UNIVERSITY OF SURREY **Department of Physics Colloquium**

Newcomers from the Island of Stability of Super Heavy Elements

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All welcome

When D.I. Mendeleev first published his Periodic Table, it contained only 63 chemical elements. Eight years later Ernest Rutherford (1911) proposes his planetary model of atom, and after two years "Bohr's atom" will puzzle all the educated physicists with his postulates, but explain the emission spectrum of a hydrogen atom. Further on, George Gamow proposes to consider the nucleus as a drop of nuclear liquid (1928). On the basis of this model, Niels Bohr and John Archibald Wheeler will develop the theory of nuclear fission (1939). From this theory it followed that spontaneous fission that is a rare process for uranium, will grow progressively with increasing number of protons resulting in complete loss of stability for nuclei with Z≥100.

However, the predictions vary greatly due to the structure of nuclear matter. One of the fundamental outcomes of the new microscopic theory (1969) was the existence of a hypothetical "Island(s) of Stability" in the area of very heavy (super heavy) nuclei where within the former concepts the nuclei cannot exist. Verification of these unusual predictions appeared to be complex and difficult.

The talk is devoted to the 30-year long Odyssey that led to this mystical Island. Here are summarized various attempts to search in Nature and artificially synthesise super heavy elements before these resulted in the discovery of the five new chemical elements in hot fusion reaction induced by 48Ca (2000-2012). Elements with atomic numbers 114, 115, 116, 117, and 118 completed the seventh period in Periodic Table. Isotopes of the new elements and products of their radioactive decay have added 52 new neutron-rich nuclides up to the mass A=294 to the nuclear map. Their decay properties, together with data for isotopes with 107 ≤ Z ≤ 113, previously obtained in cold-fusion reactions produce an impressive picture. Their decay properties together with the data for isotopes with 107 ≤ Z ≤ 113, obtained earlier in cold fusion reactions give an impressive picture.

As we move away from the latest stable Pb-208 into the region of heavier nuclei, we observe their amazing survivability. The fundamental predictions of the microscopic nuclear theory have got experimental confirmation.

The relatively long lifetimes of the new elements make it possible to investigate their chemical properties. To what extent do the super heavy elements follow their lighter homologues in their chemical behaviour? The theoretical expectations, along with the results of the first chemical experiments rapidly being discussed now in connection with the definition of the boundaries of the Table of elements.

Experimental studies of production and decay properties of the super heavy elements were carried out in Dubna, in the Laboratory of Nuclear Reactions of JINR, in extensive cooperation with the national laboratories and universities of the USA, Germany, France, Switzerland and Institutes of the JINR Member States.

The lecture is open to interested participants from the general public.
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No booking required