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Survivability of compound nuclei at extreme conditions

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One of the main techniques for the production of exotic nuclei is via heavy-ion induced reactions. Usually, nuclei produced in such a way initially have extra energies in both external and internal degrees of freedom, which are released via various de-excitation channels like fission and evaporation of light particles. The latter one defines the survivability of excited heavy nuclei against fission and is one of the most interesting and important aspects for the production of the heaviest nuclei.

The nuclei of heaviest elements have mostly been produced in fusion-evaporation reactions. These are referred to as cold (hot), depending on the low (high) excitation energies of their compound nuclei (CN), which have large (small) angular momenta [1,2].

In the last two decades, fusion–evaporation reactions with ^{48}Ca projectiles and actinide targets, in which the formed CN have relatively low excitation energy but relatively high angular momenta have successfully been used for syntheses of the elements Cn-Og (Z=112-118) [3]. However, elements beyond Og can be produced only by using heavier projectiles, e.g., ^{50}Ti, which should result in shorter interaction times between the reactant nuclei [4]. Accordingly, it is still unknown how much the change from ^{48}Ca to ^{50}Ti will reduce the cross sections of fusion-evaporation reactions leading to the formation of the heaviest elements [5,6]. In fact, it is obvious that their nuclear structures will strongly effect on the fusion probability [7,8].

At the same time, during the collision of two very heavy nuclei, many reaction channels are open [9]. Among them, the multi-nucleon transfer channels are believed to provide an access to more neutron-rich SHN [10]. Those nuclei are believed to be produced at extreme conditions (e.g., with a large angular momentum), thus, their survival probability is one of the still unexplored issues.

I will discuss these aspects within the context of some recent experimental results obtained at the gas-filled recoil separator TASCA of the SHE-Chemistry department (GSI), where we carry out an intensive program on the studies of nuclear reactions.

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