

S/U Analysis and Data Adjustment in CNDC : Progress and Perspective

Wenming Wang¹, Haicheng Wu

Presentation in
OECD/NEA, Issy-les-
Moulineaux

1. China Nuclear Data Center, China Institute of Atomic Energy, 102413, Beijing, China
eaglewwm@gmail.com

My presentation can be splitted into three parts:

1 History

2 Work For SG-33

3 Perspective

1 History

The S/U analysis and data adjustment in CNDC starts in the late 90s but halted for over 10 years. In the need of facility assessments, S/U analysis restarted from 2011.

S/U Analysis in CNDC

- In late 1970s, methodology of s/u basing on GPT developed
- In late 1990s , there was some s/u analysis on Godiva in CNDC
- In early 2000s, some s/u analysis was done for China Fast Reactor and Chinese ADS system, using MC direct perturbation method
- From 2011, systematic S/U analysis research restarted
 - New S/U codes under development
 - New covariance data evaluation plan in CENDL, both methodology and practice
 - Group-wised data with covariance proceeded by NJOY, from CENDL/ENDF/JENDL
 - Data adjustment methodology developed
 - Benchmark facility selection and target data assessment methodology developed

My presentation can be splitted into three parts:

1 History

2 Work For SG-33

3 Perspective

2 Work for SG-33

In 2011, we attended SG-33, where we have learned a lot and done our best to contribute. The data preparations were done in the following scheme.

Data Preparation

- Code: NPLC-2, preNPLC2.pl+NJOY99+PASC4
- Evaluation files(79 in total):
 - CENDL-3.1(with covariances): ^{56}Fe
 - JENDL-4.0 (with covariances): ^{10}B , ^{23}Na , $^{235,238}\text{U}$, $^{239,240}\text{Pu}$.
 - CENDL-3.1: others.
- Weight function for group XS: iwt=8, 1/e + fast reactor + fission + fusion
- Self-Shielding: Bonami-II
- Multigroup Covariance
 - Weight function: changed to 1/E.

The data preparation procedure and codes are as follows:

