Contribution ID: **10** Type: **not specified**

Construction of a framework for the systematic calculation of prompt fission observables using a four-dimensional Langevin model/4 次元 Langevin 模型を用いた即発崩壊過程に伴う核分裂観測量の体系的計算のための枠組みの構築

Thursday, 14 November 2024 13:40 (30 minutes)

Fission observables such as neutron multiplicity, the spectrum, and the mass/charge distributions of fission fragments/products play an important role in evaluating safety and effectiveness for nuclear applications. However, these types of data are limited due to the difficulties of experiments and their associated factors. Moreover, theoretical calculations for these observables are also challenging since the fission process is rooted in several different physical mechanisms.

We proposed a new framework for the systematic calculation of the prompt fission observables and applied it to a series of Pu isotopes [1]. This framework consists of calculations of deformation up to the scission of a nucleus (before the prompt decay) and the process of the prompt decay. The mass distribution of fission fragments and the total kinetic energy of the fragments before prompt decay were calculated using a four-dimensional Langevin model [2], which is a nuclear physics-based approach. We calculated accurate mass distributions of fission fragments by superposing two Langevin calculations, taking into account the influence of different magic shells. Then, fission observables after prompt decay were calculated in a consistent manner using the Hauser-Feshbach statistical decay model. We employed a nuclear reaction code TALYS [3,4] and used the obtained Langevin results as the inputs.

In the presentation, we will compare the calculated fission observables with the previous Langevin results, as well as experimental and evaluated data, and show that our results successfully capture the known trends and reasonably reproduce the data.

References

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Session Classification: Presentation by Award of Nuclear Data Division/核データ部会賞受賞者講演