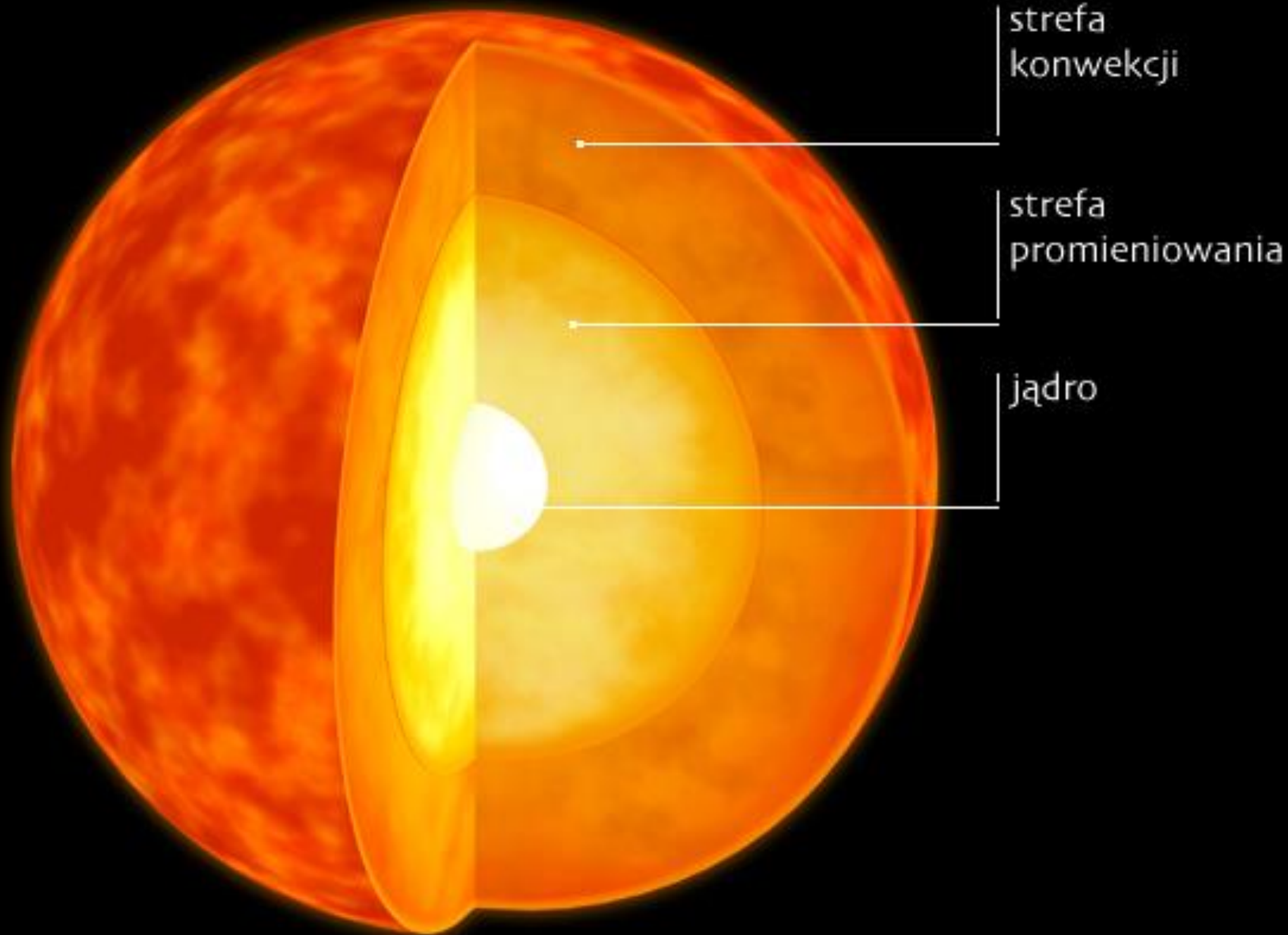


**UKŁAD
OKRESOWY
PIERWIASTKÓW**





Zaburzone centrum
galaktyki Markarian 177

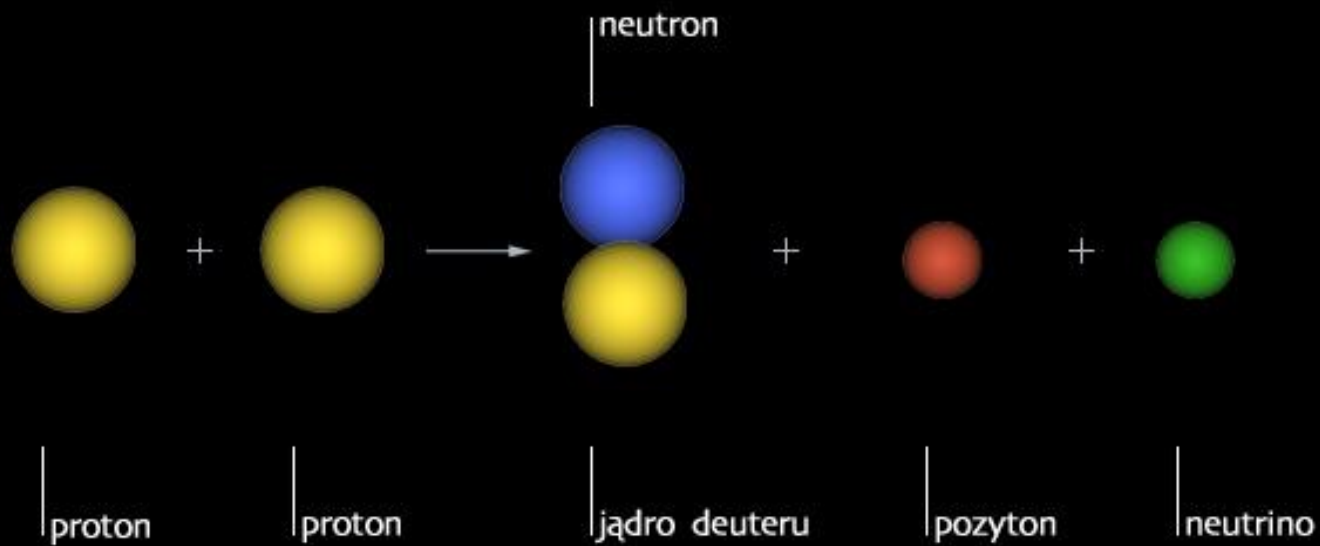
SDSS1133

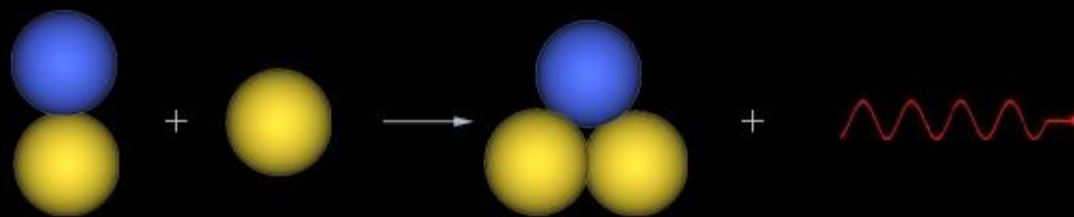
300 l.s.

Obraz karłowatej galaktyki Markarian 177, uzyskany w bliskiej podczerwieni przez teleskop Keck II. Obok (poniżej na lewo) tajemniczy obiekt SDSS1133, prawdopodobnie będący wypchniętą centralną dziurą Markariana. Jasne punkty w centrum galaktyki to obszary narodzin nowych gwiazd.

