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Study of fission for ^{258}Md

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To understand fission process is important for super-heavy-element (SHE) research as the stability of nucleus against fission regulates the existing limit of atomic nuclei. In the production of SHEs, fission barrier height significantly changes the production cross-sections for SHEs. However, our knowledge on fission is marginal, especially for the SHE region. It was found in spontaneous fission (SF) that fission-fragment mass distributions (FFMDs) show a dramatic change from mass-asymmetric fission of ^{256}Fm to sharp symmetric fission of ^{258}Fm [1], indicating an unique feature in fission for heavy- and neutron-rich nuclei.

At JAEA, we have studied fission of ^{258}Md (atomic number Z=101) from excited states. The fissioning nucleus is populated by bombarding ^{4}He beam from JAEA tandem accelerator to einsteinium target ^{254}Es ($T_{1/2}$=256 day). The ^{254}Es was obtained from ORNL, US. The experimental data shows the mass-asymmetric fission modes, similar to lighter actinide fissions. Also, symmetric fission mode with higher TKE was found. By the increase of excitation energy from 15 MeV to 18 MeV, the yield asymmetric fission mode enhances.

We carried out a Langevin calculation based on the Cassini-oval nuclear shape parametrization. Here, we introduced 6-shape dimensions, i.e. the highest dimension ever achieved in this type of calculation. The results show that at very low excitation energy, the symmetric fission mode, originating from the shell structure close to ^{132}Sn, is dominant, which is, however, quickly smeared with excitation energy. On the other hand, mass-asymmetric mode is robust against excitation energy.

References

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