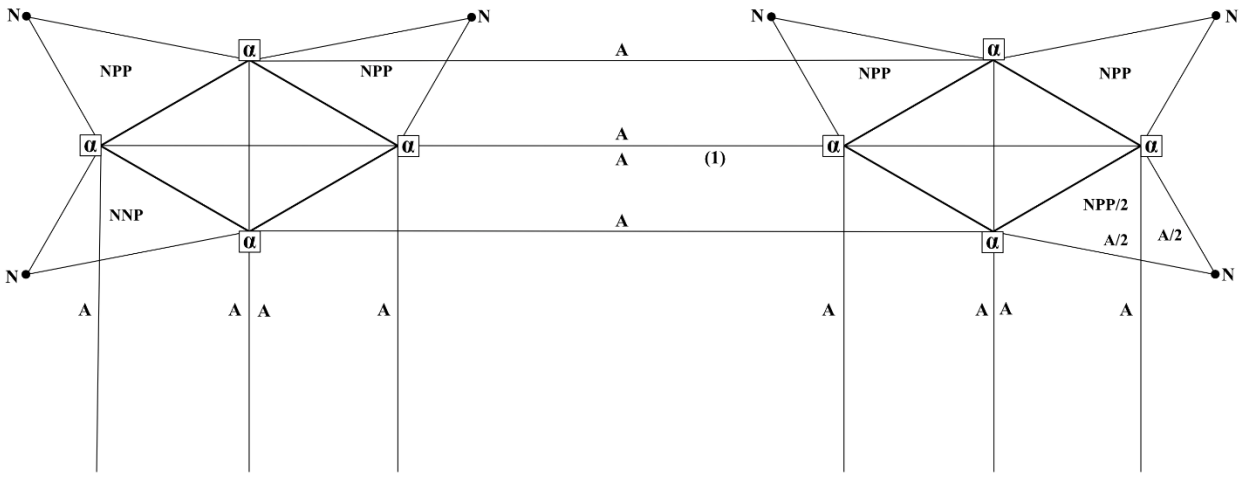




Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with either 2A bonds or other bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 2

Hg 198 – Central-upper structure



(1) 2 A bonds

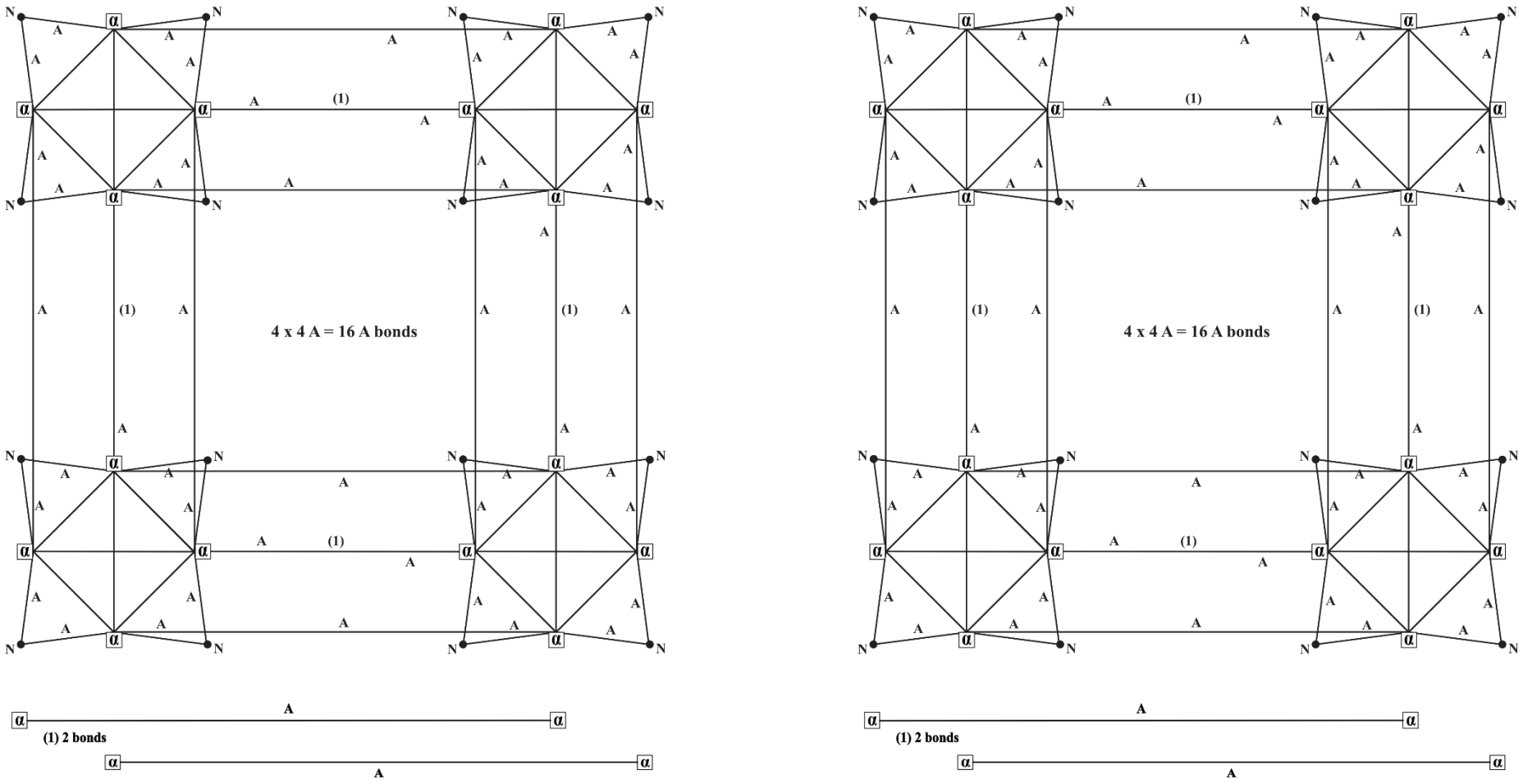
These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{198}_{80}$**Hg** Nat. abundance: 10.1% 40 α, 38N suppl. E_B in MeV = 1,566.4873 MeV

	E_B	40 α	x	28.325	1,133.0000 MeV
		22	x	4.9365	108.6030
Core		22	x	2.2246	48.9412
.		32.5	x	4.9365	160.4363
38 N suppl		32.5	x	2.2246	72.2995
		1	x	8.4818	8.4818
		4.5	x	7.7180	34.7310
					1,566.4928 MeV
					+ 0.005

Figure 2 bis

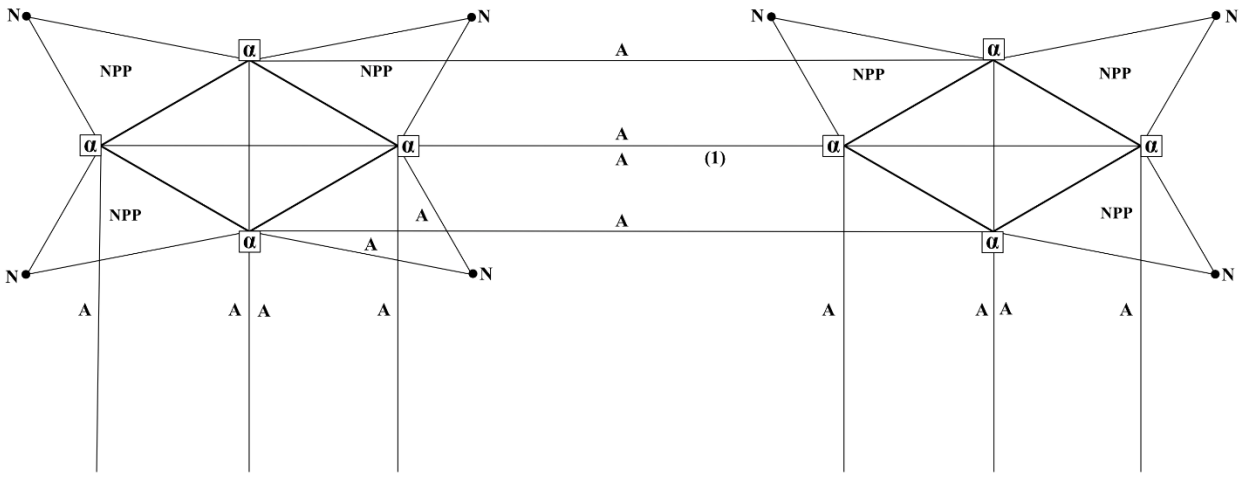
Hg 198 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 3

Hg 199 – Central-upper structure



(1) 2 A bonds

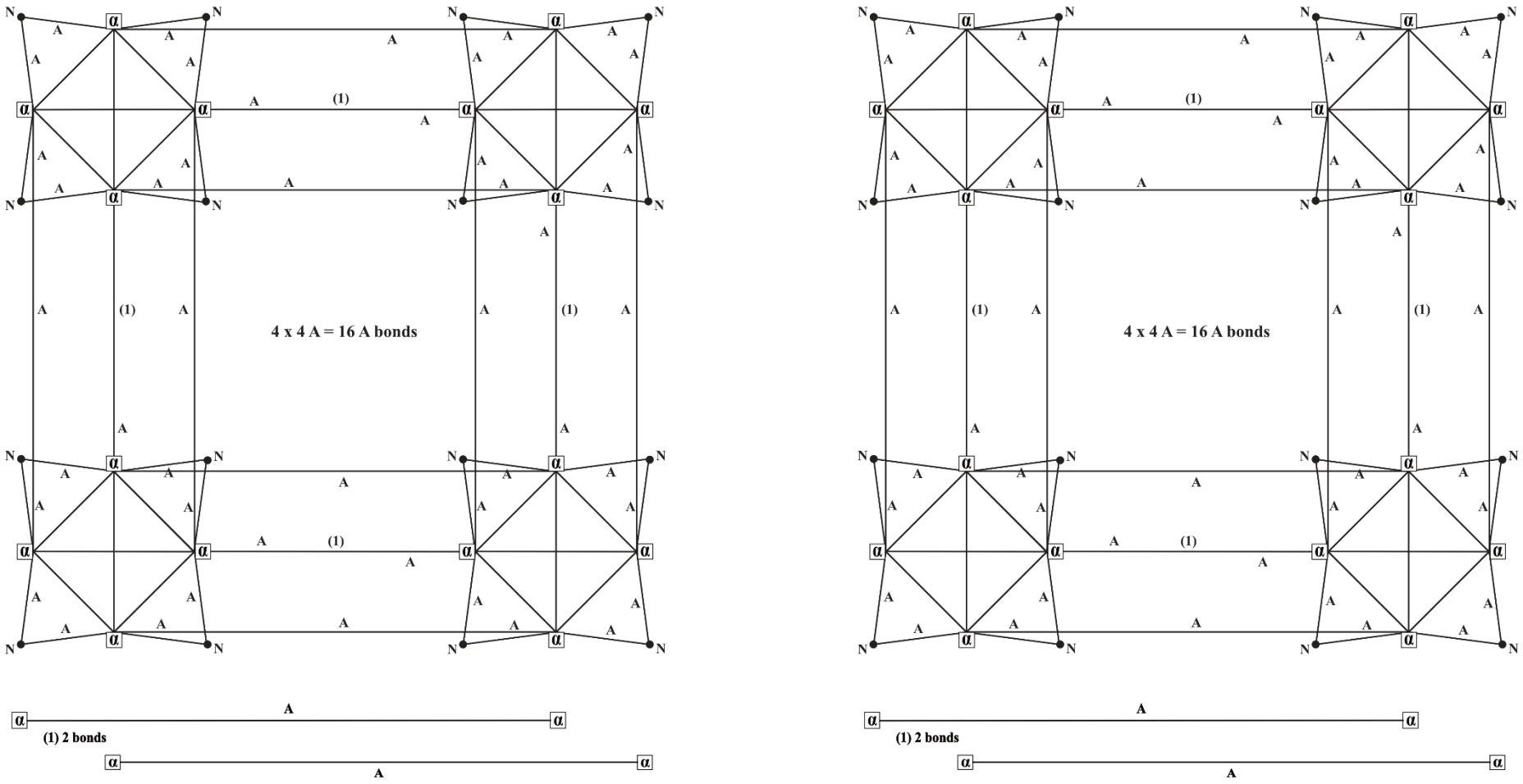
These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{199}_{80}$**Hg** Nat. abundance: 16.9% 40 α, 39N suppl. E_B in MeV = 1,573.1505 MeV

	E_B	40 α	x	28.325	1,133.0000	MeV
		22	x	4.9365	108.6030	
Core		22	x	2.2246	48.9412	
.		33	x	4.9365	162.9045	
39 N suppl		33	x	2.2246	73.4118	
		6	x	7.7180	46.3080	
					1,573.1685	MeV
					+ 0.018	

Figure 3 bis

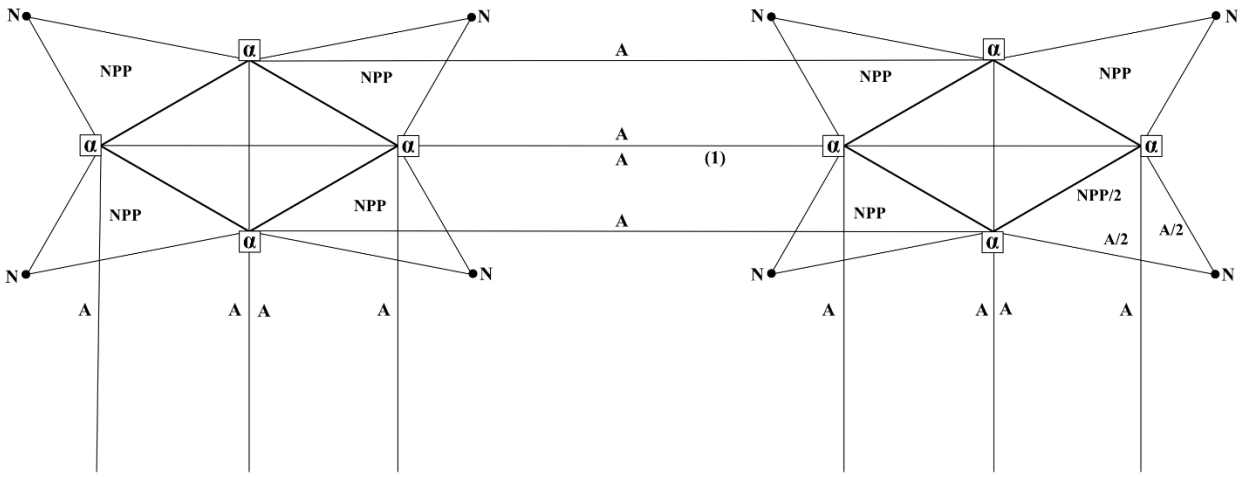
Hg 199 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 4

