

The Calculation and Comparison of Benchmark Models with ENDF/B-VIII.0 and CENDL-3.2 Fe-56 Nuclear Data

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Introduction & Motivation

- CENDL-3.2 nuclear data library was published in 2020 and data quality and category had great improvement.
- Determine the influence of improvement of CENDL-3.2.
- 29 iron sensitive models were selected from the ICSBEP and k_{eff} were calculated with CENDL-3.2 Fe-56 nuclear data by contrast with ENDF/B-VIII.0. other nuclides of ENDF/B-VIII.0 were used.

Method

- I. The k_{eff} of CENDL-3.2 and ENDF/B-VIII.0 Fe-56 nuclear data were calculated, respectively.
- II. Absolute bias($\Delta k1$) and relative bias($\Delta k2$) was used to quantify the individual difference.

$$\Delta k1 = \frac{C}{E} - 1$$

$$\Delta k2 = \frac{\Delta k1}{\sigma_{C/E}}$$

$$\sigma_{C/E} = \frac{C}{E} \sqrt{\left(\frac{\sigma_C}{C}\right)^2 + \left(\frac{\sigma_E}{E}\right)^2}$$

- III. The average($Ave_ \Delta k1$) and deviation ($Std_ \Delta k1$) of absolute bias and goodness of fit(χ^2) were selected to evaluate the integral agreement.

