Experimental report

25/01/2024

Proposal: 3-01-705 **Council:** 10/2022

Title: Completion of 235U(nth,f) mass yield measurement in the framework of fission product yield evaluations

Research area: Nuclear and Particle Physics

This proposal is a new proposal

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Samples:

Instrument	Requested days	Allocated days	From	To
PN1	14	14	29/03/2023	07/04/2023
			30/09/2023	01/10/2023

Abstract:

Fission yields are used in various fields: nuclear reactor studies, astrophysics, nuclear fission theory ... For a decade, a collaboration between CEA/ILL/LPSC aimed at improving the methodology to measure fission yield with the LOHENGRIN spectrometer. Nowadays, an accuracy of around 1% is achievable on the fission mass yields measured. Also, the bias due to the instrument is under control. This proposal requests to measure the missing masses from the May 2021 experiment on 235U(nth,f) reaction and consolidate the measured accuracy.

Experimental report on: Completion of $^{235}U(n_{th},f)$ mass yield measurement in the framework of fission product yield evaluations (3-01-705)

During the last decade, our CEA/LPSC/ILL collaboration has developed a new measurement methodology allowing the reduction of the experimental biases and the improvement of the understanding of the systematic uncertainty of fission product mass yields [1]. After a successful campaign in May 2021 (see report 3-01-696) a relative uncertainty of about 1% has been achieved on absolute fission yield for the reaction $^{235}U(n_{th},f)$. This result was a combination between, the target quality, the LOHENGRIN stability and the application of the new methodology. Figure 1 shows the preliminary results of this campaign.

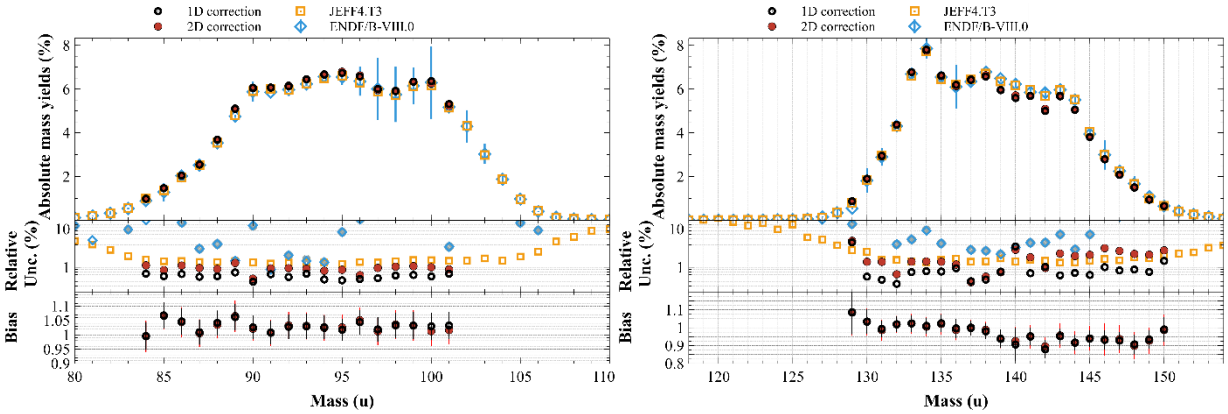

Figure 1: Mass yield measured during the May 2021 campaign. Two different corrections were applied in order to reduce the uncertainties and biases. A comparison to the new evaluation proposed by our collaboration [2], and the ENDF/B-VIII.0 seems to indicate an underestimation of the mass yields in the region A=139-150.

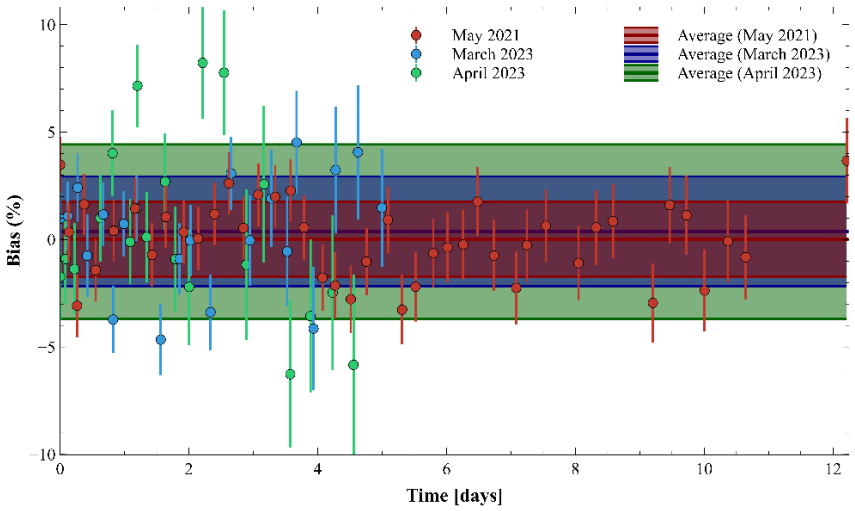

Figure 2: LOHENGRIN main stability for three different targets. In 2023, a new power supply seems to degrade the reproducibility of the instrument.