Fot. NASA, David Shano/Flickr.com, ESA/Hubble

z wodoru tworzą się gwiazdy i galaktyki
galaktyki ulegają kolizji
w centrum są czarne dziury
synteza pierwiastków w gwiazdach



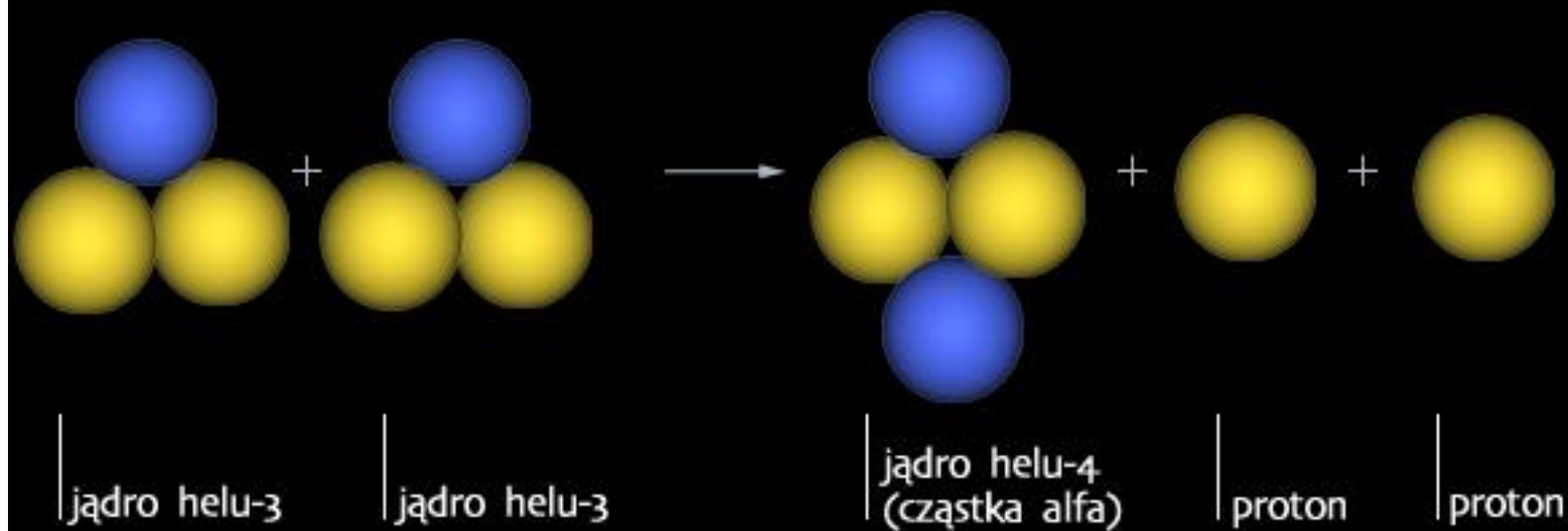


jądro
deuteru

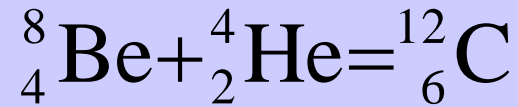
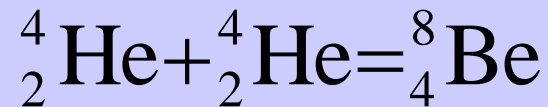
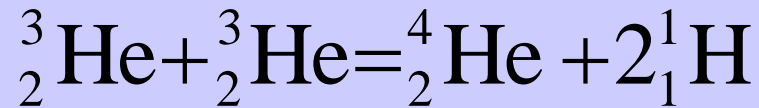
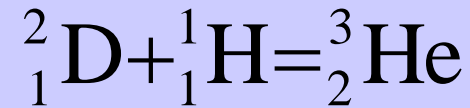
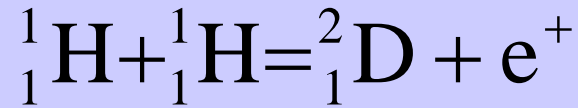
proton

