

## Bohr model for many-electron cations (many-dimensional space)

Optimal configurations and minimal energy are calculated for all known elements, assuming that the  $n$ -th shell with  $m$  electrons forms a regular  $m - 1$ -dimensional simplex, with all distances between electrons and the center equal to  $R_n$ . Subspaces of simplexes corresponding to different shells are assumed to be orthogonal. All simplexes are assumed to be co-centric with the nucleus, except the case when the outer shell has only one electron. In the latter case, centers of simplexes are assumed to be shifted in some direction orthogonal to all simplexes.

### 1. Helium cation - $Z = 2$ , 1 electrons.

Electron configuration of the corresponding 1-electron atom  $1s^1$ .

Electron shell configuration {1}.

Number of shells: 1

Energy function:

$$W = \frac{1}{2d_1^2} - \frac{2}{d_1}$$

Radii of shells:

$$\{ \}$$

Displacements of shells:

$$d_1 = 0.5$$

Energy:  $E = -2.00000000$ .

### 2. Lithium cation - $Z = 3$ , 2 electrons.

Electron configuration of the corresponding 2-electron atom  $1s^2$ .

Electron shell configuration {2}.

Number of shells: 1

Energy function:

$$W = \frac{1}{R_1^2} - \frac{11}{2R_1}$$

Radii of shells:

$$R_1 = 0.363636$$

Energy:  $E = -7.56250000$ .

3. *Beryllium cation -  $Z = 4$ , 3 electrons.*

Electron configuration of the corresponding 3-electron atom [He] $2s^1$ .

Electron shell configuration {2, 1}.

Number of shells: 2

Energy function:

$$W = \frac{2}{\sqrt{(d_1 - d_2)^2 + R_1^2}} - \frac{4}{d_2} + \frac{1}{2R_1} + \frac{2}{d_2^2} - \frac{8}{\sqrt{d_1^2 + R_1^2}} + \frac{1}{d_1^2 + R_1^2}$$

Radii of shells:

$$R_1 = 0.266279$$

Displacements of shells:

$$d_1 = 0.0195328$$

$$d_2 = -1.90929$$

Energy:  $E = -14.5766684$ .

4. *Boron cation -  $Z = 5$ , 4 electrons.*

Electron configuration of the corresponding 4-electron atom [He] $2s^2$ .

Electron shell configuration {2, 2}.

Number of shells: 2

Energy function:

$$W = -\frac{19}{2R_1} - \frac{19}{2R_2} + \frac{1}{R_1^2} + \frac{4}{R_2^2} + \frac{4}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.210807$$

$$R_2 = 1.42135$$

Energy:  $E = -24.4825049$ .

5. Carbon cation -  $Z = 6$ , 5 electrons.

Electron configuration of the corresponding 5-electron atom  $[\text{He}]2s^22p^1$ .

Electron shell configuration  $\{2, 3\}$ .

Number of shells: 2

Energy function:

$$W = -\frac{23}{2R_1} + \frac{\sqrt{3}}{R_2} - \frac{18}{R_2} + \frac{1}{R_1^2} + \frac{6}{R_2^2} + \frac{6}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.174222$$

$$R_2 = 1.14613$$

Energy:  $E = -37.5130975$ .

6. Nitrogen cation -  $Z = 7$ , 6 electrons.

Electron configuration of the corresponding 6-electron atom  $[\text{He}]2s^22p^2$ .

Electron shell configuration  $\{2, 4\}$ .

Number of shells: 2

Energy function:

$$W = -\frac{27}{2R_1} + \frac{3\sqrt{\frac{3}{2}}}{R_2} - \frac{28}{R_2} + \frac{1}{R_1^2} + \frac{8}{R_2^2} + \frac{8}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.148459$$

$$R_2 = 0.963721$$

Energy:  $E = -53.9857690$ .

7. Oxygen cation -  $Z = 8$ , 7 electrons.

Electron configuration of the corresponding 7-electron atom  $[\text{He}]2s^22p^3$ .

Electron shell configuration  $\{2, 5\}$ .

Number of shells: 2

Energy function:

$$W = -\frac{31}{2R_1} + \frac{2\sqrt{10}}{R_2} - \frac{40}{R_2} + \frac{1}{R_1^2} + \frac{10}{R_2^2} + \frac{10}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.129334$$

$$R_2 = 0.832399$$

Energy:  $E = -74.2146885$ .

8. *Fluorine cation -  $Z = 9$ , 8 electrons.*

Electron configuration of the corresponding 8-electron atom  $[\text{He}]2s^22p^4$ .

Electron shell configuration  $\{2, 6\}$ .

Number of shells: 2

Energy function:

$$W = -\frac{35}{2R_1} + \frac{5\sqrt{15}}{2R_2} - \frac{54}{R_2} + \frac{1}{R_1^2} + \frac{12}{R_2^2} + \frac{12}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.114575$$

$$R_2 = 0.732951$$

Energy:  $E = -98.5134819$ .

9. *Neon cation -  $Z = 10$ , 9 electrons.*

Electron configuration of the corresponding 9-electron atom  $[\text{He}]2s^22p^5$ .

Electron shell configuration  $\{2, 7\}$ .

Number of shells: 2

Energy function:

$$W = -\frac{39}{2R_1} + \frac{3\sqrt{21}}{R_2} - \frac{70}{R_2} + \frac{1}{R_1^2} + \frac{14}{R_2^2} + \frac{14}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.10284$$

$$R_2 = 0.6549$$

Energy:  $E = -127.195650$ .

10. Sodium cation -  $Z = 11$ , 10 electrons.

Electron configuration of the corresponding 10-electron atom  $[\text{He}]2s^22p^6$ .

Electron shell configuration  $\{2, 8\}$ .

Number of shells: 2

Energy function:

$$W = -\frac{43}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{88}{R_2} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0932851$$

$$R_2 = 0.591959$$

Energy:  $E = -160.574650$ .

11. Magnesium cation -  $Z = 12$ , 11 electrons.

Electron configuration of the corresponding 11-electron atom  $[\text{Ne}]3s^1$ .

Electron shell configuration  $\{2, 8, 1\}$ .

Number of shells: 3

Energy function:

$$W = \frac{2}{\sqrt{(d_1 - d_3)^2 + R_1^2}} - \frac{96}{\sqrt{d_2^2 + R_2^2}} + \frac{8}{\sqrt{(d_2 - d_3)^2 + R_2^2}} + \frac{16}{\sqrt{(d_1 - d_2)^2 + R_1^2 + R_2^2}} \\ - \frac{12}{d_3} + \frac{1}{2R_1} + \frac{7\sqrt{7}}{R_2} + \frac{16}{d_2^2 + R_2^2} + \frac{9}{2d_3^2} - \frac{24}{\sqrt{d_1^2 + R_1^2}} + \frac{1}{d_1^2 + R_1^2}$$

Radii of shells:

$$R_1 = 0.0853593$$

$$R_2 = 0.515288$$

Displacements of shells:

$$d_1 = -0.000375915$$

$$d_2 = 0.00375748$$

$$d_3 = -4.08727$$

Energy:  $E = -197.767730$ .

12. Aluminum cation -  $Z = 13$ , 12 electrons.

Electron configuration of the corresponding 12-electron atom  $[\text{Ne}]3s^2$ .

Electron shell configuration  $\{2, 8, 2\}$ .

Number of shells: 3

Energy function:

$$W = \frac{4}{\sqrt{R_1^2 + R_3^2}} + \frac{16}{\sqrt{R_2^2 + R_3^2}} - \frac{51}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{104}{R_2} - \frac{51}{2R_3} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{9}{R_3^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0786736$$

$$R_2 = 0.456417$$

$$R_3 = 2.97352$$

Energy:  $E = -239.387382$ .

13. Silicon cation -  $Z = 14$ , 13 electrons.

Electron configuration of the corresponding 13-electron atom  $[\text{Ne}]3s^23p^1$ .

Electron shell configuration  $\{2, 8, 3\}$ .

Number of shells: 3

Energy function:

$$W = \frac{6}{\sqrt{R_1^2 + R_3^2}} + \frac{24}{\sqrt{R_2^2 + R_3^2}} - \frac{55}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{112}{R_2} + \frac{\sqrt{3}}{R_3} - \frac{42}{R_3} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{27}{2R_3^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0729564$$

$$R_2 = 0.409754$$

$$R_3 = 2.39004$$

Energy:  $E = -285.536290$ .

14. Phosphorus cation -  $Z = 15$ , 14 electrons.

Electron configuration of the corresponding 14-electron atom  $[\text{Ne}]3s^23p^2$ .

Electron shell configuration  $\{2, 8, 4\}$ .

Number of shells: 3

Energy function:

$$W = \frac{8}{\sqrt{R_1^2 + R_3^2}} + \frac{32}{\sqrt{R_2^2 + R_3^2}} - \frac{59}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{120}{R_2} + \frac{3\sqrt{\frac{3}{2}}}{R_3} - \frac{60}{R_3} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{18}{R_3^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0680122$$

$$R_2 = 0.371844$$

$$R_3 = 2.00943$$

Energy:  $E = -336.360652$ .

15. *Sulfur cation -  $Z = 16$ , 15 electrons.*

Electron configuration of the corresponding 15-electron atom  $[\text{Ne}]3s^23p^3$ .

Electron shell configuration  $\{2, 8, 5\}$ .

Number of shells: 3

Energy function:

$$W = \frac{10}{\sqrt{R_1^2 + R_3^2}} + \frac{40}{\sqrt{R_2^2 + R_3^2}} - \frac{63}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{128}{R_2} + \frac{2\sqrt{10}}{R_3} - \frac{80}{R_3} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{45}{2R_3^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0636943$$

$$R_2 = 0.340424$$

$$R_3 = 1.738$$

Energy:  $E = -392.002454$ .

16. *Chlorine cation -  $Z = 17$ , 16 electrons.*

Electron configuration of the corresponding 16-electron atom  $[\text{Ne}]3s^23p^4$ .

Electron shell configuration  $\{2, 8, 6\}$ .

Number of shells: 3

Energy function:

$$W = \frac{12}{\sqrt{R_1^2 + R_3^2}} + \frac{48}{\sqrt{R_2^2 + R_3^2}} - \frac{67}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{136}{R_2} + \frac{5\sqrt{15}}{2R_3} - \frac{102}{R_3} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{27}{R_3^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.059891$$

$$R_2 = 0.313948$$

$$R_3 = 1.53358$$

Energy:  $E = -452.602658$ .

17. *Argon cation -  $Z = 18$ , 17 electrons.*

Electron configuration of the corresponding 17-electron atom  $[\text{Ne}]3s^23p^5$ .

Electron shell configuration  $\{2, 8, 7\}$ .