Hg 200 – Central-upper structure



(1) 2 A bonds

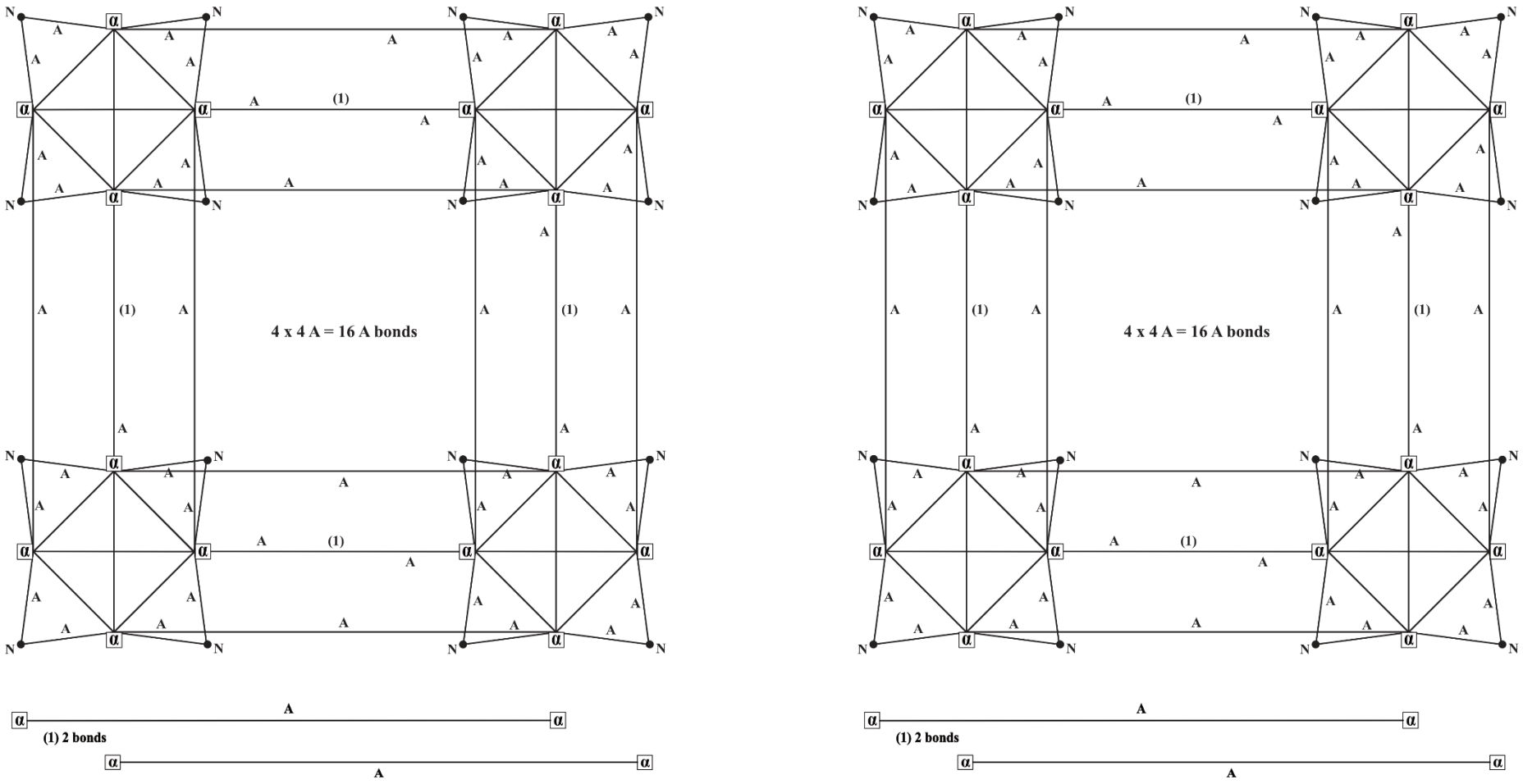
These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{200}_{80}$**Hg** Nat. abundance: 23.1% 40 α, 40N suppl. E_B in MeV = 1,581.1790 MeV

	E_B	40 α	x	28.325	1,133.0000	MeV
		22	x	4.9365	108.6030	
Core		22	x	2.2246	48.9412	
.		32.5	x	4.9365	160.4363	
40 N suppl		32.5	x	2.2246	72.2995	
		7.5	x	7.7180	57.8850	
					1,581.1650	MeV
					- 0.014	

Figure 4 bis

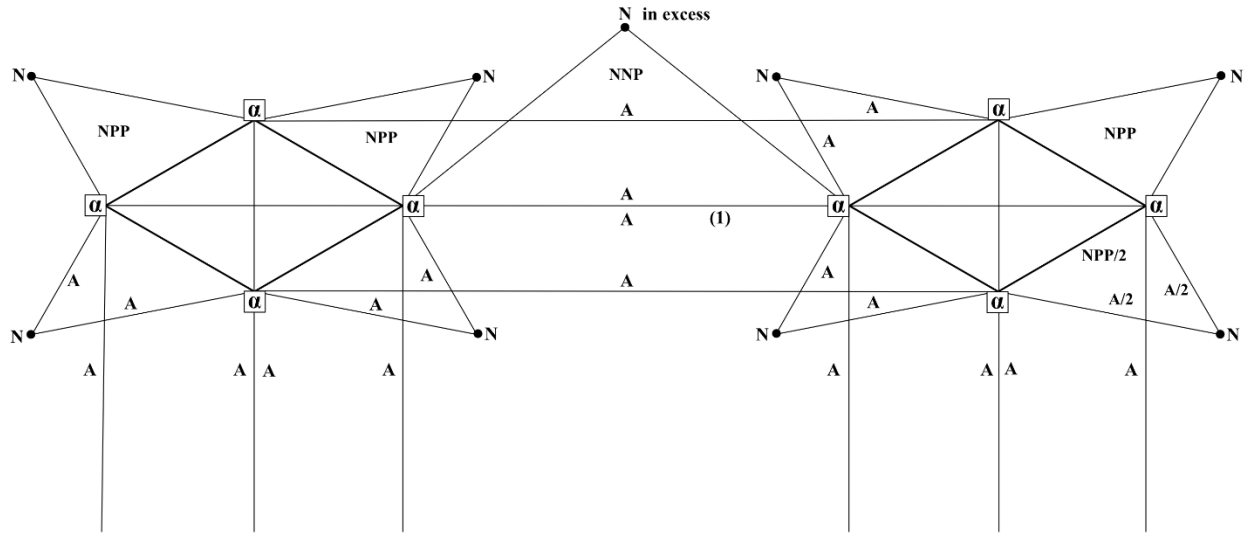
Hg 200 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 5

Hg 201 – Central-upper structure



(1) 2 A bonds

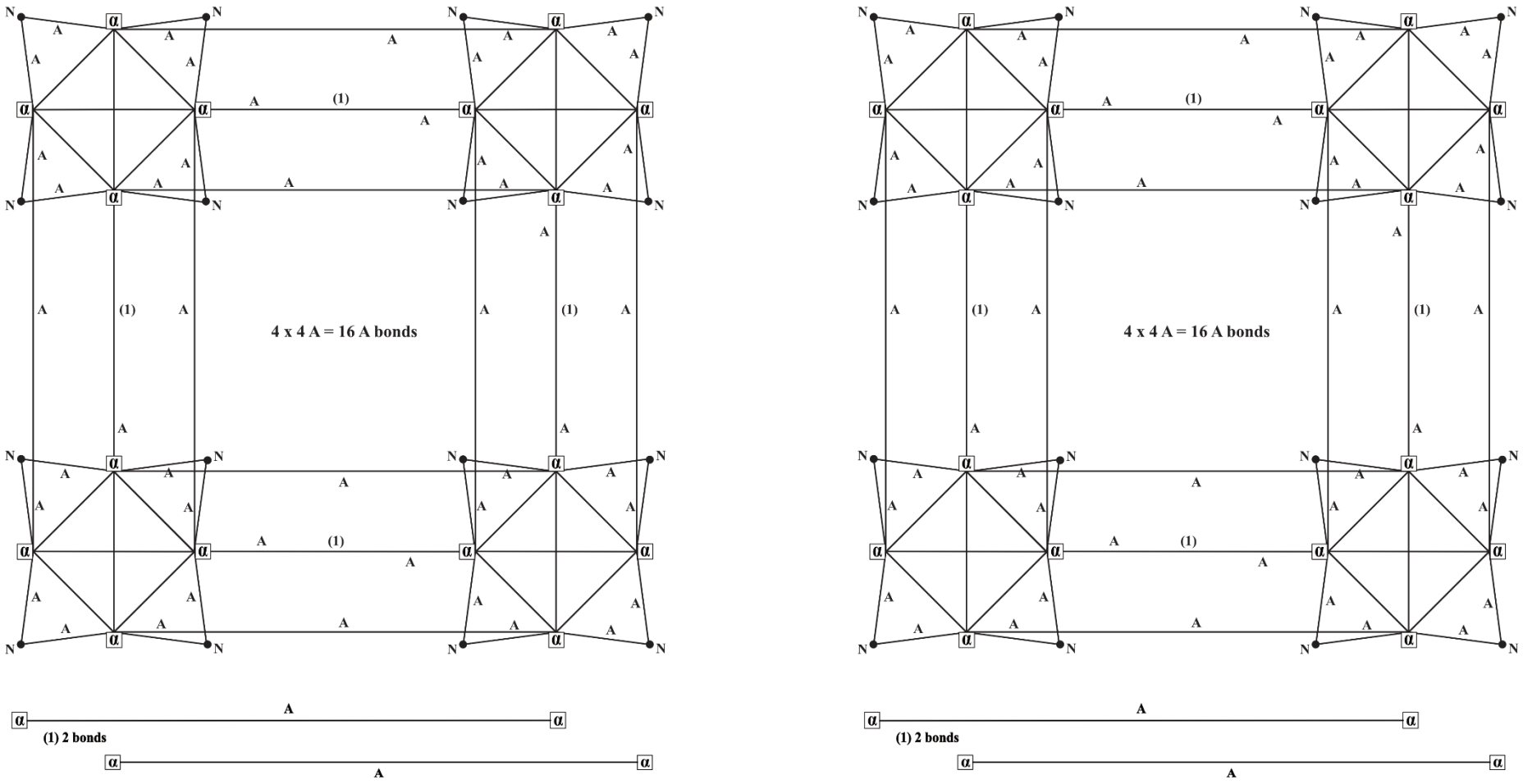
These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{201}_{80}$**Hg** Nat. abund.: 13.2% 40 α, 40N suppl, 1 N in excess E_B in MeV = 1,587.4096 MeV

	E_B	40 α	x	28.325	1,133.0000	MeV
		22	x	4.9365	108.6030	
Core		22	x	2.2246	48.9412	
.		36.5	x	4.9365	180.1823	
40 N suppl,		36.5	x	2.2246	81.1979	
		3.5	x	7.7180	27.0130	
1 N in excess		1	x	8.4818	8.4818	
					1,587.4192	MeV
					+ 0.010	

Figure 5 bis

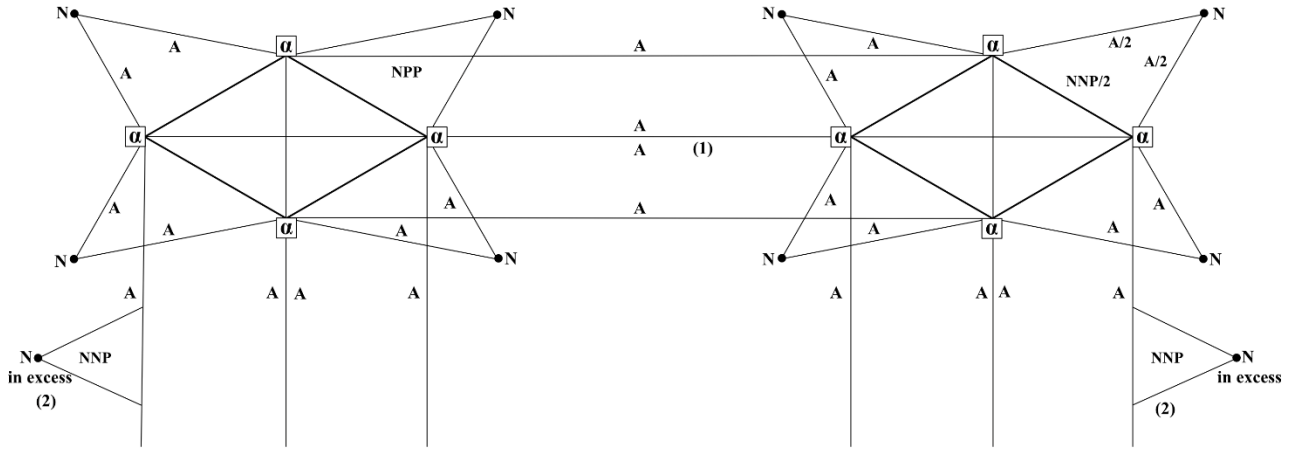
Hg 201 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 6

Hg 202 – Central-upper structure



(1) 2 A bonds
(2)The N's in excess locations are indicative. These N's are binding 2 α particles (like the other N's), one α particle of the central-upper structure and one α particle of the lower one.