jądro helu-3

foton



Synteza pierwiastków - reakcje jądrowe



1	2
Ia	IIa
1 1.0079 -259.14 -252.87 2.2 H -1, 1 1s ¹	2 4.0026 -272.2 -268.93 He 1s ²
3 6.941 180.54 1347 1.0 Li 1 He 2s ²	4 9.0122 1278 2970 1.5 Be 2 He 2s ²
11 22.990 97.81 882.9 1.0 Na 1 Ne 3s ²	12 24.305 648.8 1090 1.2 Mg 2 Ne 3s ²
19 39.098 77.4 839 0.9 K 1 Ar 4s ¹	20 40.078 839 1484 1.0 Ca 2 Ar 4s ²
37 85.468 38.89 688 0.9 Rb 1 Kr 5s ¹	38 87.62 769 1384 1.0 Sr 2 Kr 5s ²
55 132.91 28.40 678.4 0.9 Cs 1 Xe 6s ¹	56 137.33 725 1640 1.0 Ba 2 Xe 6s ²
87 *223.02 27 677 0.9 Fr 1 Rn 7s ¹	88 *226.03 700 1140 1.0 Ra 2 Rn 7s ²

1	102.91	3
45	1966	4
	3727	5
	1.5	6
2	1, 2, 3, 4 7	
	Kr 4d ⁸ 5s ¹ 8	

- Ordnungszahl
- Elementsymbol
- Relative Atommasse
- Schmelzpunkt
- Siedepunkt
- Elektronenaffinität (Allred, Rochow)
- Oxidationsstufen
- Elektronenkonfiguration

- Atomic number
- Element symbol
- Relative atomic mass
- Melting point
- Boiling point
- Electronegativity (Allred, Rochow)
- Oxidation states
- Electron configuration

- Número atómico
- Simbolo del elemento
- Peso atómico relativo
- Punto de fusión
- Punto de ebullición
- Electronegatividad (Allred, Rochow)
- Niveles de oxidación
- Configuración electrónica

MERCK

Periodensystem der Elemente
Periodic Table of the Elements
Tabla Periodica de los Elementos

- * stabilstes Isotop, most stable isotope, isótopo más estable
- Metalle, metals, metales
- Nichtmetalle, nonmetals, metaloides
- Übergangsmetalle, transition metals, elementos de transición
- Elemente der f-Reihe, elements of the f-series, elementos de la serie f
- Gruppennumerierung, column labelling, número de grupo
- IUPAC, Nomenclature of Inorganic Chemistry, 1989
- IUPAC, Rules for Inorganic Nomenclature, 1970

3	4	5	6	7	8	9	10	11	12
IIIb	IVb	Vb	VIIb	VIIIb	VIII	VIII	VIII	Ib	IIb
21 44.956 15.41 2831 1.2 Sc 3 Ar 3d ⁴ s ²	22 47.87 1660 3387 1.3 Ti 3, 4 Ar 3d ⁴ s ²	23 50.942 1890 3380 1.5 V 2, 3, 4, 5 Kr 4d ⁵ s ¹	24 51.996 1857 2672 1.6 Cr 2, 3, 6 Ar 3d ⁴ s ¹	25 54.938 1535 1962 1.6 Mn 2, 3, 4, 6, 7 Kr 4d ⁵ s ¹	26 55.845 1535 2750 1.6 Fe 2, 3, 6 Ar 3d ⁶ s ²	27 58.933 1453 2870 1.7 Co 2, 3 Ar 3d ⁷ s ²	28 58.993 1083 2732 1.8 Ni 2, 3 Ar 3d ⁸ s ²	29 63.546 1083 2567 1.8 Cu 1, 2 Ar 3d ¹⁰ s ¹	30 65.39 419.6 907 1.7 Zn 2 Ar 3d ¹⁰ s ²
39 88.906 1522 3338 1.1 Y 3 Kr 4d ⁵ s ²	40 91.224 1852 4377 1.2 Zr 3, 4 Kr 4d ⁵ s ²	41 92.906 2468 4742 1.2 Nb 3, 5 Kr 4d ⁵ s ¹	42 95.94 2617 4612 1.3 Mo 2, 3, 4, 5, 6 Kr 4d ⁵ s ¹	43 *98.906 2172 4877 1.4 Tc 7 Kr 4d ⁵ s ¹	44 101.07 2310 3900 1.4 Ru 3, 4, 8 Kr 4d ⁷ s ²	45 102.91 1966 3727 1.5 Rh 1, 2, 3, 4 Kr 4d ⁸ s ¹	46 106.42 1552 3140 1.4 Pd 2, 4 Kr 4d ¹⁰	47 107.87 961.9 2212 1.4 Ag 1, 2 Kr 4d ¹⁰ s ¹	48 112.41 320.9 765 1.5 Cd 2 Kr 4d ¹⁰ s ²
57 138.91 921 3457 1.1 La 3 Xe 5d ¹ s ²	72 178.49 2227 4602 1.2 Hf 4 Xe 4f ¹⁴ 5d ² 6s ²	73 180.95 2996 5425 1.3 Ta 5 Xe 4f ¹⁴ 5d ³ 6s ²	74 183.84 3410 5660 1.4 W 2, 3, 4, 5, 6 Xe 4f ¹⁴ 5d ⁴ 6s ²	75 186.21 3180 5627 1.5 Re 2, 4, 7 Xe 4f ¹⁴ 5d ⁵ 6s ²	76 190.23 3045 5027 1.5 Os 2, 3, 4, 6, 8 Xe 4f ¹⁴ 5d ⁶ 6s ²	77 192.22 2410 4130 1.6 Ir 1, 2, 3, 4, 6 Xe 4f ¹⁴ 5d ⁷ 6s ²	78 197.22 1064 3827 1.4 Pt 2, 4 Xe 4f ¹⁴ 5d ⁹ 6s ¹	79 195.08 964 2807 1.4 Au 1, 3 Xe 4f ¹⁴ 5d ¹⁰ 6s ¹	80 200.59 -38.84 356.6 1.5 Hg 1, 2 Xe 4f ¹⁴ 5d ¹⁰ 6s ²
89 *227.03 1050 3200 1.0 Ac 3 Rn 6d ⁷ s ²	104 *231.04 1750 4790 1.1 Rf 4 Rn 5f ¹⁴ 6d ² 7s ²	105 1600 1132 3818 1.1 Db 4, 5 Rn 5f ¹⁴ 6d ³ 7s ²	106 *238.03 1132 3818 1.2 Sg 3, 4, 5, 6 Rn 5f ¹⁴ 6d ⁴ 7s ²	107 *237.05 640 3902 1.2 Bh 3, 4, 5, 6 Rn 5f ¹⁴ 6d ⁵ 7s ²	108 *244.06 641 3232 1.2 Hs 3, 4, 5, 6 Rn 5f ¹⁴ 6d ⁶ 7s ²	109 *243.06 994 2607 -1.2 Mt 3, 4, 5, 6 Rn 5f ¹⁴ 6d ⁷ 7s ²	110 *247.07 1340 -1.2 Ds 3, 4 Rn 5f ¹⁴ 6d ⁸ 7s ²	111 *247.07 -1.2 Rg 3, 4 Rn 5f ¹⁴ 6d ⁹ 7s ²	112 *251.08 -1.2 Cn 3, 4 Rn 5f ¹⁴ 6d ¹⁰ 7s ²

