

Current Status of CIAE Activities on Nuclear Data Adjustment

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Outline

- **Introduction**
- **Methods and Procedures**
- **Nuclear Data Preparation**
- **Preliminary Benchmark Results**
- **Summary**

■ History

- No *Nuclear Data Adjustment* on multi-group cross-section (XS) library had been done before.
- Fe, $^{235,238}\text{U}$, ^{239}Pu and et al. of CENDL-2.1 were adjusted according several benchmark results.
- The total cross sections of $^{63,65}\text{Cu}$ for CENDL-3.1 were evaluated based on trend and sensitivity analysis of selected benchmarks.

■ Our plan

- **Generate a set of multigroup XS library.**
- **Generate a set of covariance matrices.**
- **Do benchmark exercise.**
- **Develop a S/U analysis code – 1/D**
- **Perform S/U analysis.**
- **Develop a nuclear data adjustment code for multigroup library?**
- **Do adjustment exercise.**
- **Others ?**

Methods and Procedures

- **Maximum Likelihood Method** is going to be used in our practice.

- **The vector of adjusted constant is given by**

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

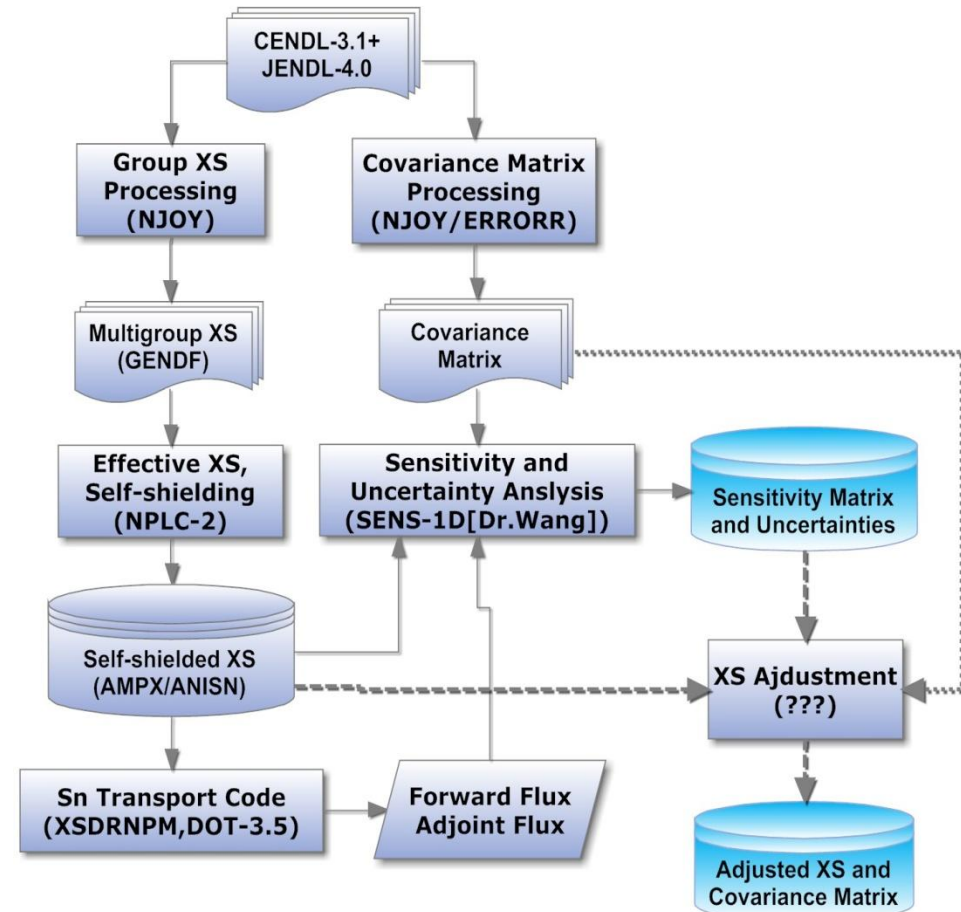
- **The best estimated results for integral quantities are given by**

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

- **Some criteria in applying the nuclear data adjustment**
 - **The benchmarks sequence used for adjustment should be clean and able to define a trend of a integral parameter (k_{eff} , reaction rate, and so on.) for one material (an isotope or an element) explicitly.**
 - **The chosen of the material to be adjusted should be based on trend and sensitivity analysis.**
 - **Reserve human judgments to avoid unreasonable adjustment occurred.**

