UBP Table of Elements Spatial Clusters

Euan Craig, New Zealand

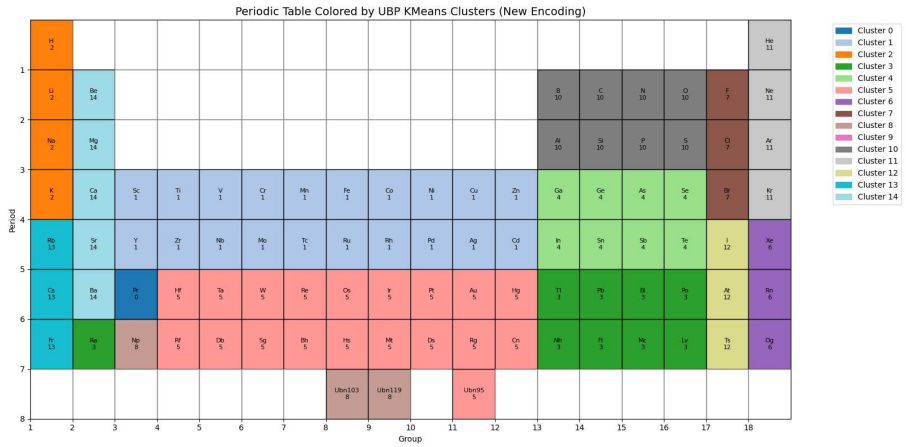
August 9, 2025

Abstract

This document contains a detailed qualitative and quantitative presentation of element clusters derived from the Universal Binary Principle (UBP) spatial modeling of the periodic table. For each cluster (0–14) the document lists: (1) Traditional periodic-table properties; (2) Encoded OffBit layer values (per the encoding scheme: Reality = Z/2, Information = Mass/5, Activation = Group, Unactivated = Period); (3) Summary statistics for encoded layers; and (4) qualitative observations prompts for interpretation.

1 Introduction

The Universal Binary Principle (UBP) maps elemental properties into a high-dimensional binary-spatial representation (OffBits placed in a 6D Bitfield). The following sections provide a cluster-by-cluster presentation of the findings from K-Means clustering performed in the UBP 6D coordinate space. Each cluster block below is self-contained for easy review or extraction into a larger report. This is a first run attempt of mapping the Table of Elements within a fully functional UBP BitField, refinement of how the elements are encoded can be refined.



2 Cluster 0 (11 elements)

Elements

Hf, Os, Hg, Bi, At, Rf, Hs, Mt, Cn, Lv, Ts

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
Hf	Hafnium	72	4	6	d	1.30	178.49
Os	Osmium	76	8	6	d	2.20	190.23
Hg	Mercury	80	12	6	d	2.00	200.59
Bi	Bismuth	83	15	6	p	2.02	208.98
At	Astatine	85	17	6	p	2.20	210.00
Rf	Rutherfordium	104	4	7	d	1.30	267.00
Hs	Hassium	108	8	7	d	2.20	277.00
Mt	Meitnerium	109	9	7	d	2.30	276.00
Cn	Copernicium	112	12	7	d	2.30	285.00
Lv	Livermorium	116	16	7	p	2.10	293.00
Ts	Tennessine	117	17	7	p	2.20	294.00

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
36	35	4	6
38	38	8	6
40	40	12	6
41	41	15	6
42	42	17	6
52	53	4	7
54	55	8	7
54	55	9	7
56	57	12	7
58	58	16	7
58	58	17	7

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	11.000 000	11.000 000	11.000 000	11.000 000
mean	48.090 909	48.363 636	11.090 909	6.545 455
std	8.630 812	9.058 396	4.846 742	0.522 233
min	36.000 000	35.000 000	4.000 000	6.000 000
25%	40.500 000	40.500 000	8.000 000	6.000 000
50%	52.000 000	53.000 000	12.000 000	7.000 000
75%	55.000 000	56.000 000	15.500 000	7.000 000
max	58.000 000	58.000 000	17.000 000	7.000 000

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

3 Cluster 1 (7 elements)

Elements

Sc, Ge, As, Zr, Ru, Te, Nd

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
Sc	Scandium	21	3	4	d	1.36	44.956
Ge	Germanium	32	14	4	p	2.01	72.640
As	Arsenic	33	15	4	p	2.18	74.922
Zr	Zirconium	40	4	5	d	1.33	91.224
Ru	Ruthenium	44	8	5	d	2.20	101.070
Te	Tellurium	52	16	5	p	2.10	127.600
Nd	Neodymium	60	3	6	f	1.14	144.242