NPLC-2

- Resonance self-shielded XS library in AMPX/ANISN format

XSDRN

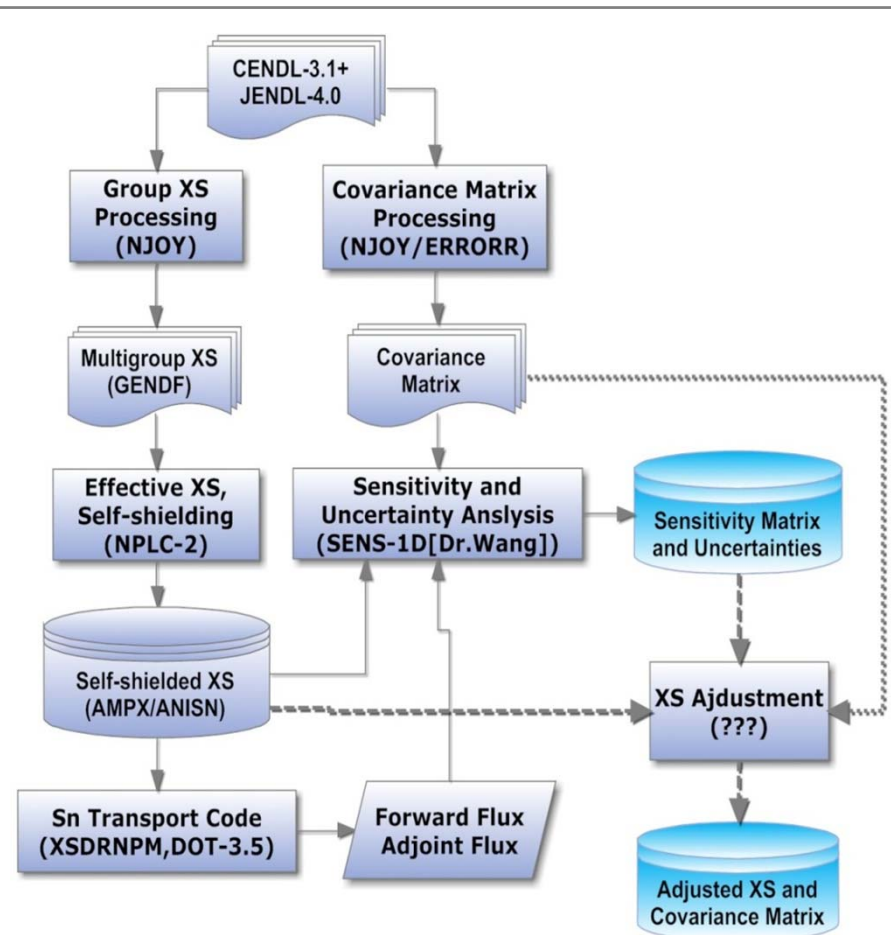
- 1D transport calculations

DOT-3.5

- 2D transport calculations

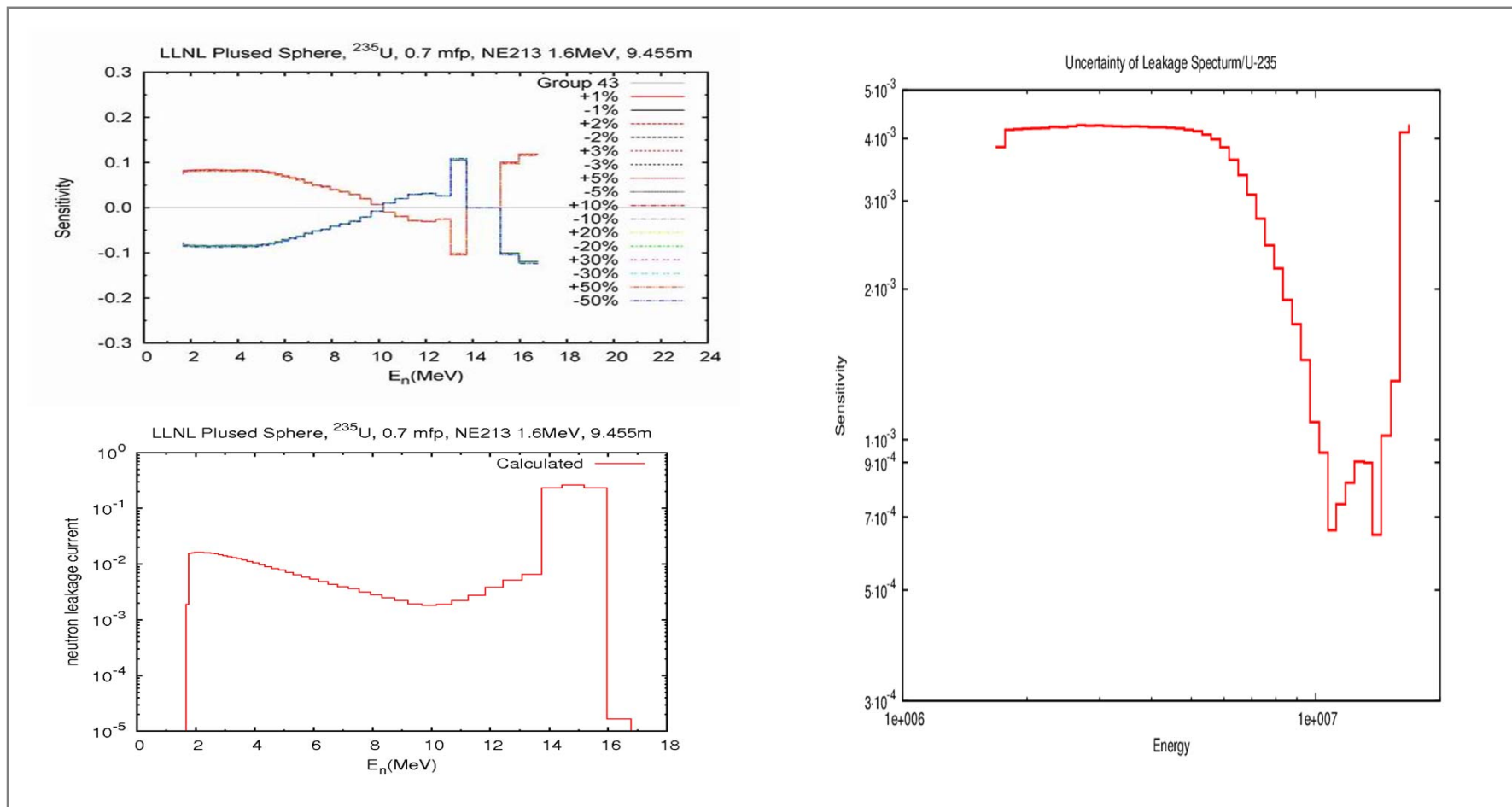
SENS

- S_N based XS sensitivity and uncertainty
- First-order perturbation theory



