PERIODIC TABLE AFTER 150 YEARS

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One of the fundamental consequences of the modern theory of atomic nuclei (1969) is the prediction of an 'Islands of Stability' in the region of hypothetical super heavy elements (SHEs). In a heavy nucleus, going through the large-scale deformation on the way to fission, the motion of single nucleons is coupled with the collective degrees of freedom of the whole system. The most striking effect of this coupling is obtained for the case of fission of the heaviest nuclei, whose existence is defined entirely by the nuclear structure, i.e. by the shell effect.

From this point of view, the synthesis and study of properties of super heavy nuclei (SHN) is a direct way for checking the basic statements of the microscopic nuclear theory. On the nuclide map, SHN outline the border of the heaviest nuclear masses. SHN set the limits of the periodic system of chemical elements. The study of possible existence of SHN in nature offers a way for testing different scenarios of astrophysical nucleosynthesis.

The talk presents results concerning the synthesis and decay properties of the super heavy nuclei from this 'Stability Islands' of SHEs obtained in cold and hot fusion reactions. The region of heavy nuclei have expanded and advanced up to mass of 294. New elements filled the 7th row of the Periodic Table of Elements. The results of the first chemical experiments and theoretical predictions about the influence of the "relativistic effect" on the electronic structure of the SH atom are presented.

Super heavy atoms are synthesized today in unit quantities. Theoretical expectations of the chemical properties of the new elements with respect to their light homologues is discussed in connection with the synthesis of elements heavier than 118. A significant increase in the sensitivity of experiments is expected with accelerator complexes of the new generation. At one of them, the "SHE Factory" in JINR (Dubna) the first beam was obtained in the end 2018.

The talk used results of the experiments conducted in 2000-2015 at FLNR (JINR, Dubna) at the U400 heavy ion accelerator in collaboration with researchers from national laboratories and universities: LLNL (Livermore, USA), ORNL (Oak-Ridge, USA), IAR (Dimitrovgrad, Russia), Vanderbilt, Knoxville and Texas A & M Universities (all in USA), as well as data obtained at national nuclear centers: GSI (Darmstadt, Germany), GANIL (Caen, France) and RIKEN (Wako-shi, Japan).