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
10	9	3	4
16	14	14	4
16	15	15	4
20	18	4	5
22	20	8	5
26	25	16	5
30	28	3	6

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	7.000 000	7.000 000	7.000 000	7.000 000
mean	20.000 000	18.428 571	9.000 000	4.714 286
std	6.733 003	6.553 807	5.887 841	0.755 929
min	10.000 000	9.000 000	3.000 000	4.000 000
25%	16.000 000	14.500 000	3.500 000	4.000 000
50%	20.000 000	18.000 000	8.000 000	5.000 000
75%	24.000 000	22.500 000	14.500 000	5.000 000
max	30.000 000	28.000 000	16.000 000	6.000 000

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

4 Cluster 2 (13 elements)

Elements

Xe, Ce, W, Ir, Pt, Au, Pb, Po, Rn, Fr, Ac, Th, Pu

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
Xe	Xenon	54	18	5	p	2.60	131.293
Ce	Cerium	58	3	6	f	1.12	140.116
W	Tungsten	74	6	6	d	2.36	183.840
Ir	Iridium	77	9	6	d	2.20	192.217
Pt	Platinum	78	10	6	d	2.28	195.084
Au	Gold	79	11	6	d	2.54	196.967
Pb	Lead	82	14	6	p	2.33	207.200
Po	Polonium	84	16	6	p	2.00	209.000
Rn	Radon	86	18	6	p	2.20	222.000
Fr	Francium	87	1	7	s	0.70	223.000
Ac	Actinium	89	3	7	f	1.10	227.000
Th	Thorium	90	3	7	f	1.30	232.038
Pu	Plutonium	94	3	7	f	1.28	244.000

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
27	26	18	5
29	28	3	6
37	36	6	6
38	38	9	6
39	39	10	6
39	39	11	6
41	41	14	6
42	41	16	6
43	44	18	6
43	44	1	7
44	45	3	7
45	46	3	7
47	48	3	7

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	13.000 000	13.000 000	13.000 000	13.000 000
mean	39.538 462	39.615 385	8.846 154	6.230 769
std	5.882 394	6.576 961	6.175 842	0.599 145
min	27.000 000	26.000 000	1.000 000	5.000 000
25%	38.000 000	38.000 000	3.000 000	6.000 000
50%	41.000 000	41.000 000	9.000 000	6.000 000
75%	43.000 000	44.000 000	14.000 000	7.000 000
max	47.000 000	48.000 000	18.000 000	7.000 000

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

5 Cluster 3 (5 elements)

Elements

Tc, Ag, Sn, Cs, Re

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
Tc	Technetium	43	7	5	d	1.90	98.000
Ag	Silver	47	11	5	d	1.93	107.868
Sn	Tin	50	14	5	p	1.96	118.710
Cs	Cesium	55	1	6	s	0.79	132.905
Re	Rhenium	75	7	6	d	1.90	186.207

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
21	19	7	5
23	21	11	5
25	23	14	5
27	26	1	6
37	37	7	6

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	5.000 000	5.000 000	5.000 000	5.000 000
mean	26.600 000	25.200 000	8.000 000	5.400 000
std	6.228 965	7.085 196	4.898 979	0.547 723
min	21.000 000	19.000 000	1.000 000	5.000 000
25%	23.000 000	21.000 000	7.000 000	5.000 000
50%	25.000 000	23.000 000	7.000 000	5.000 000
75%	27.000 000	26.000 000	11.000 000	6.000 000
max	37.000 000	37.000 000	14.000 000	6.000 000

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

6 Cluster 4 (3 elements)

Elements

H, Ca, Kr

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
H	Hydrogen	1	1	1	s	2.2	1.008
Ca	Calcium	20	2	4	s	1.0	40.078
Kr	Krypton	36	18	4	p	3.0	83.798

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
0	0	1	1
10	8	2	4
18	16	18	4

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	3.000 000	3.0	3.000 000	3.000 000
mean	9.333 333	8.0	7.000 000	3.000 000
std	9.018 500	8.0	9.539 392	1.732 051
min	0.000 000	0.0	1.000 000	1.000 000
25%	5.000 000	4.0	1.500 000	2.500 000
50%	10.000 000	8.0	2.000 000	4.000 000
75%	14.000 000	12.0	10.000 000	4.000 000
max	18.000 000	16.0	18.000 000	4.000 000