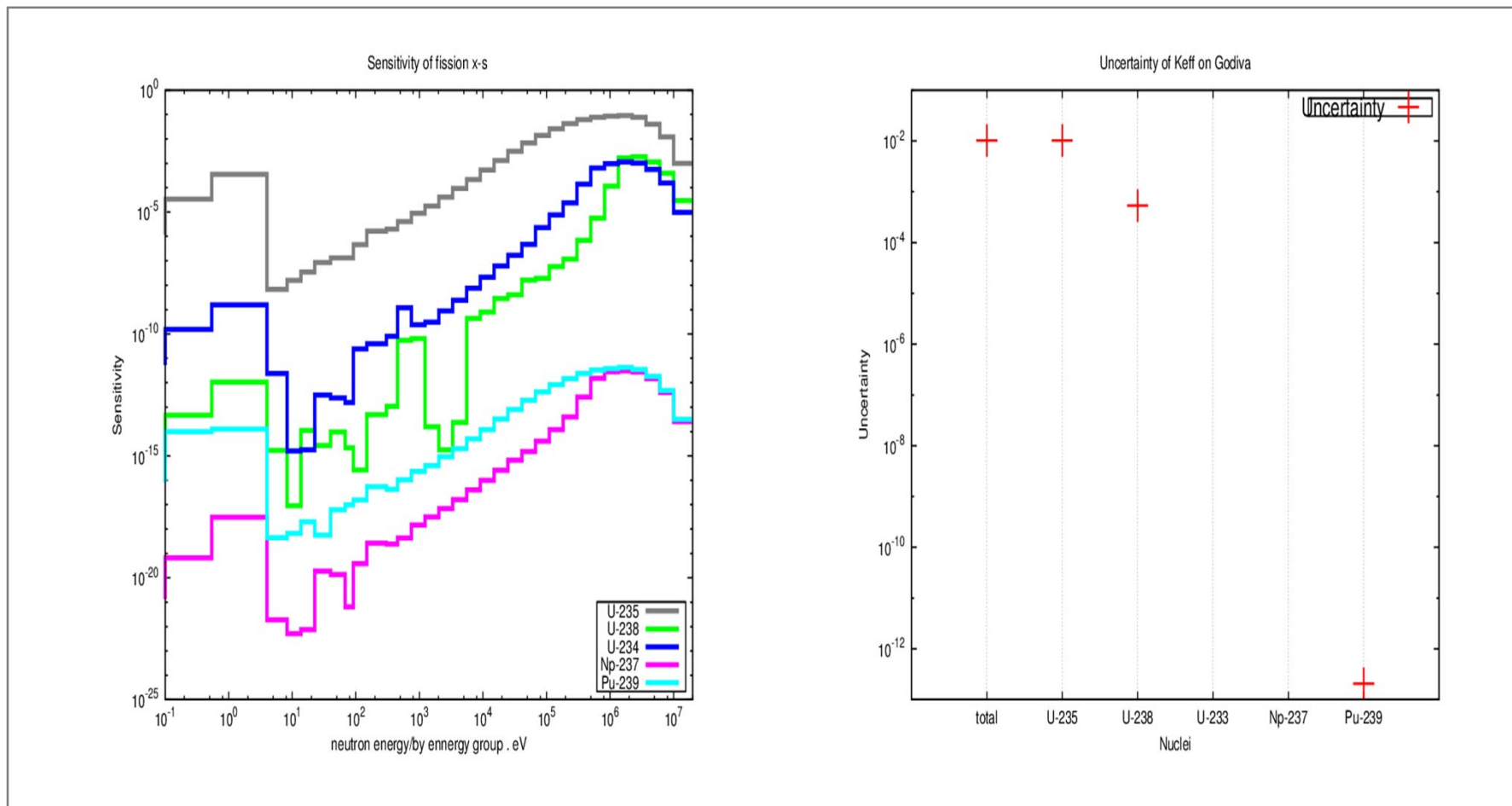
2 Work for SG-33

As for S/U analysis, a new code system SENS is under development which will combine both MC and GPT to analysis S/U of target integral parameters. Now 1D module for keff has been done and 2D module is under testing.



