The search for superheavy elements has yielded exciting results for both the “cold fusion” approach with reactions employing Pb and Bi targets and the “hot fusion” reactions with \(^{48}\text{Ca}\) beams on actinide targets [1-4]. In recent years the accelerator laboratories in Berkeley, Dubna and Darmstadt have been joint by new players in the game in France with GANIL, Caen, and in Japan with RIKEN, Tokyo. The latter yielding very encouraging results for the reactions on Pb/Bi targets which confirmed the results from GSI [5] and which succeeded in the synthesis of the isotope \(^{278}\text{113}\) [6].

Beyond the successful synthesis, interesting features of the structure of the very heavy nuclei like the hint for a possible K-isomer in \(^{270}\text{Ds}\) [7] or the population of states at a spin of up to 22 h in \(^{254}\text{No}\) [8] give a flavour of the exciting physics we can expect in the region at the very extreme upper left of the nuclear chart. For a review of the nuclear structure of heavy actinide and trans-actinide nuclei see ref. [9]. Systematic investigation of the two aspects, reaction mechanism and nuclear structure, is essential for the understanding of the observations made for the heaviest nuclei and for a successful progress towards elements with even higher Z. The methods employed to study the reaction mechanism are fusion/fission excitation functions and recently also the compound nucleus partial wave distribution [10].

Apart from the classical in-beam experiments and RDT (recoil decay tagging) experiments, radioactive decay studies, i.e. evaporation residue(ER)-a(-a) and ER-a-?-(-?) coincidences of ER implanted into a solid state detector after a separator, are a powerful tool to investigate the structure of heavy nuclei.

To get a hand on it a considerable increase in sensitivity is demanded from future experimental set-ups. High intensity stable beam accelerators, mass measurement in ion traps and mass spectrometers, as well as the possible employment of unstable neutron rich projectile species, initially certainly only for systematic studies of reaction mechanism and nuclear structure features for lighter exotic neutron rich isotopes, are some of the technological challenges which have been taken on.

References