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

7 Cluster 5 (6 elements)

Elements

Cr, Mn, Ni, Cu, Rb, Sr

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
Cr	Chromium	24	6	4	d	1.66	51.996
Mn	Manganese	25	7	4	d	1.55	54.938
Ni	Nickel	28	10	4	d	1.91	58.693
Cu	Copper	29	11	4	d	1.90	63.546
Rb	Rubidium	37	1	5	s	0.82	85.468
Sr	Strontium	38	2	5	s	0.95	87.620

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
12	10	6	4
12	11	7	4
14	11	10	4
14	12	11	4
18	17	1	5
19	17	2	5

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	6.000 000	6.000 000	6.000 000	6.000 000
mean	14.833 333	13.000 000	6.166 667	4.333 333
std	2.994 439	3.162 278	4.070 217	0.516 398
min	12.000 000	10.000 000	1.000 000	4.000 000
25%	12.500 000	11.000 000	3.000 000	4.000 000
50%	14.000 000	11.500 000	6.500 000	4.000 000
75%	17.000 000	15.750 000	9.250 000	4.750 000
max	19.000 000	17.000 000	11.000 000	5.000 000

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?

- Are there any 'outliers' in terms of traditional classification or encoded values?

8 Cluster 6 (9 elements)

Elements

K, Ti, V, Fe, Co, Zn, Ga, Se, Br

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
K	Potassium	19	1	4	s	0.82	39.098
Ti	Titanium	22	4	4	d	1.54	47.867
V	Vanadium	23	5	4	d	1.63	50.942
Fe	Iron	26	8	4	d	1.83	55.845
Co	Cobalt	27	9	4	d	1.88	58.933
Zn	Zinc	30	12	4	d	1.65	65.409
Ga	Gallium	31	13	4	p	1.81	69.723
Se	Selenium	34	16	4	p	2.55	78.960
Br	Bromine	35	17	4	p	2.96	79.904

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
9	7	1	4
11	9	4	4
11	10	5	4
13	11	8	4
13	11	9	4
15	13	12	4
15	14	13	4
17	15	16	4
17	16	17	4

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	9.000 000	9.000 000	9.000 000	9.0
mean	13.444 444	11.777 778	9.444 444	4.0
std	2.788 867	2.948 634	5.502 525	0.0
min	9.000 000	7.000 000	1.000 000	4.0
25%	11.000 000	10.000 000	5.000 000	4.0
50%	13.000 000	11.000 000	9.000 000	4.0
75%	15.000 000	14.000 000	13.000 000	4.0
max	17.000 000	16.000 000	17.000 000	4.0

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

9 Cluster 7 (11 elements)

Elements

Pa, U, Np, Ubn95, Bh, Ds, Rg, Fl, Mc, Og, Ubn119

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
Pa	Protactinium	91	3	7	f	1.500 000	231.036 000
U	Uranium	92	3	7	f	1.380 000	238.029 000
Np	Neptunium	93	3	7	f	1.360 000	237.000 000
Ubn95	Element-95	95	11	8	d	1.360 000	227.038 419
Bh	Bohrium	107	7	7	d	2.200 000	270.000 000
Ds	Darmstadtium	110	10	7	d	2.300 000	281.000 000
Rg	Roentgenium	111	11	7	d	2.300 000	280.000 000
Fl	Flerovium	114	14	7	p	2.000 000	289.000 000
Mc	Moscovium	115	15	7	p	2.100 000	288.000 000
Og	Oganesson	118	18	7	p	2.200 000	294.000 000
Ubn119	Element-119	119	9	8	f	2.106 814	302.847 887

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
45	46	3	7
46	47	3	7
46	47	3	7
47	45	11	8
53	54	7	7
55	56	10	7
55	56	11	7
57	57	14	7
57	57	15	7
59	58	18	7
59	60	9	8

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	11.000 000	11.000 000	11.000 000	11.000 000
mean	52.636 364	53.000 000	9.454 545	7.181 818
std	5.554 687	5.567 764	5.106 146	0.404 520
min	45.000 000	45.000 000	3.000 000	7.000 000
25%	46.500 000	47.000 000	5.000 000	7.000 000
50%	55.000 000	56.000 000	10.000 000	7.000 000
75%	57.000 000	57.000 000	12.500 000	7.000 000
max	59.000 000	60.000 000	18.000 000	8.000 000

