Plato's Atoms

Edward Krupa

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Abstract

This article attempts to describe an atom as a system in which electrons occupy stationary positions around the nucleus, grouped into spherical shells defined by the positions of the vertices of the Platonic solids. In these positions, the electrons are held together by the forces of Coulomb attraction and electrostatic repulsion.

1 Introduction

Plato's solids are regular polyhedra whose vertices lie on the surface of the sphere they circumscribe. We know five Platonic solids: a regular tetrahedron with 4 vertices and 4 edges, a regular cube with 8 vertices and 12 edges, a regular octahedron with 6 vertices and 12 edges, an icosahedron with 12 vertices and 30 edges, and a regular dodecahedron with 20 vertices and 30 edges.

The number of vertices in these solids forms the series: 4, 6, 8, 12, 20. Considering the ionization energies of atoms according to increasing atomic numbers, we see a similarity in the ionization energy maxima occurring for the corresponding Z numbers and vertex numbers in the Platonic solids. Thus: the first maximum occurs for He - 2, the next for Be - 4, neon - 10, argon - 18, zinc - 30, krypton - 36, cadmium - 48, xenon - 54, tungsten - 74, and radon - 86.

It is suggested that, with increasing numbers, electrons in atoms of the periodic table arrange themselves around the nucleus in such a way that, at a certain number, they occupy positions where their binding energy is

greatest, producing a peak on the graph. Electrons are bound to the nucleus by attractive Coulomb forces, and they interact with each other by repulsive forces. The repulsive forces between the positive nucleus and the two K-shell electrons hold the remaining electrons in their stationary positions. It can be said that the "forbidden proton-electron reaction is the foundation that maintains the atom and the Universe in a stable state'.

In 1914, Henry G. J. Moseley, plotting the dependence of $\sqrt{1/\lambda}$, where λ is the wavelength of the X-ray line K_α of the element, on the ordinal number Z, demonstrated that the potential energy of an electron in an atom depends not only on the charge of the nucleus and the electron in question but also on the total charge of the electrons in the atom, Ze, and is proportional to $\frac{Z^2e^2}{R}$, where R is the shell radius. Electrons in atoms are strongly bound to the nucleus by attractive and repulsive forces. Thus, the atom, as a nucleus and the electrons surrounding it, constitutes a homogeneous object strongly bound by electrical forces. Any disturbance of the state of one electron due to electrical interaction stimulates the oscillations of the remaining electrons. The ejection of one electron from an equilibrium state in a shell generates a hole, which is immediately filled by an electron from a higher shell falling to a lower level. This electron, falling in the electric field of the nucleus and the remaining electrons, oscillates in this field until equilibrium is reached. Because this motion, in the field of the nucleus and the remaining electrons, occurs with acceleration, the electron emits electromagnetic radiation in the form of a wave packet $h\nu$ until equilibrium is reached, to radiate the excess energy. This wave packet propagates in one direction, and this is the challenge for theoretical physicists – to modify Maxwell's equations to a single-directional form.

The emitted wave packet solves the problem of wave-particle duality for processes involving photons. Radiation absorption—ionization of an atom—can be described as a process in which an incident photon—a wave packet—moving close to an electron in the atom, as a consequence of its electric field, excites the electron to oscillate with increasing amplitude until it reaches sufficient kinetic energy to escape the atom. Considering the ionization energies of atoms as a function of Z, we see that ionization peaks occur when ΔZ reaches the values: 8, 8, 18, 18, 32. Comparing these numbers with the vertex numbers in Platon's solids, we see their correspondence to the numbers: 8, 8, 12 + 6, 12 + 20.

2 Electrostatic Interactions of Electrons in an Atom

In the previous chapter, we assumed that electrons in an atom are arranged in spherical shells surrounding the atomic nucleus. The stability of such a system requires a balance between the pressures exerted by the higher shells, attracted by the nucleus, and the pressure exerted by the lower shells outward due to the repulsion of the electrons in that shell.