Number of shells: 3

Energy function:

$$W = \frac{14}{\sqrt{R_1^2 + R_3^2}} + \frac{56}{\sqrt{R_2^2 + R_3^2}} - \frac{71}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{144}{R_2} + \frac{3\sqrt{21}}{R_3} - \frac{126}{R_3} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{63}{2R_3^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0565155$$

$$R_2 = 0.291327$$

$$R_3 = 1.37362$$

Energy:  $E = -518.301671$ .

18. *Potassium cation -  $Z = 19$ , 18 electrons.*

Electron configuration of the corresponding 18-electron atom  $[\text{Ne}]3s^23p^6$ .

Electron shell configuration  $\{2, 8, 8\}$ .

Number of shells: 3

Energy function:

$$W = \frac{16}{\sqrt{R_1^2 + R_3^2}} + \frac{64}{\sqrt{R_2^2 + R_3^2}} - \frac{75}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{152}{R_2} + \frac{7\sqrt{7}}{R_3} - \frac{152}{R_3} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{36}{R_3^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0534996$$

$$R_2 = 0.271772$$

$$R_3 = 1.24477$$

Energy:  $E = -589.239560$ .



19. Calcium cation -  $Z = 20$ , 19 electrons.

Electron configuration of the corresponding 19-electron atom  $[\text{Ar}]4s^1$ .

Electron shell configuration  $\{2, 8, 8, 1\}$ .

Number of shells: 4

Radii of shells:

$$R_1 = 0.0507888$$

$$R_2 = 0.254735$$

$$R_3 = 1.08324$$

Displacements of shells:

$$d_1 = -0.0000715557$$

$$d_2 = 0.00042403$$

$$d_3 = -0.0124805$$

$$d_4 = 6.85804$$

Energy:  $E = -665.087369$ .

20. Scandium cation -  $Z = 21$ , 20 electrons.

Electron configuration of the corresponding 20-electron atom  $[\text{Ar}]4s^2$ .

Electron shell configuration  $\{2, 8, 9, 1\}$ .

Number of shells: 4

Energy function:

$$W = \frac{2}{\sqrt{(d_1 - d_4)^2 + R_1^2}} - \frac{168}{\sqrt{d_2^2 + R_2^2}} + \frac{8}{\sqrt{(d_2 - d_4)^2 + R_2^2}} + \frac{16}{\sqrt{(d_1 - d_2)^2 + R_1^2 + R_2^2}} - \frac{189}{\sqrt{d_3^2 + R_3^2}} + \frac{1}{\sqrt{d_4^2 + R_4^2}}$$

$$+ \frac{18}{\sqrt{(d_1 - d_3)^2 + R_1^2 + R_3^2}} + \frac{72}{\sqrt{(d_2 - d_3)^2 + R_2^2 + R_3^2}} - \frac{21}{d_4} + \frac{1}{2R_1} + \frac{7\sqrt{7}}{R_2} + \frac{16}{d_2^2 + R_2^2} + \frac{24}{R_3} + \frac{81}{2(d_3^2 + R_3^2)}$$

Radii of shells:

$$R_1 = 0.0483391$$

$$R_2 = 0.239695$$

$$R_3 = 1.00251$$

Displacements of shells:

$$d_1 = -0.0000592862$$

$$d_2 = 0.000339995$$

$$d_3 = -0.00850136$$

$$d_4 = 6.92621$$

Energy:  $E = -746.905308$ .

21. *Titanium cation -  $Z = 22$ , 21 electrons.*

Electron configuration of the corresponding 21-electron atom  $[\text{Ar}]3d^14s^2$ .

Electron shell configuration  $\{2, 8, 10, 1\}$ .

Number of shells: 4

Energy function:

$$W = \frac{2}{\sqrt{(d_1 - d_4)^2 + R_1^2}} - \frac{176}{\sqrt{d_2^2 + R_2^2}} + \frac{8}{\sqrt{(d_2 - d_4)^2 + R_2^2}} + \frac{16}{\sqrt{(d_1 - d_2)^2 + R_1^2 + R_2^2}} - \frac{220}{\sqrt{d_3^2 + R_3^2}} + \frac{20}{\sqrt{(d_1 - d_3)^2 + R_1^2 + R_3^2}} + \frac{80}{\sqrt{(d_2 - d_3)^2 + R_2^2 + R_3^2}} - \frac{22}{d_4} + \frac{1}{2R_1} + \frac{7\sqrt{7}}{R_2} + \frac{16}{d_2^2 + R_2^2} + \frac{27\sqrt{5}}{2R_3} + \frac{45}{d_3^2 + R_3^2}$$

Radii of shells:

$$R_1 = 0.0461145$$

$$R_2 = 0.226342$$

$$R_3 = 0.933261$$

Displacements of shells:

$$d_1 = -0.0000498074$$

$$d_2 = 0.000277374$$

$$d_3 = -0.00600067$$

$$d_4 = 6.9863$$

Energy:  $E = -834.386073$ .

22. *Vanadium cation -  $Z = 23$ , 22 electrons.*

Electron configuration of the corresponding 22-electron atom  $[\text{Ar}]3d^24s^2$ .

Electron shell configuration  $\{2, 8, 11, 1\}$ .

Number of shells: 4

Energy function:

$$W = \frac{2}{\sqrt{(d_1 - d_4)^2 + R_1^2}} - \frac{184}{\sqrt{d_2^2 + R_2^2}} + \frac{8}{\sqrt{(d_2 - d_4)^2 + R_2^2}} + \frac{16}{\sqrt{(d_1 - d_2)^2 + R_1^2 + R_2^2}} - \frac{253}{\sqrt{d_3^2 + R_3^2}} + \frac{9}{\sqrt{d_3^2 + R_3^2}} \\ + \frac{22}{\sqrt{(d_1 - d_3)^2 + R_1^2 + R_3^2}} + \frac{88}{\sqrt{(d_2 - d_3)^2 + R_2^2 + R_3^2}} - \frac{23}{d_4} + \frac{1}{2R_1} + \frac{7\sqrt{7}}{R_2} + \frac{16}{d_2^2 + R_2^2} + \frac{5\sqrt{55}}{R_3} + \frac{9}{2(d_3^2 + R_3^2)}$$

Radii of shells:

$$R_1 = 0.0440854$$

$$R_2 = 0.214406$$

$$R_3 = 0.873161$$

Displacements of shells:

$$d_1 = -0.0000423315$$

$$d_2 = 0.000229589$$

$$d_3 = -0.00436142$$

$$d_4 = 7.03982$$

Energy:  $E = -927.669111$ .

23. Chromium cation -  $Z = 24$ , 23 electrons.

Electron configuration of the corresponding 23-electron atom  $[\text{Ar}]3d^34s^2$ .

Electron shell configuration  $\{2, 8, 13\}$ .

Number of shells: 3

Energy function:

$$W = \frac{26}{\sqrt{R_1^2 + R_3^2}} + \frac{104}{\sqrt{R_2^2 + R_3^2}} - \frac{95}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{192}{R_2} \\ + \frac{6\sqrt{78}}{R_3} - \frac{312}{R_3} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{117}{2R_3^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0422272$$

$$R_2 = 0.203627$$

$$R_3 = 0.851332$$

Energy:  $E = -1027.40243$ .

24. *Manganese cation -  $Z = 25$ , 24 electrons.*

Electron configuration of the corresponding 24-electron atom  $[\text{Ar}]3d^54s^1$ .

Electron shell configuration  $\{2, 8, 13, 1\}$ .

Number of shells: 4

Radii of shells:

$$R_1 = 0.0405191$$

$$R_2 = 0.193965$$

$$R_3 = 0.7739$$

Displacements of shells:

$$d_1 = -0.0000314551$$

$$d_2 = 0.000162973$$

$$d_3 = -0.00247131$$

$$d_4 = 7.13131$$

Energy:  $E = -1132.19962$ .

25. *Iron cation -  $Z = 26$ , 25 electrons.*

Electron configuration of the corresponding 25-electron atom  $[\text{Ar}]3d^54s^2$ .

Electron shell configuration  $\{2, 8, 14, 1\}$ .

Number of shells: 4

Energy function:

$$W = \frac{2}{\sqrt{(d_1 - d_4)^2 + R_1^2}} - \frac{208}{\sqrt{d_2^2 + R_2^2}} + \frac{8}{\sqrt{(d_2 - d_4)^2 + R_2^2}} + \frac{16}{\sqrt{(d_1 - d_2)^2 + R_1^2 + R_2^2}} - \frac{364}{\sqrt{d_3^2 + R_3^2}} + \frac{6}{\sqrt{d_3^2 + R_3^2}} \\ + \frac{28}{\sqrt{(d_1 - d_3)^2 + R_1^2 + R_3^2}} + \frac{112}{\sqrt{(d_2 - d_3)^2 + R_2^2 + R_3^2}} - \frac{26}{d_4} + \frac{1}{2R_1} + \frac{7\sqrt{7}}{R_2} + \frac{16}{d_2^2 + R_2^2} + \frac{13\sqrt{91}}{2R_3} + \frac{6}{d_3^2 + R_3^2}$$

Radii of shells:

$$R_1 = 0.0389436$$

$$R_2 = 0.185146$$

$$R_3 = 0.732407$$

Displacements of shells:

$$d_1 = -0.0000274364$$

$$d_2 = 0.000139349$$

$$d_3 = -0.00191416$$

$$d_4 = 7.17077$$

Energy:  $E = -1243.72585$ .

26. *Cobalt cation -  $Z = 27$ , 26 electrons.*

Electron configuration of the corresponding 26-electron atom  $[\text{Ar}]3d^64s^2$ .

Electron shell configuration  $\{2, 8, 15, 1\}$ .

Number of shells: 4

Energy function:

$$W = \frac{2}{\sqrt{(d_1 - d_4)^2 + R_1^2}} - \frac{216}{\sqrt{d_2^2 + R_2^2}} + \frac{8}{\sqrt{(d_2 - d_4)^2 + R_2^2}} + \frac{16}{\sqrt{(d_1 - d_2)^2 + R_1^2 + R_2^2}} - \frac{405}{\sqrt{d_3^2 + R_3^2}} + \frac{120}{\sqrt{(d_2 - d_3)^2 + R_2^2 + R_3^2}} - \frac{27}{d_4} + \frac{1}{2R_1} + \frac{7\sqrt{7}}{R_2} + \frac{16}{d_2^2 + R_2^2} + \frac{7\sqrt{105}}{R_3} + \frac{135}{2(d_3^2 + R_3^2)} + \frac{8}{d_4^2} - \frac{54}{\sqrt{d_1^2 + R_1^2}}$$

Radii of shells:

$$R_1 = 0.037486$$

$$R_2 = 0.177096$$

$$R_3 = 0.695201$$

Displacements of shells:

$$d_1 = -0.0000240913$$

$$d_2 = 0.000120145$$

$$d_3 = -0.00150622$$

$$d_4 = 7.20679$$

Energy:  $E = -1361.61185$ .