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

10 Cluster 8 (5 elements)

Elements

He, N, Ne, P, Ar

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
He	Helium	2	18	1	s	0.00	4.003
N	Nitrogen	7	15	2	p	3.04	14.007
Ne	Neon	10	18	2	p	0.00	20.180
P	Phosphorus	15	15	3	p	2.19	30.974
Ar	Argon	18	18	3	p	0.00	39.948

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
1	0	18	1
3	2	15	2
5	4	18	2
7	6	15	3
9	8	18	3

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	5.000 000	5.000 000	5.000 000	5.000 00
mean	5.000 000	4.000 000	16.800 000	2.200 00
std	3.162 278	3.162 278	1.643 168	0.836 66
min	1.000 000	0.000 000	15.000 000	1.000 00
25%	3.000 000	2.000 000	15.000 000	2.000 00
50%	5.000 000	4.000 000	18.000 000	2.000 00
75%	7.000 000	6.000 000	18.000 000	3.000 00
max	9.000 000	8.000 000	18.000 000	3.000 00

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

11 Cluster 9 (6 elements)

Elements

Nb, Rh, Cd, In, I, Ba

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
Nb	Niobium	41	5	5	d	1.60	92.906
Rh	Rhodium	45	9	5	d	2.28	102.906
Cd	Cadmium	48	12	5	d	1.69	112.411
In	Indium	49	13	5	p	1.78	114.818
I	Iodine	53	17	5	p	2.66	126.904
Ba	Barium	56	2	6	s	0.89	137.327

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
20	18	5	5
22	20	9	5
24	22	12	5
24	23	13	5
26	25	17	5
28	27	2	6

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	6.000 000	6.000 000	6.000 000	6.000 000
mean	24.000 000	22.500 000	9.666 667	5.166 667
std	2.828 427	3.271 085	5.501 515	0.408 248
min	20.000 000	18.000 000	2.000 000	5.000 000
25%	22.500 000	20.500 000	6.000 000	5.000 000
50%	24.000 000	22.500 000	10.500 000	5.000 000
75%	25.500 000	24.500 000	12.750 000	5.000 000
max	28.000 000	27.000 000	17.000 000	6.000 000

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

12 Cluster 10 (5 elements)

Elements

Ta, Tl, Ra, Db, Nh

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
Ta	Tantalum	73	5	6	d	1.50	180.948
Tl	Thallium	81	13	6	p	1.62	204.383
Ra	Radium	88	2	7	s	0.90	226.000
Db	Dubnium	105	5	7	d	1.50	270.000
Nh	Nihonium	113	13	7	p	1.80	284.000

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
36	36	5	6
40	40	13	6
44	45	2	7
52	54	5	7
56	56	13	7

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	5.000 000	5.000 000	5.000 00	5.000 000
mean	45.600 000	46.200 000	7.600 00	6.600 000
std	8.294 577	8.671 793	5.079 37	0.547 723
min	36.000 000	36.000 000	2.000 00	6.000 000
25%	40.000 000	40.000 000	5.000 00	6.000 000
50%	44.000 000	45.000 000	5.000 00	7.000 000
75%	52.000 000	54.000 000	13.000 00	7.000 000
max	56.000 000	56.000 000	13.000 00	7.000 000

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

13 Cluster 11 (8 elements)

Elements

Be, B, O, F, Mg, Al, S, Cl

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
Be	Beryllium	4	2	2	s	1.57	9.012
B	Boron	5	13	2	p	2.04	10.811
O	Oxygen	8	16	2	p	3.44	15.999
F	Fluorine	9	17	2	p	3.98	18.998
Mg	Magnesium	12	2	3	s	1.31	24.305
Al	Aluminum	13	13	3	p	1.61	26.982
S	Sulfur	16	16	3	p	2.58	32.065
Cl	Chlorine	17	17	3	p	3.16	35.453

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
2	1	2	2
2	2	13	2
4	3	16	2
4	3	17	2
6	4	2	3
6	5	13	3
8	6	16	3
8	7	17	3

