Fisrt study of the ^{235}U multi-chance fission with the FIFRELIN code

M. Sabathé[1], O. Litaize[1], P. Tamagno[1] and T. Ogawa[2]

[1] CEA, DES, IRESNE, DER, SPRC, Cadarache, 13108 Saint-Paul-lez-Durance, France

[2] JAEA, 2-4, Shirakata, Tokai, Naka, Ibaraki, Japan, 319-1195

Neutron emission is a physical process which can occur at the different steps of the nuclear fission. The first source of neutron emission comes from the primary fission fragments after full acceleration. Indeed after scission, fragments are generally excited and neutron, gamma and conversion electron emission are the different ways to release this excess of energy. Another source of neutron emission comes from the deexcitation of the nucleus before scission. When the excitation energy is sufficient, neutron emission is energetically allowed. This phenomenon generates a competition between fission and neutron emission. This physical mechanism is called multi-chance fission. It becomes signifiant when the incident neutron has enough energy to eject one – or more – neutrons while leaving the residual nucleus with excitation energy larger than its fission barrier height. For energies lower than this limit, multi-chance fission is only possible by tunnel effect. Pre-scission neutron, which comes from multi-chance fission, can be released through two different mechanisms. The first ones are emitted from the compound nucleus. In this case, neutron emission mechanism is similar to the fragment neutron evaporation process. The second ones are emitted during the pre-equilibrium phase and the proportion of these neutrons depends on the excitation energy.

Multi-chance fission process is not yet implemented in the FIFRELIN code. The aim of this work is to add the possibility for FIFRELIN to simulate this phenomenon. At first, only the second and the third chance fission will be considered. It will allow to extend the scope of FIFRELIN for incident neutron energies up to 20 MeV approximately.

In this conference, we will discuss the physical models used in FIFRELIN and how they have been implemented into the code by two different algorithms. The purpose is to calculate the probability for the nucleus to undergo fission or to emit neutrons. The first algorithm uses energy dependent partial width ratio Γ_n/Γ_f and the second one uses ratio of evaluated multi-chance fission cross sections. We will also discuss how these methods calculate the spectrum of emitted neutrons, how we treat the input data during the deexcitation, and how this new functionality has been integrated in the existing code.