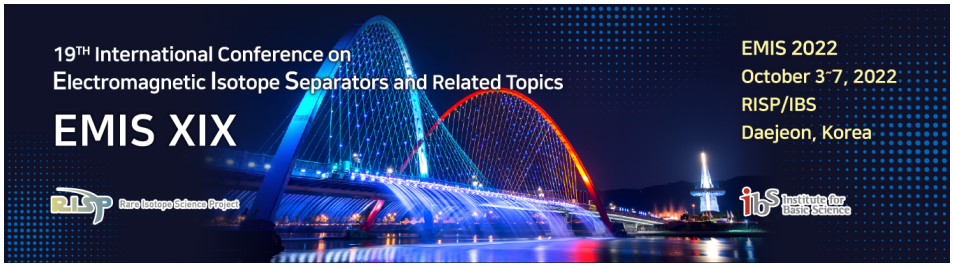

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Optimal reaction energy for synthesis of element 119 via 51V+248Cm reaction probed by quasielastic barrier distribution measurement

Thursday, 6 October 2022 17:20 (20 minutes)

The periodic table is now completely filled up to the seventh period. The synthesis of elements 119 and 120 has been attempted in several cases using the combination of actinide targets and projectile beams heavier than ^{48}Ca. However, these new elements have not been discovered yet so far [1-4].
In the synthesis of superheavy elements, the reaction energy is the most important parameter that significantly affects the experimental efficiency. At RIKEN, element 119 is being searched using a ^{51}V+^{248}Cm hot fusion reaction. The optimal reaction energy of this reaction system is unknown since theoretical predictions vary widely.
Under these circumstances, our group has developed a method to estimate the optimal energy from the quasielastic (QE) barrier distribution [5,6]. From the systematic studies of the relation between the QE barrier distribution and the fusion-evaporation cross section $\sigma_{\rm ER}$ for the hot-fusion reaction systems with an actinide target, the optimal reaction energy for maximizing $\sigma_{\rm ER}$ was found to be slightly larger than the average Coulomb barrier height B_0 obtained from the QE barrier distribution [6]. Furthermore, it was also pointed out that the side-collision energy $B_{\rm side}$, which leads to a compact configuration of the colliding nuclei by touching along the short axis of the prolately-deformed target nucleus, deduced from the experimental B_0 value, is in good agreement with the optimal energy of the experimental $\sigma_{\rm ER}$ [6].
In our latest study [7], we measured the QE barrier distribution of ^{51}V+^{248}Cm, using a gas-filled recoil ion separator GARIS-III at a recently upgraded Superconducting RIKEN Heavy Ion LINAC (SRILAC) facility. The energy corresponding to the $B_{\rm side}$ was derived from the B_0 value determined from the present experiment, and the optimal reaction energy was estimated based almost purely on experimental evidence. Using the optimal energy obtained in this study, an experiment to synthesize element 119 is currently in progress at RIKEN.
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