Methods and Procedures

- **NPLC-2**
 - **Resonance self-shielded XS library in AMPX/ANISN format**
- **XSDRN-PM**
 - **1D transport calculations**
- **DOT-3.5**
 - **2D transport calculations**
- **SENS-1D**
 - **S_N based XS sensitivity and uncertainty**
 - **First-order perturbation theory**

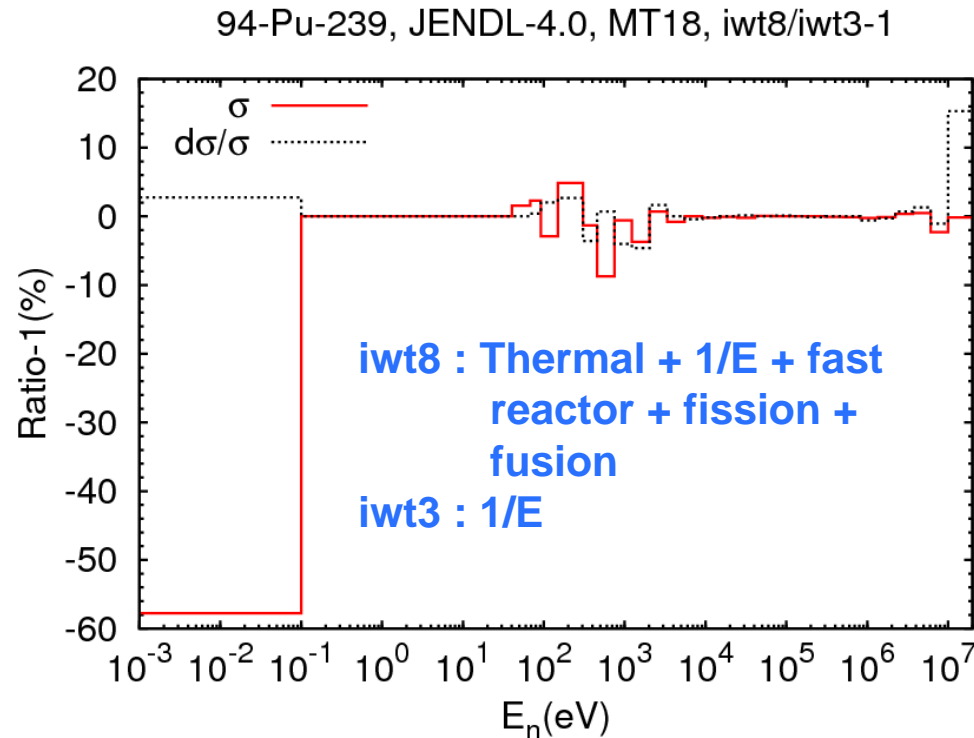


Nuclear Data Preparation

- **Multigroup Cross Section Library**
 - **Code: NPLC-2, preNPLC2.pl+NJOY99+PASC4**
 - **Evaluation files(78 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.**
 - **GRP. Structure: 33g**
 - **Weight function: iwt=8, thermal+ 1/e + fast reactor + fission + fusion**
 - **Self-Shielding: Bonami-II**
 - **Effective XS: XSDRN-PM**