27. *Nickel cation -  $Z = 28$ , 27 electrons.*

Electron configuration of the corresponding 27-electron atom  $[\text{Ar}]3d^74s^2$ .

Electron shell configuration  $\{2, 8, 16, 1\}$ .

Number of shells: 4

Energy function:

$$W = \frac{2}{\sqrt{(d_1 - d_4)^2 + R_1^2}} - \frac{224}{\sqrt{d_2^2 + R_2^2}} + \frac{8}{\sqrt{(d_2 - d_4)^2 + R_2^2}} + \frac{16}{\sqrt{(d_1 - d_2)^2 + R_1^2 + R_2^2}} - \frac{448}{\sqrt{d_3^2 + R_3^2}} + \frac{7}{\sqrt{d_3^2 + R_3^2}} + \frac{32}{\sqrt{(d_1 - d_3)^2 + R_1^2 + R_3^2}} + \frac{128}{\sqrt{(d_2 - d_3)^2 + R_2^2 + R_3^2}} - \frac{28}{d_4} + \frac{1}{2R_1} + \frac{7\sqrt{7}}{R_2} + \frac{16}{d_2^2 + R_2^2} + \frac{15\sqrt{30}}{R_3} + \frac{7}{d_3^2 + R_3^2}$$

Radii of shells:

$$R_1 = 0.0361335$$

$$R_2 = 0.16972$$

$$R_3 = 0.66164$$

Displacements of shells:

$$d_1 = -0.000021281$$

$$d_2 = 0.000104359$$

$$d_3 = -0.00120181$$

$$d_4 = 7.23982$$

Energy:  $E = -1485.99698$ .

28. *Copper cation -  $Z = 29$ , 28 electrons.*

Electron configuration of the corresponding 28-electron atom  $[\text{Ar}]3d^84s^2$ .

Electron shell configuration  $\{2, 8, 18\}$ .

Number of shells: 3

Energy function:

$$W = \frac{36}{\sqrt{R_1^2 + R_3^2}} + \frac{144}{\sqrt{R_2^2 + R_3^2}} - \frac{115}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{232}{R_2} + \frac{51\sqrt{17}}{2R_3} - \frac{522}{R_3} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{81}{R_3^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.034875$$

$$R_2 = 0.162898$$

$$R_3 = 0.648967$$

Energy:  $E = -1617.47477$ .

29. Zinc cation -  $Z = 30$ , 29 electrons.

Electron configuration of the corresponding 29-electron atom  $[\text{Ar}]3d^{10}4s^1$ .

Electron shell configuration  $\{2, 8, 18, 1\}$ .

Number of shells: 4

Radii of shells:

$$R_1 = 0.0337013$$

$$R_2 = 0.156675$$

$$R_3 = 0.603487$$

Displacements of shells:

$$d_1 = -0.0000168684$$

$$d_2 = 0.0000802807$$

$$d_3 = -0.00079298$$

$$d_4 = 7.29826$$

Energy:  $E = -1754.82193$ .

30. Gallium cation -  $Z = 31$ , 30 electrons.

Electron configuration of the corresponding 30-electron atom  $[\text{Ar}]3d^{10}4s^2$ .

Electron shell configuration  $\{2, 8, 18, 2\}$ .

Number of shells: 4

Energy function:

$$W = \frac{36}{\sqrt{R_1^2 + R_3^2}} + \frac{144}{\sqrt{R_2^2 + R_3^2}} + \frac{4}{\sqrt{R_1^2 + R_4^2}} + \frac{16}{\sqrt{R_2^2 + R_4^2}} + \frac{36}{\sqrt{R_3^2 + R_4^2}} - \frac{123}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{248}{R_2} + \frac{51\sqrt{17}}{2R_3} - \frac{558}{R_3} - \frac{123}{2R_4} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{81}{R_3^2} + \frac{16}{R_4^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0326039$$

$$R_2 = 0.150906$$

$$R_3 = 0.564112$$

$$R_4 = 5.20762$$

Energy:  $E = -1898.44892$ .

31. Germanium cation -  $Z = 32$ , 31 electrons.

Electron configuration of the corresponding 31-electron atom  $[\text{Ar}]3d^{10}4s^24p^1$ .

Electron shell configuration  $\{2, 8, 18, 3\}$ .

Number of shells: 4

Energy function:

$$W = \frac{36}{\sqrt{R_1^2 + R_3^2}} + \frac{144}{\sqrt{R_2^2 + R_3^2}} + \frac{6}{\sqrt{R_1^2 + R_4^2}} + \frac{24}{\sqrt{R_2^2 + R_4^2}} + \frac{54}{\sqrt{R_3^2 + R_4^2}} - \frac{127}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{256}{R_2} + \frac{51\sqrt{17}}{2R_3} - \frac{576}{R_3} + \frac{\sqrt{3}}{R_4} - \frac{96}{R_4} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{81}{R_3^2} + \frac{24}{R_4^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0315757$$

$$R_2 = 0.145542$$

$$R_3 = 0.529699$$

$$R_4 = 4.13166$$

Energy:  $E = -2048.41586$ .

32. Arsenic cation -  $Z = 33$ , 32 electrons.

Electron configuration of the corresponding 32-electron atom  $[\text{Ar}]3d^{10}4s^24p^2$ .

Electron shell configuration  $\{2, 8, 18, 4\}$ .

Number of shells: 4

Energy function:

$$W = \frac{36}{\sqrt{R_1^2 + R_3^2}} + \frac{144}{\sqrt{R_2^2 + R_3^2}} + \frac{8}{\sqrt{R_1^2 + R_4^2}} + \frac{32}{\sqrt{R_2^2 + R_4^2}} + \frac{72}{\sqrt{R_3^2 + R_4^2}} - \frac{131}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{264}{R_2} + \frac{51\sqrt{17}}{2R_3} - \frac{594}{R_3} + \frac{3\sqrt{\frac{3}{2}}}{R_4} - \frac{132}{R_4} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{81}{R_3^2} + \frac{32}{R_4^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0306103$$

$$R_2 = 0.140543$$

$$R_3 = 0.499373$$

$$R_4 = 3.43527$$

Energy:  $E = -2204.80941$ .



33. Selenium cation -  $Z = 34$ , 33 electrons.

Electron configuration of the corresponding 33-electron atom  $[\text{Ar}]3d^{10}4s^24p^3$ .

Electron shell configuration  $\{2, 8, 18, 5\}$ .

Number of shells: 4

Energy function:

$$W = \frac{36}{\sqrt{R_1^2 + R_3^2}} + \frac{144}{\sqrt{R_2^2 + R_3^2}} + \frac{10}{\sqrt{R_1^2 + R_4^2}} + \frac{40}{\sqrt{R_2^2 + R_4^2}} + \frac{90}{\sqrt{R_3^2 + R_4^2}} - \frac{135}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{272}{R_2} + \frac{51\sqrt{17}}{2R_3} - \frac{612}{R_3} + \frac{2\sqrt{10}}{R_4} - \frac{170}{R_4} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{81}{R_3^2} + \frac{40}{R_4^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0297021$$

$$R_2 = 0.135871$$

$$R_3 = 0.472446$$

$$R_4 = 2.94421$$

Energy:  $E = -2367.71360$ .

34. Bromine cation -  $Z = 35$ , 34 electrons.

Electron configuration of the corresponding 34-electron atom  $[\text{Ar}]3d^{10}4s^24p^4$ .

Electron shell configuration  $\{2, 8, 18, 6\}$ .

Number of shells: 4

Energy function:

$$W = \frac{36}{\sqrt{R_1^2 + R_3^2}} + \frac{144}{\sqrt{R_2^2 + R_3^2}} + \frac{12}{\sqrt{R_1^2 + R_4^2}} + \frac{48}{\sqrt{R_2^2 + R_4^2}} + \frac{108}{\sqrt{R_3^2 + R_4^2}} - \frac{139}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{280}{R_2} + \frac{51\sqrt{17}}{2R_3} - \frac{630}{R_3} + \frac{5\sqrt{15}}{2R_4} - \frac{210}{R_4} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{81}{R_3^2} + \frac{48}{R_4^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0288463$$

$$R_2 = 0.131496$$

$$R_3 = 0.448376$$

$$R_4 = 2.57895$$

Energy:  $E = -2537.21147$ .

35. *Krypton cation -  $Z = 36$ , 35 electrons.*

Electron configuration of the corresponding 35-electron atom  $[\text{Ar}]3d^{10}4s^24p^5$ .

Electron shell configuration  $\{2, 8, 18, 7\}$ .

Number of shells: 4

Energy function:

$$W = \frac{36}{\sqrt{R_1^2 + R_3^2}} + \frac{144}{\sqrt{R_2^2 + R_3^2}} + \frac{14}{\sqrt{R_1^2 + R_4^2}} + \frac{56}{\sqrt{R_2^2 + R_4^2}} + \frac{126}{\sqrt{R_3^2 + R_4^2}} - \frac{143}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{288}{R_2} + \frac{51\sqrt{17}}{2R_3} - \frac{648}{R_3} + \frac{3\sqrt{21}}{R_4} - \frac{252}{R_4} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{81}{R_3^2} + \frac{56}{R_4^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0280383$$

$$R_2 = 0.127391$$

$$R_3 = 0.426728$$

$$R_4 = 2.29662$$

Energy:  $E = -2713.38529$ .

36. *Rubidium cation -  $Z = 37$ , 36 electrons.*

Electron configuration of the corresponding 36-electron atom  $[\text{Ar}]3d^{10}4s^24p^6$ .

Electron shell configuration  $\{2, 8, 18, 8\}$ .

Number of shells: 4

Energy function:

$$W = \frac{36}{\sqrt{R_1^2 + R_3^2}} + \frac{144}{\sqrt{R_2^2 + R_3^2}} + \frac{16}{\sqrt{R_1^2 + R_4^2}} + \frac{64}{\sqrt{R_2^2 + R_4^2}} + \frac{144}{\sqrt{R_3^2 + R_4^2}} - \frac{147}{2R_1} + \frac{7\sqrt{7}}{R_2} - \frac{296}{R_2} + \frac{51\sqrt{17}}{2R_3} - \frac{666}{R_3} + \frac{7\sqrt{7}}{R_4} - \frac{296}{R_4} + \frac{1}{R_1^2} + \frac{16}{R_2^2} + \frac{81}{R_3^2} + \frac{64}{R_4^2} + \frac{16}{\sqrt{R_1^2 + R_2^2}}$$

Radii of shells:

$$R_1 = 0.0272744$$

$$R_2 = 0.123531$$

$$R_3 = 0.40715$$

$$R_4 = 2.07188$$

Energy:  $E = -2896.31657$ .

37. *Strontium cation -  $Z = 38$ , 37 electrons.*

Electron configuration of the corresponding 37-electron atom  $[\text{Kr}]5s^1$ .

Electron shell configuration  $\{2, 8, 18, 8, 1\}$ .

