In 1869-1871, Dmitri Mendeleev, a prominent Russian scientist, published the “Fundamentals of Chemistry”, which described the Periodic Law and several versions of the Periodic Table. The Periodic Table, proposed in more than a thousand versions and variations over the years, remains the primary instrument for research in chemistry, physics, geology, engineering and other sciences. Dmitri Mendeleev made his discovery by analyzing experimental data on atomic weights and chemical properties of the 64 naturally occurring chemical elements known at the time.

A physical explanation of the periodic trends discovered by Dmitri Mendeleev is presented in the works by Mikhail Mikhailovich Protodyakonov. Based on the hypothesis of interaction between electron shells of different atoms, Protodyakonov developed the Theory of Anisotropic Shells (TAS), explaining the origins of periods and rows as shown in Dmitri Mendeleev’s periodic table.

After an introduction to Ilia Gerlovin’s Fundamental Field Theory (FFT), the two scientists worked together to produce a mutually acceptable theory of atomic nuclei and electron shell structures, molecules and crystals of different chemical elements. They proved that the anisotropic field angles for protons and electrons, as predicted by the FFT, match the directions of crystal axes from the statistical models developed by Mikhail Protodyakonov for nuclei consisting of protons, meta-electrons (metons) and neutrons (compound particles).

Based on his supposed discovery of the crystal structure of atoms, which qualitatively determines the stability of atoms, isotopes and isomers, and allows for calculating their basic parameters – mass, magnetic moment, conductivity, etc., Protodyakonov developed a number of models – nucleus, atom, molecule, crystal – for individual elements in the Periodic Table and compound substances. The key parameters predicted by the models were confirmed by existing and subsequent experimental data. Unfortunately, the limitations of the computing technology of the time and an extended illness prevented M.M. Protodyakonov from developing his supposed discovery into a mathematical description and computational algorithms. These issues are of great practical importance for physical chemistry, geology and crystallography, and they remain outstanding for the next generation of theoretical and experimental researchers to address.

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