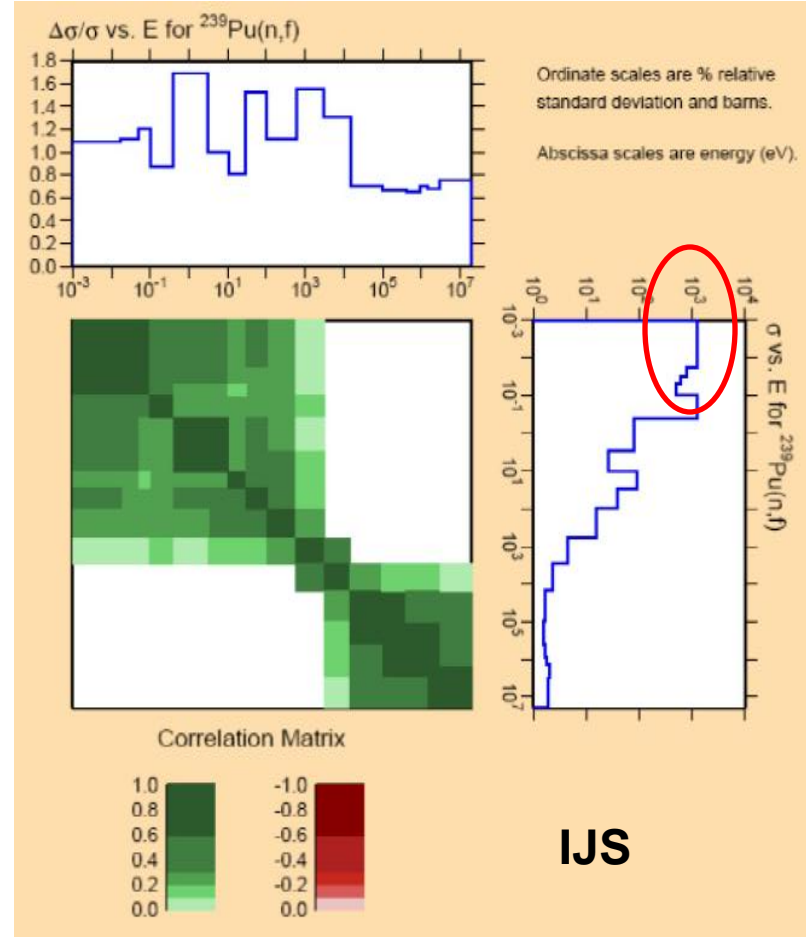
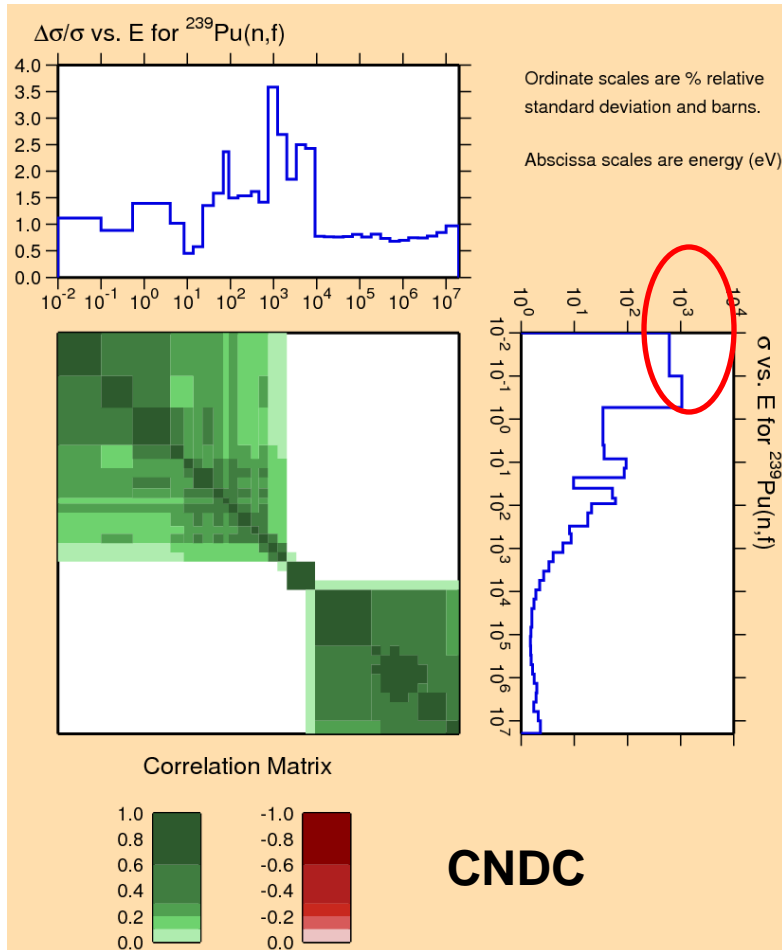
■ Covariance Matrix

- **Different weight function -- different multigroup covariance**
- The same weight function was used both in our multigroup XS and covariance matrix preparing.