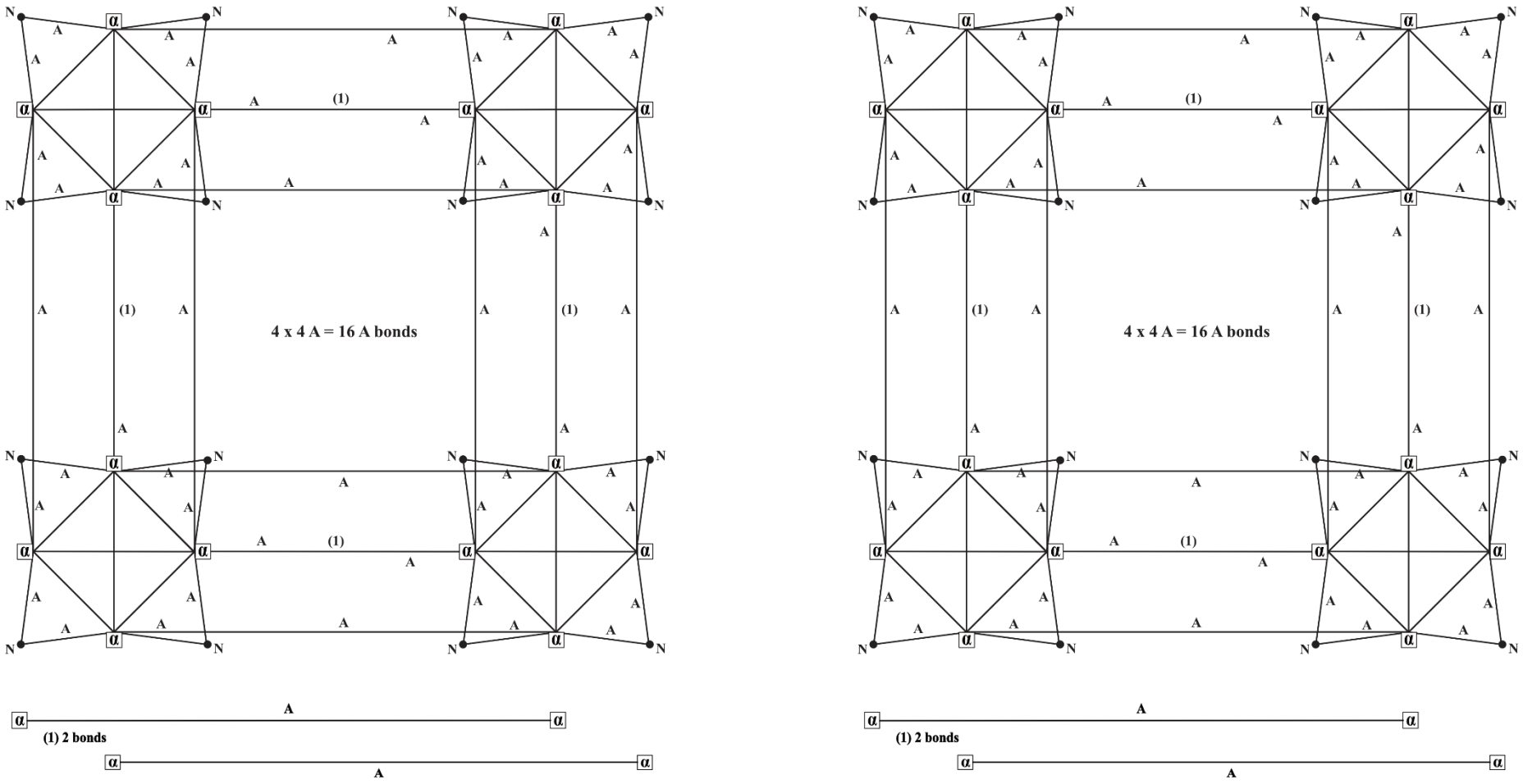
These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{202}_{80}$**Hg** Nat. abund.: 29.7% 40 α, 40N suppl, 2 N in excess E_B in MeV = 1,595.1637 MeV

	E_B	40 α	x	28.325	1,133.0000 MeV
		22	x	4.9365	108.6030
Core		22	x	2.2246	48.9412
.		38.5	x	4.9365	190.0553
40 N suppl,		38.5	x	2.2246	85.6471
		0.5	x	8.4818	4.2409
		1	x	7.7180	7.7180
2 N in excess		2	x	8.4818	16.9636
					1,595.1691 MeV
					+ 0.006

Figure 6 bis

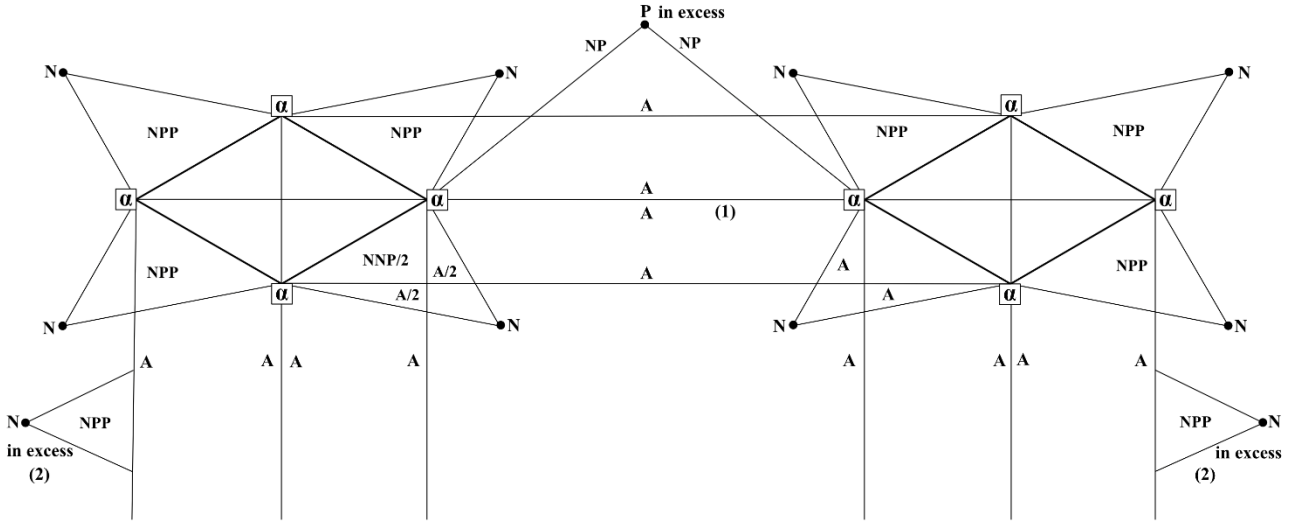
Hg 202 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 7

Tl 203 – Central-upper structure



(1) 2 A bonds
(2)The N's in excess locations are indicative. These N's are binding 2 α particles (like the other N's), one α particle of the central-upper structure and one α particle of the lower one.

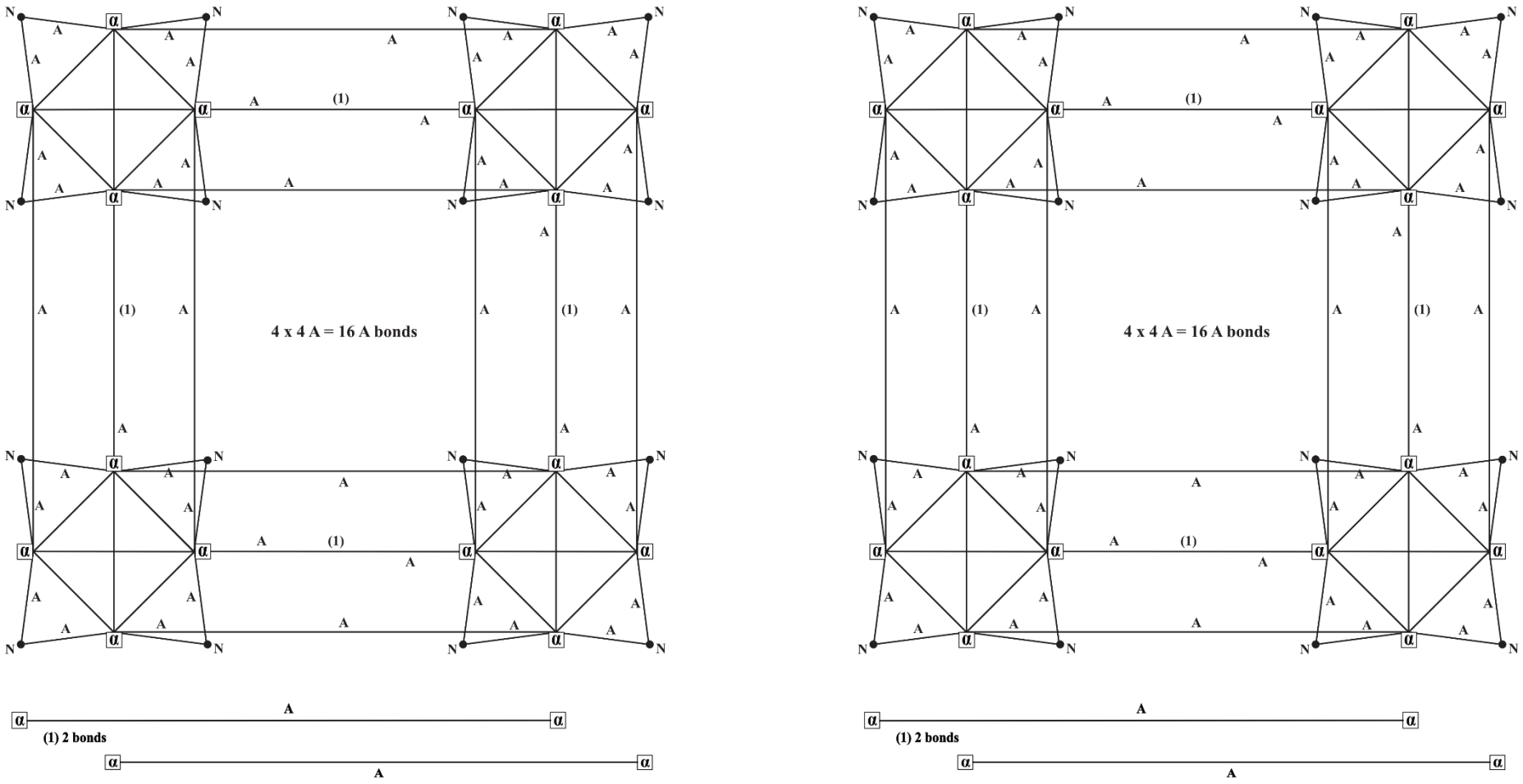
These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{203}_{81}$**Tl** Nat. abund.: 29.5% 40 α, 40N suppl, 2 N, 1 P in excess E_B in MeV = 1,600.8688 MeV

	E_B	40 α	x	28.325	1,133.0000	MeV
		22	x	4.9365	108.6030	
Core		22	x	2.2246	48.9412	
.		33.5	x	4.9365	165.3728	
40 N suppl,		33.5	x	2.2246	74.5241	
		0.5	x	8.4818	4.2409	
		6	x	7.7180	46.3080	
2 N, 1 P in excess		2	x	2.2246	4.4492	
		2	x	7.7180	15.4360	
					1,600.8752	MeV
					+ 0.007	

Figure 7 bis

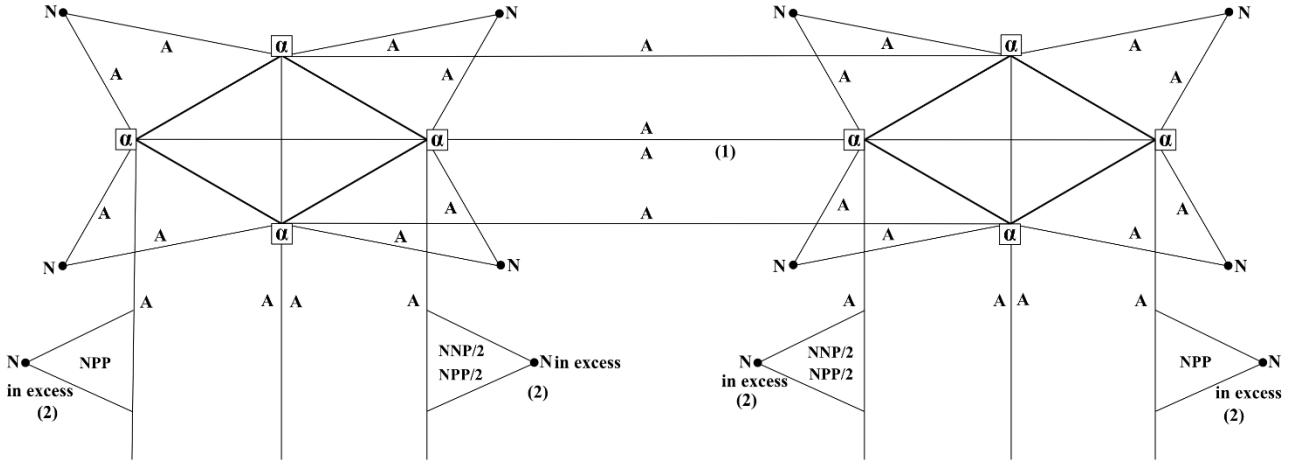
Tl 203 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 8

Hg 204 – Central-upper structure



(1) 2 A bonds
(2)The N's in excess locations are indicative. These N's are binding 2 α particles (like the other N's), one α particle of the central-upper structure and one α particle of the lower one.

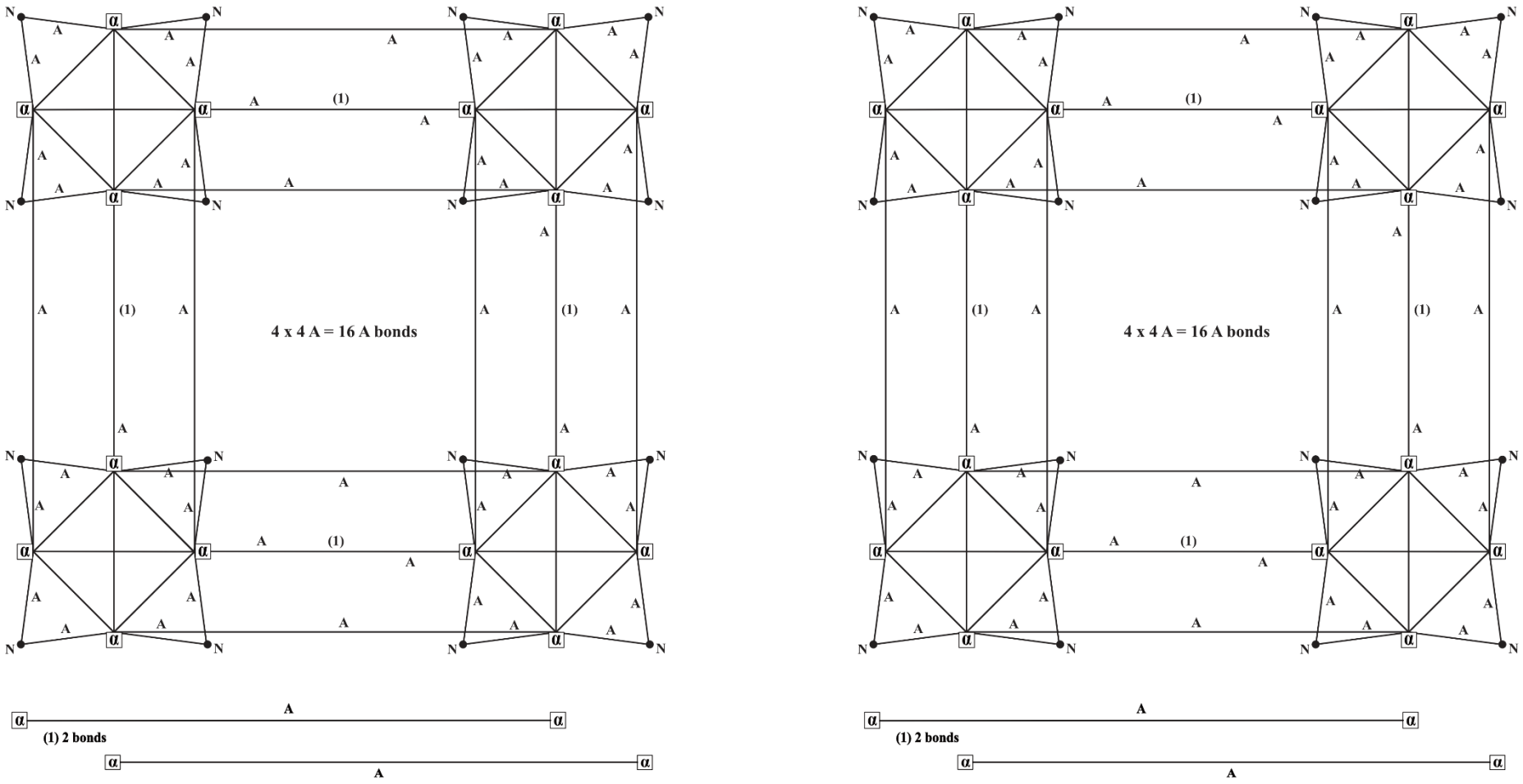
These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{204}_{80}$**Hg** Nat. abund.: 6.8% 40 α, 40N suppl, 4 N in excess E_B in MeV = 1,608.6512 MeV