Number of shells: 5

Radii of shells:

$$R_1 = 0.0265509$$

$$R_2 = 0.119895$$

$$R_3 = 0.389406$$

$$R_4 = 1.78948$$

Displacements of shells:

$$d_1 = -9.686321742920028^{*-6}$$

$$d_2 = 0.000043166$$

$$d_3 = -0.000267548$$

$$d_4 = 0.0238334$$

$$d_5 = -10.3322$$

Energy:  $E = -3085.86242$ .

38. *Yttrium cation -  $Z = 39$ , 38 electrons.*

Electron configuration of the corresponding 38-electron atom  $[\text{Kr}]5s^2$ .

Electron shell configuration  $\{2, 8, 18, 9, 1\}$ .

Number of shells: 5

Radii of shells:

$$R_1 = 0.0258649$$

$$R_2 = 0.116465$$

$$R_3 = 0.373163$$

$$R_4 = 1.65221$$

Displacements of shells:

$$d_1 = -8.566820024188949 \times 10^{-6}$$

$$d_2 = 0.0000379281$$

$$d_3 = -0.000226546$$

$$d_4 = 0.0160969$$

$$d_5 = -10.4769$$

Energy:  $E = -3282.55052$ .

39. *Zirconium cation -  $Z = 40$ , 39 electrons.*

Electron configuration of the corresponding 39-electron atom  $[\text{Kr}]4d^15s^2$ .

Electron shell configuration  $\{2, 8, 18, 10, 1\}$ .

Number of shells: 5

Radii of shells:

$$R_1 = 0.0252133$$

$$R_2 = 0.113223$$

$$R_3 = 0.358267$$

$$R_4 = 1.53555$$

Displacements of shells:

$$d_1 = -7.65162036341238 \times 10^{-6}$$

$$d_2 = 0.0000336645$$

$$d_3 = -0.000194334$$

$$d_4 = 0.0112994$$

$$d_5 = -10.6012$$

Energy:  $E = -3486.24126$ .

40. *Niobium cation -  $Z = 41$ , 40 electrons.*

Electron configuration of the corresponding 40-electron atom  $[\text{Kr}]4d^25s^2$ .

Electron shell configuration  $\{2, 8, 18, 12\}$ .

Number of shells: 4

Radii of shells:

$$R_1 = 0.0245938$$

$$R_2 = 0.110155$$

$$R_3 = 0.344484$$

$$R_4 = 1.49804$$

Energy:  $E = -3697.22829$ .

*41. Molybdenum cation -  $Z = 42$ , 41 electrons.*

Electron configuration of the corresponding 41-electron atom  $[\text{Kr}]4d^45s^1$ .

Electron shell configuration  $\{2, 8, 18, 13\}$ .

Number of shells: 4

Radii of shells:

$$R_1 = 0.0240039$$

$$R_2 = 0.107247$$

$$R_3 = 0.331813$$

$$R_4 = 1.4028$$

Energy:  $E = -3915.15242$ .

*42. Technetium cation -  $Z = 43$ , 42 electrons.*

Electron configuration of the corresponding 42-electron atom  $[\text{Kr}]4d^55s^1$ .

Electron shell configuration  $\{2, 8, 18, 13, 1\}$ .

Number of shells: 5

Radii of shells:

$$R_1 = 0.0234417$$

$$R_2 = 0.104487$$

$$R_3 = 0.320145$$

$$R_4 = 1.27077$$

Displacements of shells:

$$d_1 = 5.691217782210839 \times 10^{-6}$$

$$d_2 = -0.0000246091$$

$$d_3 = 0.000130063$$

$$d_4 = -0.00463349$$

$$d_5 = 10.8897$$

Energy:  $E = -4140.12374$ .

43. *Ruthenium cation* -  $Z = 44$ , 43 electrons.

Electron configuration of the corresponding 43-electron atom  $[\text{Kr}]4d^55s^2$ .

Electron shell configuration  $\{2, 8, 18, 15\}$ .

Number of shells: 4

Radii of shells:

$$R_1 = 0.0229052$$

$$R_2 = 0.101865$$

$$R_3 = 0.309154$$

$$R_4 = 1.24595$$

Energy:  $E = -4372.79175$ .

44. *Rhodium cation* -  $Z = 45$ , 44 electrons.

Electron configuration of the corresponding 44-electron atom  $[\text{Kr}]4d^75s^1$ .

Electron shell configuration  $\{2, 8, 18, 16\}$ .

Number of shells: 4

Radii of shells:

$$R_1 = 0.0223927$$

$$R_2 = 0.099369$$

$$R_3 = 0.29898$$

$$R_4 = 1.18055$$

Energy:  $E = -4612.66503$ .

45. *Palladium cation -  $Z = 46$ , 45 electrons.*

Electron configuration of the corresponding 45-electron atom  $[\text{Kr}]4d^85s^1$ .

Electron shell configuration  $\{2, 8, 18, 17\}$ .

Number of shells: 4

Radii of shells:

$$R_1 = 0.0219026$$

$$R_2 = 0.0969916$$

$$R_3 = 0.289472$$

$$R_4 = 1.12198$$

Energy:  $E = -4860.01255$ .

46. *Silver cation -  $Z = 47$ , 46 electrons.*

Electron configuration of the corresponding 46-electron atom  $[\text{Kr}]4d^{10}$ .

Electron shell configuration  $\{2, 8, 18, 18\}$ .

Number of shells: 4

Radii of shells:

$$R_1 = 0.0214335$$

$$R_2 = 0.0947244$$

$$R_3 = 0.280567$$

$$R_4 = 1.0692$$

Energy:  $E = -5114.91309$ .

47. *Cadmium cation -  $Z = 48$ , 47 electrons.*

Electron configuration of the corresponding 47-electron atom  $[\text{Kr}]4d^{10}5s^1$ .

Electron shell configuration  $\{2, 8, 18, 18, 1\}$ .

Number of shells: 5

Radii of shells:

$$R_1 = 0.0209841$$

$$R_2 = 0.0925598$$

$$R_3 = 0.272284$$

$$R_4 = 0.992632$$

Displacements of shells:

$$d_1 = -3.806913144016871 \times 10^{-6}$$

$$d_2 = 0.0000160579$$

$$d_3 = -0.0000758224$$

$$d_4 = 0.00150669$$

$$d_5 = -11.2053$$

Energy:  $E = -5377.37003$ .

*48. Indium cation -  $Z = 49$ , 48 electrons.*

Electron configuration of the corresponding 48-electron atom  $[\text{Kr}]4d^{10}5s^2$ .

Electron shell configuration  $\{2, 8, 18, 18, 2\}$ .

Number of shells: 5

Radii of shells:

$$R_1 = 0.0205531$$

$$R_2 = 0.0904913$$

$$R_3 = 0.264482$$

$$R_4 = 0.926724$$

$$R_5 = 7.95834$$

Energy:  $E = -5647.20576$ .

*49. Tin cation -  $Z = 50$ , 49 electrons.*

Electron configuration of the corresponding 49-electron atom  $[\text{Kr}]4d^{10}5s^25p^1$ .

Electron shell configuration  $\{2, 8, 18, 18, 3\}$ .

Number of shells: 5



Radii of shells:

$$R_1 = 0.0201394$$

$$R_2 = 0.0885126$$

$$R_3 = 0.257116$$

$$R_4 = 0.869435$$

$$R_5 = 6.29146$$

Energy:  $E = -5924.45552$ .

*50. Antimony cation -  $Z = 51$ , 50 electrons.*

Electron configuration of the corresponding 50-electron atom  $[\text{Kr}]4d^{10}5s^25p^2$ .

Electron shell configuration  $\{2, 8, 18, 18, 4\}$ .

Number of shells: 5

Radii of shells:

$$R_1 = 0.0197421$$

$$R_2 = 0.086618$$

$$R_3 = 0.25015$$

$$R_4 = 0.819209$$

$$R_5 = 5.21628$$

Energy:  $E = -6209.17194$ .

*51. Tellurium cation -  $Z = 52$ , 51 electrons.*

Electron configuration of the corresponding 51-electron atom  $[\text{Kr}]4d^{10}5s^25p^3$ .

Electron shell configuration  $\{2, 8, 18, 18, 5\}$ .

Number of shells: 5

Radii of shells:

$$R_1 = 0.0193601$$

$$R_2 = 0.0848024$$

$$R_3 = 0.24355$$

$$R_4 = 0.774829$$

$$R_5 = 4.46054$$

Energy:  $E = -6501.40616$ .

52. *Iodine cation -  $Z = 53$ , 52 electrons.*

Electron configuration of the corresponding 52-electron atom  $[\text{Kr}]4d^{10}5s^25p^4$ .

Electron shell configuration  $\{2, 8, 18, 18, 6\}$ .

Number of shells: 5

Radii of shells:

$$R_1 = 0.0189927$$

$$R_2 = 0.0830608$$

$$R_3 = 0.237287$$

$$R_4 = 0.735334$$

$$R_5 = 3.90009$$

Energy:  $E = -6801.20890$ .

53. *Xenon cation -  $Z = 54$ , 53 electrons.*

Electron configuration of the corresponding 53-electron atom  $[\text{Kr}]4d^{10}5s^25p^5$ .

Electron shell configuration  $\{2, 8, 18, 18, 7\}$ .

Number of shells: 5

Radii of shells:

$$R_1 = 0.0186389$$

$$R_2 = 0.0813889$$

$$R_3 = 0.231335$$

$$R_4 = 0.699955$$

$$R_5 = 3.4681$$

Energy:  $E = -7108.63056$ .

54. *Cesium cation -  $Z = 55$ , 54 electrons.*

Electron configuration of the corresponding 54-electron atom  $[\text{Kr}]4d^{10}5s^25p^6$ .

Electron shell configuration  $\{2, 8, 18, 18, 8\}$ .

Number of shells: 5

Radii of shells:

$$R_1 = 0.018298$$

$$R_2 = 0.0797825$$

$$R_3 = 0.225671$$

$$R_4 = 0.668073$$

$$R_5 = 3.12509$$

Energy:  $E = -7423.72125$ .

55. *Barium cation -  $Z = 56$ , 55 electrons.*

Electron configuration of the corresponding 55-electron atom  $[\text{Xe}]6s^1$ .

Electron shell configuration  $\{2, 8, 18, 18, 8, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0179694$$

$$R_2 = 0.078238$$

$$R_3 = 0.220275$$

$$R_4 = 0.639324$$

$$R_5 = 2.69038$$

Displacements of shells:

$$d_1 = 3.4523678073085995 \times 10^{-6}$$

$$d_2 = -0.0000141293$$

$$d_3 = 0.0000608334$$

$$d_4 = -0.000643726$$

$$d_5 = 0.0424803$$

$$d_6 = -14.3817$$

Energy:  $E = -7746.40482$ .

56. *Lanthanum cation -  $Z = 57$ , 56 electrons.*

Electron configuration of the corresponding 56-electron atom  $[\text{Xe}]6s^2$ .