As an example, let's consider the interaction between the L and M shells in an argon atom. As is generally accepted, atoms in these shells each have eight electrons, which in this article are assumed to be located at the vertices of cubes. We will calculate the repulsive force acting on an electron located at one of the cube's vertices by seven electrons at the other vertices. Because these forces act on the electron in question from different directions and from different distances, we must calculate the resultant of these forces by projecting them onto the direction determined by the radius of the electron in question. We can distinguish here:
1. 3 closest electrons, located at a distance of the cube's edge a,
2. 3 electrons occurring on the cube's wall diagonals at a distance of $\frac{a\sqrt{2}}{\sqrt{3}}$,
3. 1 electron occurring at a distance of the sphere's diameter 2R.
Accordingly, these three force expressions must be multiplied by the cosines of the angles between the sphere's radii and: the edge - $\cos\alpha = \frac{a}{2R} = \frac{1}{\sqrt{3}}$, the diagonal - $cos\beta = \frac{a\sqrt{2}}{2R} = \frac{\sqrt{2}}{\sqrt{3}}$, and the diameter - $\cos\gamma = 1$. For the cube $a = 2R/\sqrt{3}$. Consequently, the repulsive force of one electron at the cube vertex by the seven remaining electrons can be written as:

$$F_{rep} = \frac{e^2}{4\pi\varepsilon_0}\left(\frac{3cos\alpha}{a^2}+\frac{3cos\beta}{2a^2}+\frac{1}{R^2}\right) = \frac{e^2}{4\pi\varepsilon_0 R^2}\left(\frac{9}{4\sqrt{3}}+\frac{9\sqrt{2}}{8\sqrt{3}}+\frac{1}{4}\right) = \frac{e^2}{4\pi\varepsilon_0 R^2}2.4676 \tag{1}$$

Similar calculations for other Platonic solids yield the results given in Table I.

Table I. Repulsion coefficients for Platonic shells.[1]

Shell	Number Vertices	Value Repulsion
Dipole	2	+ 0.5
Tetrahedron	4	+0.9186
Octahedron	6	+1.6642
Cube	8	+2.4676
Dodecahedron	12	+4.3551
Ikosaedron	20	+6.7368

As mentioned above, we assume that electrons in atoms, as Z increases, arrange themselves into spherical shells such that when their number reaches the number of vertices in the corresponding Platonic solid, their binding energy reaches a maximum value. Electrons in shells are attracted by the nucleus and repelled by other electrons. The force equilibrium condition is satisfied when the force acting on an electron between shells is zero. In other words, the attractive force of the higher shell must equal the repulsive force of the lower shell. Because electrons are point objects, we will treat the shells as a cloud of the entire shell charge, distributed over the surface of a sphere of radius R_1 with two electrons, etc.

First, we compare the pressures in the argon atom: the repulsive pressure exerted by the electrons of the shell of radius R_2 directed outward with the inward pressure of the shell R_3 resulting from the attraction of the effective nuclear charge of +8e, according to Gauss's law. The nucleus attracts the electrons of the shell R_3 but at the same time must overcome the repulsion of the electrons of this shell, therefore the term on the right-hand side of the equation must be reduced by the effect of the repulsion of the electrons of this shell. Furthermore, since Coulomb forces are inversely proportional to the square of the distance, the pressure of the outer shell must be increased by $\frac{R_3^2}{R_2^2}$.

$$\frac{8 \times 2.4676}{4\pi\varepsilon_0 R_2^2 4\pi R_2^2} = \frac{8(8 - 2.4676)}{4\pi\varepsilon_0 R_3^2 4\pi R_3^2} \frac{R_3^2}{R_2^2} \tag{2}$$