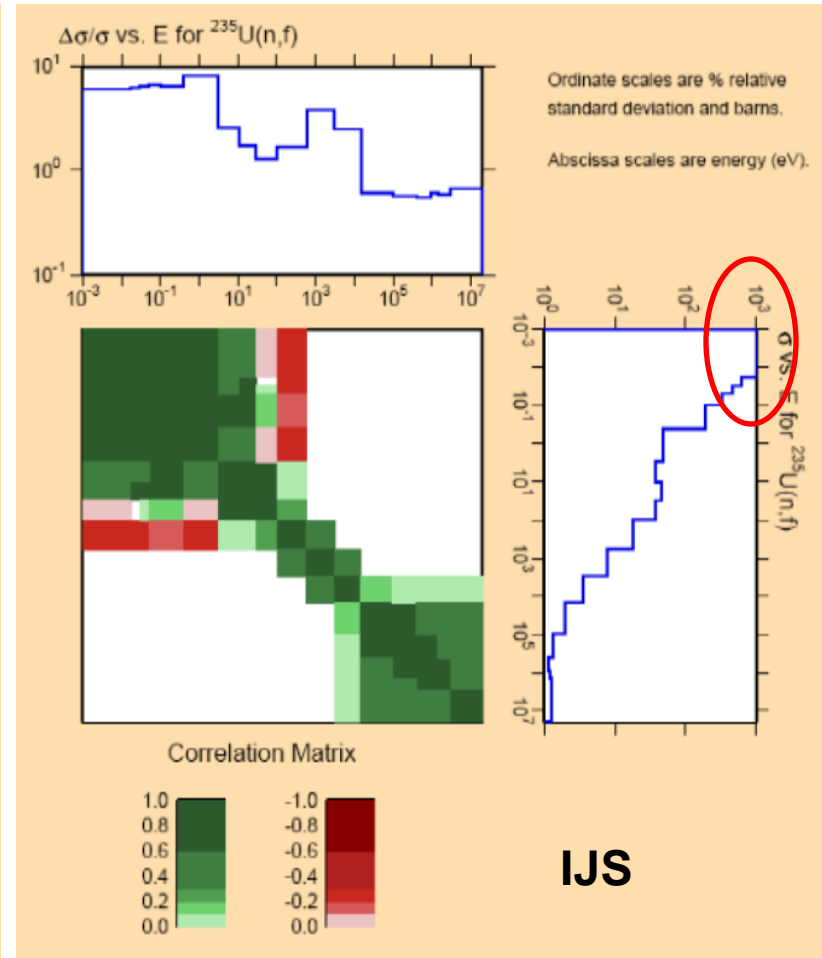
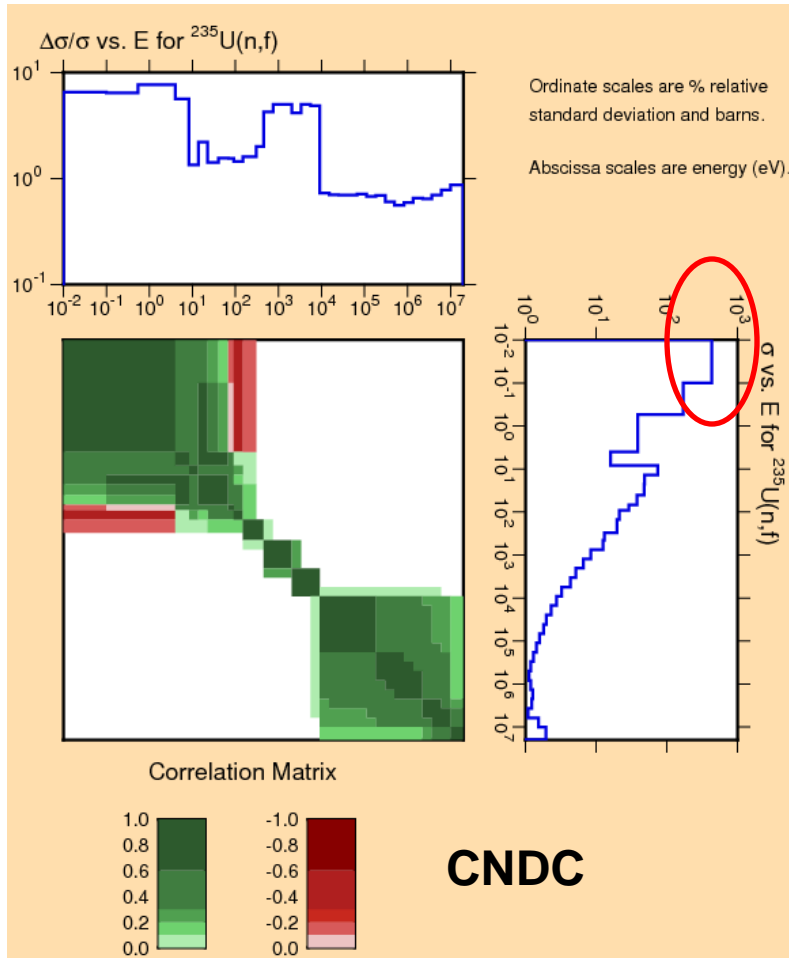
Nuclear Data Preparation