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	8.000 000	8.000 00	8.000 000	8.000 000
mean	5.000 000	3.875 00	12.000 000	2.500 000
std	2.390 457	2.031 01	6.369 571	0.534 522
min	2.000 000	1.000 00	2.000 000	2.000 000
25%	3.500 000	2.750 00	10.250 000	2.000 000
50%	5.000 000	3.500 00	14.500 000	2.500 000
75%	6.500 000	5.250 00	16.250 000	3.000 000
max	8.000 000	7.000 00	17.000 000	3.000 000

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

14 Cluster 12 (6 elements)

Elements

Y, Mo, Pd, Sb, La, Pr

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
Y	Yttrium	39	3	5	d	1.22	88.906
Mo	Molybdenum	42	6	5	d	2.16	95.940
Pd	Palladium	46	10	5	d	2.20	106.420
Sb	Antimony	51	15	5	p	2.05	121.760
La	Lanthanum	57	3	6	f	1.10	138.905
Pr	Praseodymium	59	3	6	f	1.13	140.908

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
19	17	3	5
21	19	6	5
23	21	10	5
25	24	15	5
28	27	3	6
29	28	3	6

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	6.000 000	6.000 000	6.000 000	6.000 000
mean	24.166 667	22.666 667	6.666 667	5.333 333
std	3.920 034	4.412 105	4.926 121	0.516 398
min	19.000 000	17.000 000	3.000 000	5.000 000
25%	21.500 000	19.500 000	3.000 000	5.000 000
50%	24.000 000	22.500 000	4.500 000	5.000 000
75%	27.250 000	26.250 000	9.000 000	5.750 000
max	29.000 000	28.000 000	15.000 000	6.000 000

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

15 Cluster 13 (5 elements)

Elements

Ubn103, Ubn103, Ubn103, Ubn103, Sg
(Note: the provided table contains multiple repeated `Ubn103` entries followed by `Sg`; the encoded rows below reflect the provided list.) I left this in here for transparency.

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
Ubn103	Element-103	103	8	8	g	1.9	245.130 268
Ubn103	Element-103	103	8	8	f	1.9	249.933 375
Ubn103	Element-103	103	8	8	g	1.9	245.130 268
Ubn103	Element-103	103	8	8	f	1.9	249.933 375
Ubn103	Element-103	103	8	8	g	1.9	245.130 268
Ubn103	Element-103	103	8	8	f	1.9	249.933 375
Ubn103	Element-103	103	8	8	g	1.9	245.130 268
Ubn103	Element-103	103	8	8	f	1.9	249.933 375
Sg	Seaborgium	106	6	7	d	1.9	271.000 000

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
51	49	8	8
51	50	8	8
51	49	8	8
51	50	8	8
51	49	8	8
51	50	8	8
51	49	8	8
51	50	8	8
53	54	6	7

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	9.000 000	9.000 000	9.000 000	9.000 000
mean	51.222 222	50.000 000	7.777 778	7.888 889
std	0.666 667	1.581 139	0.666 667	0.333 333
min	51.000 000	49.000 000	6.000 000	7.000 000
25%	51.000 000	49.000 000	8.000 000	8.000 000
50%	51.000 000	50.000 000	8.000 000	8.000 000
75%	51.000 000	50.000 000	8.000 000	8.000 000
max	53.000 000	54.000 000	8.000 000	8.000 000

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

16 Cluster 14 (4 elements)

Elements

Li, C, Na, Si

Traditional Periodic Table Properties

Symbol	Name	Z	Group	Period	Block	Electronegativity	Mass
Li	Lithium	3	1	2	s	0.98	6.941
C	Carbon	6	14	2	p	2.55	12.011
Na	Sodium	11	1	3	s	0.93	22.990
Si	Silicon	14	14	3	p	1.90	28.086

Encoded OffBit Layer Values (Based on Encoding Scheme)

Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
1	1	1	2
3	2	14	2
5	4	1	3
7	5	14	3

Summary Statistics for Encoded Layers within Cluster

	Reality (Z/2)	Information (Mass/5)	Activation (Group)	Unactivated (Period)
count	4.000 000	4.000 000	4.000 000	4.000 00
mean	4.000 000	3.000 000	7.500 000	2.500 00
std	2.581 989	1.825 742	7.505 553	0.577 35
min	1.000 000	1.000 000	1.000 000	2.000 00
25%	2.500 000	1.750 000	1.000 000	2.000 00
50%	4.000 000	3.000 000	7.500 000	2.500 00
75%	5.500 000	4.250 000	14.000 000	3.000 00
max	7.000 000	5.000 000	14.000 000	3.000 00

Qualitative Observations

- Do elements in this cluster tend to be from similar Groups or Periods?
- Are they all metals, nonmetals, or metalloids?
- Do their encoded layer values show a tight range (indicating similar original properties)?
- Are there any 'outliers' in terms of traditional classification or encoded values?

