# Identification of a new chemical element with atomic number Z=117

There is still an open question as to how many protons and neutrons a nucleus can hold together, i.e., what is the heaviest atomic nucleus bound against immediate disintegration. The answer depends on the actual properties of the states occupied by protons and neutrons in these extremely heavy atoms. Therefore, the studies aimed at new super-heavy nuclei contribute to the fundamental knowledge of nuclear forces. In particular, we are searching for signatures of an "Island of Stability" predicted to exist for nuclei heavier than the ones identified to date.

Two new super-heavy nuclei, isotopes of the new element with 117 protons, have been discovered after a long experiment performed by a Russia-US collaboration involving Dubna, Oak Ridge, Las Vegas, Livermore, Nashville and Dmitrovgrad [1]. These Z=117 isotopes with mass numbers 293 and 294, see Fig 1, were found among the fusion-evaporation products of the reaction between a beam of doubly magic $^{48}$Ca and radioactive $^{249}$Bk targets. The $^{249}$Bk($T_{1/2}$=320 days) was produced during the neutron irradiation (250 days duration) of Americium and Curium seed isotopes at the High Flux Isotope Reactor at Oak Ridge National Laboratory (ORNL). Subsequent chemical separation performed at the ORNL Radiochemical Engineering Development Center resulted in 22 milligrams of very pure $^{249}$Bk material. Following target manufacture at Dmitrovgrad, the experiment started in July 2009 using the Dubna Gas Filled Recoil Separator at the Joint Institute for Nuclear Research at Dubna. The decays of 11 new heavy nuclei (Fig.1) could be identified after 150 days. The observed trend of increased stability with large neutron number in Fig. 2 represents experimental verification for the existence of the predicted "Island of Stability" of super-heavy elements.

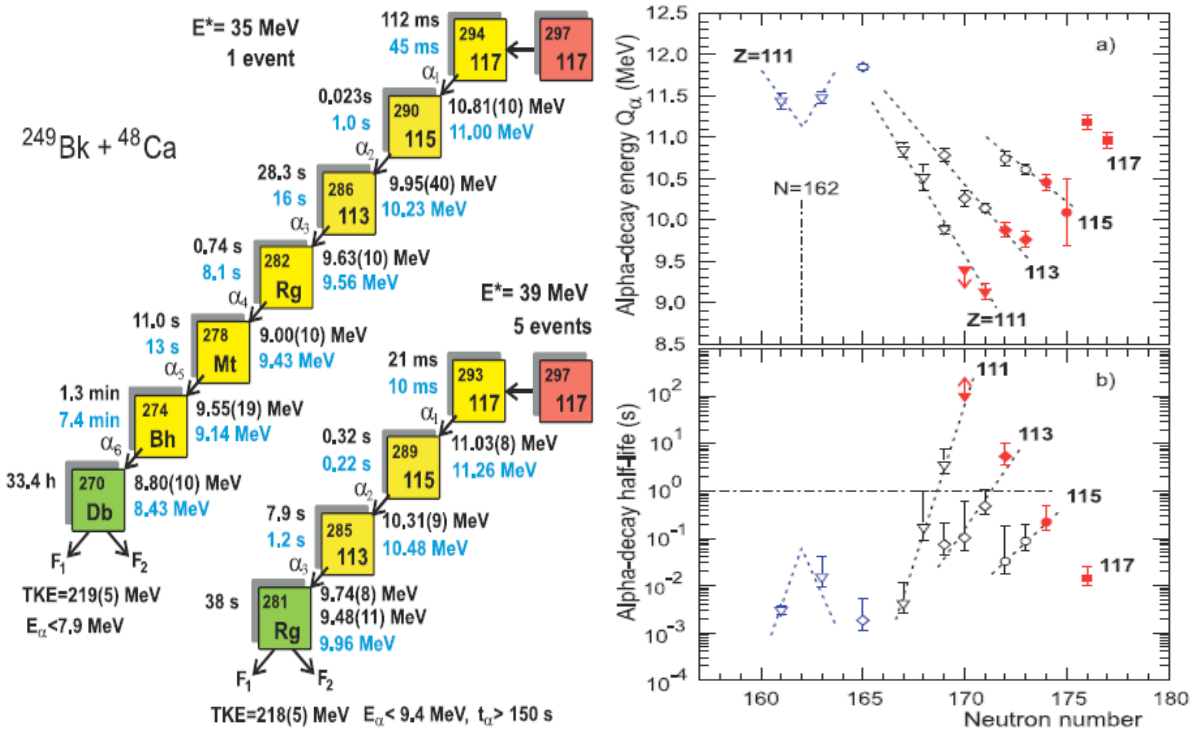


Fig. 1 (left). Observed decay chains interpreted as originating from the 293(117) and 294(117) isotopes. The deduced and predicted lifetimes and α-energies [1] are shown in black and blue, respectively.

Fig. 2 (right). Alpha-decay energies (a) and half-lives (b) versus neutron number for the isotopes of elements with Z=111 to Z=117. New results are shown in red


[1] Yu. Ts. Oganessian *et al.,* Phys. Rev. Lett. **104**, 142502 (2010).