Atomic number similarity law in individual electronic shells of all natural elements

Shpatakovskaya G V

Keldysh Institute of Applied Mathematics of the Russian Academy of Sciences, Miusskaya Square 4, Moscow 125047, Russia

shpagalya@yandex.ru

Experimental data on the electronic binding energies in atoms are analyzed using special reduced coordinates [1]. Application of the method to the analysis of K and L shells in many-electron atoms ($Z \geq 10$) [2] made it possible to describe experimental K, L_I, $L_{\rm II}$, $L_{\rm III}$ X-ray levels with an accuracy better than one percent and to control their reliability. The method has also shown its efficiency in the analysis of the internal and outer electron shells of lanthanides [3], detected patterns in the measured first ionization potentials of lanthanides and actinides [4].

In present paper we apply the method to study the available experimental [5–7] and theoretical electronic binding energies [8] in all natural atoms of the periodic table ($1 \leq Z \leq 92$). Our goal is to show the general picture of the dependence of the measured binding energies in individual electron subshells on the atomic number, detect patterns and explain deviations from them and thus provide a way to recover missing or erroneous data.

[1] Shpatakovskaya G V 2019 *Phys.-Usp.* **62** 186–197
[2] Shpatakovskaya G V 2018 *JETP Letters* **108** 768–771
[3] Shpatakovskaya G V 2020 *JETP* **131** 385–393
[4] Shpatakovskaya G V 2020 *JETP Letters* **111** 463–466
[5] Thompson A *et al* 2009 X-ray data booklet URL `http://xdb.lbl.gov/`
[6] Nist x-ray photoelectron spectroscopy database URL `https://srdata.nist.gov/xps/selEnergyType.aspx`
[7] Thomas D Binding energies of electrons in atoms from hydrogen to lawrensium URL `http://www.chembio.uoguelph.ca/educmat/atomdata/bindener/elecbind.htm`
[8] Atomic reference data for electronic structure calculations. URL `http://www.nist.gov/pml/data/dftdata/index.cfm`