	E_B	40 α	x	28.325	1,133.0000 MeV
		22	x	4.9365	108.6030
Core		22	x	2.2246	48.9412
40 N suppl		40	x	4.9365	197.4600
		40	x	2.2246	88.9840
4 N in excess		1	x	8.4818	8.4818
		3	x	7.7180	23.1540
					1,608.6240 MeV
					- 0.027

Figure 8 bis

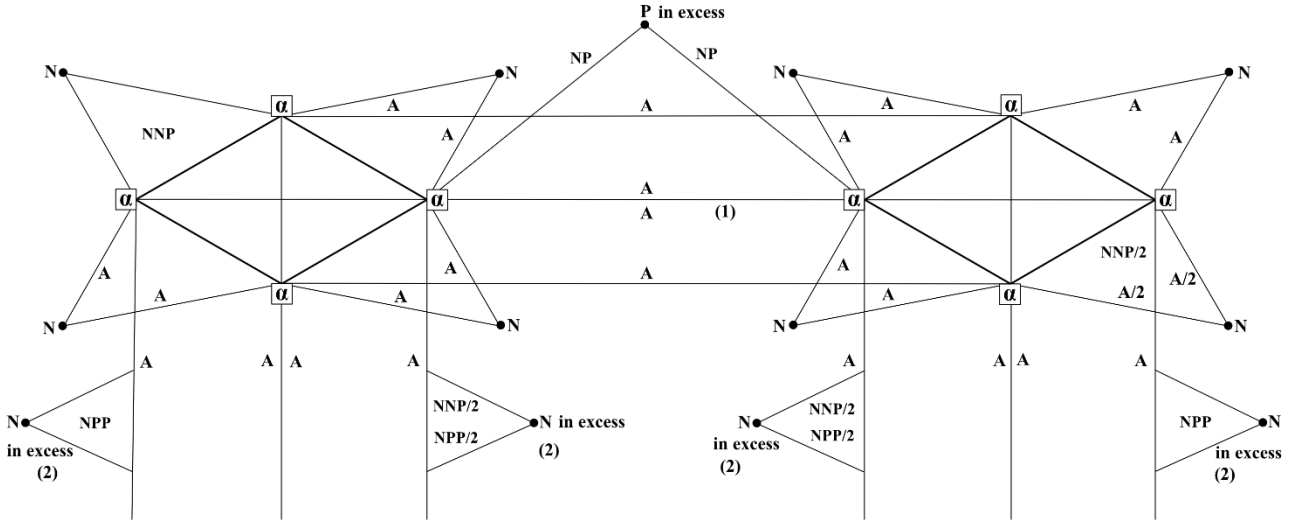
Hg 204 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 9

Tl 205 – Central-upper structure



(1) 2 A bonds
(2)The N's in excess locations are indicative. These N's are binding 2 α particles (like the other N's), one α particle of the central-upper structure and one α particle of the lower one.

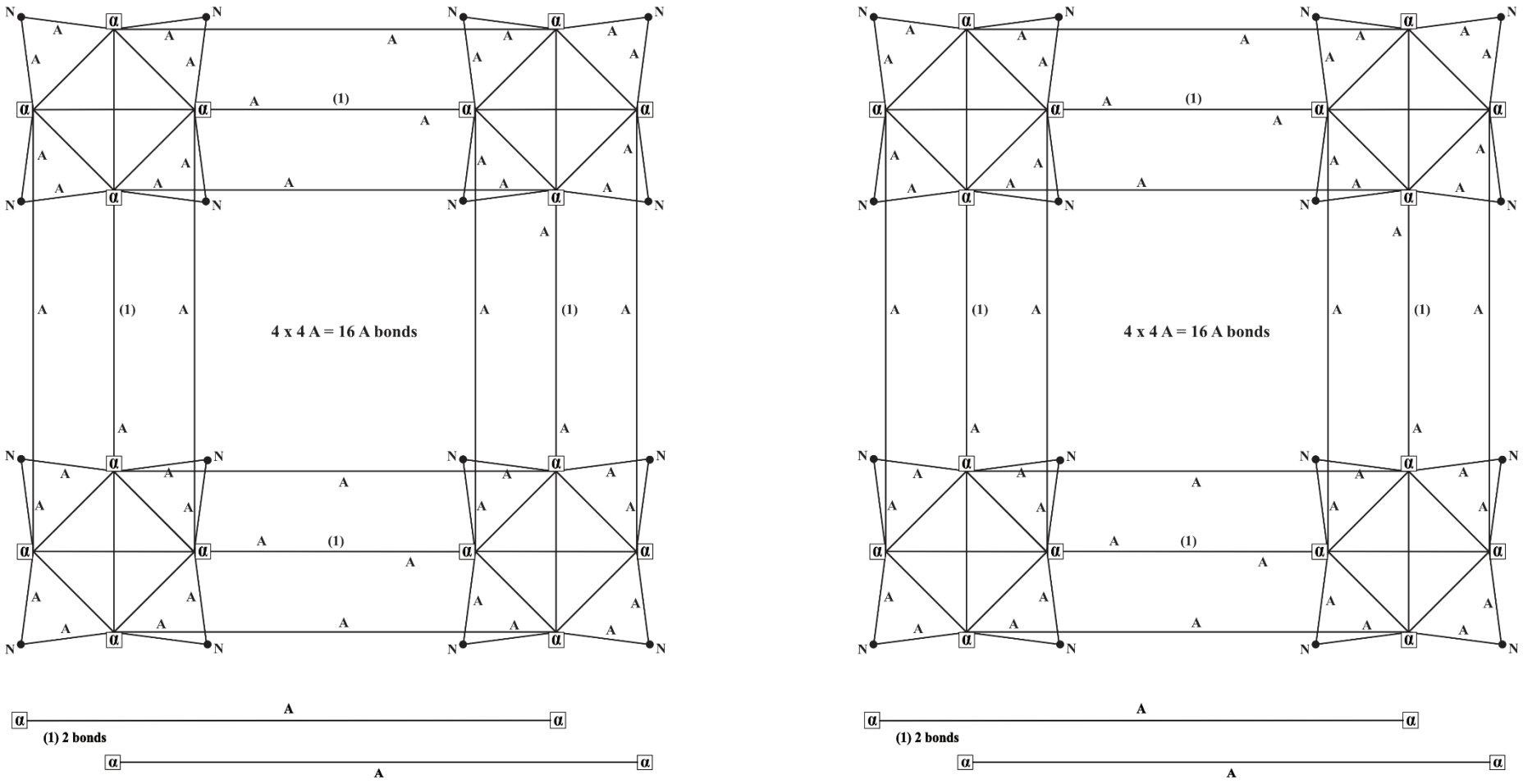
These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

$^{205}_{81}$**Tl** Nat. abund.: 70.5% 40 α, 40N suppl, 4 N, 1 P in excess E_B in MeV = 1,615.0708 MeV

	E_B	40 α	x	28.325	1,133.0000	MeV
		22	x	4.9365	108.6030	
Core		22	x	2.2246	48.9412	
		38.5	x	4.9365	190.0553	
40 N suppl		38.5	x	2.2246	85.6471	
		1.5	x	8.4818	12.7227	
		2	x	2.2246	4.4492	
4 N, 1 P in excess		1	x	8.4818	8.4818	
		3	x	7.7180	23.1540	
					1,615.0543	MeV
					- 0.016	

Figure 9 bis

Tl 205 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with 2A bonds.
They are also linked together with the 2 x 16A bonds of the lower structure.

CHAPTER 13

STRUCTURAL BREAKDOWN OF PB 206, PB 207, PB 208, AND BI 209

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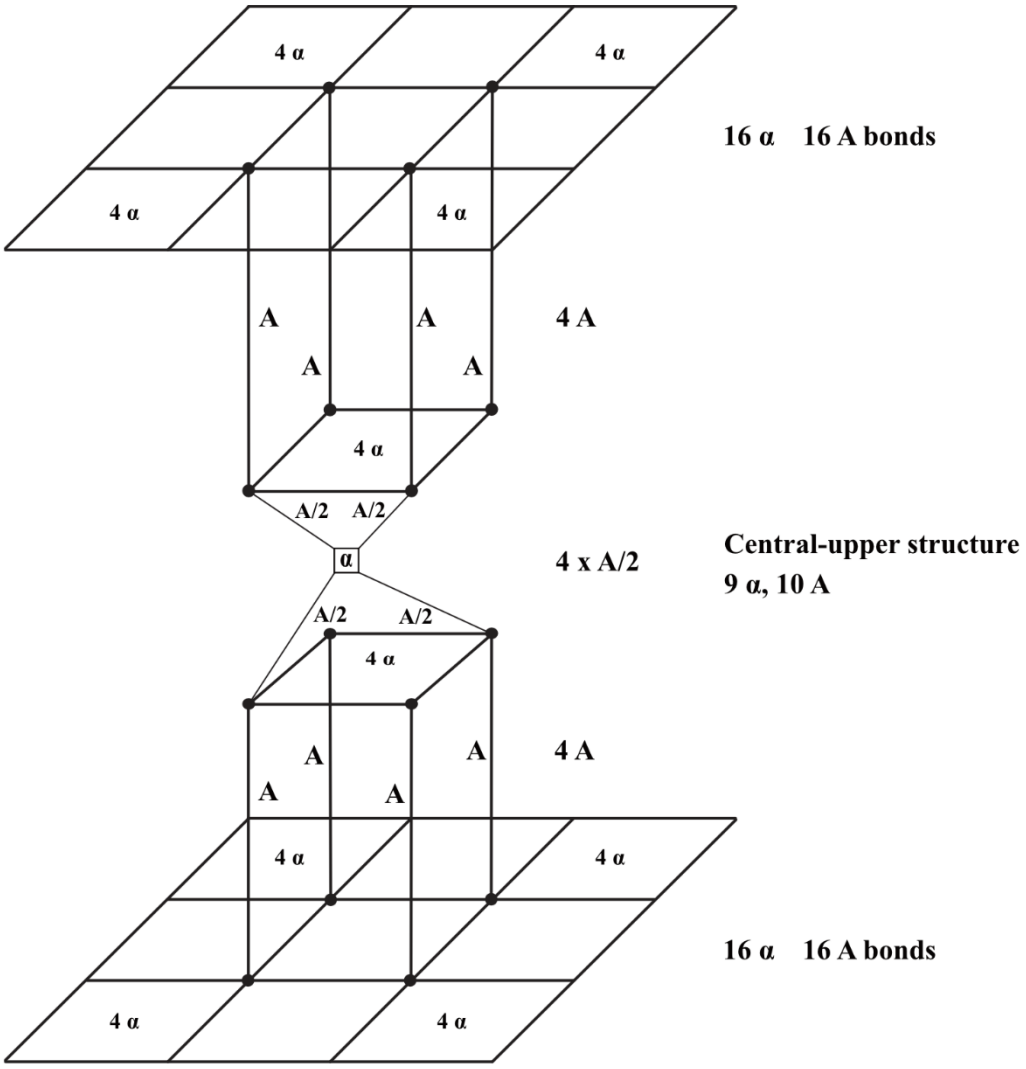
1. Core structure of lead (82 Pb) and Bismuth (83 Bi)



This core structure is similar to that one of Mercury (Hg 80) and Thallium (Tl 81). Instead of 4 A bonds at the center there is one α more linked to the lower structure with 4 x A/2.

2. Structural breakdown of Pb 206, Pb207, Pb208 and Bi 209

As these nuclides are the last ones of the Periodic Table to be stable it is of great interest to study their structures and to determine how these are related.

According to the structure of elements described in the former chapters the structures presented below (Pb 204 to Bi 209) are constituted with 41 α particles, 41 supplementary neutrons to these α particles and 1 to 4 nucleons in excess to these structures (except for Pb 204 and Pb 205).

On table 1 the different constituents of these nuclides, as well as the values of these constituents are displayed. All have 41 α particles linked together with 42 A bonds (A = NN/2 + NP/2). 40 supplementary N are linked to the α particles with numerous A bonds and other bonds (NNP and NPP). The 41^{th} N is linked to the α particles with one A bond and one NPP/2 bond. The neutrons and proton in excess are linked to the structures in a similar way.

On figures 1 to 7 these structures are presented. These figures are split in two sub structures, a central-upper one and a lower one. The lower structures are identical for the nuclides: (12 x 2) α particles are linked with A bonds, and (4 x 2) α particles are linked with (NPP/2 + A) bonds. They are also linked 4 to 4 with 2 x 16 A bonds.

The 2 x 4 α particles of each central-upper structure are linked to the lower structure with 2 x 4 A bonds. Also, 2 x 4 supplementary N are linked to the α particles with A bonds and NNP and /or NPP bonds.

The 41^{th} α particle is linked to the other α particles with two A bonds in all cases. Also, the 41^{th} supplementary N of the central-upper structure is linking two α particles with one (A+ NPP/2) bond in each of the cases.

The structures of Pb 204 to Bi 209 are different as far as their nucleons in excess are concerned.

Remarks:

1. Considering Pb 205 nuclide close to those studied, (Pb 206, 207, 208, 209, Bi 209) (see figures 6):

   - its structure is close to the other ones studied,

   - it does not have any nucleon in excess,

   - it is decaying in creating nucleons in excess: Pb 205 is EC decaying into Tl 205 having 4 N and 1 P in excess.