Simplifying the above equation, we obtain:

$$\frac{8 \times 2.4676}{R_2^2} = \frac{8(8 - 2.4676)}{R_3^2}$$

and

$$R_3 = R_2 \sqrt{\frac{8(8 - 2.4676)}{8 \times 2.4676}}$$

[1]Values for ikosahedron are determined from measurements on the papier model

In calculations for different shells, the numbers of electrons in the shells may differ, so we left the number 8 in the last equations without simplifying it. In the case of a large number of shells, the pressure of electrons lying outside the shell under consideration must be taken into account. For example, in the case of Ca -20 (2.8.8.2), we obtain:

$$\frac{8 \times 2.4676}{R_2^2} = \frac{8(8 - 2.4676) + 2 \times 0.5}{R_3^2}$$

In calculations of the shell radii, the first radius R_1 of the considered atom was taken as the basis, calculated from the energy K_α of the X-ray radiation, reducing Z by 0.5 to account for the electron repulsion energy K according to the equation:

$$-\frac{Ze^2}{R_1} + \frac{e^2}{2R_1} = -\frac{(Z - 0.5)e^2}{R_1}$$

As an example, we provide calculations for nickel Z=28 with electron configuration (2.8.12.6). The repulsion coefficient for the shell K, determined from the equation:

$$\frac{2e^2}{(2R_1)^2} = \frac{e^2}{R_1^2} \times 0.5$$

has a value of 0.5 and the pressure equation between the first and second shells becomes:

$$\frac{0.5}{R_1^{2.03}} = \frac{8(26 - 2.4676) + 12 \times 4.3551 + 6 \times 1.6642}{R_2^2} = \frac{250.5056}{R_2^2}$$

When calculating the considered values for the atoms presented in Table II, it was necessary to introduce a correction for the Coulomb coefficient a, which increases with incre*a*sing Z. According to the Gauss equation, in the equations for hither shells, the shelding of the nucleus by K electrons and subsequent shells, up to the shell under consideration, must be taken into account. Hence, the number of protons in parentheses replaces Z=28 on the right -hand side of the equation with 26 protons. From this relationship, for $R_1 = 4.7522 \times 10^{-12}$m, $R_2 = 6.9151 \times 10^{-11}$m is obtained. Knowing R_2, from Moseley"s formula:

$$E = \frac{Z_e f f^2 e^2}{4\pi\varepsilon_0 R_2 \times 4}$$

we obtain the value of Z_{eff} for the 1008.1eV state as equal to: 13.9. From the equation for the next gap between the 8- and 12-electron shells:

$$\frac{8 \times 2.4676}{R_2^2} = \frac{12(12.1 - 4.3551) + 6 \times 1.6642}{R_3^2}$$

we obtain $R_3 = 1.5790 \times 10^{-10}$m and from the relationship:

$$E = \frac{Z_e f f^2 e^2}{4\pi\varepsilon_0 R_2 \times 9}$$

Z_{ef} for the 111.8 eV energy state, the value is: $Z_{eff} = 10.5$. The potential energy in eV of the energy levels under study can be obtained from the last relations by replacing e^2 in the numerators of these expressions with e. The coefficient $\frac{e}{4\pi\varepsilon_0}$ calculated in this way is equal to: 1.4399651×10^{-9}.

Table II

Atom	$_{10}Ne$	$_{12}Mg$	$_{16}S$	$18Ar$	$_{20}Ca$	$_{22}Ti$
Kon f.el.	2.8	2.8.2	2.8.6	2.8.8	2.8.8.2	2.8.12
E_k (eV)	866.9	1305.0	2472.0	3202.9	4038.1	4966.4
R_1	1.5780-11	1.2689-11	9.0289-12	7.8768-12	6.9540-12	6.2337-12
a	2.00	2.003	2.009	2.011	2.013	2.015
R_2	1.7853-10	1.5458-10	1.0040-10	1.0950-10	1.0050-10	1.0080-10
$\frac{Z_e f f^2}{4}$	$\frac{3^2}{4}$	$\frac{6.2^2}{4}$	$\frac{8^2}{4}$	$\frac{9.9^2}{4}$	$\frac{11^2}{4}$	$\frac{12.6^2}{4}$
L1	18.3	89.4	229.2	320	437.8	563.7
R_3				1.7216-10	1.3961-10	1.3714-10
$\frac{Z_e f f^2}{9}$				$\frac{5.2^2}{9}$	$\frac{6.2^2}{9}$	$\frac{7.2^2}{9}$
M1				25.3	43.7	60.3
$\Sigma Z_e f f$	5	8.2	10	17.1	19.2	21.8