13	14	15	16	17	18
IIIa	IVa	Va	VIa	VIIa	0
5 10.811 2079 2550 2.0 B 3 He 2s ² 2p ¹	6 12.011 3367 4827 2.5 C -4, 2, 4 He 2s ² 2p ²	7 14.007 -209.86 -195.8 3.1 N -3, 2, 3, 4, 5 He 2s ² 2p ³	8 15.999 -218.4 -182.96 3.5 O -2, -1 He 2s ² 2p ⁴	9 18.998 -219.62 -188.14 4.1 F -1 He 2s ² 2p ⁵	10 20.18 -248.67 -246.05 Ne He 2s ² 2p ⁶
13 26.982 660.37 2467 1.5 Al 3 Ne 3s ² 3p ¹	14 28.086 1410 2355 1.7 Si 4 Ne 3s ² 3p ²	15 30.974 44.1 280 2.1 P -3, 3, 5 Ne 3s ² 3p ³	16 32.066 112.8 444.67 2.4 S -2, 2, 4, 6 Ne 3s ² 3p ⁴	17 35.453 -100.98 -34.6 2.8 Cl -1, 1, 3, 5, 7 Ne 3s ² 3p ⁵	18 39.948 -189.2 -185.7 Ar Ne 3s ² 3p ⁶
31 69.723 2978 2403 1.8 Ga 3 Ar 3d ¹⁰ 4s ¹ 4p ¹	32 72.61 937.4 2830 2.0 Ge 4 Ar 3d ¹⁰ 4s ² 4p ²	33 74.922 817 613 2.2 As -3, 3, 5 Ar 3d ¹⁰ 4s ² 4p ³	34 78.96 217 684.9 2.5 Se -2, 4, 6 Ar 3d ¹⁰ 4s ² 4p ⁴	35 79.904 -7.2 58.78 2.7 Br -1, 1, 3, 5, 7 Ar 3d ¹⁰ 4s ² 4p ⁵	36 83.80 -156.6 -152.3 Kr Ar 3d ¹⁰ 4s ² 4p ⁶
49 114.82 156.6 2080 1.5 In 3 Kr 4d ¹⁰ 5s ² 5p ¹	50 118.71 232.0 2270 1.7 Sn 2, 4 Kr 4d ¹⁰ 5s ² 5p ²	51 121.76 630.7 1750 1.8 Sb -3, 3, 5 Kr 4d ¹⁰ 5s ² 5p ³	52 127.60 449.5 990 2.0 Te -2, 4, 6 Kr 4d ¹⁰ 5s ² 5p ⁴	53 126.90 113.5 184.4 2.2 I -1, 1, 3, 5, 7 Kr 4d ¹⁰ 5s ² 5p ⁵	54 131.29 -111.9 -107.1 Xe 2, 4, 6 Kr 4d ¹⁰ 5s ² 5p ⁶
81 204.38 303.5 1457 1.4 Tl 1, 3 Xe 4f ¹⁴ 5d ¹⁰ 6s ² 6p ¹	82 207.2 327.5 1740 1.6 Pb 2, 4 Xe 4f ¹⁴ 5d ¹⁰ 6s ² 6p ²	83 208.98 271.3 1550 1.7 Bi 3, 5 Xe 4f ¹⁴ 5d ¹⁰ 6s ² 6p ³	84 209.98 254 962 1.8 Po 2, 4, 6 Xe 4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁴	85 *209.99 302 337 2.0 At -1, 1, 3, 5, 7 Xe 4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁵	86 *222.02 -71 -61.8 Rn 2 Xe 4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁶

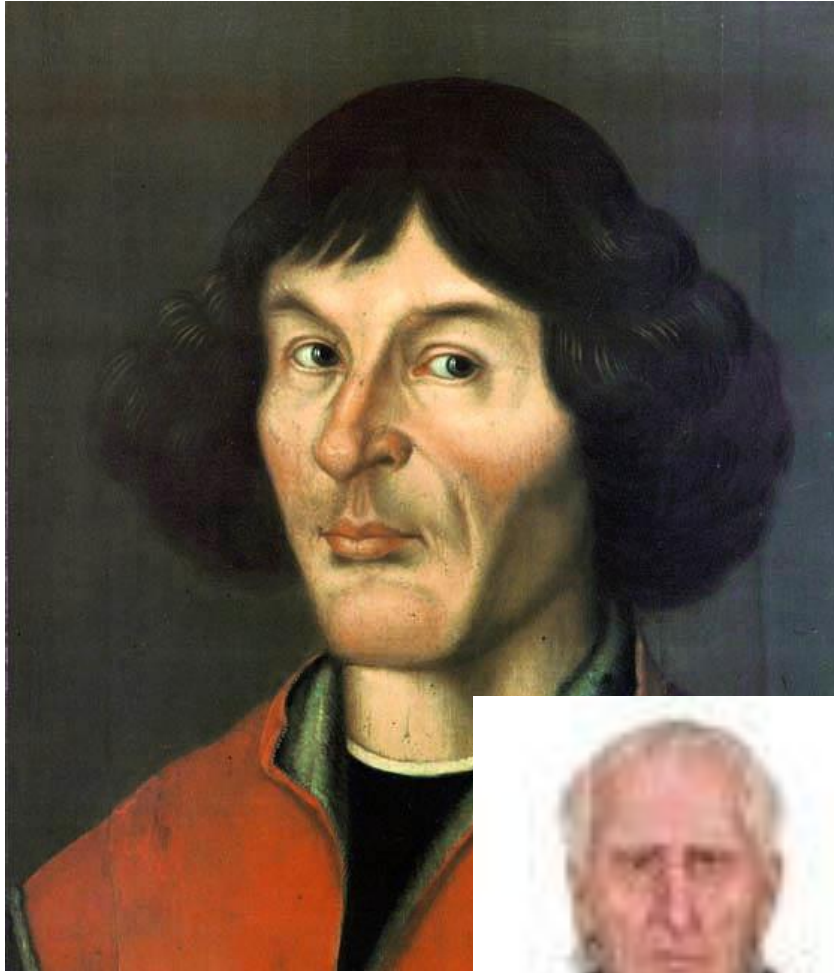
- Db Dubnium
- Jl Joliotium
- Rf Rutherfordium
- Bh Bohrium
- Hn Hahnium
- Mt Meitnerium

** IUPAC Empfehlung
IUPAC Recommendation
IUPAC Recomendación
(Pure and Appl. Chem., 66, 2423-2444, 1994)

Lanthaniden Lanthanides Lantánidos	58 140.12 799 3426 1.1 Ce 3, 4 Xe 4f ¹ 6s ²	59 140.91 931 3512 1.1 Pr 3, 4 Xe 4f ² 6s ²	60 144.24 1021 3068 1.1 Nd 3 Xe 4f ³ 6s ²	61 *146.92 1168 2460 1.1 Pm 3 Xe 4f ⁴ 6s ²	62 150.36 1077 1791 1.1 Sm 2, 3 Xe 4f ⁶ 6s ²	63 151.96 822 1597 1.0 Eu 2, 3 Xe 4f ⁷ 6s ²	64 157.25 1313 3266 1.1 Gd 3 Xe 4f ⁷ 5d ¹ 6s ²	65 158.93 1356 3123 1.1 Tb 3, 4 Xe 4f ⁹ 6s ²	66 162.50 1412 2562 1.1 Dy 3 Xe 4f ¹⁰ 6s ²	67 164.93 1474 2695 1.1 Ho 3 Xe 4f ¹¹ 6s ²	68 167.26 1497 2900 1.1 Er 3 Xe 4f ¹² 6s ²	69 168.93 1545 1947 1.1 Tm 2, 3 Xe 4f ¹³ 6s ²	70 173.04 819 1194 1.1 Yb 2, 3 Xe 4f ¹⁴ 6s ²	71 174.97 1663 3395 1.1 Lu 3 Xe 4f ¹⁴ 5d ¹ 6s ²
	Actiniden Actinides Actinidos	90 *232.04 1750 4790 1.1 Th 4 Rn 6d ² 7s ²	91 1600 1132 3818 1.1 Pa 4, 5 Rn 5f ¹⁴ 6d ¹ 7s ²	92 *238.03 1132 3818 1.2 U 3, 4, 5, 6 Rn 5f ¹⁴ 6d ² 7s ²	93 *237.05 640 3902 1.2 Np 3, 4, 5, 6 Rn 5f ¹⁴ 6d ³ 7s ²	94 *244.06 641 3232 1.2 Pu 3, 4, 5, 6 Rn 5f ¹⁴ 6d ⁴ 7s ²	95 *243.06 994 2607 -1.2 Am 3, 4, 5, 6 Rn 5f ¹⁴ 6d ⁵ 7s ²	96 *247.07 1340 -1.2 Cm 3, 4 Rn 5f ¹⁴ 6d ⁶ 7s ²	97 *247.07 -1.2 Bk 3, 4 Rn 5f ¹⁴ 6d ⁷ 7s ²	98 *251.08 -1.2 Cf 3, 4 Rn 5f ¹⁴ 6d ⁸ 7s ²	99 *252.08 -1.2 Es 3 Rn 5f ¹⁴ 6d ⁹ 7s ²	100 *257.10 -1.2 Fm 3 Rn 5f ¹⁴ 6d ¹⁰ 7s ²	101 *258.10 -1.2 Md 3 Rn 5f ¹⁴ 6d ¹¹ 7s ²	102 *259.10 -1.2 No 2, 3 Rn 5f ¹⁴ 6d ¹² 7s ²

Copernicum, Cn

- odkryty w 1996 roku w Darmstadt, Niemcy
- przez naukowców z Niemiec, Finlandii, Rosji i Słowacji pod kierunkiem Sigurda Hofmana
- 277 razy cięższy od wodoru
- powstaje np. przez fuzję jądrową ołowiu 208 i cynku 70.
- rozpada się po ułamku sekundy, nie występuje w naturze
- uznany przez Międzynarodowa Unia Chemii Czystej i Stosowanej w 2010 roku



112

227

Cn

$Rn5f_{14}6d_{10}7s_2$

Discovery of Elements 113 and 115



A calcium-48 ion is accelerated to a high velocity in a cyclotron and directed at an americium-243 target. The accelerated calcium-48 ion collides into an americium-243 target atom (above) and creates the new 115 element that begins decaying with the emission of alpha particles into element 113.