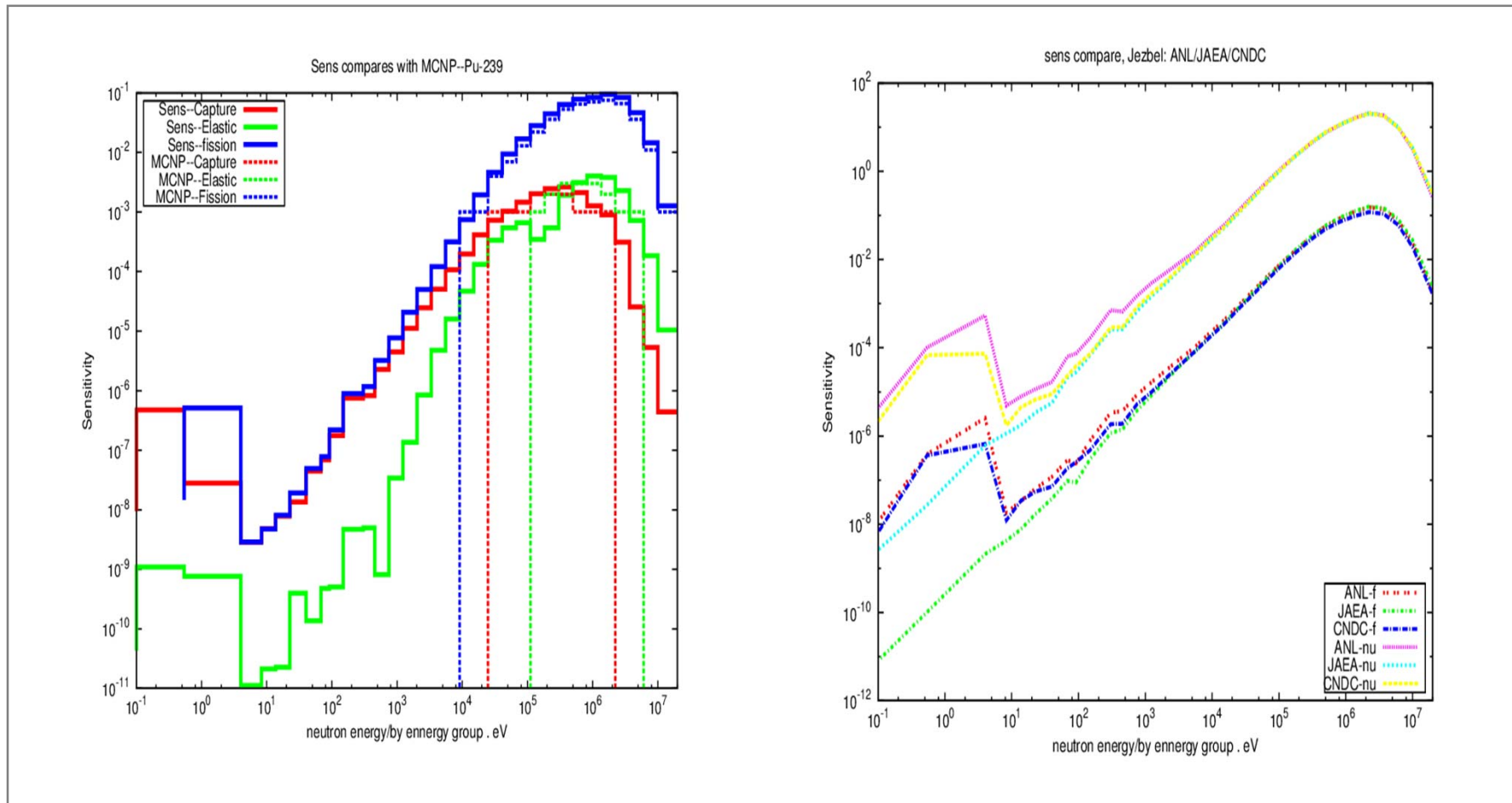
2 Work for SG-33

Regarding keff , several 1D benchmark facilities were analyzed, including Jezebel series/Godiva/Flattop series. All the data and sensitivity results have been converted to SG-33 format.



