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Reaction parameter study of the 51V beam onto deformed targets: 51V+159Tb reaction

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With the syntheses of elements up to oganesson (Z = 118), all the fusion evaporation reactions using the 48Ca beams on deformed actinide targets have already been performed. Due to the lack of target material beyond the californium, the use of 50Ti, 51V, and 54Cr is now becoming mandatory to access elements beyond the oganesson (Z = 118). In the SHE mass region, these beams have only been used in reaction on spherical Pb and Bi targets to produce neutron deficient Sg, Db, and Rf isotopes. In addition, the cross-section predictions for SHE elements past Oganesson are currently extrapolated from the reaction performed with 48Ca beams, resulting in a wide range of predictions depending on the model used.

Thus, in addition to reaction parameter measurements [1,2], the precise systematic measurements of excitation functions of lighter systems based on deformed targets around lanthanide nuclei provide a suitable training dataset for training and improving the predictive power of existing models. These lighter systems are good substitutes for the deformed actinide targets used in the current search for new elements above Oganesson. They have similar deformation parameters, but at a much higher production rate (μb range). In addition, the simultaneous measurement of the barrier distribution and the excitation function allows for the direct correlation between the barrier distribution and the maximum cross-section of production. This correlation is an important part of the discussion in the selection of the optimal beam energy for the synthesis of superheavy elements [1,2].

The search for the new element Z = 119 is currently underway at RIKEN using the reaction 248Cm(51V,xn)299-x119 on the GARIS-III experimental setup [3]. The goal of this work is thus to extend the systematic study of reaction parameters with deformed targets using the 51V beam to see if the behavior observed in [1,2] can be reproduced with lighter surrogate systems. In this work, the effects of the beam energy and nuclear deformation in the reaction 159Tb(51V,xn)210-xRa have been studied by measuring both the barrier distribution and the detailed excitation functions. The goal is to extend the systematic study of the quasielastic (QE) barrier distribution with 51V and to compare it with the results obtained in [2,3] as well as theoretical prediction using the Couple Channel Calculation (CCFULL [4]). In addition, the production of the full and detailed excitation function for the xn, pxn and αxn, also allowed us to study the correlation between the barrier distribution and the maximum cross-section of production and compare it with prediction made using the Fusion-By-Diffusion model [5]. The experimental setup, analysis and preliminary results of both studies will be presented in this presentation.

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