□ $^{239}\text{Pu}(n,f)$ -- Different weight func. and group structure ?



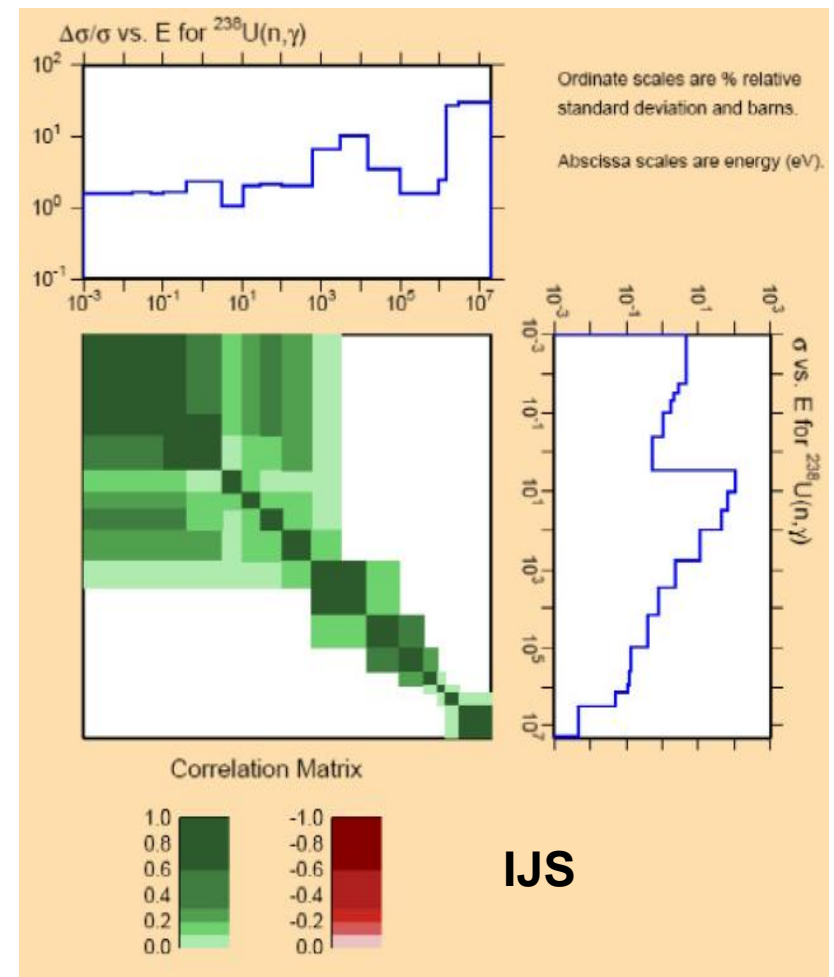
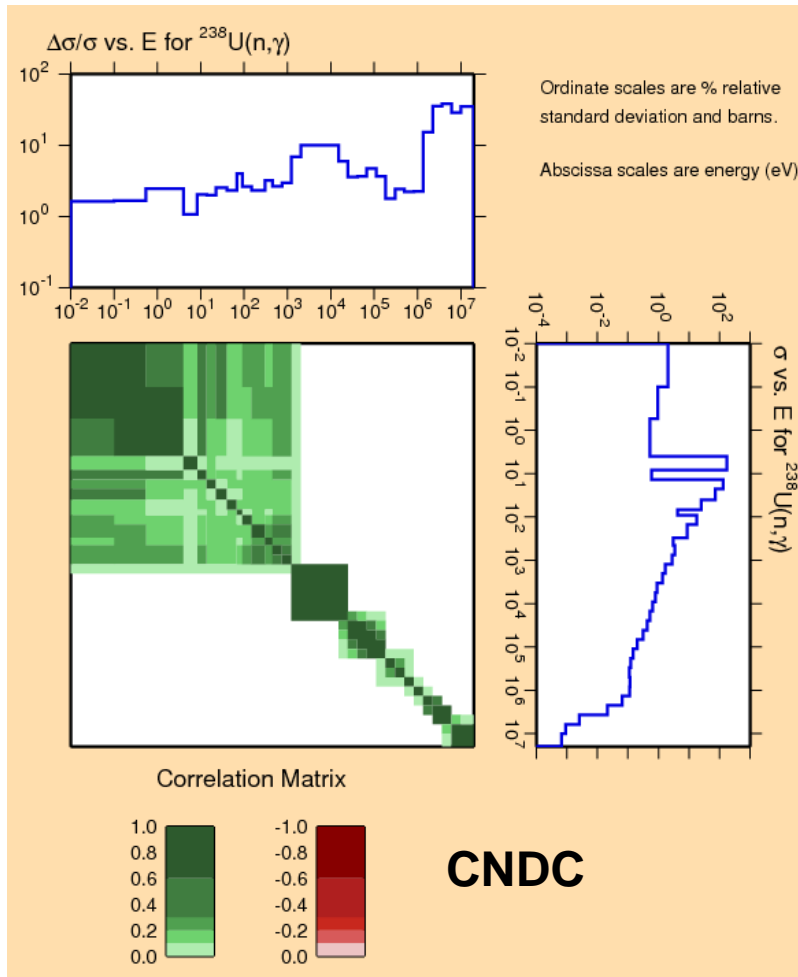
Nuclear Data Preparation