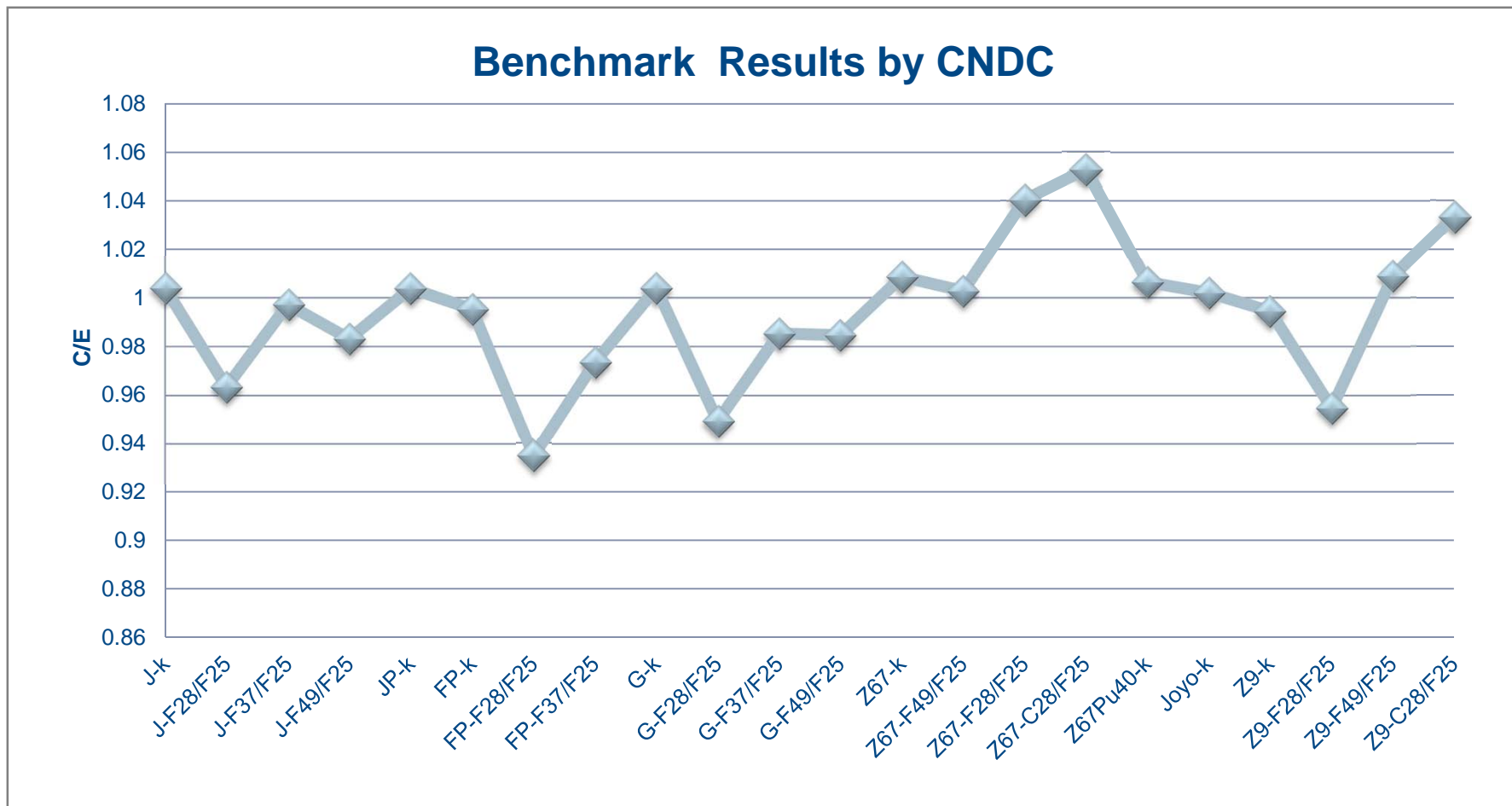
2 Work for SG-33

The S/U results have been preliminarily compared to the MC direct perturbation results and SG-33 results from ANL and JAEA, some of which shows a good agreement. However, the V-V procedure of the codes are still on the way.



2 Work for SG-33

As reported by Dr. Wu during the last meeting, the S_N and some MC benchmark calculations were done by CNDC, using XSDRN for 1D facilities, Dot 3.5 for 2D facilities and MC codes for comparison, details of which can be found in his presentation.



The adjustment methodology in CDNC is quite like others in SG-33, using maximum likelihood method. However, as an exercise, the codes have not been developed yet, but Matlab were used instead.