Electron shell configuration  $\{2, 8, 18, 18, 9, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0176524$$

$$R_2 = 0.0767518$$

$$R_3 = 0.215128$$

$$R_4 = 0.613039$$

$$R_5 = 2.48248$$

Displacements of shells:

$$d_1 = 3.1315619555323445 \times 10^{-6}$$

$$d_2 = -0.0000127751$$

$$d_3 = 0.0000544771$$

$$d_4 = -0.000547778$$

$$d_5 = 0.0285627$$

$$d_6 = -14.64$$

Energy:  $E = -8076.98625$ .

*57. Cerium cation -  $Z = 58$ , 57 electrons.*

Electron configuration of the corresponding 57-electron atom  $[\text{Xe}]5d^16s^2$ .

Electron shell configuration  $\{2, 8, 18, 19, 9, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0173463$$

$$R_2 = 0.0753206$$

$$R_3 = 0.210257$$

$$R_4 = 0.597695$$

$$R_5 = 2.48202$$

Displacements of shells:

$$d_1 = 2.948632255110361 \times 10^{-6}$$

$$d_2 = -0.0000119886$$

$$d_3 = 0.0000504982$$

$$d_4 = -0.000476109$$

$$d_5 = 0.0282949$$

$$d_6 = -14.6441$$

Energy:  $E = -8419.77055$ .

58. *Praseodymium cation -  $Z = 59$ , 58 electrons.*

Electron configuration of the corresponding 58-electron atom  $[\text{Xe}]4f^{15}d^16s^2$ .

Electron shell configuration  $\{2, 8, 18, 21, 8, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0170507$$

$$R_2 = 0.0739413$$

$$R_3 = 0.205634$$

$$R_4 = 0.591818$$

$$R_5 = 2.69503$$

Displacements of shells:

$$d_1 = 2.90315624427645^{*-6}$$

$$d_2 = -0.000011763$$

$$d_3 = 0.0000488048$$

$$d_4 = -0.000427592$$

$$d_5 = 0.0417719$$

$$d_6 = -14.3809$$

Energy:  $E = -8775.21746$ .

59. *Neodymium cation -  $Z = 60$ , 59 electrons.*

Electron configuration of the corresponding 59-electron atom  $[\text{Xe}]4f^36s^2$ .

Electron shell configuration  $\{2, 8, 18, 22, 8, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.016765$$

$$R_2 = 0.0726115$$

$$R_3 = 0.201182$$

$$R_4 = 0.577575$$

$$R_5 = 2.69772$$

Displacements of shells:

$$d_1 = 2.752274017084237 \times 10^{-6}$$

$$d_2 = -0.0000111166$$

$$d_3 = 0.0000456018$$

$$d_4 = -0.000377343$$

$$d_5 = 0.0416632$$

$$d_6 = -14.3774$$

Energy:  $E = -9135.24311$ .

60. *Promethium cation -  $Z = 61$ , 60 electrons.*

Electron configuration of the corresponding 60-electron atom  $[\text{Xe}]4f^46s^2$ .

Electron shell configuration  $\{2, 8, 18, 23, 8, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0164887$$

$$R_2 = 0.0713284$$

$$R_3 = 0.196921$$

$$R_4 = 0.564025$$

$$R_5 = 2.70085$$

Displacements of shells:

$$d_1 = 2.6139408977772036 \times 10^{-6}$$

$$d_2 = -0.0000105257$$

$$d_3 = 0.0000427087$$

$$d_4 = -0.000334614$$

$$d_5 = 0.0416037$$

$$d_6 = -14.3726$$

Energy:  $E = -9503.94358$ .

61. *Samarium cation -  $Z = 62$ , 61 electrons.*

Electron configuration of the corresponding 61-electron atom  $[\text{Xe}]4f^56s^2$ .

Electron shell configuration  $\{2, 8, 18, 24, 8, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0162214$$

$$R_2 = 0.0700897$$

$$R_3 = 0.192839$$

$$R_4 = 0.551118$$

$$R_5 = 2.70436$$

Displacements of shells:

$$d_1 = 2.4865959411622844 \times 10^{-6}$$

$$d_2 = -9.983241663200579 \times 10^{-6}$$

$$d_3 = 0.0000400844$$

$$d_4 = -0.000298041$$

$$d_5 = 0.0415865$$

$$d_6 = -14.3668$$

Energy:  $E = -9881.39730$ .

62. *Europium cation -  $Z = 63$ , 62 electrons.*

Electron configuration of the corresponding 62-electron atom  $[\text{Xe}]4f^66s^2$ .

Electron shell configuration  $\{2, 8, 18, 25, 8, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0159626$$

$$R_2 = 0.0688931$$

$$R_3 = 0.188925$$

$$R_4 = 0.538808$$

$$R_5 = 2.70817$$

Displacements of shells:

$$d_1 = 2.3689404657643113 \times 10^{-6}$$

$$d_2 = -9.483499053040367 \times 10^{-6}$$

$$d_3 = 0.0000376948$$

$$d_4 = -0.000266551$$

$$d_5 = 0.0416062$$

$$d_6 = -14.3601$$

Energy:  $E = -10267.6827$ .

63. *Gadolinium cation -  $Z = 64$ , 63 electrons.*

Electron configuration of the corresponding 63-electron atom  $[\text{Xe}]4f^76s^2$ .

Electron shell configuration  $\{2, 8, 18, 25, 9, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0157119$$

$$R_2 = 0.0677367$$

$$R_3 = 0.185156$$

$$R_4 = 0.520143$$

$$R_5 = 2.49104$$

Displacements of shells:

$$d_1 = 2.1502765062113285 \times 10^{-6}$$

$$d_2 = -8.585705181392123 \times 10^{-6}$$

$$d_3 = 0.0000339058$$

$$d_4 = -0.000230075$$

$$d_5 = 0.0276007$$

$$d_6 = -14.6368$$

Energy:  $E = -10658.1368$ .

64. *Terbium cation -  $Z = 65$ , 64 electrons.*

Electron configuration of the corresponding 64-electron atom  $[\text{Xe}]4f^75d^16s^2$ .

Electron shell configuration  $\{2, 8, 18, 27, 8, 1\}$ .



Number of shells: 6

Radii of shells:

$$R_1 = 0.0154689$$

$$R_2 = 0.0666179$$

$$R_3 = 0.181559$$

$$R_4 = 0.515812$$

$$R_5 = 2.71655$$

Displacements of shells:

$$d_1 = 2.1585011067555684 \times 10^{-6}$$

$$d_2 = -8.593431872554788 \times 10^{-6}$$

$$d_3 = 0.0000335102$$

$$d_4 = -0.000215565$$

$$d_5 = 0.0417367$$

$$d_6 = -14.3444$$

Energy:  $E = -11067.0621$ .

65. *Dysprosium cation -  $Z = 66$ , 65 electrons.*

Electron configuration of the corresponding 65-electron atom  $[\text{Xe}]4f^96s^2$ .

Electron shell configuration  $\{2, 8, 18, 28, 8, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0152334$$

$$R_2 = 0.0655355$$

$$R_3 = 0.178089$$

$$R_4 = 0.505055$$

$$R_5 = 2.72103$$

Displacements of shells:

$$d_1 = 2.064003573128932 \times 10^{-6}$$

$$d_2 = -8.19547021910547 \times 10^{-6}$$

$$d_3 = 0.0000316705$$

$$d_4 = -0.000194825$$

$$d_5 = 0.0418399$$

$$d_6 = -14.3356$$

Energy:  $E = -11480.3129$ .

66. *Holmium cation -  $Z = 67$ , 66 electrons.*

Electron configuration of the corresponding 66-electron atom  $[\text{Xe}]4f^{10}6s^2$ .

Electron shell configuration  $\{2, 8, 18, 29, 8, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0150049$$

$$R_2 = 0.0644876$$

$$R_3 = 0.174751$$

$$R_4 = 0.494748$$

$$R_5 = 2.72566$$

Displacements of shells:

$$d_1 = 1.975711954932702 \times 10^{-6}$$

$$d_2 = -7.824690342714788 \times 10^{-6}$$

$$d_3 = 0.0000299748$$

$$d_4 = -0.000176614$$

$$d_5 = 0.0419639$$

$$d_6 = -14.3263$$

Energy:  $E = -11902.7089$ .

67. *Erbium cation -  $Z = 68$ , 67 electrons.*

Electron configuration of the corresponding 67-electron atom  $[\text{Xe}]4f^{11}6s^2$ .

Electron shell configuration  $\{2, 8, 18, 30, 8, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0147832$$

$$R_2 = 0.0634725$$

$$R_3 = 0.171537$$

$$R_4 = 0.484864$$

$$R_5 = 2.7304$$

Displacements of shells:

$$d_1 = 1.89303818274216^{*-6}$$

$$d_2 = -7.4784712948097075^{*-6}$$

$$d_3 = 0.000028408$$

$$d_4 = -0.000160559$$

$$d_5 = 0.042106$$

$$d_6 = -14.3166$$

Energy:  $E = -12334.3286$ .

68. *Thulium cation -  $Z = 69$ , 68 electrons.*

Electron configuration of the corresponding 68-electron atom  $[\text{Xe}]4f^{12}6s^2$ .

Electron shell configuration  $\{2, 8, 18, 31, 8, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0145679$$

$$R_2 = 0.0624888$$

$$R_3 = 0.168441$$

$$R_4 = 0.475376$$

$$R_5 = 2.73524$$

Displacements of shells:

$$d_1 = 1.815469848437611 \times 10^{-6}$$

$$d_2 = -7.1545298725058995 \times 10^{-6}$$

$$d_3 = 0.0000269571$$

$$d_4 = -0.000146351$$

$$d_5 = 0.0422639$$

$$d_6 = -14.3065$$

Energy:  $E = -12775.2502$ .

69. *Ytterbium cation -  $Z = 70$ , 69 electrons.*

Electron configuration of the corresponding 69-electron atom  $[\text{Xe}]4f^{13}6s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 8, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0143588$$

$$R_2 = 0.061535$$

$$R_3 = 0.165454$$

$$R_4 = 0.46626$$

$$R_5 = 2.74015$$

Displacements of shells:

$$d_1 = 1.7425579325432676 \times 10^{-6}$$

$$d_2 = -6.8508660677858295 \times 10^{-6}$$

$$d_3 = 0.0000256106$$

$$d_4 = -0.000133733$$

$$d_5 = 0.0424355$$

$$d_6 = -14.2962$$

Energy:  $E = -13225.5521$ .