2. Considering Pb 204 which is stable, see figures 7

Table 1

Structural breakdown of Pb 204, Pb 205, Pb 206, Pb207, Pb208, Pb 209 and Bi 209 (in MeV)

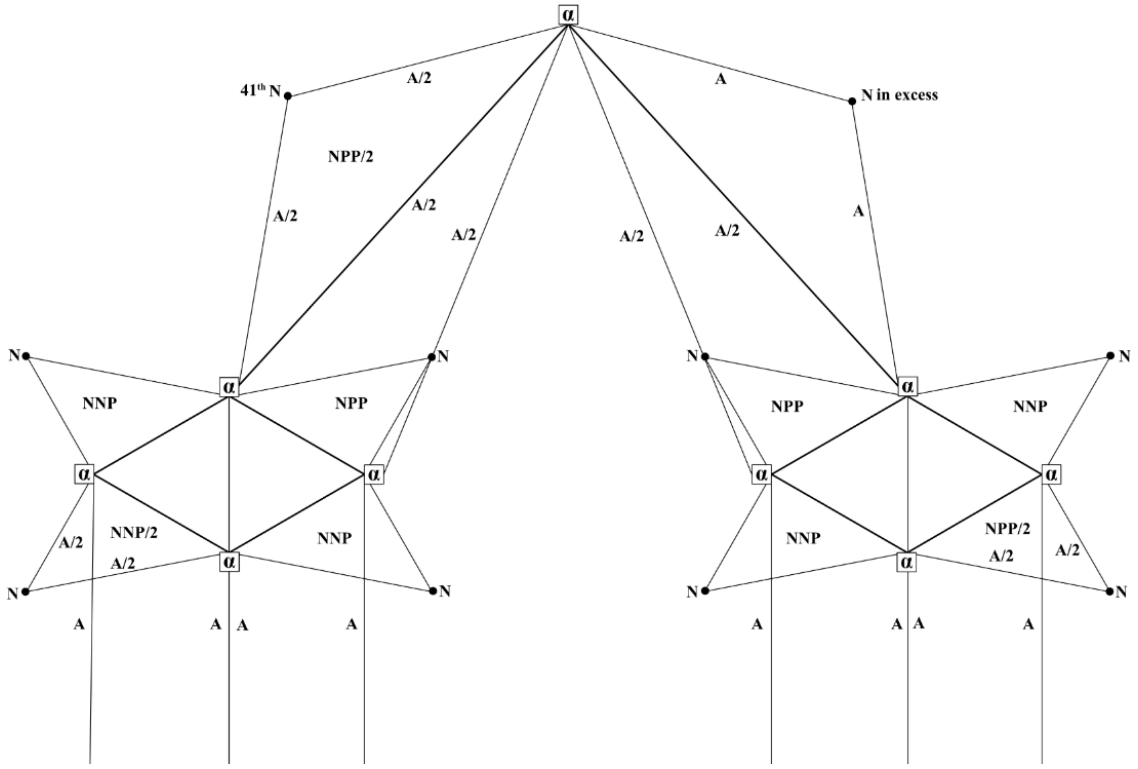
Pb 204		Pb 205		Pb 206	
41 α	1,161.3250	**41 α**	1,161.3250	**41 α**	1,161.3250
21 NN } 42A	103.6665	21 NN } 42A	103.6665	21 NN } 42A	103.6665
21 NP }	46.7166	21 NP }	46.7166	21 NP }	46.7166
40 N suppl. to 40 α's		**40 N** suppl. to 40 α's		**40 N** suppl. to 40 α's	
Lower structure		**Lower structure**		**Lower structure**	
(32 N)		**(32 N)**		**(32 N)**	
28 NN	138.2220	28 NN	138.2220	28 NN	138.2220
28 NP	62.2888	28 NP	62.2888	28 NP	62.2888
4 NPP	30.8720	4 NPP	30.8720	4 NPP	30.8720
Upper structure		**Upper structure**		**Upper structure**	
(8 N)		**(8 N)**		**(8 N)**	
3.5 NNP	29.6863	2 NN	9.8730	1 NN	4.9365
4.5 NPP	34.7310	2 NP	4.4492	1 NP	2.2246
		4 NNP	33.9272	4.5 NNP	38.1681
		2 NPP	15.4360	2.5 NPP	19.2950
(No **41th N** suppl.)		**41th N** suppl. to 41th α		**41th N** suppl. to 41th α	
		0.5 NN	2.4683	0.5 NN	2.4683
		0.5 NP	1.1123	0.5 NP	1.1123
		0.5 NPP	3.8590	0.5 NPP	3.8590
				1 N in excess to α's	
				1 NN	4.9365
				1 NP	2.2246
Total in MeV	1,607.5082	Total in MeV	1,614.2159	Total in MeV	1,622.3158
	+ 0.002		- 0.022		- 0.009

Table 1 (continued)

Pb 207		Pb 208		Pb 209		Bi 209	
41 α	1,161.3250	**41 α**	1,161.3250	**41 α**	1,161.3250	**41 α**	1,161.3250
21 NN } 42A	103.6665	21 NN } 42A	103.6665	21 NN } 42A	103.6665	21 NN } 42A	103.6665
21 NP }	46.7166	21 NP }	46.7166	21 NP }	46.7166	21 NP }	46.7166
40 N suppl. to 40 α's		**40 N** suppl. to 40 α's		**40 N** suppl. to 40 α's		**40 N** suppl. to 40 α's	
Lower structure		**Lower structure**		**Lower structure**		**Lower structure**	
(32 N)		**(32 N)**		**(32 N)**		**(32 N)**	
28 NN	138.2220	28 NN	138.2220	28 NN	138.2220	28 NN	138.2220
28 NP	62.2888	28 NP	62.2888	28 NP	62.2888	28 NP	62.2888
4 NPP	30.8720	4 NPP	30.8720	4 NPP	30.8720	4 NPP	30.8720
Upper structure		**Upper structure**		**Upper structure**		**Upper structure**	
(8 N)		**(8 N)**		**(8 N)**		**(8 N)**	
1 NN	4.9365	1 NN	4.9365	3.5 NN	17.2778	1 NN	4.9365
1 NP	2.2246	1 NP	2.2246	3.5 NP	7.7861	1 NP	2.2246
2.5 NNP	21.2045	2.5 NNP	21.2045	4.5 NNP	38.1681	2.5 NNP	21.2045
4.5 NPP	34.7310	4.5 NPP	34.7310			4.5 NPP	34.7310
41th N suppl. to 41th α		**41th N** suppl. to 41th α		**41th N** suppl. to 41th α		**41th N** suppl. to 41th α	
0.5 NN	2.4683	0.5 NN	2.4683	0.5 NN	2.4683	0.5 NN	2.4683
0.5 NP	1.1123	0.5 NP	1.1123	0.5 NP	1.1123	0.5 NP	1.1123
0.5 NPP	3.8590	0.5 NPP	3.8590	0.5 NPP	3.8590	0.5 NPP	3.8590
2 N in excess to α's		**3 N in excess to α's**		**4 N in excess to α's**		**3 N, 1 P in excess to α's**	
2 NPP	15.4360	2 NN	9.8730	2.5 NN	12.3413	2.5 NN	12.3413
		2 NP	4.4492	4.5 NP	10.0107	4.5 NP	10.0107
		1 NNP	8.4818	0.5 NNP	4.2409	0.5 NNP	4.2409
Total in MeV	1,629.0631	Total in MeV	1,636.4311	Total in MeV	1,640.3554	Total in MeV	1,640.2200
	+ 0.001		+ 0.001		- 0.012		- 0.009

Figure 1

Pb 206 – Central-upper structure

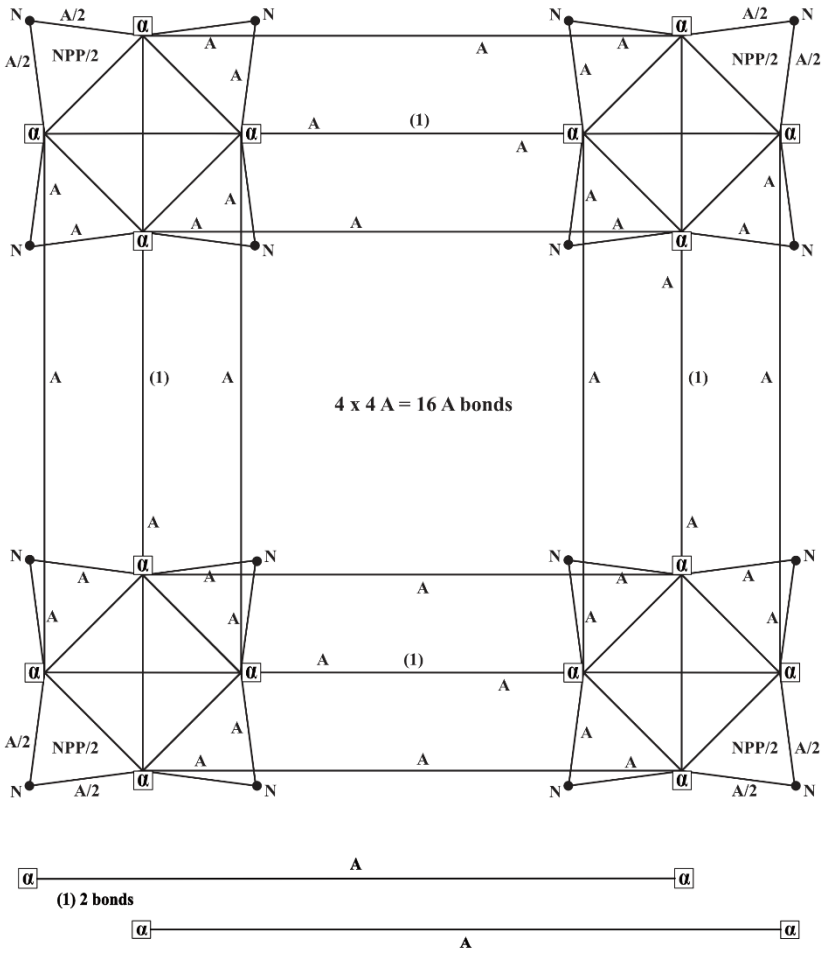


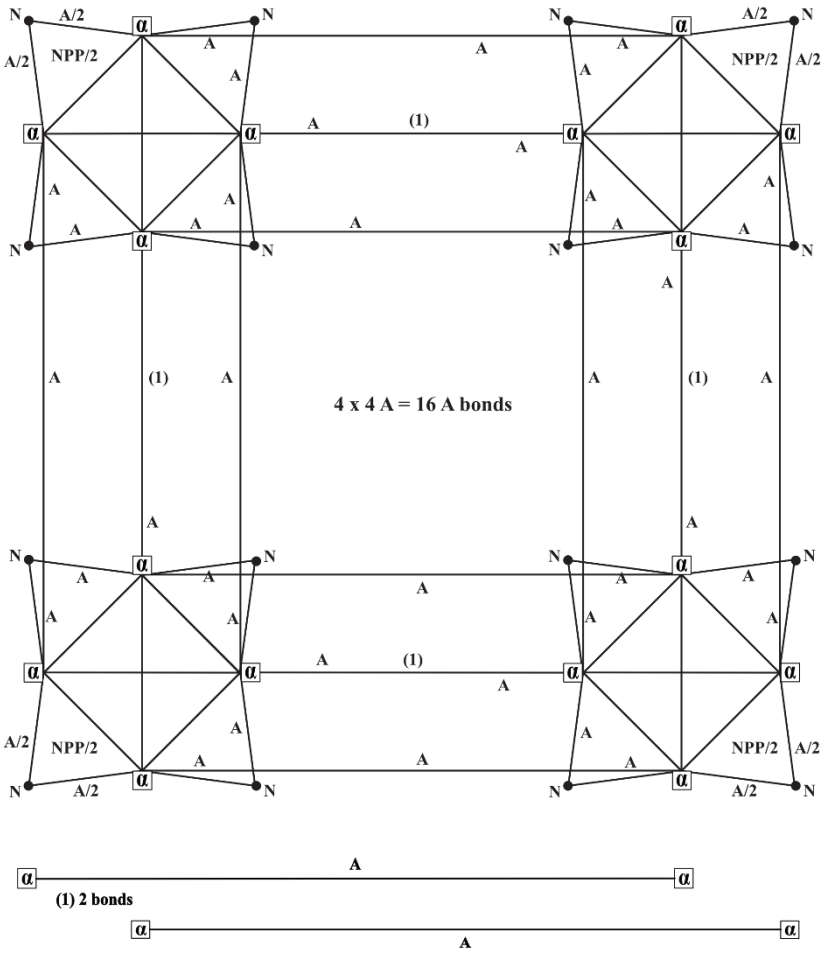
4A bonds 4A bonds

These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

Figure 1 bis

Pb 206 – Lower structure

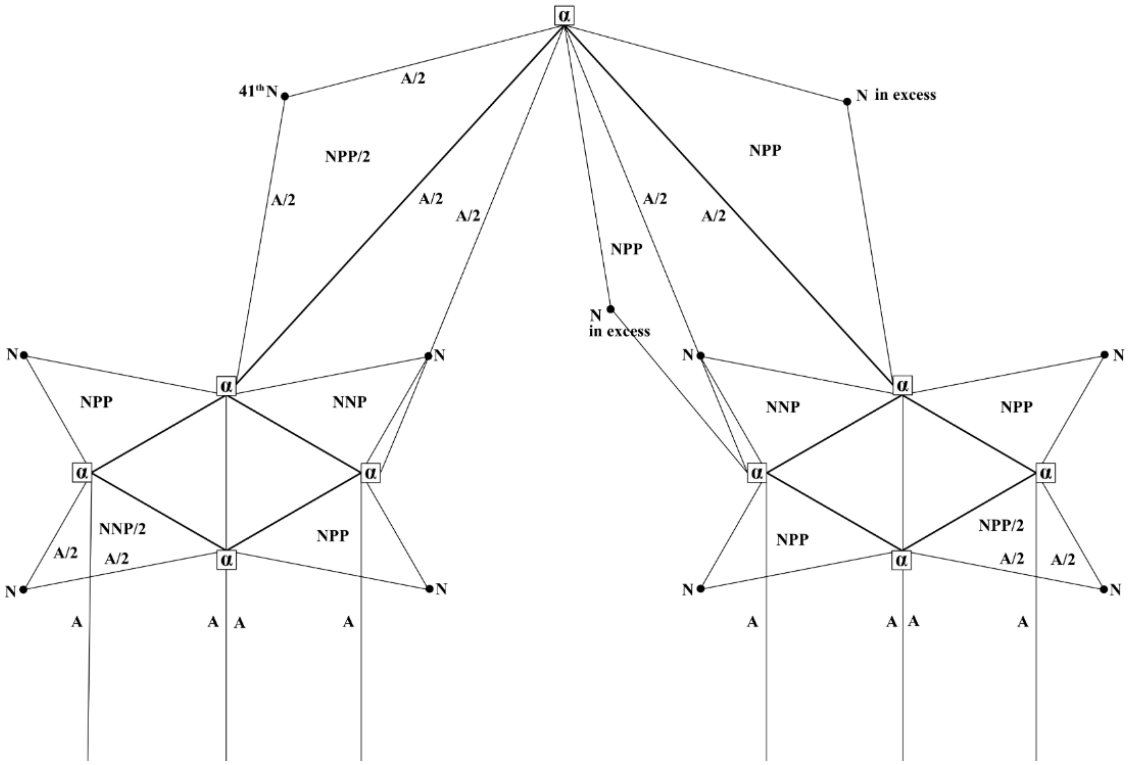




Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with either 2A bonds or (NPP/2 + A) bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 2