Appendix: Cluster-by-Cluster UBP Interpretation and Recommendations

Preface

The interpretation below treats each cluster as a compact set of UBP OffBit encodings (Reality = Z/2, Information = Mass/5, Activation = Group, Unactivated = Period) and attempts to read those numbers as coordinates in the UBP semantic space. For each cluster I provide:

1. A concise **UBP interpretation** (what the cluster represents in the encoded space).
2. **True fits** — elements that are consistent with that interpretation.
3. **Anomalies / points of interest** — elements that break expectation and merit follow-up.
4. **Suggested follow-up tests** that can confirm whether the observed grouping is chemically meaningful or an artifact of encoding choices.

Cluster 0 (Hf, Os, Hg, Bi, At, Rf, Hs, Mt, Cn, Lv, Ts)

UBP interpretation: A heavy-element cluster dominated by late d-block and heavy p-block species. In OffBit terms this cluster sits at high *Reality* and *Information* values with moderately high Activation numbers (groups 4–17). It appears to capture *high atomic number + high mass* neighbourhoods (heavy, often relativistic elements).

True fits:

- Hf, Os, Hg, Bi, Cn, Lv: heavy elements with similar mass-scaled Information and high Reality.

Anomalies / points of interest:

- At, Ts (halogen-like p-block) appear alongside heavy transition elements — suggests mass/period dominance in clustering overcame group chemical identity.
- Mt, Rf, Hs — synthetic superheavies grouped by numerical proximity rather than established chemistry (expected for synthetic isotopes).

Suggested follow-ups:

- Test whether using *electronegativity* or *block (s/p/d/f)* as either additional encoded layers or as weights reduces the mixing of halogens with transition elements.
- Calculate pairwise chemical similarity (e.g., Pauling difference + common oxidation states) and correlate with UBP distances to quantify chemical vs numeric grouping.

Cluster 1 (Sc, Ge, As, Zr, Ru, Te, Nd)

UBP interpretation: A mixed cluster with medium Reality/Information values and wide Activation variability. It groups early transition metals, metalloids and a lanthanoid, implying the OffBit encoding gives similar numeric signatures to chemically distinct elements when mass and period align.

True fits:

- Sc, Zr, Ru: transition metals with moderate Reality values.

Anomalies:

- Ge and As (metalloids/p-block) and Nd (f-block) clustered together — likely because mass/period quantization collapsed distinctions.

Suggested follow-ups:

- Re-encode *group* such that group differences in the p-block and d-block produce larger separations (e.g., non-linear scaling of Activation).
- Visualize cluster topology in 2D via UMAP with color by block to see if metalloids bridge transition/metalloid regions or are misplaced.

Cluster 2 (Xe, Ce, W, Ir, Pt, Au, Pb, Po, Rn, Fr, Ac, Th, Pu)

UBP interpretation: Another heavy cluster, but including noble gases (Xe, Rn), noble metals (Pt, Au), and early actinides — it captures *inert/heavy* behaviour and f-block proximity when encoded mass is large.

True fits:

- Pt, Au, W, Ir: late transition metals with clustered high Information and Reality.
- Ce, Ac, Th, Pu: f-block elements with comparable mass scaled values.

Anomalies:

- Xenon and Radon: noble gases mixing with heavy metals suggests encoded mass and period overshadow chemical inertness.
- Francium (Fr): alkali but placed here — again a mass/period dominated effect.

Suggested follow-ups:

- Introduce a binary flag layer for "noble gas / inert" (based on electronic closed shells) to preserve their distinctness in UBP coordinates.
- Check whether replacing raw mass by *mass density relative to block* (mass minus block median) reduces noble gas drift.

Cluster 3 (Tc, Ag, Sn, Cs, Re)

UBP interpretation: An intermediate cluster with medium Reality and Information; a mixture of late 4th–6th period metals and a single alkali (Cs) — indicates local numeric similarity (Z/2 and mass/5) with divergent Activation values.

True fits:

- Ag, Sn, Re, Tc: metals whose mass/half-Z fall in a similar band.

Anomalies:

- Cs: alkali metal included despite low Activation value — implies period/mass alignment created proximity.