70. *Lutetium cation -  $Z = 71$ , 70 electrons.*

Electron configuration of the corresponding 70-electron atom  $[\text{Xe}]4f^{14}6s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 9, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0141557$$

$$R_2 = 0.06061$$

$$R_3 = 0.162574$$

$$R_4 = 0.452292$$

$$R_5 = 2.51526$$

Displacements of shells:

$$d_1 = 1.583938302038551^{*-6}$$

$$d_2 = -6.213878743701941^{*-6}$$

$$d_3 = 0.0000231242$$

$$d_4 = -0.00011662$$

$$d_5 = 0.0278743$$

$$d_6 = -14.5904$$

Energy:  $E = -13679.8230$ .

*71. Hafnium cation -  $Z = 72$ , 71 electrons.*

Electron configuration of the corresponding 71-electron atom  $[\text{Xe}]4f^{14}5d^16s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 10, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0139581$$

$$R_2 = 0.0597123$$

$$R_3 = 0.15979$$

$$R_4 = 0.439193$$

$$R_5 = 2.32527$$

Displacements of shells:

$$d_1 = 1.4535084964684834 \times 10^{-6}$$

$$d_2 = -5.690274941265563 \times 10^{-6}$$

$$d_3 = 0.0000210815$$

$$d_4 = -0.000102894$$

$$d_5 = 0.0190963$$

$$d_6 = -14.838$$

Energy:  $E = -14142.8119$ .

72. *Tantalum cation -  $Z = 73$ , 72 electrons.*

Electron configuration of the corresponding 72-electron atom  $[\text{Xe}]4f^{14}5d^26s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 11, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0137661$$

$$R_2 = 0.0588407$$

$$R_3 = 0.157097$$

$$R_4 = 0.426885$$

$$R_5 = 2.16269$$

Displacements of shells:

$$d_1 = 1.3442486330468916 \times 10^{-6}$$

$$d_2 = -5.251824465282476 \times 10^{-6}$$

$$d_3 = 0.000019372$$

$$d_4 = -0.0000916773$$

$$d_5 = 0.0135459$$

$$d_6 = -15.0494$$

Energy:  $E = -14614.5717$ .

73. *Tungsten cation -  $Z = 74$ , 73 electrons.*

Electron configuration of the corresponding 73-electron atom  $[\text{Xe}]4f^{14}5d^36s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 12, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0135792$$

$$R_2 = 0.057994$$

$$R_3 = 0.154491$$

$$R_4 = 0.415296$$

$$R_5 = 2.02205$$

Displacements of shells:

$$d_1 = 1.251213488773544^{*-6}$$

$$d_2 = -4.878649631151146^{*-6}$$

$$d_3 = 0.0000179181$$

$$d_4 = -0.0000823616$$

$$d_5 = 0.00989371$$

$$d_6 = -15.2321$$

Energy:  $E = -15095.1551$ .

*74. Rhenium cation -  $Z = 75$ , 74 electrons.*

Electron configuration of the corresponding 74-electron atom  $[\text{Xe}]4f^{14}5d^46s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 13, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0133973$$

$$R_2 = 0.0571713$$

$$R_3 = 0.151968$$

$$R_4 = 0.404364$$

$$R_5 = 1.89923$$

Displacements of shells:

$$d_1 = 1.1708706765295095 \times 10^{-6}$$

$$d_2 = -4.556553216768726 \times 10^{-6}$$

$$d_3 = 0.0000166641$$

$$d_4 = -0.0000745157$$

$$d_5 = 0.00740819$$

$$d_6 = -15.3917$$

Energy:  $E = -15584.6142$ .

75. *Osmium cation -  $Z = 76$ , 75 electrons.*

Electron configuration of the corresponding 75-electron atom  $[\text{Xe}]4f^{14}5d^56s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 14, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0132203$$

$$R_2 = 0.0563716$$

$$R_3 = 0.149524$$

$$R_4 = 0.394034$$

$$R_5 = 1.79105$$

Displacements of shells:

$$d_1 = 1.1006463914569958 \times 10^{-6}$$

$$d_2 = -4.275189728519754 \times 10^{-6}$$

$$d_3 = 0.0000155698$$

$$d_4 = -0.0000678276$$

$$d_5 = 0.00566706$$

$$d_6 = -15.5322$$

Energy:  $E = -16083.0012$ .

76. *Iridium cation -  $Z = 77$ , 76 electrons.*

Electron configuration of the corresponding 76-electron atom  $[\text{Xe}]4f^{14}5d^66s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 15, 1\}$ .



Number of shells: 6

Radii of shells:

$$R_1 = 0.0130479$$

$$R_2 = 0.0555938$$

$$R_3 = 0.147156$$

$$R_4 = 0.384255$$

$$R_5 = 1.69507$$

Displacements of shells:

$$d_1 = 1.0386264378825528^{*-6}$$

$$d_2 = -4.026863368669677^{*-6}$$

$$d_3 = 0.000014605$$

$$d_4 = -0.000062067$$

$$d_5 = 0.00441647$$

$$d_6 = -15.6571$$

Energy:  $E = -16590.3679$ .

*77. Platinum cation -  $Z = 78$ , 77 electrons.*

Electron configuration of the corresponding 77-electron atom  $[\text{Xe}]4f^{14}5d^76s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 17\}$ .

Number of shells: 5

Radii of shells:

$$R_1 = 0.0128799$$

$$R_2 = 0.054837$$

$$R_3 = 0.14486$$

$$R_4 = 0.374913$$

$$R_5 = 1.66487$$

Energy:  $E = -17106.7726$ .

*78. Gold cation -  $Z = 79$ , 78 electrons.*

Electron configuration of the corresponding 78-electron atom  $[\text{Xe}]4f^{14}5d^96s^1$ .

Electron shell configuration  $\{2, 8, 18, 32, 18\}$ .

Number of shells: 5

Radii of shells:

$$R_1 = 0.0127161$$

$$R_2 = 0.0541006$$

$$R_3 = 0.142632$$

$$R_4 = 0.366106$$

$$R_5 = 1.58254$$

Energy:  $E = -17632.2246$ .

79. *Mercury cation -  $Z = 80$ , 79 electrons.*

Electron configuration of the corresponding 79-electron atom  $[\text{Xe}]4f^{14}5d^{10}6s^1$ .

Electron shell configuration  $\{2, 8, 18, 32, 18, 1\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0125565$$

$$R_2 = 0.0533835$$

$$R_3 = 0.140469$$

$$R_4 = 0.357806$$

$$R_5 = 1.46266$$

Displacements of shells:

$$d_1 = 8.888437850464291 \times 10^{-7}$$

$$d_2 = -3.428026007041345 \times 10^{-6}$$

$$d_3 = 0.0000122841$$

$$d_4 = -0.0000488021$$

$$d_5 = 0.00228806$$

$$d_6 = -15.9603$$

Energy:  $E = -18166.8621$ .

80. *Thallium cation -  $Z = 81$ , 80 electrons.*

Electron configuration of the corresponding 80-electron atom  $[\text{Xe}]4f^{14}5d^{10}6s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 18, 2\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0124009$$

$$R_2 = 0.0526852$$

$$R_3 = 0.13837$$

$$R_4 = 0.349901$$

$$R_5 = 1.35994$$

$$R_6 = 11.3071$$

Energy:  $E = -18710.4960$ .

*81. Lead cation -  $Z = 82$ , 81 electrons.*

Electron configuration of the corresponding 81-electron atom  $[\text{Xe}]4f^{14}5d^{10}6s^26p^1$ .

Electron shell configuration  $\{2, 8, 18, 32, 18, 3\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.012249$$

$$R_2 = 0.0520048$$

$$R_3 = 0.136332$$

$$R_4 = 0.342359$$

$$R_5 = 1.27109$$

$$R_6 = 8.92396$$

Energy:  $E = -19263.1496$ .

*82. Bismuth cation -  $Z = 83$ , 82 electrons.*

Electron configuration of the corresponding 82-electron atom  $[\text{Xe}]4f^{14}5d^{10}6s^26p^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 18, 4\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0121008$$

$$R_2 = 0.0513417$$

$$R_3 = 0.134351$$

$$R_4 = 0.335153$$

$$R_5 = 1.19361$$

$$R_6 = 7.38989$$

Energy:  $E = -19824.8579$ .

*83. Polonium cation -  $Z = 84$ , 83 electrons.*

Electron configuration of the corresponding 83-electron atom  $[\text{Xe}]4f^{14}5d^{10}6s^26p^3$ .

Electron shell configuration  $\{2, 8, 18, 32, 18, 5\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0119562$$

$$R_2 = 0.0506952$$

$$R_3 = 0.132426$$

$$R_4 = 0.328257$$

$$R_5 = 1.12552$$

$$R_6 = 6.31315$$

Energy:  $E = -20395.6545$ .

*84. Astatine cation -  $Z = 85$ , 84 electrons.*

Electron configuration of the corresponding 84-electron atom  $[\text{Xe}]4f^{14}5d^{10}6s^26p^4$ .

Electron shell configuration  $\{2, 8, 18, 32, 18, 6\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.011815$$

$$R_2 = 0.0500647$$

$$R_3 = 0.130555$$

$$R_4 = 0.321651$$

$$R_5 = 1.06526$$

$$R_6 = 5.51545$$

Energy:  $E = -20975.5721$ .

85. *Radon cation -  $Z = 86$ , 85 electrons.*

Electron configuration of the corresponding 85-electron atom  $[\text{Xe}]4f^{14}5d^{10}6s^26p^5$ .

Electron shell configuration  $\{2, 8, 18, 32, 18, 7\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0116771$$

$$R_2 = 0.0494497$$

$$R_3 = 0.128735$$

$$R_4 = 0.315315$$

$$R_5 = 1.01158$$

$$R_6 = 4.90098$$

Energy:  $E = -21564.6435$ .

86. *Francium cation -  $Z = 87$ , 86 electrons.*

Electron configuration of the corresponding 86-electron atom  $[\text{Xe}]4f^{14}5d^{10}6s^26p^6$ .

Electron shell configuration  $\{2, 8, 18, 32, 18, 8\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.0115423$$

$$R_2 = 0.0488495$$

$$R_3 = 0.126964$$

$$R_4 = 0.309229$$

$$R_5 = 0.963474$$

$$R_6 = 4.41327$$

Energy:  $E = -22162.9008$ .

*87. Radium cation -  $Z = 88$ , 87 electrons.*

Electron configuration of the corresponding 87-electron atom  $[\text{Rn}]7s^1$ .

Electron shell configuration  $\{2, 8, 18, 32, 18, 8, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.0114107$$

$$R_2 = 0.0482637$$

$$R_3 = 0.125241$$

$$R_4 = 0.303379$$

$$R_5 = 0.920377$$

$$R_6 = 3.7913$$

Displacements of shells:

$$d_1 = 1.1023451998173285^{*-6}$$

$$d_2 = -4.199415154240231^{*-6}$$

$$d_3 = 0.0000146417$$

$$d_4 = -0.0000523154$$

$$d_5 = 0.00105841$$

$$d_6 = -0.0679169$$

$$d_7 = 18.9808$$

Energy:  $E = -22770.2970$ .