Pb 207 – Central-upper structure

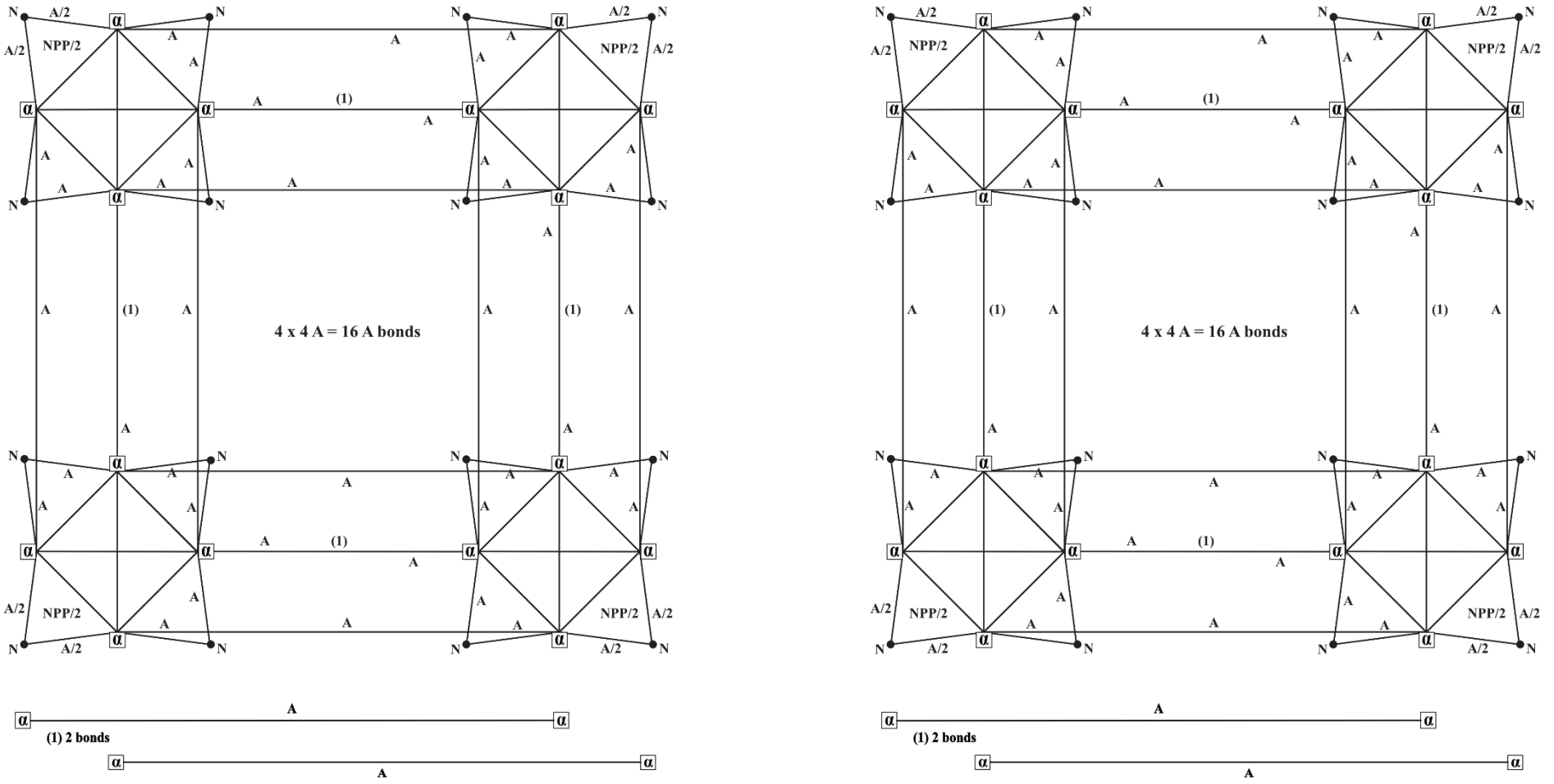


4A bonds 4A bonds

These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

Figure 2 bis

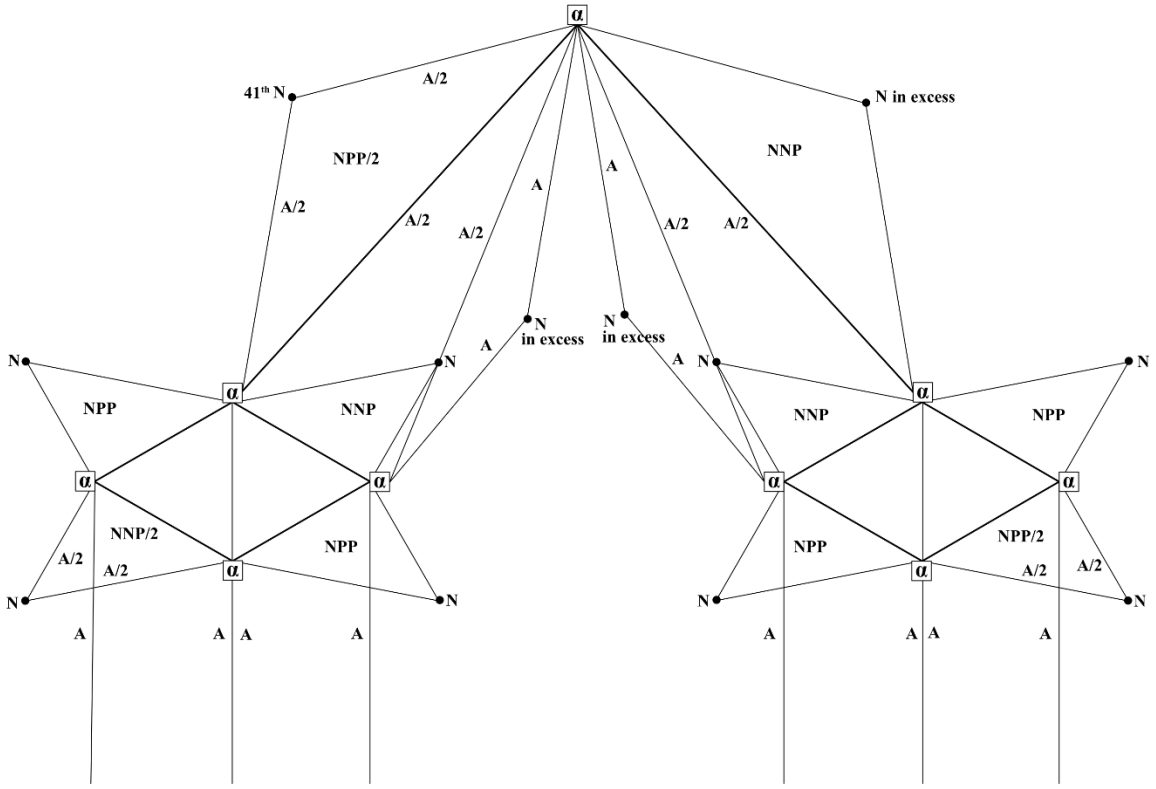
Pb 207 – Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with either 2A bonds or (NPP/2 + A) bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 3

Pb 208 – Central-upper structure

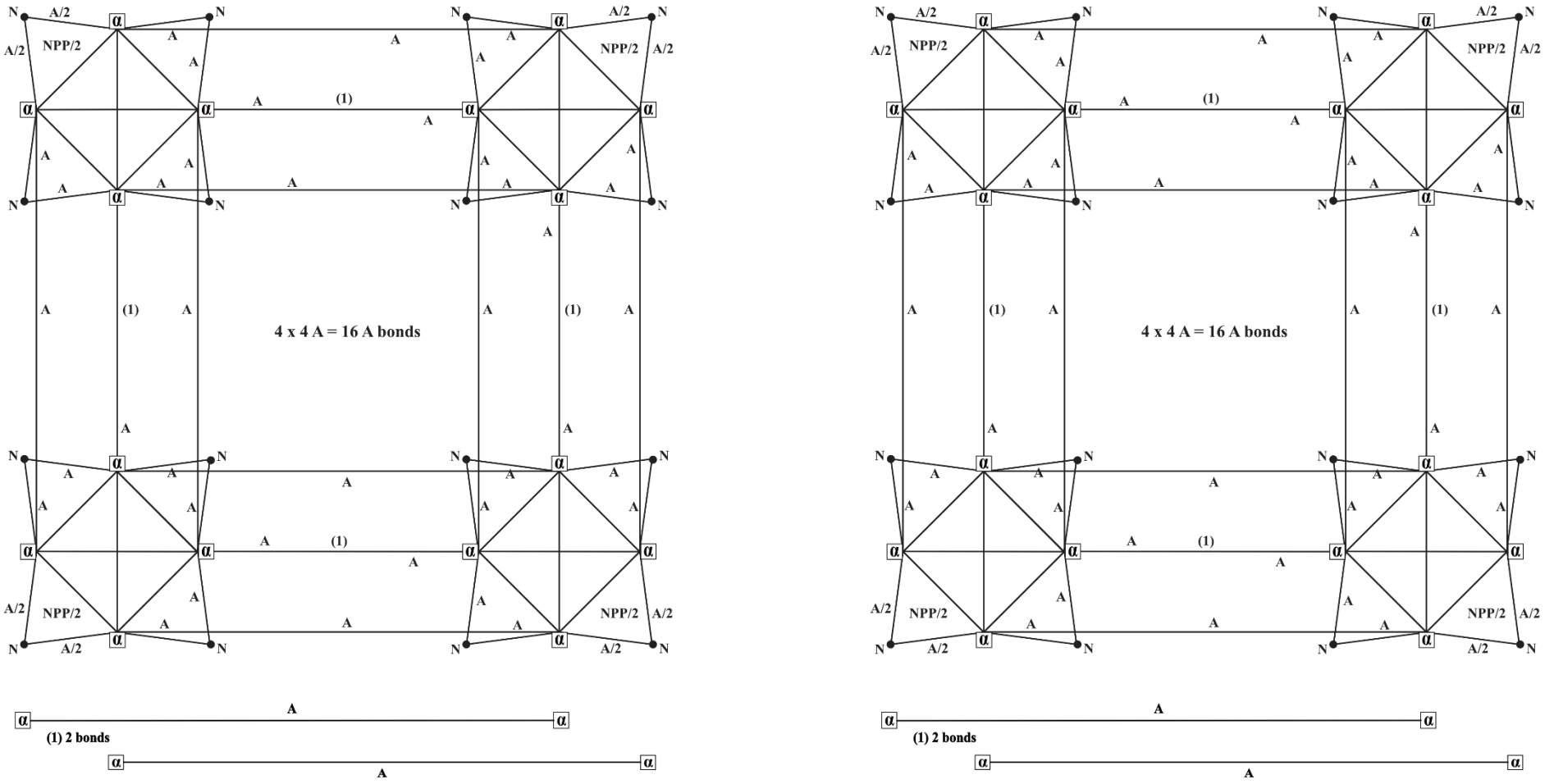


4A bonds 4A bonds

These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

Figure 3 bis

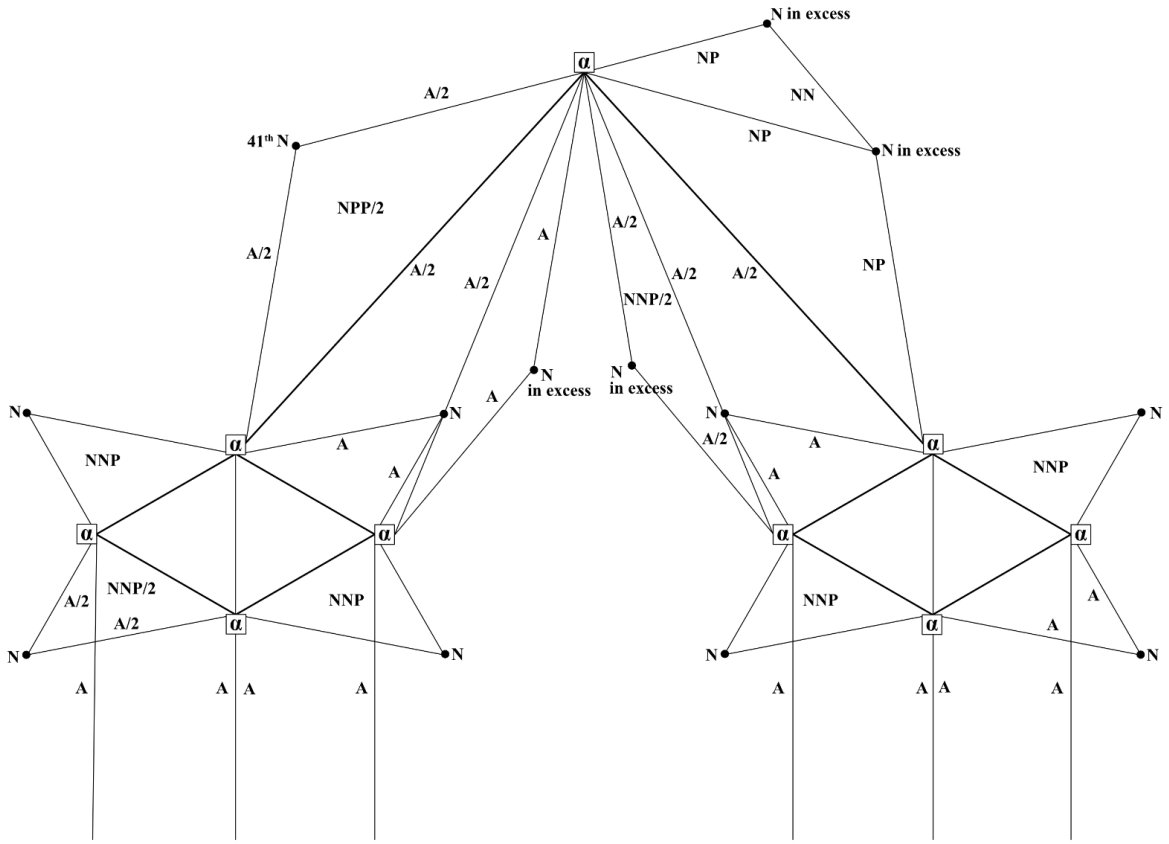
Pb 208 – Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with either 2A bonds or (NPP/2 + A) bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 4