Group members include (left to right): Philip Wilk, Jackie Kenneally, Ken Moody, Dawn Shaughnessy, Mark Stoyer, Nancy Stoyer, and John Wild (retired). Two retirees not pictured are Jerry Landrum and Ron Loughheed.

When will elements 113 and 115 be named?

We don't know when the elements will be named. The naming of new elements is a long process governed by the International Union of Pure and Applied Chemistry (IUPAC). Any discovery of new elements must first be confirmed by an independent laboratory and established beyond a reasonable doubt. Afterwards, the research team that discovered the element is asked to propose a name and symbol for the element. The proposed name is then reviewed by a panel of experts and, if all goes well, finally approved by the IUPAC. This naming process can take many years. For example, element 110 was discovered in 1995 and received its name, darmstadtium (Ds), in 2003, while element 106 was discovered in 1974 but was not officially named as seaborgium (Sg) until 1997.

The man-made elements 114 and 116, which contain 114 and 116 protons per atom, respectively, are now officially called flerovium (Fl) and livermorium (Lv).

The names were chosen to honor the laboratories that first created the elements: the Flerov Laboratory of Nuclear Reactions in Dubna, Russia, and Lawrence Livermore National Laboratory in Livermore, Calif.

June 01, 2012

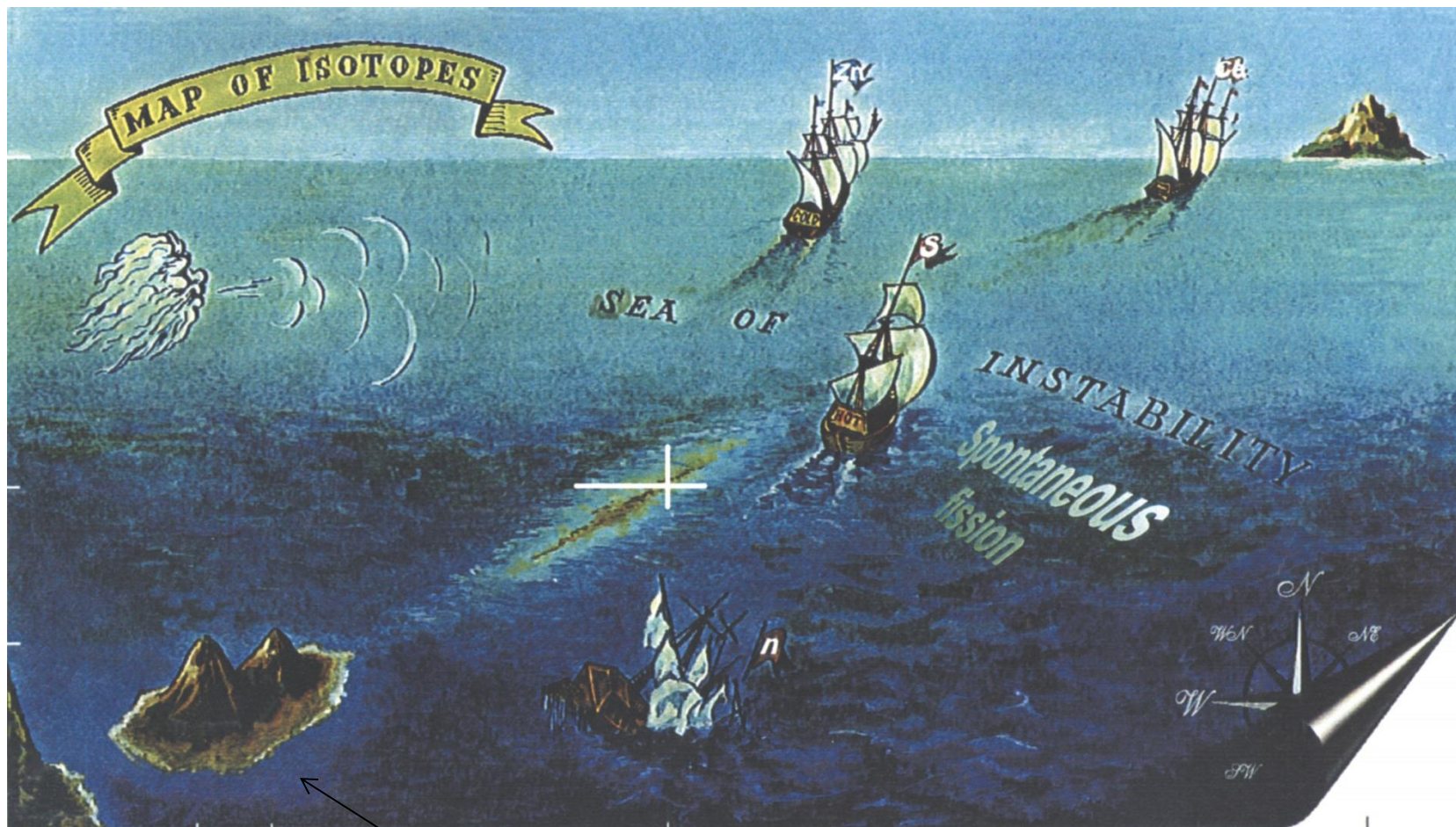
How long did it take to discover elements 113, 114, 115, 116, and 118?

Elements 113 and 115—The experiment began on July 14, 2003, and ended on August 10, 2003. In that time, four atoms of element 115 were produced that decayed after a given time, thereby producing element 113, which also decayed and so on. However, years of successful experiments, previous to the 115 and 113 discovery, were needed to show that the experiment could be successful. More than a year was then spent to clean the target material, ship it to Russia, make the target, and run the experiment.

Element 114—The first element 114 experiment lasted about one year, and two atoms were discovered during that time.

Element 116—The element 116 experiment also lasted about one year, and three atoms were discovered during that time.