The purpose of the new campaign held in March 2023 aimed to complete the mass yield measurement in the region A=102-106 and in the far asymmetric regions (region A<84 and A>150). The first week, we have used a ^{235}U target covered by a 0.25 µm Ni foil. We have focused our measurement in the region A=102-106, leading to more than 1900 data files. However, the quality of these data seemed less good than the previous one. One explanation may come from the use of a new power supply for the main magnet. Indeed this new power supply induces a worst stability of the spectrometer as we can see on fig. 2, which represents the dispersion of the count rate

measured with the same LOHENGRIN setting, in between 30 minutes. It is clear that this reproducibility test fails for the current campaign.

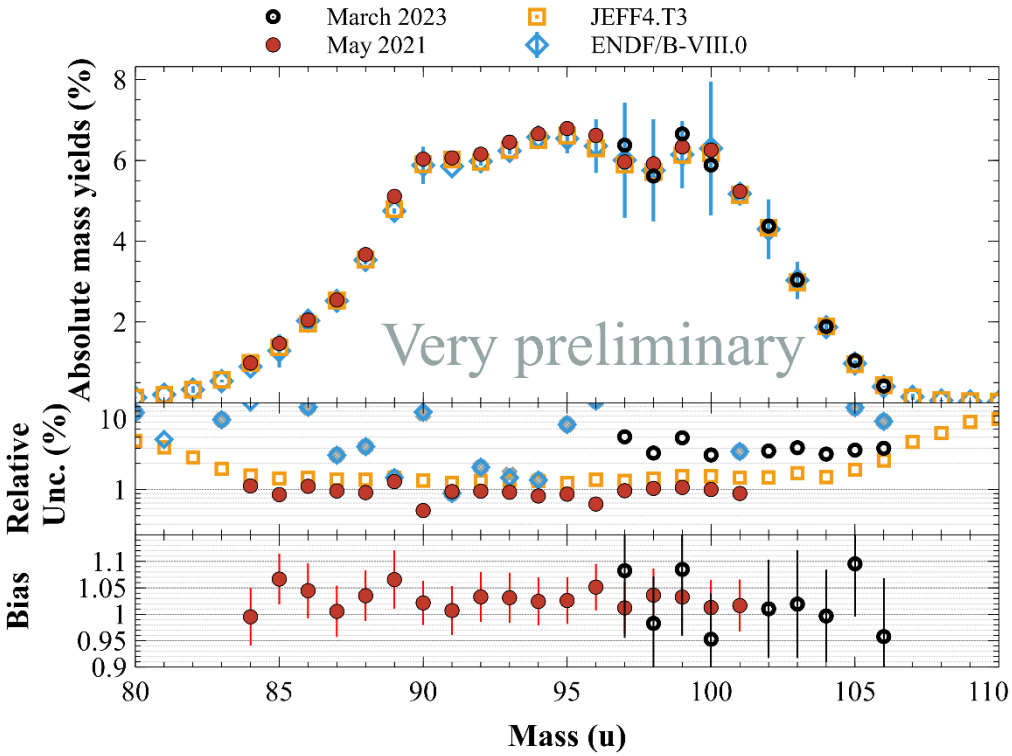

Figure 3: Absolute fission product mass yield for $^{235}U(n_{th},f)$ with the new measurement performed in March 2023. A good agreement with all the recent nuclear data libraries is observed. The 2d correction was used.

Therefore, the achieved precision is of the order of 3% instead of the targeted 1% as we can see on fig. 3. The uncertainty due to the normalisation procedure has been propagated. A second target (labelled April 2023) has been used for the measurement of the far asymmetry region. In addition, of the LOHENGRIN stability, the target quality was not sufficient to provide precise mass yields. The analysis of this campaign is still ongoing.

[1] A. Chebboubi et al., Eur. Phys. J. A, 57, 335, 2021
[2] S.-M. Cheikh et al., EPJ Web of Conferences 284, 08002 (2023)