Pb 209 – Central-upper structure

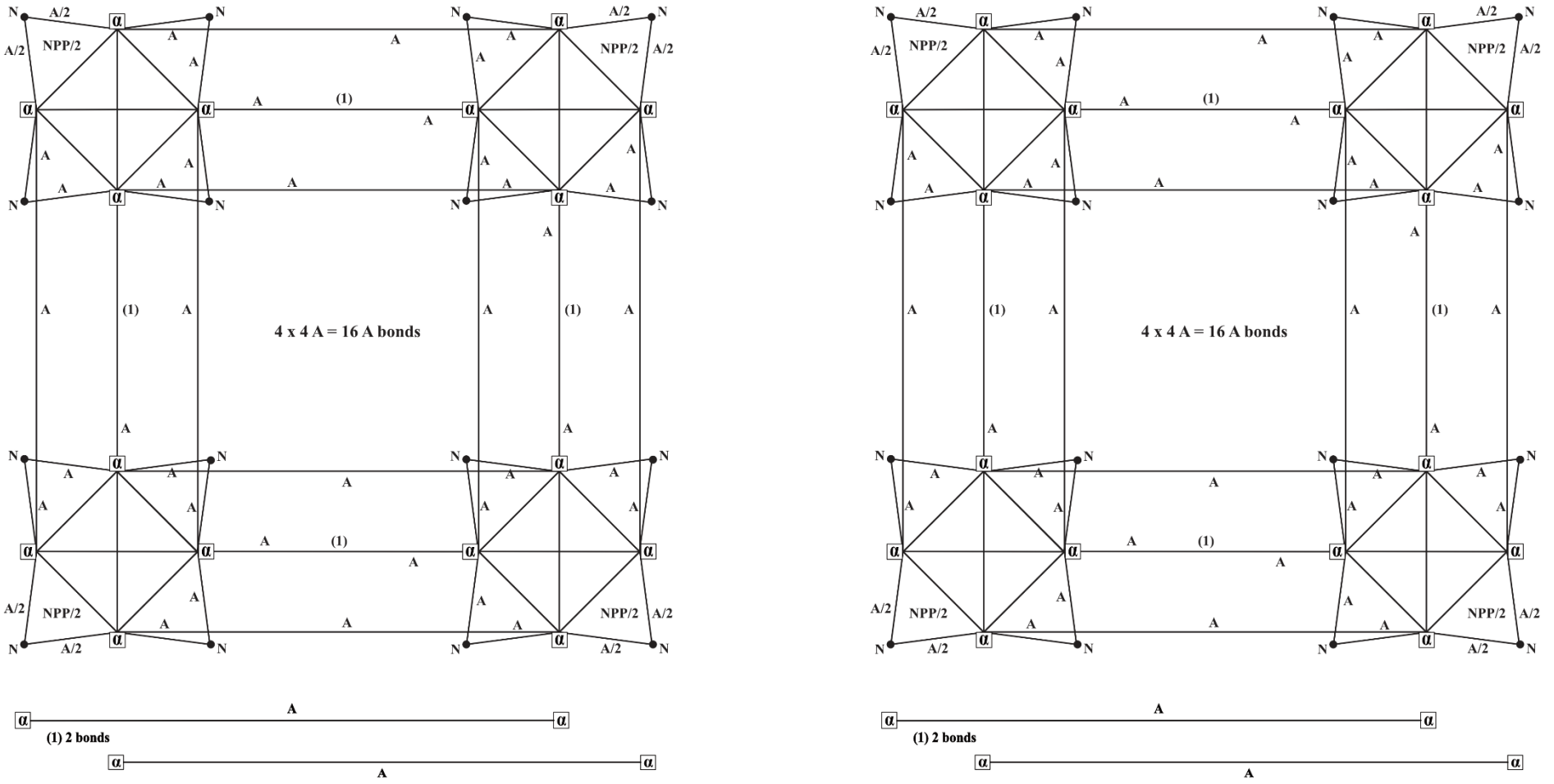


4A bonds 4A bonds

These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

Figure 4 bis

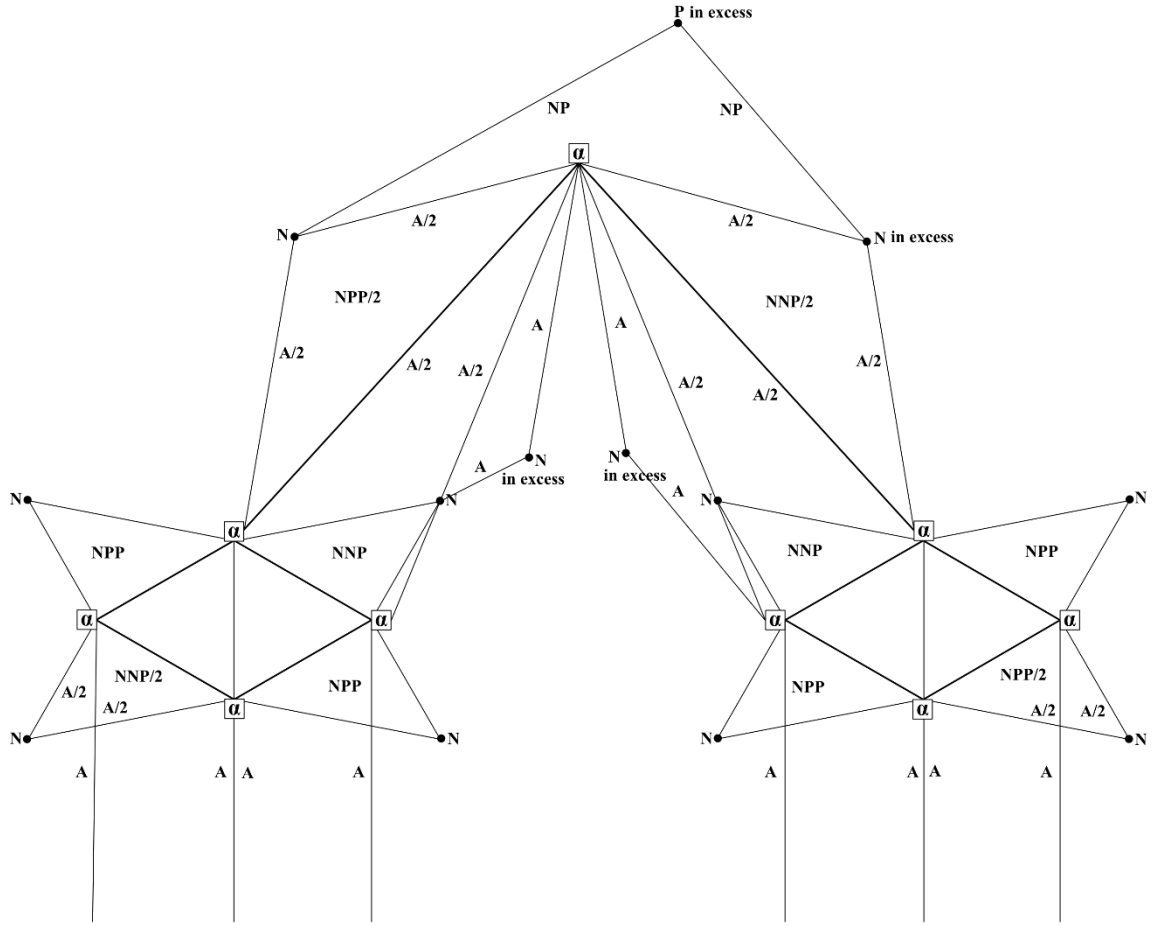
Pb 209 – Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with either 2A bonds or (NPP/2 + A) bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

Figure 5

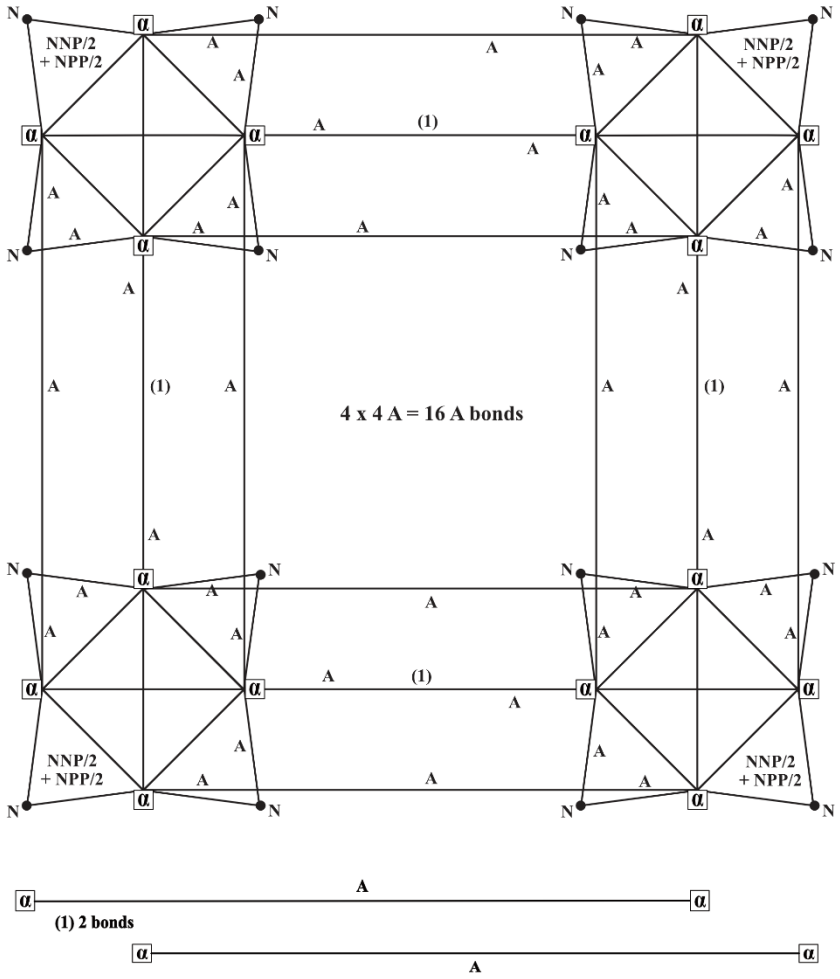
Bi 209 – Central-upper structure

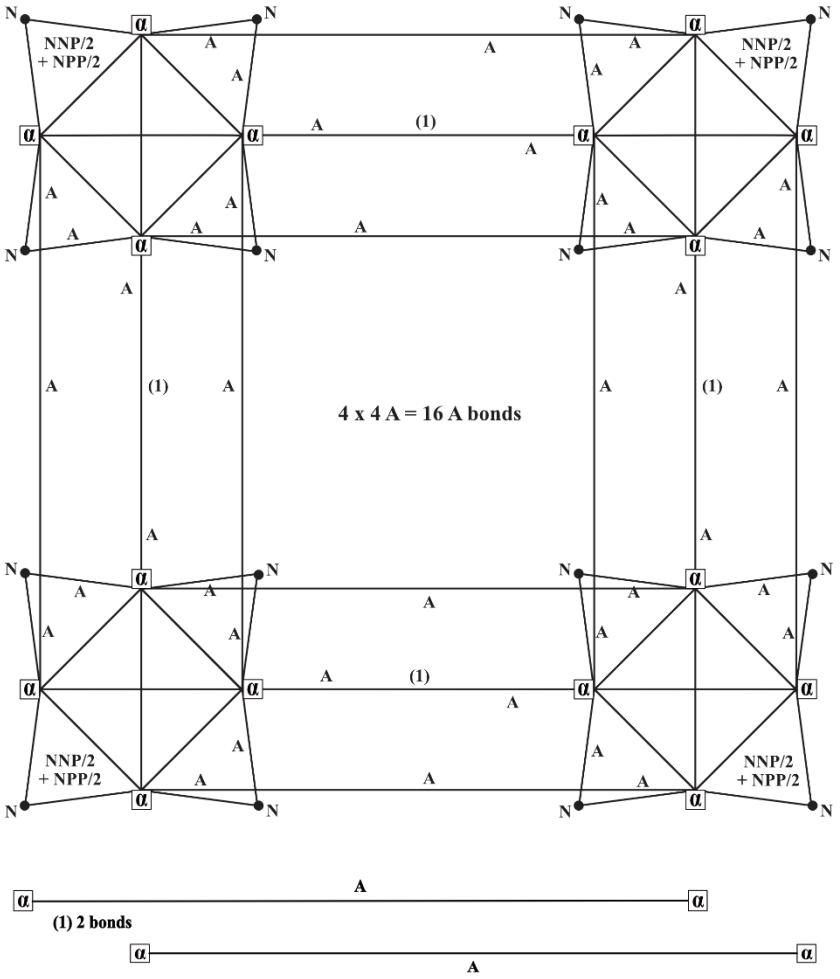


These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

Figure 5 bis

Bi 209 – Lower structure





Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with either 2A bonds or (NPP/2 + A) bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

$^{205}_{82}$Pb - E_B calculation

Core 42A	E_B	41	α	1,161.3250	MeV	E_B exp : 1,614.2379 MeV
		21	NN	103.6665		
		21	NP	46.7166		
41 N suppl.		30.5	NN	150.5633		
		30.5	NP	67.8503		
		4	NNP	33.9272		
		6.5	NPP	50.1670		
				1,614.2159	MeV	
				- 0.022		

The structure of Pb 205 is the following:

41α, 42A (A = NN/2 + NP/2)

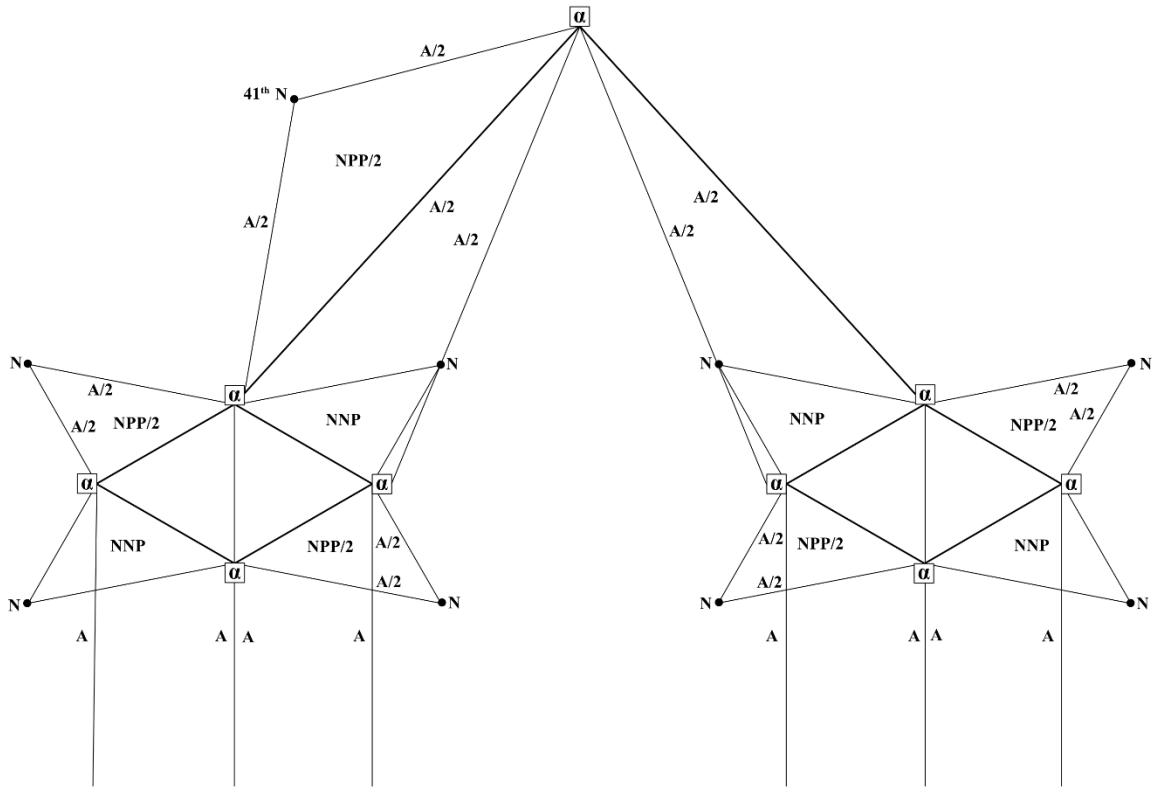
41 N supplementary: 24 N are bound to the α's with 24 x 2 A and 8 N are bound with 8 (NPP/2 + A) (lower structure).