Table II(Continued)

Atom	$_{24}Cr$	$_{26}Fe$	$_{27}Co$	$_{28}Ni$	$_{29}Cu$	$_{30}Zn$
Kon f.el.	2.8.12.2	2.8.12.4	2.8.12.5	2.8.12.6	2.8.12.7	2.8.12.8
E_K (eV)	5989.2	7112.0	7708.9	8332.8	8978.9	9658.6
R_1	5.6500-12	5.1630-12	4.9500-12	4.7522-12	4.5706-12	4.3980-12
a	2.02	2.025	2.025	2.03	2.035	2.04
R_2	8.9447-11	7.9704-11	7.8464-11	6.9151-11	6.6019-11	6.1277-11
$\frac{Z_e f f^2}{4}$	$\frac{13.2^2}{4}$	$\frac{13.7^2}{4}$	$\frac{14.2^2}{4}$	$\frac{13.9^2}{4}$	$\frac{14.2^2}{4}$	$\frac{14.3^2}{4}$
L1	694.6	846.1	925.6	1008.1	1096.6	1193.6
R_3	2.5975-10	1.5537-10	1.6345-10	1.5790-10	1.5794-10	1.5838-10
$\frac{Z_e f f^2}{9}$	$\frac{8.5^2}{9}$	$\frac{9.5^2}{9}$	$\frac{10.1^2}{9}$	$\frac{10.5^2}{9}$	$\frac{11^2}{9}$	$\frac{11.6^2}{9}$
M1	74.1	92.9	100.7	111.8	119.8	135.9
$\Sigma Z_e f f$	23.7	25.2	26.3	26.4	27.2	27.9

Table II(Continued)

Atom	$_{31}Ga$	$_{32}Ge$	$_{34}Se$	$_{36}Kr$	$_{37}Rb$	$_{38}Sr$
Conf.el.	2.8.12.8.1	2.8.12.8.2	2.8.12.8.4	2.8.12.8.6	2.8.12.8.6.1	2.8.12.8.6.2
E_K (eV)	10367.1	11103.1	12657.8	14325.6	15199.7	16104.7
R_1	4.2364-12	4.0852-12	3.8110-12	3.5683-12	3.4579-12	3.3530-12
a	2.04	2.05	2.06	2.075	2.11	2.11
R_2	5.9925-11	4.7299-11	4.3253-11	3.4335-11	1.1218-11	2.0805-11
$\frac{Zeff^2}{4}$	$\frac{14.7^2}{4}$	$\frac{13.7^2}{4}$	$\frac{14.1^2}{4}$	$\frac{13.6^2}{4}$	$\frac{11.03^2}{4}$	$\frac{11.3^2}{4}$
L1	1297.7	1414.3	1653.9	1921.0	2065.1	2216.3
R_3	1.5958-10	1.3844-10	1.3275-10	1.1521-10	9.3829-11	7.7818-11
$\frac{Zeff^2}{9}$	$\frac{12.5^2}{9}$	$\frac{12.5^2}{9}$	$\frac{13.9^2}{9}$	$\frac{19^2}{9}$	$\frac{13.8^2}{9}$	$\frac{13.2^2}{9}$
M1	158.1	180.0	231.5		322.1	357.5
R_4				1.0259-10	1.6029-10	9.8706-11
$\frac{Zeff^2}{16}$				$\frac{5.2^2}{16}$	$\frac{7.2^2}{16}$	$\frac{5.7^2}{16}$
$N1$				24	29.3	37.7
R_5					2.9914-10	1.2714-10
$\frac{Zeff^2}{25}$					$\frac{4.7^2}{25}$	$\frac{3.55^2}{25}$
$O1_{Calc.}$					4.25	5.7
$E_{ion.}$					4.18	5.75
ΣZ_eff	29.2	28.2	30	39.8	38.73	35.75

Table II(Continued)

