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ФАКУЛТЕТЕН СЕМИНАР

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Synthesis and Study of Properties of Superheavy Elements: Status, Problems, and Prospects

The study of nuclear physical and chemical properties of recently discovered superheavy elements (SHE, $Z = 112-118$) as well as synthesis of new elements ($Z > 118$) remain one of the most crucial tasks in modern science. Over the past decade, the unique results [1] have been obtained that are of utmost importance both in nuclear physics and astrophysics (experimental evidence of existence of islands of increased stability of SHE) as well as in chemistry (influence of relativistic effects on the chemical properties of the elements 112–114). As per the IUPAC decision, the two new elements are now officially called Fl - Flerovium (element 114) and Lv - Livermorium (element 116). The discovery of elements 117 [2] and 118 closed the 7th period of Mendeleev's Periodic Table of the Elements. Possibilities to study synthesis of heavier elements in reactions with the double-magic ^{48}Ca nucleus are exhausted because production of actinides with $Z > 98$ (Es, Fm, etc.) in necessary quantity (several mg) is impossible in neutron-capture reactions within the framework of existing today reactor technologies. One needs to use ions heavier than ^{48}Ca , for example, ^{50}Ti , ^{58}Fe , and ^{64}Ni ; however, production cross sections with these ions are expected to be at least one order of magnitude less. Implementation of the large-scale program on the study of earlier synthesized SHE requires, in turn, significant experiment efficiency improvement. Further development implies the construction of a first-ever SHE factory at JINR FLNR, which shall include the following: (i) a new accelerator complex with the average-mass ion beam intensity 10-20 times higher than that of today; (ii) physical and chemical new-generation experimental set-ups (highly effective gas-filled recoil separator, gas catcher, selective laser ionization, etc.).