The vector of adjusted constant is given by

$$C' = C + MH^T (V + HMH^T)^{-1} (I_e - I_p)$$

And the best estimated results for integral quantities are given by

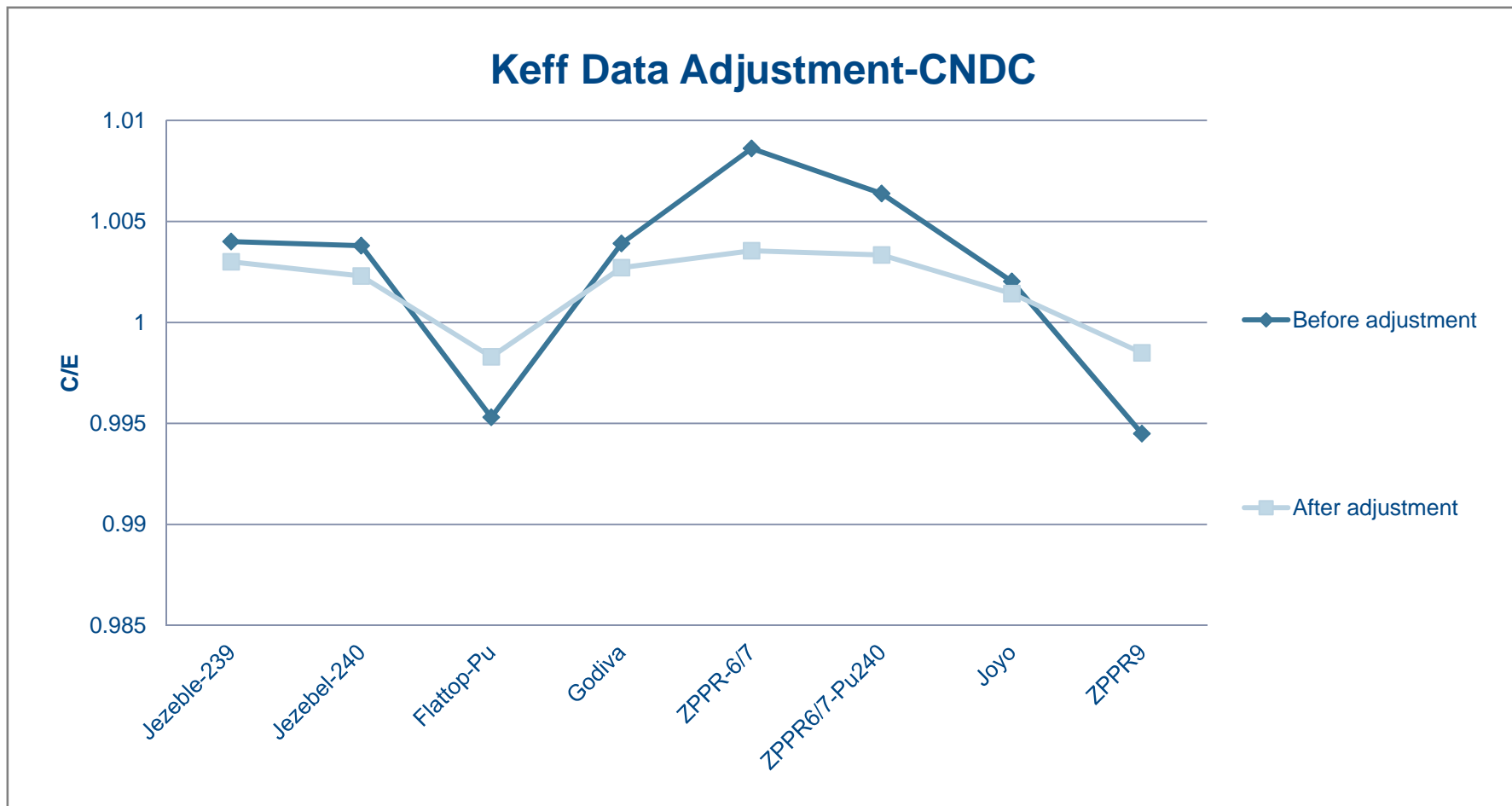
$$I' = I_c + HMH^T (V + HMH^T)^{-1} (I_e - I_c)$$

Where, Only keff value are considered into I, with the sensitivity matrix not only 1D results calculated via SENS but also 2D results from SG-33 documentation, especially the results by JAEA.

Moreover, V matrix were adopted as Prof. Ishikawa suggested before.