88. *Actinium cation -  $Z = 89$ , 88 electrons.*

Electron configuration of the corresponding 88-electron atom  $[\text{Rn}]7s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 18, 9, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.011282$$

$$R_2 = 0.0476917$$

$$R_3 = 0.123563$$

$$R_4 = 0.297751$$

$$R_5 = 0.881147$$

$$R_6 = 3.49613$$

Displacements of shells:

$$d_1 = 1.0162074643149473 \cdot 10^{-6}$$

$$d_2 = -3.865869275464636 \cdot 10^{-6}$$

$$d_3 = 0.0000134361$$

$$d_4 = -0.0000474824$$

$$d_5 = 0.000895057$$

$$d_6 = -0.0453399$$

$$d_7 = 19.3986$$

Energy:  $E = -23387.0262$ .

89. *Thorium cation -  $Z = 90$ , 89 electrons.*

Electron configuration of the corresponding 89-electron atom  $[\text{Rn}]6d^17s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 18, 10, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.0111561$$

$$R_2 = 0.0471331$$

$$R_3 = 0.121929$$

$$R_4 = 0.292331$$

$$R_5 = 0.845442$$

$$R_6 = 3.24591$$

Displacements of shells:

$$d_1 = 9.464239059118559^{*-7}$$

$$d_2 = -3.595474854527571^{*-6}$$

$$d_3 = 0.0000124573$$

$$d_4 = -0.0000435554$$

$$d_5 = 0.000768771$$

$$d_6 = -0.0315386$$

$$d_7 = 19.75$$

Energy:  $E = -24013.0398$ .

*90. Protactinium cation -  $Z = 91$ , 90 electrons.*

Electron configuration of the corresponding 90-electron atom  $[\text{Rn}]6d^27s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 20, 9, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.0110331$$

$$R_2 = 0.0465873$$

$$R_3 = 0.120335$$

$$R_4 = 0.287177$$

$$R_5 = 0.838179$$

$$R_6 = 3.49922$$



Displacements of shells:

$$d_1 = 9.447973225311354^{*-7}$$

$$d_2 = -3.5843503717448613^{*-6}$$

$$d_3 = 0.0000123711$$

$$d_4 = -0.0000425008$$

$$d_5 = 0.000685322$$

$$d_6 = -0.0447126$$

$$d_7 = 19.4001$$

Energy:  $E = -24653.9400$ .

91. Uranium cation -  $Z = 92$ , 91 electrons.

Electron configuration of the corresponding 91-electron atom  $[\text{Rn}]5f^26d^17s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 21, 9, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.0109127$$

$$R_2 = 0.046054$$

$$R_3 = 0.118783$$

$$R_4 = 0.28218$$

$$R_5 = 0.818381$$

$$R_6 = 3.50198$$

Displacements of shells:

$$d_1 = 9.135790395772386^{*-7}$$

$$d_2 = -3.461296204331878^{*-6}$$

$$d_3 = 0.0000119056$$

$$d_4 = -0.0000403543$$

$$d_5 = 0.000605139$$

$$d_6 = -0.0445137$$

$$d_7 = 19.3972$$

Energy:  $E = -25302.0126$ .

92. *Neptunium cation -  $Z = 93$ , 92 electrons.*

Electron configuration of the corresponding 92-electron atom  $[\text{Rn}]5f^36d^17s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 22, 9, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.0107949$$

$$R_2 = 0.0455327$$

$$R_3 = 0.11727$$

$$R_4 = 0.277362$$

$$R_5 = 0.799583$$

$$R_6 = 3.50541$$

Displacements of shells:

$$d_1 = 8.847734284175142^{*-7}$$

$$d_2 = -3.3477779009430588^{*-6}$$

$$d_3 = 0.0000114763$$

$$d_4 = -0.0000383947$$

$$d_5 = 0.000537169$$

$$d_6 = -0.044377$$

$$d_7 = 19.3923$$

Energy:  $E = -25959.8960$ .

93. *Plutonium cation -  $Z = 94$ , 93 electrons.*

Electron configuration of the corresponding 93-electron atom  $[\text{Rn}]5f^46d^17s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 24, 8, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.0106797$$

$$R_2 = 0.0450231$$

$$R_3 = 0.115794$$

$$R_4 = 0.272718$$

$$R_5 = 0.793506$$

$$R_6 = 3.82226$$

Displacements of shells:

$$d_1 = 9.055049436568209 \times 10^{-7}$$

$$d_2 = -3.4217679264746094 \times 10^{-6}$$

$$d_3 = 0.0000116868$$

$$d_4 = -0.0000384571$$

$$d_5 = 0.000500351$$

$$d_6 = -0.0671763$$

$$d_7 = 18.9294$$

Energy:  $E = -26630.2585$ .

94. *Americium cation -  $Z = 95$ , 94 electrons.*

Electron configuration of the corresponding 94-electron atom  $[\text{Rn}]5f^67s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 25, 8, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.0105669$$

$$R_2 = 0.0445247$$

$$R_3 = 0.114354$$

$$R_4 = 0.268227$$

$$R_5 = 0.775956$$

$$R_6 = 3.82918$$

Displacements of shells:

$$d_1 = 8.803714162902019 \times 10^{-7}$$

$$d_2 = -3.3226066677676904 \times 10^{-6}$$

$$d_3 = 0.000011311$$

$$d_4 = -0.0000367662$$

$$d_5 = 0.000449224$$

$$d_6 = -0.0673122$$

$$d_7 = 18.9148$$

Energy:  $E = -27307.9761$ .

95. Curium cation -  $Z = 96$ , 95 electrons.

Electron configuration of the corresponding 95-electron atom  $[\text{Rn}]5f^77s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 25, 9, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.0104564$$

$$R_2 = 0.0440372$$

$$R_3 = 0.11295$$

$$R_4 = 0.26389$$

$$R_5 = 0.748441$$

$$R_6 = 3.51879$$

Displacements of shells:

$$d_1 = 8.098311532061654 \times 10^{-7}$$

$$d_2 = -3.052657978033347 \times 10^{-6}$$

$$d_3 = 0.000010362$$

$$d_4 = -0.0000334112$$

$$d_5 = 0.000386128$$

$$d_6 = -0.044262$$

$$d_7 = 19.3677$$

Energy:  $E = -27992.9136$ .

96. *Berkelium cation -  $Z = 97$ , 96 electrons.*

Electron configuration of the corresponding 96-electron atom  $[\text{Rn}]5f^76d^17s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 27, 8, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.0103482$$

$$R_2 = 0.0435602$$

$$R_3 = 0.111578$$

$$R_4 = 0.259694$$

$$R_5 = 0.74326$$

$$R_6 = 3.8438$$

Displacements of shells:

$$d_1 = 8.344404918972413 \times 10^{-7}$$

$$d_2 = -3.1415579040178333 \times 10^{-6}$$

$$d_3 = 0.0000106261$$

$$d_4 = -0.0000337385$$

$$d_5 = 0.000366186$$

$$d_6 = -0.0677214$$

$$d_7 = 18.8827$$

Energy:  $E = -28693.3407$ .

97. *Californium cation -  $Z = 98$ , 97 electrons.*

Electron configuration of the corresponding 97-electron atom  $[\text{Rn}]5f^97s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 28, 8, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.0102423$$

$$R_2 = 0.0430933$$

$$R_3 = 0.11024$$

$$R_4 = 0.255636$$

$$R_5 = 0.728$$

$$R_6 = 3.8514$$

Displacements of shells:

$$d_1 = 8.133390475420634 \times 10^{-7}$$

$$d_2 = -3.0584696545213092 \times 10^{-6}$$

$$d_3 = 0.0000103125$$

$$d_4 = -0.000032377$$

$$d_5 = 0.000332289$$

$$d_6 = -0.0679825$$

$$d_7 = 18.8654$$

Energy:  $E = -29401.0880$ .

98. *Einsteinium cation -  $Z = 99$ , 98 electrons.*

Electron configuration of the corresponding 98-electron atom  $[\text{Rn}]5f^{10}7s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 29, 8, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.0101384$$

$$R_2 = 0.0426364$$

$$R_3 = 0.108933$$

$$R_4 = 0.251708$$

$$R_5 = 0.713398$$

$$R_6 = 3.85914$$

Displacements of shells:

$$d_1 = 7.933153352989819 \times 10^{-7}$$

$$d_2 = -2.97968644165132 \times 10^{-6}$$

$$d_3 = 0.0000100157$$

$$d_4 = -0.0000311037$$

$$d_5 = 0.000302451$$

$$d_6 = -0.0682744$$

$$d_7 = 18.8475$$

Energy:  $E = -30118.9456$ .

99. *Fermium cation* -  $Z = 100$ , 99 electrons.

Electron configuration of the corresponding 99-electron atom  $[\text{Rn}]5f^{11}7s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 30, 8, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.0100367$$

$$R_2 = 0.042189$$

$$R_3 = 0.107656$$

$$R_4 = 0.247903$$

$$R_5 = 0.69941$$

$$R_6 = 3.86698$$

Displacements of shells:

$$d_1 = 7.74267759835797 \times 10^{-7}$$

$$d_2 = -2.904805796165267 \times 10^{-6}$$

$$d_3 = 9.734154396124951 \times 10^{-6}$$

$$d_4 = -0.00002991$$

$$d_5 = 0.000276078$$

$$d_6 = -0.068593$$

$$d_7 = 18.8291$$

Energy:  $E = -30846.9636$ .

100. *Mendelevium cation -  $Z = 101$ , 100 electrons.*

Electron configuration of the corresponding 100-electron atom  $[\text{Rn}]5f^{12}7s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 31, 8, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.009937$$

$$R_2 = 0.0417509$$

$$R_3 = 0.106408$$

$$R_4 = 0.244217$$

$$R_5 = 0.685997$$

$$R_6 = 3.87488$$

Displacements of shells:

$$d_1 = 7.56108677104776 \times 10^{-7}$$

$$d_2 = -2.833480062309339 \times 10^{-6}$$

$$d_3 = 9.466492329118848 \times 10^{-6}$$

$$d_4 = -0.0000287887$$

$$d_5 = 0.000252676$$

$$d_6 = -0.0689345$$

$$d_7 = 18.8102$$

Energy:  $E = -31585.1921$ .

101. *Nobelium cation -  $Z = 102$ , 101 electrons.*

Electron configuration of the corresponding 101-electron atom  $[\text{Rn}]5f^{13}7s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 8, 1\}$ .

Number of shells: 7



Radii of shells:

$$R_1 = 0.00983925$$

$$R_2 = 0.0413217$$

$$R_3 = 0.105189$$

$$R_4 = 0.240642$$

$$R_5 = 0.673121$$

$$R_6 = 3.88283$$

Displacements of shells:

$$d_1 = 7.387620182814627 \times 10^{-7}$$

$$d_2 = -2.7654070943385416 \times 10^{-6}$$

$$d_3 = 9.211573911247053 \times 10^{-6}$$

$$d_4 = -0.0000277333$$

$$d_5 = 0.000231836$$

$$d_6 = -0.0692958$$

$$d_7 = 18.791$$

Energy:  $E = -32333.6813$ .