Element 118—Element 118 was produced during two separate experiments, each one lasting for several months. A total of three atoms were discovered in both experiments combined.



ciężkie pierwiastki, liczba atomowa powyżej 120

H
1
Wodór

2

Piotr Gogolewski, 2004

Układ okresowy pierwiastków

1
3

14

15

16

17

He
2
Hel

Li
3
Lit

Be
4
Beryl

B
5
Bor

C
6
Węgiel

N
7
Azot

O
8
Tlen

F
9
Fluor

Ne
10
Neon

Na
11
Sód

Mg
12
Magnez

3

4

5

6

7

8

9

10

11

12

Al
13
Glin

Si
14
Krzem

P
15
Fosfor

S
16
Siarka

Cl
17
Chlor

Ar
18
Argon

K
19
Potas

Ca
20
Wapń

Sc
21
Skand

Ti
22
Tytan

V
23
Wana

Cr
24
Chrom

Mn
25
Manga

Fe
26
Żelazo

Co
27
Kobalt

Ni
28
Nikiel

Cu
29
Miedź

Zn
30
Cynk

Ga
31
Gal

Ge
32
Germa

As
33
Arsen

Se
34
Selen

Br
35
Brom

Kr
36
Krypto

Rb
37
Rubid

Sr
38
Stront

Y
39
Itr

Zr
40
Cyrkon

Nb
41
Niob

Mo
42
Molibde

Tc
43
Technet

Ru
44
Ruten

Rh
45
Rod

Pd
46
Pallad

Ag
47
Srebro

Cd
48
Kadm

In
49
Ind

Sn
50
Cyna

Sb
51
Antymo

Te
52
Tellur

I
53
Jod

Xe
54
Kseno

Cs
55
Cez

Ba
56
Bar

*

Hf
72
Hafn

Ta
73
Tantal

W
74
Wolfram

Re
75
Ren

Os
76
Osm

Ir
77
Iryd

Pt
78
Platyna

Au
79
Złoto

Hg
80
Rtęć

Tl
81
Tal

Pb
82
Ołów

Bi
83
Bizmut

Po
84
Polon

At
85
Astat

Rn
86
Radon

Fr
87
Frans

Ra
88
Rad

**

Rf
104
Rutherford

Db
105
Dubn

Sg
106
Seaborg

Bh
107
Bohr

Hs
108
Has

Mt
109
Meitner

Ds
110
Darms.

Rg
111
Roent

Uub
112

Uut
113

Uuq
114

Uup
115

Uuh
116

Uus
117

Uuo
118

Lantanowce

<u>La</u> 57 Lantan	<u>Ce</u> 58 Cer	<u>Pr</u> 59 Prazeodym	<u>Nd</u> 60 Neodym	<u>Pm</u> 61 Promet	<u>Sm</u> 62 Samar	<u>Eu</u> 63 Europ	<u>Gd</u> 64 Gadolin	<u>Tb</u> 65 Terb	<u>Dy</u> 66 Dysproz	<u>Ho</u> 67 Holm	<u>Er</u> 68 Erb	<u>Tm</u> 69 Tul	<u>Yb</u> 70 Iterb	<u>Lu</u> 71 Lutet
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Aktynowce

<u>Ac</u> 89 Aktyn	<u>Th</u> 90 Tor	<u>Pa</u> 91 Protaktyn	<u>U</u> 92 Uran	<u>Np</u> 93 Neptun	<u>Pu</u> 94 Pluton	<u>Am</u> 95 Ameryk	<u>Cm</u> 96 Kiur	<u>Bk</u> 97 Berkel	<u>Cf</u> 98 Kaliforn	<u>Es</u> 99 Einstein	<u>Fm</u> 100 Ferm	<u>Md</u> 101 Mendelew	<u>No</u> 102 Nobel	<u>Lr</u> 103 Lorens
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Czãdowi Ùstôw Pierwiãców

Stanisław Geppert, 2003

18

1	¹ H Wödzyk	2											13	14	15	16	17	² He Éi
2	³ Li Lët	⁴ Be Beril											⁵ B Bòr	⁶ C Wädze l	⁷ N Täche ń	⁸ O Krzise ń	⁹ F Fluòr	¹⁰ Ne Néon
3	¹¹ Na Natrij ò	¹² Mg Magné z	3	4	5	6	7	8	9	10	11	12	¹³ Al Alumi nijò	¹⁴ Si Krzém	¹⁵ P Fòsfòr	¹⁶ S Sarka	¹⁷ Cl Chlor	¹⁸ Ar Argón
4	¹⁹ K Kali	²⁰ Ca Kalcéń	²¹ Sc Skónd	²² Ti Titan	²³ V Wônò d	²⁴ Cr Chróm	²⁵ Mn Mangan	²⁶ Fe Zelazło	²⁷ Co Kobalt	²⁸ Ni Nik el	²⁹ Cu Kòper	³⁰ Zn Cynk	³¹ Ga Gól	³² Ge Germón	³³ As Arsén	³⁴ Se Selén	³⁵ Br Bróm	³⁶ Kr Kriptón
5	³⁷ Rb Rubid	³⁸ Sr Starnt	³⁹ Y Éter	⁴⁰ Zr Cyrkón	⁴¹ Nb Niób	⁴² Mo Molibd én	⁴³ Tc Techn et	⁴⁴ Ru Ruten	⁴⁵ Rh Ród	⁴⁶ Pd Pall òd	⁴⁷ Ag Strzéb ro	⁴⁸ Cd Kadm	⁴⁹ In Jind	⁵⁰ Sn Cèna	⁵¹ Sb Antim ón	⁵² Te Tellur	⁵³ I Jód	⁵⁴ Xe Ksenón
6	⁵⁵ Cs Céz	⁵⁶ Ba Bar	*	⁷² Hf Hafen	⁷³ Ta Tantól	⁷⁴ W Wòlfram	⁷⁵ Re Rén	⁷⁶ Os Òsm	⁷⁷ Ir Jirid	⁷⁸ Pt Platina	⁷⁹ Au Złoto	⁸⁰ Hg Tãż	⁸¹ Tl Tól	⁸² Pb Òtów	⁸³ Bi Bizmù t	⁸⁴ Po Pòlón	⁸⁵ At Astat	⁸⁶ Rn Redón
7	⁸⁷ Fr Frãś	⁸⁸ Ra Ròd	**	¹⁰⁴ Rf Ruthe r- ford	¹⁰⁵ D Dubn	¹⁰⁶ Sg Seabó rg	¹⁰⁷ B Bòhr	¹⁰⁸ Hs Has	¹⁰⁹ Mt Meitn er	¹¹⁰ Uu n	¹¹¹ Uuu	¹¹² Uub						