2 Work for SG-33

As described in the former slice, data adjustments were done using Matlab, basing on combined S/U and benchmarking results. The results seem good, for all C/E values seem to be improved, but more analysis and stress tests needed to be done.

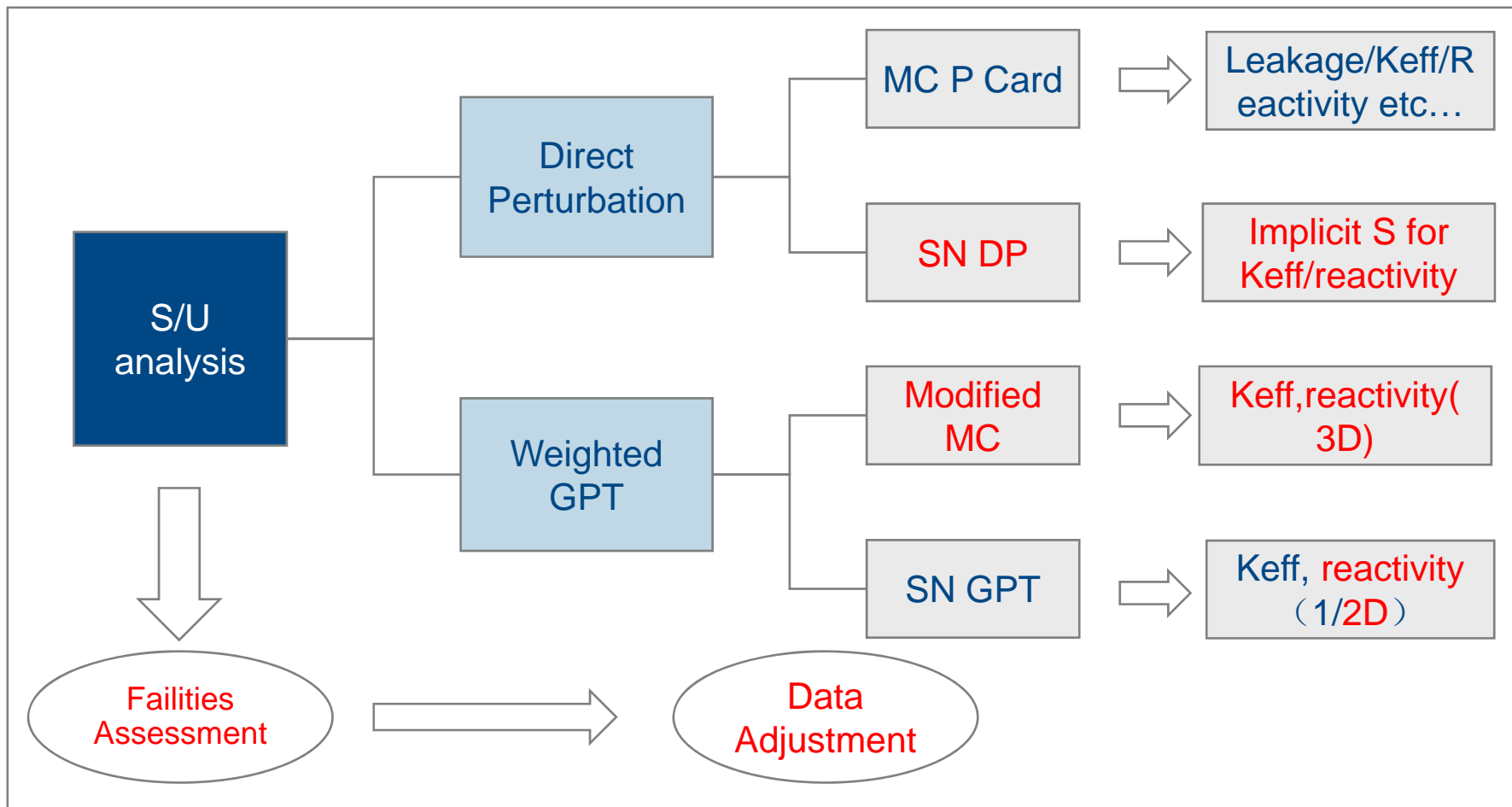


My presentation can be splitted into three parts:

- 1 History
- 2 Work For SG-33
- 3 Perspective**

3 Perspective

A plan for systematic S/U analysis applied to nuclear data research has been proposed in CNDC, where a whole picture was plotted for that in future CNDC.



THANKS FOR
YOUR
ATTENTION