4 N are bound to the α's with 4 NNP bonds (central-upper structure).
4 N are bound to the α's with 4 (NPP/2 + A) bonds (central-upper structure).
The 41th N is bound to the α's with 1 (NPP/2 + A bond (central-upper structure)

This structure is not stable as the last α is bound with only two A bonds and one N supplementary bond to the structure.
Pb 206 has 2 N (one supplementary, one in excess) linked to the structure and strengthening that one.
Pb 204 has no 41th N supplementary. The structure is better balanced than Pb 205.
So, only 2 A bonds link one α particle to the rest of the structure, hence a certain fragility and less occurrence in the nature.
Solution: the last α particle is β^+ and EC decaying into 3 N and 1 P to become $^{205}_{81}$Tl.

Figure 6

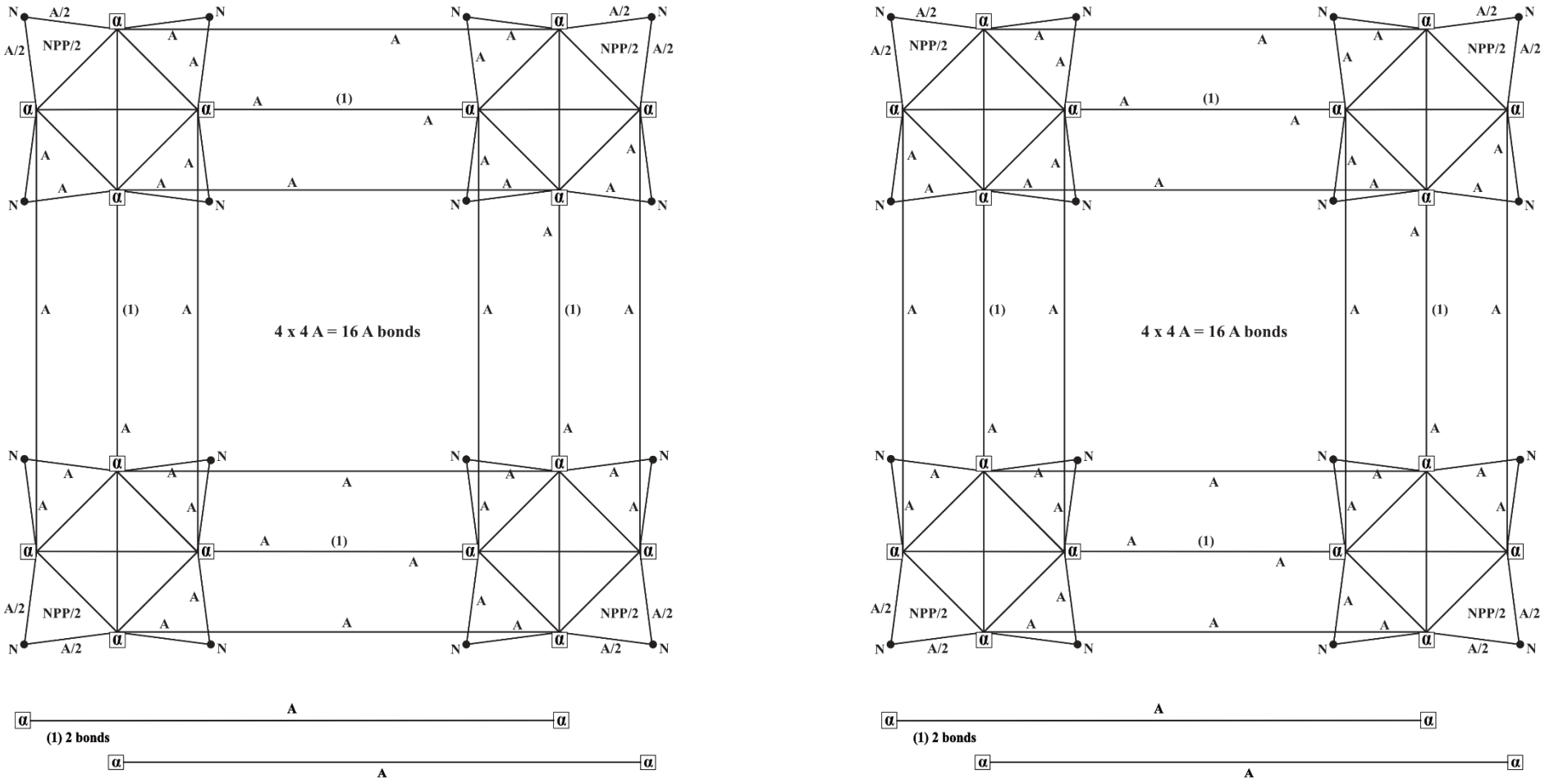
Pb 205 – Central-upper structure



These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

Figure 6 bis

Pb 205 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with either 2A bonds or NPP + A bonds. They are also linked together with the 2 x 16A bonds of the lower structure.

$^{204}_{82}$Pb - E_B calculation

Core 42A	E_B	41	α	1,161.3250	MeV	E_B exp: 1,607.5061 MeV
		21	NN	103.6665		
		21	NP	46.7166		
40 N suppl.		28	NN	138.2220		
		28	NP	62.2888		
		3.5	NNP	29.6863		
		8.5	NPP	65.6030		
				1,607.5082	MeV	
				+ 0.002		

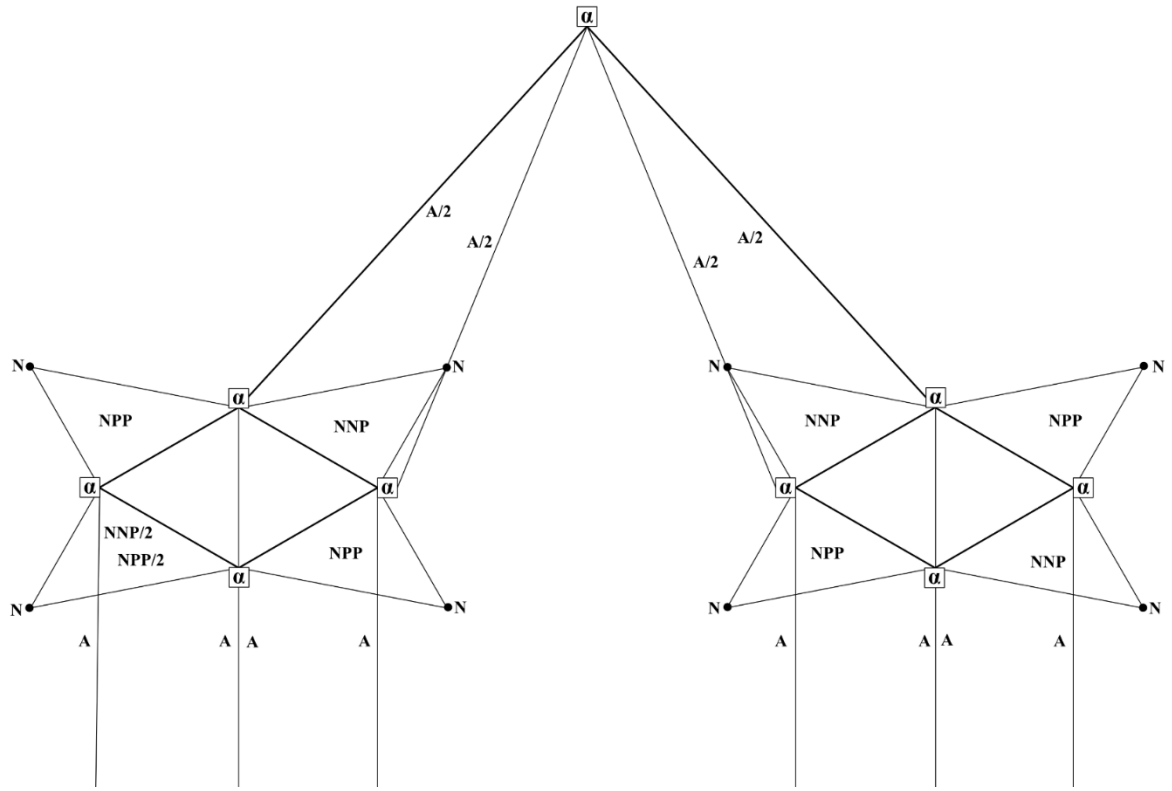
The structure of Pb 204 is the following:

41α, 42A (A = NN/2 + NP/2)

40 N supplementary: 28 N are bound to the α's with 28 x 2 A and 4 N are bound with 4 NPP (lower structure).
8 N of central-upper structure are bound with 3.5 NNP and 4.5 NNP to the α's.

Figure 7

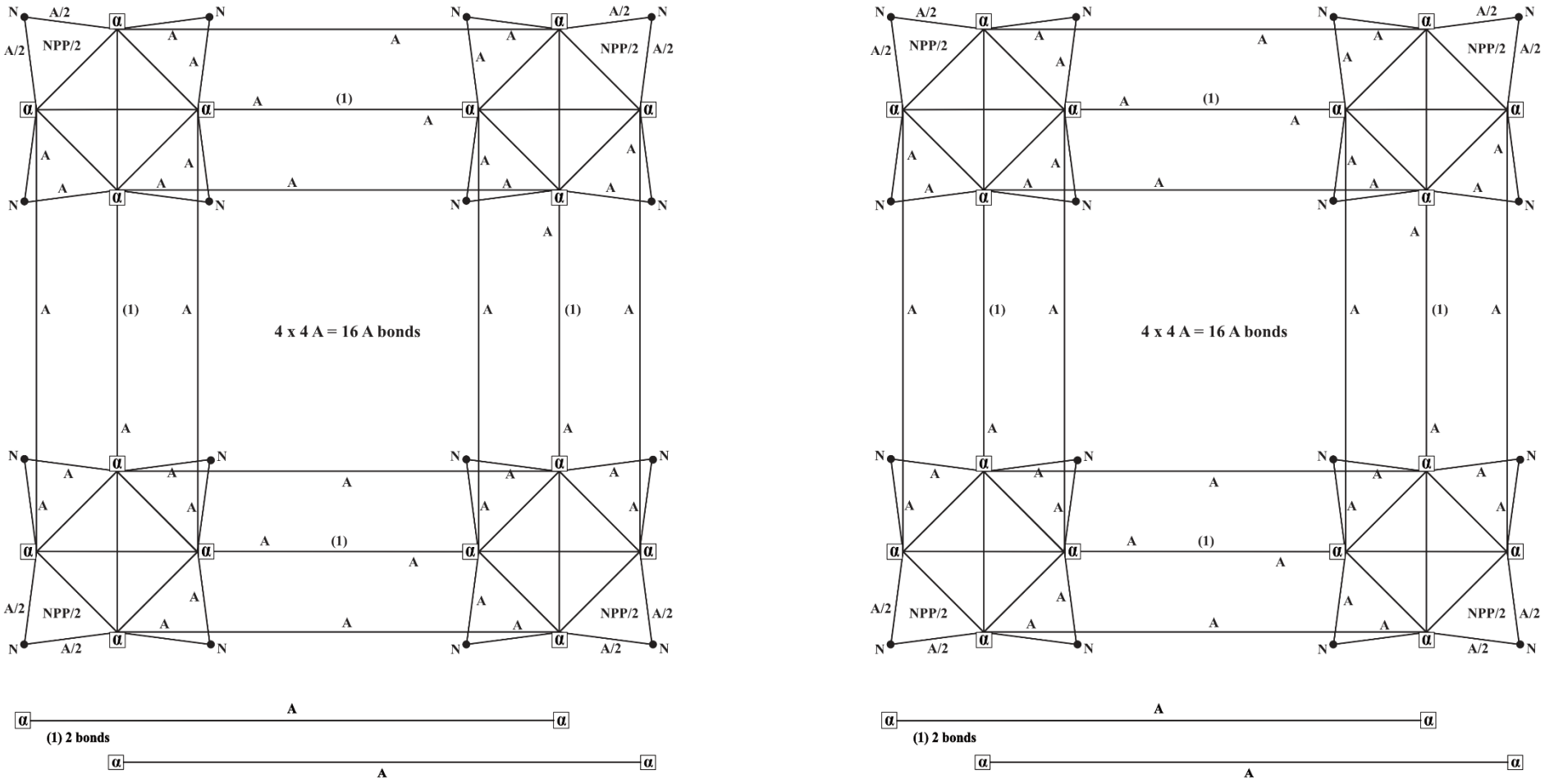
Pb 204 – Central-upper structure



These twice four A bonds are linking the twice four α particles of the central-upper structure to twice four α particles of the lower structure.

Figure 7 bis

Pb 204 - Lower structure



Remark: the α particles are no longer linked together with direct A bonds but through the N (neutrons) supplementary to the α's with either 2A bonds or (NPP/2 + A) bonds. They are also linked together with the 2 x 16A bonds of the lower structure.