Comparing Nuclear Fission Codes: GEF as standalone code vs GEF+TALYS

Mattera, A., Pomp, S., Al-Adili, A., Lantz, M., Rakopoulos, V., Solders, A.
Department of Physics and Astronomy, Uppsala University, Uppsala, Sweden

Fission codes for the calculation of fission observables are a way to assist experimental nuclear physicists in data analysis and in the interpretation of their results. Assumptions in the models and tuning of parameters behind the codes provide, in many cases, a good reproduction of experimental data. In this work, we have explored a way of comparing different fission codes in the description of observables that can be fit to experimental data, such as isomeric yield ratios and $\nu(A)$ distribution.

The first step in this work was done comparing a standalone version of the GEF code [1] with a combination of GEF and Talys. In the latter approach, the fragments in their excited states (with mass, and excitation energy distributions obtained from GEF for every fission on an event-by-event basis) were given as input to Talys [2], that handled the de-excitation. From the output of Talys, it was then possible to extract measurable quantities (such as ground/isomeric-yield distributions, but also total $\nu$ and $\nu(A)$) that were compared with the same quantities extracted from GEF and with experimental data.

The results of the first comparison, despite proving not conclusive in the case of Isomeric Yield Ratios, show good consistency between how the de-excitation is treated in the two codes. In the case we analyzed ($^{235}\text{U}+n_{th}$, $^{239}\text{Pu}+n_{th}$ and $^{252}\text{Cf}(SF)$), the $\nu(A)$ from the two codes agree both in absolute values and in the shape, even though some structures that were observed in GEF - such as a slight enhancement of neutron emission around mass 140 - were not reproduced in Talys.

The method we are testing is proposed as a way to compare different codes against each other and with data in terms of the fission fragments observables right after scission. This is done by decoupling the de-excitation process, which is handled in an independent and consistent fashion using the models built into Talys.

The effect on fission observables of different sets of excitation energies calculated using various assumptions and models (e.g. Freya, PbP, ...) can then be easily evaluated and is the focus of a more extended study that is being carried out.

References