* Lantanowce

⁵⁷ La Lantón	⁵⁸ Ce Cer	⁵⁹ Pr Praze- òdim	⁶⁰ Nd Neòdim	⁶¹ Pm Promet	⁶² Sm Samar	⁶³ Eu Eur op	⁶⁴ Gd Gadolin	⁶⁵ Tb Terb	⁶⁶ Dy Dispòz	⁶⁷ Ho Hòlm	⁶⁸ Er Érb	⁶⁹ Tm Tul	⁷⁰ Yb Éterb	⁷¹ Lu Lutet
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liczba
atomowa

14

28,086

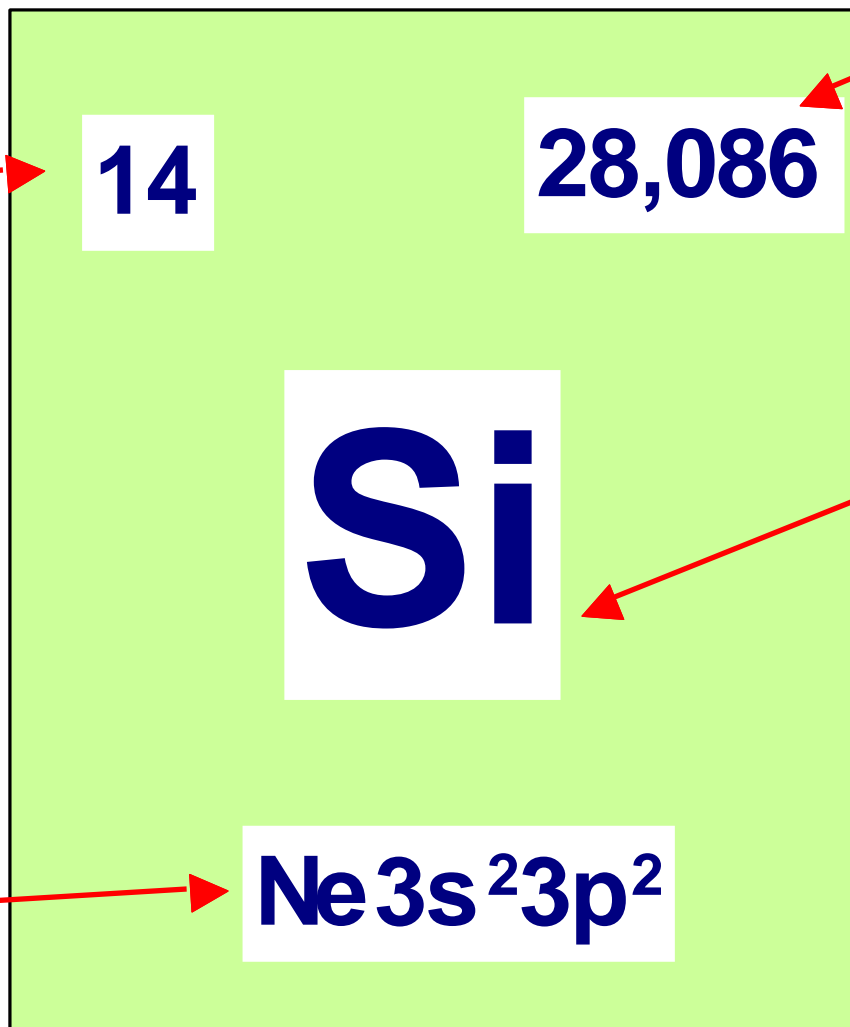
wzgl.masa
atomowa

Si

symbol

konfiguracja
atomowa

Ne 3s²3p²



Liczby kwantowe i rozmieszczenie elektronów w atomie

n	l	typ orbitala	m	liczba orbitali	m _s	Maks. liczba elektronów	
						podpowłoki	powłoki
1	0	s	0	1	+1/2, -1/2	2	2
2	0	s	0	1	+1/2, -1/2	2	8
	1	p	-1, 0, 1	3	+1/2, -1/2	6	
3	0	s	0	1	+1/2, -1/2	2	18
	1	p	-1, 0, 1	3	+1/2, -1/2	6	
	2	d	-2, -1, 0, 1, 2	5	+1/2, -1/2	10	
4	0	s	0	1	+1/2, -1/2	2	32
	1	p	-1, 0, 1	3	+1/2, -1/2	6	
	2	d	-2, -1, 0, 1, 2	5	+1/2, -1/2	10	
	3	f	-3, -2, -1, 0, 1, 2, 3	7	+1/2, -1/2	14	

liczby kwantowe

n – główna, l – orbitalna, m – magnetyczna, m_s – spinowa

Liczby kwantowe

n główna liczba kwantowa (kwantuje energię)

n od 1 do 7

l orbitalna (kwantuje moment pędu-kształt orb.)

l od 0 do n-1

m magnetyczna (kwantuje rzut momentu pędu na kierunek pola magnetycznego)

m od -l do +l

m_S spinowa (kwantuje rzut momentu spinowego)

+1/2, -1/2

Kolejność zapełniania powłok elektronowych