Atom	$_{40}Zr$	$_{42}Mo$	$_{44}Ru$	$_{46}Pd$	$_{47}Ag$	$_{48}Cd$
Konf.el.	2.8.12.8.	2.8.12.20.	2.8.12.20.	2.8.12.20.	2.8.12.20.	2.8.12.20.
	8.2		2	4	5	6
E_k (eV)	17997.6	19999.5	22117.2	24350.3	25514.0	26711.2
R_1	3.1603-12	2.9880-12	2.8321-12	2.6687-12	2.6244-12	2.5607-12
a	2.12	2.14	2.145	2.147	2.15	2.15
R_2	1.3737-11	1.4793-11	1.3094-11	1.2172-12	1.5841-12	1.1423-11
$\frac{Zeff^2}{4}$	$\frac{11.2^2}{4}$	$\frac{10.8^2}{4}$	$\frac{10.82^2}{4}$	$\frac{11.05^2}{4}$	$\frac{11.05^2}{4}$	$\frac{11.3^2}{4}$
L1	2531.6	2865.5	3224.0	3604.3	3805.8	4018.0
R_3	7.0363-11	7.1168-11	6.4645-11	6.0119-11	5.7976-11	5.7997-11
$\frac{Zeff^2}{9}$	$\frac{13.7^2}{9}$	$\frac{15^2}{9}$	$\frac{15.4^2}{9}$	$\frac{15.8^2}{9}$	$\frac{16.1^2}{9}$	$\frac{16.7^2}{9}$
M1	430.3	504.6	585.0	669.9	717.5	770.2
R_4	1.1566-10	1.7720-10	1.2087-10	1.2107-10	1.4214-10	1.2305-10
$\frac{Zeff^2}{16}$	$\frac{7.6^2}{16}$	$\frac{11^2}{16}$	$\frac{10^2}{16}$	$\frac{10.8^2}{16}$	$\frac{12.3^2}{16}$	$\frac{12.2^2}{16}$
N1	51.3	61.8	74.9	86.4	95.2	107.6
ΣZ_eff	34.5	38.8	38.2	39.65	41.95	42.2

Table II(Continued)

Atom	$_{50}Sn$	$_{52}Te$	$_{55}Cs$	$_{56}Ba$	$_{60}Nd$	$_{62}Sm$
Konf.el.	2.8.12.	2.8.12	2.8.12	2.8.12	2.8.12	2.8.12
	20.8	20.8.2	20.8.4.1	20.8.6	20.12.6	20.12.8
E_k (eV)	29200.1	31813.8	35984.6	37440.6	43568.9	46834.2
R_1	2.4410-12	2.3310-12	2.1809-12	2.1345-12	1.9965-12	1.8909-12
a	2.155	2.16	2.175	2.18	2.185	2.19
R_2	1.0386-11	9.3855-12	7.4178-12	6.7418-12	6.0153-12	5.4891-12
$\frac{Zeff^2}{4}$	$\frac{11.3^2}{4}$	$\frac{11.35^2}{4}$	$\frac{10.85^2}{4}$	$\frac{10.6^2}{4}$	$\frac{11.05^2}{4}$	$\frac{10.85^2}{4}$
L1	4464.7	4939.2	5714.3	5988.8	7126.0	7736.8
R_3	5.4451-11	5.0338-11	4.1322-11	3.8176-11	3.6851-11	3.3524-11
$\frac{Zeff^2}{9}$	$\frac{17.3^2}{9}$	$\frac{17.8^2}{9}$	$\frac{17.8^2}{9}$	$\frac{17.6^2}{9}$	$\frac{19.1^2}{9}$	$\frac{19^2}{9}$
M1	883.8	1006.0	1217.1	1292.8	1575.3	1722.8
R_4	1.2445-10	1.2137-10	1.4043-10	1.0706-10	1.1221-10	1.0700-10
$\frac{Zeff^2}{16}$	$\frac{13.8^2}{16}$	$\frac{15^2}{16}$	$\frac{19^2}{16}$	$\frac{17.4^2}{16}$	$\frac{19.9^2}{16}$	$\frac{20}{16}$
N1	136.5	168.3	230.8	253.0	315.2	345.7
R_5			1.3167-10	7.1825-11	7.0486-11	8.5264-11
$\frac{Zeff^2}{25}$			$\frac{7.2^2}{25}$	$\frac{7^2}{25}$	$\frac{6.8^2}{25}$	$\frac{7.5^2}{25}$
			22.7	39.3	37.8	38
O1	0.9	11.6	22.7	39.1	37.5	37.4
$\Sigma Z_e ff$	44.4	46.15	56.85	54.6	58.85	59.35