□ $^{235}\text{U}(n,f)$



Nuclear Data Preparation

□ $^{238}\text{U}(n,\gamma)$



Preliminary Benchmark Results

■ Jezebel – ^{239}Pu

Parameters	MC Benchmark Model	S_4P_1	Corr. Fact.	Experiment
k_{eff}	0.9984	1.0040	0.9945	1.00000 \pm 200pcm
F28/F25	0.2069	0.2056	1.0066	0.2133 \pm 1.1%
F37/F25	0.9811	0.9809	1.0002	0.9835 \pm 1.4%
F49/F25	1.4374	1.4364	1.0007	1.4609 \pm 0.9%

■ Jezebel – ^{240}Pu

Parameters	MC Benchmark Model	S_4P_1	Corr. Fact.	Experiment
k_{eff}	0.9985	1.0037	0.9948	1.00000 \pm 200pcm

■ Flattop-Pu

Parameters	MC Benchmark Model	S_4P_1	Corr. Fact.	Experiment
k_{eff}	0.9988	0.9939	1.0050	1.00000 \pm 300pcm
F28/F25	0.1759	0.1685	1.0438	0.1799 \pm 1.1%
F37/F25	0.8645	0.8447	1.0234	0.8561 \pm 1.4%

Preliminary Benchmark Results

■ ZPR6-7 standard

- ❑ **The result of deterministic code is unreasonable ☹️**
- ❑ **Insufficient resonance self-shielding for ^{238}U ?**

Parameters	MC Benchmark Model	S_4P_1	Corr. Fact.	Experiment
k_{eff}	0.9902	0.9467	1.0460	0.9866 \pm 230pcm
F49/F25	0.9159	0.9633	0.9510	0.9435 \pm 2.1%
F28/F25	0.0205	0.0249	0.8250	0.0223 \pm 3.0%
C28/F25	0.1393	0.1693	0.8230	0.1323 \pm 2.4%

■ To be done

- ❑ **ZPR6-7 High Pu-240**
- ❑ **ZPRR-9**
- ❑ **Joyo MK-1**

Summary

- A 33g AMPX library has been generated for nuclear data adjustment.
- Covariance matrices are also generated with .
 - Additional uncertainties can be imported during processing.
- Benchmark exercises have not been finished yet☹
- **Develop a S/U analysis code – 1D**
 - **Dr. Wang will give a talk later.**
- **Work has not be done**
 - **Perform S/U analysis with SENS-1D.**
 - **Develop an adjustment code.**
 - **Do adjustment exercise.**

Thank you for your attention.