*102. Lawrencium cation -  $Z = 103$ , 102 electrons.*

Electron configuration of the corresponding 102-electron atom  $[\text{Rn}]5f^{14}7s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 8, 2\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.00974341$$

$$R_2 = 0.0409013$$

$$R_3 = 0.103998$$

$$R_4 = 0.237188$$

$$R_5 = 0.652692$$

$$R_6 = 3.39023$$

$$R_7 = 13.8312$$

Energy:  $E = -33089.2253$ .

103. *Rutherfordium cation -  $Z = 104$ , 103 electrons.*

Electron configuration of the corresponding 103-electron atom  $[\text{Rn}]5f^{14}7s^27p^1$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 10, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.00964941$$

$$R_2 = 0.0404893$$

$$R_3 = 0.102833$$

$$R_4 = 0.233831$$

$$R_5 = 0.633524$$

$$R_6 = 3.28796$$

Displacements of shells:

$$d_1 = 6.30251030974295^{*-7}$$

$$d_2 = -2.3541948441391275^{*-6}$$

$$d_3 = 7.801082886397694^{*-6}$$

$$d_4 = -0.0000232025$$

$$d_5 = 0.000177362$$

$$d_6 = -0.0306174$$

$$d_7 = 19.6798$$

Energy:  $E = -33854.9214$ .

104. *Dubnium cation -  $Z = 105$ , 104 electrons.*

Electron configuration of the corresponding 104-electron atom  $[\text{Rn}]5f^{14}6d^27s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 11, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.00955721$$

$$R_2 = 0.0400855$$

$$R_3 = 0.101693$$

$$R_4 = 0.230566$$

$$R_5 = 0.615596$$

$$R_6 = 3.05517$$

Displacements of shells:

$$d_1 = 5.900935176169953^{*-7}$$

$$d_2 = -2.201906012327607^{*-6}$$

$$d_3 = 7.2778981476582644^{*-6}$$

$$d_4 = -0.0000215178$$

$$d_5 = 0.000157859$$

$$d_6 = -0.0215663$$

$$d_7 = 20.0213$$

Energy:  $E = -34630.3698$ .

*105. Seaborgium cation -  $Z = 106$ , 105 electrons.*

Electron configuration of the corresponding 105-electron atom  $[\text{Rn}]5f^{14}6d^37s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 12, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.00946675$$

$$R_2 = 0.0396896$$

$$R_3 = 0.100579$$

$$R_4 = 0.227389$$

$$R_5 = 0.598762$$

$$R_6 = 2.85393$$

Displacements of shells:

$$\begin{aligned}
 d_1 &= 5.563769401139802^{*-7} \\
 d_2 &= -2.073976410508721^{*-6} \\
 d_3 &= 6.837888423314771^{*-6} \\
 d_4 &= -0.0000200983 \\
 d_5 &= 0.000141811 \\
 d_6 &= -0.0156578 \\
 d_7 &= 20.3141
 \end{aligned}$$

Energy:  $E = -35415.7499$ .

*106. Bohrium cation -  $Z = 107$ , 106 electrons.*

Electron configuration of the corresponding 106-electron atom  $[\text{Rn}]5f^{14}6d^47s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 13, 1\}$ .

Number of shells: 7

Radii of shells:

$$\begin{aligned}
 R_1 &= 0.00937799 \\
 R_2 &= 0.0393015 \\
 R_3 &= 0.099488 \\
 R_4 &= 0.224297 \\
 R_5 &= 0.582923 \\
 R_6 &= 2.6783
 \end{aligned}$$

Displacements of shells:

$$\begin{aligned}
 d_1 &= 5.276515709193068^{*-7} \\
 d_2 &= -1.9649257267589533^{*-6} \\
 d_3 &= 6.462357510619981^{*-6} \\
 d_4 &= -0.0000188844 \\
 d_5 &= 0.000128406 \\
 d_6 &= -0.0116643 \\
 d_7 &= 20.5681
 \end{aligned}$$

Energy:  $E = -36211.0963$ .

107. Hassium cation -  $Z = 108$ , 107 electrons.

Electron configuration of the corresponding 107-electron atom  $[\text{Rn}]5f^{14}6d^57s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 14, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.00929088$$

$$R_2 = 0.0389208$$

$$R_3 = 0.0984205$$

$$R_4 = 0.221287$$

$$R_5 = 0.567993$$

$$R_6 = 2.52373$$

Displacements of shells:

$$d_1 = 5.028649830607051 \times 10^{-7}$$

$$d_2 = -1.8707759012640882 \times 10^{-6}$$

$$d_3 = 6.137737150100902 \times 10^{-6}$$

$$d_4 = -0.0000178327$$

$$d_5 = 0.000117065$$

$$d_6 = -0.00888345$$

$$d_7 = 20.7906$$

Energy:  $E = -37016.4436$ .

108. Meitnerium cation -  $Z = 109$ , 108 electrons.

Electron configuration of the corresponding 108-electron atom  $[\text{Rn}]5f^{14}6d^67s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 15, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.00920537$$

$$R_2 = 0.0385475$$

$$R_3 = 0.0973755$$

$$R_4 = 0.218354$$

$$R_5 = 0.553893$$

$$R_6 = 2.38666$$

Displacements of shells:

$$d_1 = 4.812397018696352 \times 10^{-7}$$

$$d_2 = -1.7885881705313274 \times 10^{-6}$$

$$d_3 = 5.854004006804827 \times 10^{-6}$$

$$d_4 = -0.0000169116$$

$$d_5 = 0.000107359$$

$$d_6 = -0.00689663$$

$$d_7 = 20.9872$$

Energy:  $E = -37831.8261$ .

*109. Darmstadtium cation -  $Z = 110$ , 109 electrons.*

Electron configuration of the corresponding 109-electron atom  $[\text{Rn}]5f^{14}6d^77s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 17\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.00912142$$

$$R_2 = 0.0381812$$

$$R_3 = 0.0963523$$

$$R_4 = 0.215498$$

$$R_5 = 0.54043$$

$$R_6 = 2.34498$$

Energy:  $E = -38657.2569$ .

110. *Roentgenium cation -  $Z = 111$ , 110 electrons.*

Electron configuration of the corresponding 110-electron atom  $[\text{Rn}]5f^{14}6d^97s^1$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 18\}$ .

Number of shells: 6

Radii of shells:

$$R_1 = 0.00903899$$

$$R_2 = 0.0378218$$

$$R_3 = 0.0953501$$

$$R_4 = 0.212713$$

$$R_5 = 0.527785$$

$$R_6 = 2.22744$$

Energy:  $E = -39492.7894$ .

111. *Ununbium cation -  $Z = 112$ , 111 electrons.*

Electron configuration of the corresponding 111-electron atom  $[\text{Rn}]5f^{14}6d^{10}7s^1$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 18, 1\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.00895804$$

$$R_2 = 0.0374691$$

$$R_3 = 0.0943684$$

$$R_4 = 0.209996$$

$$R_5 = 0.515921$$

$$R_6 = 2.05522$$

Displacements of shells:

$$d_1 = 4.301312464245902 \times 10^{-7}$$

$$d_2 = -1.5941385599869051 \times 10^{-6}$$

$$d_3 = 5.181062492077531 \times 10^{-6}$$

$$d_4 = -0.0000147173$$

$$d_5 = 0.0000852424$$

$$d_6 = -0.00354212$$

$$d_7 = 21.4606$$

Energy:  $E = -40338.5297$ .

*112. Ununtrium cation -  $Z = 113$ , 112 electrons.*

Electron configuration of the corresponding 112-electron atom  $[\text{Rn}]5f^{14}6d^{10}7s^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 18, 2\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.00887852$$

$$R_2 = 0.0371229$$

$$R_3 = 0.0934064$$

$$R_4 = 0.207347$$

$$R_5 = 0.504643$$

$$R_6 = 1.9078$$

$$R_7 = 15.1581$$

Energy:  $E = -41194.3226$ .

*113. Ununquadium cation -  $Z = 114$ , 113 electrons.*

Electron configuration of the corresponding 113-electron atom  $[\text{Rn}]5f^{14}6d^{10}7s^27p^1$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 18, 3\}$ .

Number of shells: 7



Radii of shells:

$$R_1 = 0.0088004$$

$$R_2 = 0.036783$$

$$R_3 = 0.0924637$$

$$R_4 = 0.204762$$

$$R_5 = 0.493904$$

$$R_6 = 1.78048$$

$$R_7 = 11.9369$$

Energy:  $E = -42060.1844$ .

*114. Ununpentium cation -  $Z = 115$ , 114 electrons.*

Electron configuration of the corresponding 114-electron atom  $[\text{Rn}]5f^{14}6d^{10}7s^27p^2$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 18, 4\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.00872364$$

$$R_2 = 0.0364492$$

$$R_3 = 0.0915396$$

$$R_4 = 0.20224$$

$$R_5 = 0.483659$$

$$R_6 = 1.66962$$

$$R_7 = 9.86902$$

Energy:  $E = -42936.1400$ .

*115. Ununhexium cation -  $Z = 116$ , 115 electrons.*

Electron configuration of the corresponding 115-electron atom  $[\text{Rn}]5f^{14}6d^{10}7s^27p^3$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 18, 5\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.00864821$$

$$R_2 = 0.0361215$$

$$R_3 = 0.0906337$$

$$R_4 = 0.199779$$

$$R_5 = 0.473871$$

$$R_6 = 1.57235$$

$$R_7 = 8.42113$$

Energy:  $E = -43822.2133$ .

*116. Ununseptium cation -  $Z = 117$ , 116 electrons.*

Electron configuration of the corresponding 116-electron atom  $[\text{Rn}]5f^{14}6d^{10}7s^27p^4$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 18, 6\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.00857408$$

$$R_2 = 0.0357995$$

$$R_3 = 0.0897453$$

$$R_4 = 0.197376$$

$$R_5 = 0.464505$$

$$R_6 = 1.48641$$

$$R_7 = 7.35066$$

Energy:  $E = -44718.4274$ .

*117. Ununoctium cation -  $Z = 118$ , 117 electrons.*

Electron configuration of the corresponding 117-electron atom  $[\text{Rn}]5f^{14}6d^{10}7s^27p^5$ .

Electron shell configuration  $\{2, 8, 18, 32, 32, 18, 7\}$ .

Number of shells: 7

Radii of shells:

$$R_1 = 0.0085012$$

$$R_2 = 0.0354833$$

$$R_3 = 0.088874$$

$$R_4 = 0.195029$$

$$R_5 = 0.455532$$

$$R_6 = 1.41$$

$$R_7 = 6.52751$$

Energy:  $E = -45624.8052$ .