Table II(Continued)

Atom	$_{65}Tb$	$_{68}Er$	$_{71}Lu$	$_{74}W$	$_{77}Ir$	$_{78}Pt$
Konf.el.	2.8.12.20.	2.8.12.20.	2.8.12.20.	2.8.12.20.	2.8.12.20.	2.8.12.20.
	12.8.3	12.8.6	12.8.8.1	12.20	12.20.3	12.20.4
E_k (eV)	51995.7	57489.5	63312.8	69925.0	76111.0	78394.8
R_1	1.7862-12	1.6908-12	1.6034-12	1.5223-12	1.4473-12	1.4235-12
a	2.19	2.2	2.2	2.21	2.22	2.23
R_2	5.2816-12	4.4309-12	4.2738-12	3.7711-12	3.1565-12	2.7164-12
$\frac{Z_eff^2}{4}$	$\frac{11.3^2}{4}$	$\frac{10.95^2}{4}$	$\frac{11.33^2}{4}$	$\frac{11.25^2}{4}$	$\frac{10.85^2}{4}$	$\frac{10.4^2}{4}$
L1	8708.0	9751.3	10870.4	12099.8	13418.5	14352.8
R_3	3.3149-11	2.8645-11	2.8322-11	2.681.9-11	2.2933-11	1.9908-11
$\frac{Z_eff^2}{9}$	$\frac{20.1^2}{9}$	$\frac{19.95^2}{9}$	$\frac{21.1^2}{9}$	$\frac{21.7^2}{9}$	$\frac{21.4^2}{9}$	$\frac{20.2^2}{9}$
M1	1967.5	2206.5	2491.2	2819.6	3173.7	3296.0
R_4	1.0967-10	1.0096-10	1.0275-10	1.0767-10	9.5696-11	8.5600-11
$\frac{Z_eff^2}{16}$	$\frac{22^2}{16}$	$\frac{22.3^2}{16}$	$\frac{24^2}{16}$	$\frac{26.7^2}{16}$	$\frac{27^2}{16}$	$\frac{26.1^2}{16}$
N1	397.9	449.1	506.2	595	690.1	722.0
R_5	8.7331-11	9.9580-11	1.0405-10	1.4252-10	1.3652-10	1.3156-10
$\frac{Z_eff^2}{25}$	$\frac{7.7^2}{25}$	$\frac{10.2^2}{25}$	$\frac{10.15^2}{25}$	$\frac{13.8^2}{25}$	$\frac{15^2}{25}$	$\frac{15.3^2}{25}$
O1	39.0	59.8	56.8	77.1	95.2	101.7
ΣZ_eff	63.1	65.4	68.58	75.45	76.25	74

Table II(Continued)