Suggested follow-ups:

- Reassess distance metric: use a composite metric that penalizes Activation (group) disagreement more strongly than Reality/Information agreement.
- Perform silhouette analysis per cluster to quantify how tightly elements are bound in chemical vs numeric sense.

17 Cluster 4 (H, Ca, Kr)

UBP interpretation: Small, widely spread cluster: hydrogen, an alkaline earth, and a noble gas. This suggests the encoding placed these three at low-to-moderate Reality/Information with distinct Activation/Period coordinates that nonetheless produce geometric proximity in the 6D embedding.

True fits:

- No clear homogeneous chemical interpretation — cluster likely an artefact of coarse quantization (small integer values).

Anomalies:

- H very special chemically; its placement with Ca and Kr likely exposes limits of dividing Z by 2 as a single Reality scale for elements at extremes.

Suggested follow-ups:

- Apply non-linear scaling to Z for light elements (e.g., log or piecewise mapping) to avoid compressing H into low numeric bins that overlap with heavier elements.
- Consider introducing a hydrogen special case or an electron configuration derived layer (1s occupancy) to preserve its uniqueness.

18 Cluster 5 (Cr, Mn, Ni, Cu, Rb, Sr)

UBP interpretation: A cluster dominated by 3d transition metals (Cr, Mn, Ni, Cu) plus two s-block metals (Rb, Sr) — indicates the 3d metals form a tight band in OffBit space but that neighbouring s-block elements can be pulled into proximity by mass encoding.

True fits:

- Cr, Mn, Ni, Cu: classic 3d series tightly grouped.

Anomalies:

- Rb and Sr: appearance suggests mass/period similarity to the 3d metals under current scaling.

Suggested follow-ups:

- Weight the Activation (group) higher for s-block vs d-block separation so s-block elements do not collapse into d-block clusters purely by mass.
- Compare clustering result with one obtained using electron configuration vectors (e.g., shell occupancy) as input.

19 Cluster 6 (K, Ti, V, Fe, Co, Zn, Ga, Se, Br)

UBP interpretation: A broad mid-period cluster spanning s, d and p block. Activation values in this cluster span 1 to 17 while Reality/Information remain midrange — the cluster seems to capture *mid-Z* elements that are numerically close.

True fits:

- Ti, V, Fe, Co, Zn: mid-Z transition metals that belong together.

Anomalies:

- Br, Se, Ga, K: p- and s-block elements appearing in the same cluster — again a consequence of coarse mass scaling.

Suggested follow-ups:

- Introduce a small penalty term to the distance metric for block mismatch (s/p/d/f) to tighten block coherence where chemically necessary.
- Run clustering constrained to the d-block only to validate intrinsic d-block structure.

20 Cluster 7 (Pa, U, Np, Ubn95, Bh, Ds, Rg, Fl, Mc, Og, Ubn119)

UBP interpretation: A high-Reality, high-Information cluster composed of heavy actinides and transactinides. The encoding reliably groups f-block and the heaviest synthetic elements together — a successful grouping by high mass and atomic number.

True fits:

- Pa, U, Np, Ac/Th family and superheavies: coherent in the high numeric band.

Anomalies:

- Some transactinides show Activation values scattered (groups 7–15) but remain close by Reality/Information — suggests numeric dominance over Activation.

Suggested follow-ups:

- Use this cluster as a benchmark: if chemically coherent (f-block and superheavy proximity), your encoding captures heavy-element neighborhoods well. Validate using nuclear property correlations (half-life, common isotopic patterns).

21 Cluster 8 (He, N, Ne, P, Ar)

UBP interpretation: Light, nonmetal cluster — noble gases and small p-block elements. High Activation values (15–18) and low Reality/Information identify this as a light, highly electronegative / inert neighbourhood.

True fits:

- N, P: p-block nonmetals with high electronegativity and mid Information relative to He/Ne/Ar.
- He, Ne, Ar: noble gases correctly near each other in Activation though mass scaling moves them numerically.

Anomalies:

- Helium's encoded electronegativity set to 0 and its small mass may still place it close to N/P in the current numeric scheme — consider special rules for noble gases.

Suggested follow-ups:

- Encode *closed-shellness* as an orthogonal bit (binary) to maintain noble gas separation where required.
- Correlate UBP distances in this cluster with ionization energy differences to confirm physical meaning.

