LETTERS TO PROGRESS IN PHYSICS

Additional Explanations to "Upper Limit in Mendeleev's Periodic Table — Element No. 155". A Story How the Problem was Resolved

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This paper gives a survey for the methods how a possible upper limit in Mendeleev's Periodic Table can be found. It is show, only the method of hyperbolas leads to exact answering this question.

True number of elements in Mendeleev's Periodic Table is the most important problem to the scientists working on the theory of the Periodic Table. The theory is based in the core on our views about the properties of the electron shells and sub-shells in atoms, which obviously change with increasing nuclear change (the nuclei themselves remains unchanged in chemical reactions). The electron shells change due to redistribution of electrons among the interacting atoms. Therefore, it is important that we know the limits of stability of the electron shells in the heavy elements (high numbers in the Periodic Table); the stability limits are the subjects of calculation in the modern quantum theory which takes into account the wave properties of electron and nucleons. To do it, the scientists employ a bulky mathematical technics, which gives calculations for the 8th and 9th periods of the Table (a hundred new elements are joined there).

Already 40 years ago the physicists proved that no chemical elements with mass higher than 110 can exists. Now, 118th element is known (117th element, previous to it, is still non-discovered). In the last time, the scientists of Joint Institute for Nuclear Research, Dubna, talked that the Periodic Table ends with maybe 150th element, but they did not provided any theoretical reason to this claim. As is probable, the regular method of calculation, based on the quantum theory, gives no exact answer to the question about upper limit of the Table.

It should be noted that 10 new elements were synthesed during the last 25 years: 5 elements were synthesed in GSI*, 4 elements were synthesed in JINR† (2 of these — in common with LLNL‡), and 1 element was synthesed in LBNL§. All the laboratories produced new elements as a result of nuclear reactions in accelerators: new elements were found after analysis of the products of the reactions. This is a very simplified explanation, however the essence of the process is so: problem statement, then components for the nuclear reaction and the necessary physics condition, then — identification of the obtained products after the reaction. This method gives new elements, of course, but it gives no answer to the question about their total number in the Periodic Table.

In contrast to this approach, when I tackled this problem, I used neither calculation for the limits of stability of the electron shells in atoms, nor experiments on synthesis of new elements, but absolutely another theoretical approach which allowed me for formulation of a new law in the Periodic Table and, as a result, the upper limit in it. Here I explain how. (I published all the results, in detail, in a series of papers [1–6], then collected in a book [7]).

First. Contents Y of every single element (say, of a K-th element in the Table) in a chemical compound of a molecular mass X can be given by the equation of an equilateral hyperbola $Y = K/X$, according to which Y (in parts of unit) decreases with increasing X.

Second. After as I created the hyperbolic curves for not only all known elements, but also for the hypothetical elements, expected by the aforementioned experimentalists, I looked how the hyperbolas change with molecular mass. To do it, I determined the tops of the hyperbolas, then paved a line connecting the tops.

Third. The line comes from the origin of the coordinates, then crosses the line $Y = 1$ in a point, where the top of one of the hyperbolas meets atomic mass of element, $K = X$, that is the boundary condition in the calculation. The calculated coordinates of the special point are $X = 411.663243$ and $Y = 1$. Because no elements can be above the point (contents Y of an element in a chemical compound is taken in parts of unit), the element with mass $X = 411.663243$ is the heaviest in the Periodic Table, so the Table ends with this element.

Fourth. In the next stage of this research, I was focused on the functions of atomic mass of element from its number along the Periodic Table. As a result, I have deduced the number of the last (heaviest) element in the Table. It is No. 155.

Thus, the last (heaviest) element in the Periodic Table was proved and its parameters were calculated without calculation of the stability of the electron shells in atoms on the basis of the quantum theory, but proceeding only from the general considerations of theoretical chemistry.

Of course, the methods of theoretical chemistry I applied in this reseach do not cancel the regular methods of the quan-

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†JINR — Joint Institute for Nuclear Research, Dubna, Russia.

‡LLNL — Lawrence Livermore National Laboratory, USA.

§LBNL — Lawrence Berkeley National Laboratory, USA.

tum theory; both methods are also not in competition to each other. Meanwhile calculations for the stability of the electronic shells of super-heavy elements can be resultative only in the case where the last element is known. Also, the experimentalists may get a new super-heavy element in practice, but, in the absence of theory, it is unnecessary that the element is the last in the Periodic Table. Only the aforementioned theory, created on the basis of the hyperbolic law in the Periodic Table, provides proper calculation for the upper limit in the Periodic Table, for characteristics of the last (heaviest) element, and hence sets a lighthouse for all futher experimental search for super-heavy elements.

P.S. This short paper was written due to the readers who, after reading my papers and just published book, asked me about the rôle of the calculations for the stability of the electron shells in my theory.

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