Atom	$_{79}Au$	$_{80}Hg$	$_{82}Pb$	$_{88}Ra$	$_{90}Th$	$_{92}U$
Konf.el.	2.8.12.20.	2.8.12.20.	2.8.12.20.	2.8.12.20.	2.8.12.20.	2.8.12.20.
	12.20.5	12.20.6	12.20.8	12.20.12.2	12.20.12.4	12.20.12.6
E_K (eV)	80724.9	83102.3	88004.5	103921.9	109690.9	115606
R_1	1.4003-12	1.3775-12	1.3335-12	1.2124-12	1.1754-12	1.1397-12
a	2.23	2.235	2.24	2.3	2.3	2.3
R_2	2.6792-12	2.4740-12	2.4527-12	1.2186-12	9.0091-13	8.7824-13
$\frac{Zeff^2}{4}$	$\frac{10.35^2}{4}$	$\frac{10.1^2}{4}$	$\frac{10.4^2}{4}$	$\frac{8.05^2}{4}$	$\frac{7.15^2}{4}$	$\frac{7.3^2}{4}$
L1	14352.8	14839.3	15860.8	19236.7	20472.1	21757.4
R_3	1.9761-11	1.8419-11	1.8511-11	9.7357-12	7.2985-12	7.2540-12
$\frac{Zeff^2}{9}$	$\frac{20.6^2}{9}$	$\frac{20.2^2}{9}$	$\frac{21.15^2}{9}$	$\frac{17.2^2}{9}$	$\frac{15.4^2}{9}$	$\frac{15.9^2}{9}$
M1	3424.9	3561.6	3850.7	4822.0	5182.3	5548.0
R_4	8.5477-11	8.1224-11	8.2617-11	4895.4-11	3.8007-11	3.8216-11
$\frac{Zeff^2}{16}$	$\frac{26.8^2}{16}$	$\frac{27^2}{16}$	$\frac{28.6^2}{16}$	$\frac{25.5^2}{16}$	$\frac{23.6^2}{16}$	$\frac{24.8^2}{16}$
N1	758.8	800.3		1208.4	1329.5	1440.8
R_5	1.3133-10	1.2919-10	1.3132-10	1.9764-11	8.2874-11	8.3856-11
$\frac{Zeff^2}{25}$	$\frac{15.7^2}{25}$	$\frac{16.5^2}{25}$	$\frac{18.3^2}{25}$	$\frac{21^2}{25}$	$\frac{20.5^2}{25}$	$\frac{21.7^2}{25}$
O1	107.8	120.3	147.3	254.4	290.2	323.7
R_6				1.9728-10	2.13915-10	2.1184-10
$\frac{Zeff^2}{36}$				$\frac{14.25^2}{36}$	$\frac{18.5^2}{36}$	$\frac{20^2}{36}$
O1			3.1	43.5	59.5	70.7
$\Sigma Z_e ff$	75.45	75.8	80.45	88	87.15	91.7

3 Conclusion

Table II presents the results of atomic radius calculations for a series of elements from $_{10}Ne$ to $_{92}U$, corresponding to the stationary atomic states: L, M, N, O, and P of these elements [1]. The calculated atomic radii were used to calculate Z_{eff} for these atomic states using Moseley's formula $E = \frac{Z^2e^2}{Rn^2}$, where n denotes the shell number. The atomic radii for individual elements vary from 10^{-13}m in the uranium region to values of the order of 10^{-10}m close to the Golsdsmith value. The calculations performed should be considered preliminary, and the results approximate. By introducing the a coefficient in Coulomb's formula, an approximate correspondence of $\Sigma Z_e ff$ with the Z value for individual elements was achieved.

During the calculations, it was found that, with the assumed electron configuration, the elements Mo(2.8.12.20) and W(2.8.12.20.12.20), which have 20- and 12-vertices shells, overlap in such a way that the vertex of one shell lies above the face of the other shell, and vice versa. In this way, the shells,

bound by the forces of attraction by the nucleus and the repulsive forces between electrons, create a strongly bonded "architectural lattice" system, which manifests itself in the very high hardness of materials made from these elements. The hardness of molybdenum is $140 - 230 kg/mm^2$ in Brinell scale and of tungsten $200 - 250 kg/mm^2$ or even $350 - 400 kg/mm^2$ for a forged rod, while for iron it is $35 - 45 kg/mm^2$ and for nickel $60 - 80 kg/mm^2$. These examples clearly indicate that the configuration of electrons in atoms in stationary states has a significant influence on the mechanical properties of materials composed of these atoms.

These mechanical properties of molybdenum and tungsten strongly support the proposed model of the atom's structure as a system with stationary electrons located at the vertices of Platonic figures. The excited states of the atom, on the other hand, represent a system in which all the electrons of the atom are excited and when this state is discharged, energy is transferred to one electron of the atom, which, when excited to vibration, can emit energy in the form of a wave packet - a photon.

References

1. J.A.Bearden, A.F.Burr, Rev.Mod.Phys.**39,125** (1967), *Reevaluation of X-Ray Atomic Energy Levels.*