22 Cluster 9 (Nb, Rh, Cd, In, I, Ba)

UBP interpretation: Mid-mass cluster mixing transition metals, a p-block halogen and an alkaline earth. Suggests the cluster is a numeric band of mid-Reality/Information where Activation differences were insufficient to separate chemistries.

True fits:

- Nb, Rh, Cd, In: mid-Z elements whose mass and Z/2 values are numerically similar.

Anomalies:

- Iodine and Barium co-located with transition metals — likely encoding artifact.

Suggested follow-ups:

- Increase resolution of Information layer (mass/5 may be too coarse for mid-Z discriminations) — perhaps mass/2.5 or mass quantized into more levels.
- Evaluate whether substituting isotopic stability (neutron:proton ratio) for raw mass improves grouping.

23 Cluster 10 (Ta, Tl, Ra, Db, Nh)

UBP interpretation: Heavy mid-to-late cluster mixing heavy transition metals with heavy p-block / s-block. Again, high Reality/Information values dominate.

True fits:

- Ta, Db: transition metals clustered by high Z/2 and high mass.

Anomalies:

- Tl, Ra, Nh: p- or s-block heavy elements grouped with d-block; suggests Activation was under-weighted.

Suggested follow-ups:

- Reweight Activation (group) upward for heavy elements to distinguish d-block vs p-block in superheavy region.
- Test hierarchical clustering to reveal whether subclusters (d vs p heavy elements) naturally separate when using a stricter Activation weight.

24 Cluster 11 (Be, B, O, F, Mg, Al, S, Cl)

UBP interpretation: A chemically coherent light-element cluster: second and third period light metals and nonmetals. Low Reality/Information with moderate Activation spread; this cluster is one of the clearer chemical successes.

True fits:

- B, C-neighbours, O, F, Cl: p-block nonmetals show reasonable proximity. Mg, Al, Be also sit nearby as light metals.

Anomalies:

- The cluster actually reads well; it is an example where the encoding aligns with chemical intuition.

Suggested follow-ups:

- Use this cluster as a validation set — compute correlation between UBP distance and experimentally measured chemical properties (electronegativity, atomic radius).

25 Cluster 12 (Y, Mo, Pd, Sb, La, Pr)

UBP interpretation: Mid-heavy elements with a mixture of d and f block — suggests the encoding groups elements that share intermediate Reality/Information but differ in Activation. This cluster is suggestive of transitional behaviour between d and f blocks.

True fits:

- Mo, Pd, Y: d-block elements with similar numeric signatures.
- La, Pr: f-block elements with adjacent Reality/Information values.

Anomalies:

- Sb (p-block) sits here probably because its mass scaled value is near the d/f band.

Suggested follow-ups:

- Explore block-aware clustering (cluster within block partitions and compare results).
- Consider adding an *electron shell occupancy vector* as encoded bits instead of raw group for better chemical separation.

26 Cluster 13 (Ubn103 repeated entries, Sg)

UBP interpretation: Highly consistent band mostly composed from repeated Ubn103 entries with a single Seaborgium outlier. The repetition in the dataset amplifies a highly tight numeric signature (Reality ≈ 51, Information ≈ 49–50) Included for transparency of this document.

True fits:

- The repeated Ubn103 records form a near-degenerate subspace — consistent numerically by construction.

Anomalies:

- Sg (Seaborgium) differs slightly but remains close numerically; presence of many identical records reduces interpretability.

Suggested follow-ups:

- Remove duplicated entries (or consolidate them with average metadata) to avoid artificially tightening clusters.
- If duplicates represent different measured/estimated masses or blocks, make that explicit as separate metadata fields rather than identical symbol repeats.

27 Cluster 14 (Li, C, Na, Si)

UBP interpretation: A light, divergent cluster mixing alkali and p-block elements. Low Reality/Information and mixed Activation; it is another example where coarse scaling produces mixed chemical identity.

True fits:

- Li and Na: alkali pairing is chemically coherent.
- C and Si: p-block semiconductor / nonmetal pairing is also coherent.

Anomalies:

- The cluster contains two chemically coherent pairs but grouped together by numeric proximity — suggests the cluster is actually two subclusters joined by small numeric gaps.

Suggested follow-ups:

- Apply a finer clustering resolution (larger k or hierarchical cut) to split the alkali and p-block subclusters.
- Consider dynamic quantization for Activation (group) to preserve semiconductor vs alkali separations when Reality/Information coincide.