$$Ave_ \Delta k1 = \frac{\sum \Delta k1}{n}$$

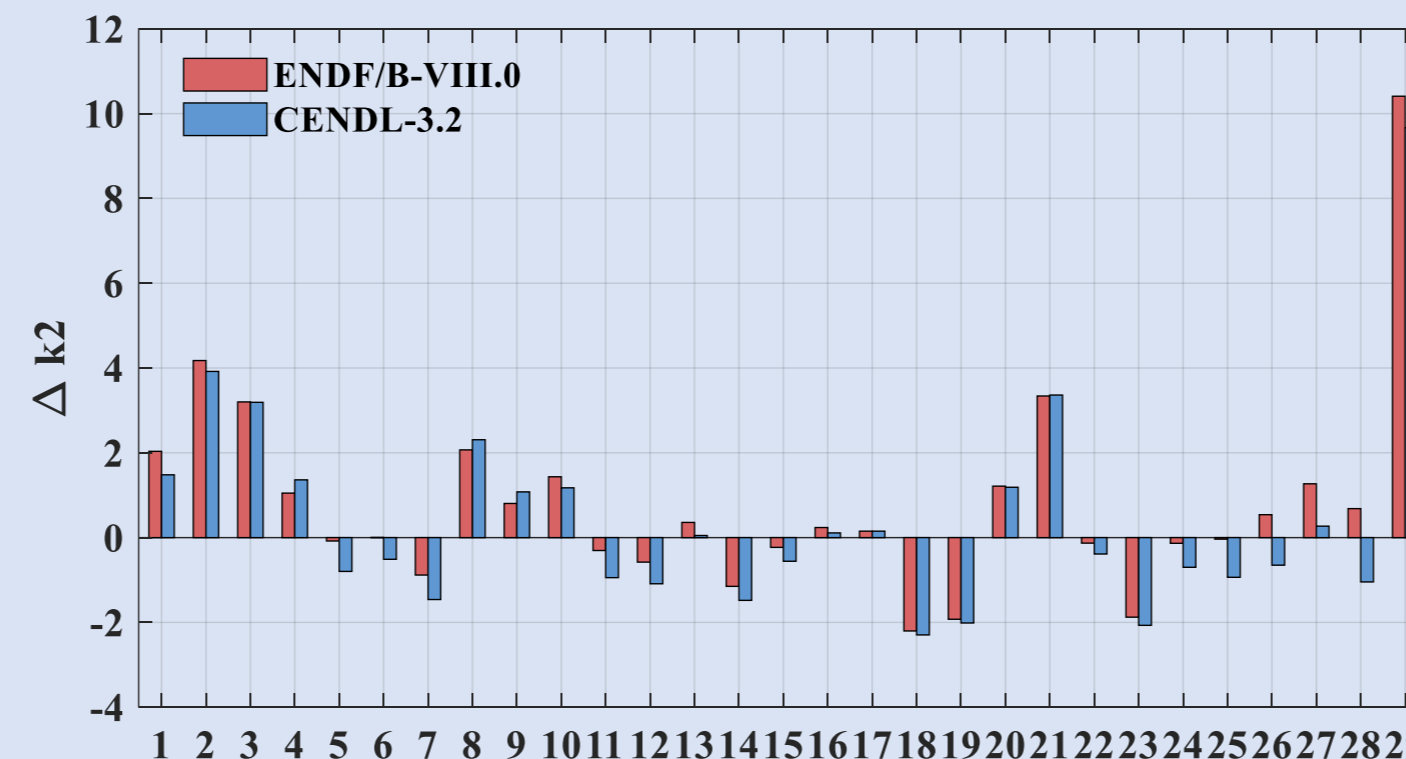
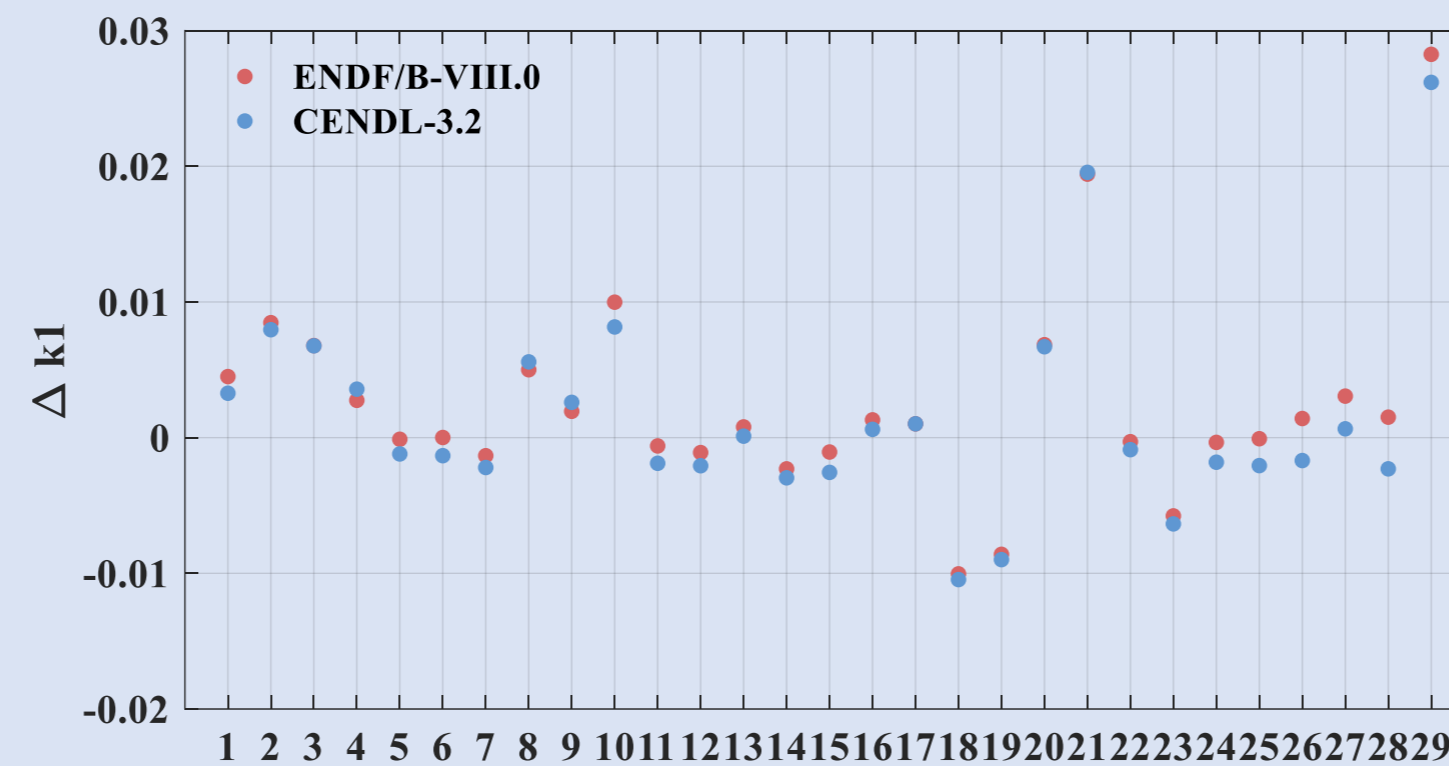
$$Std_ \Delta k1 = \sqrt{\frac{\sum (\Delta k1 - Ave_ \Delta k1)^2}{n}}$$

$$\chi^2 = \frac{\sum ((C - E)/\sigma_E)^2}{n}$$

Note: C is calculated values; E is benchmark values; $\sigma_{C/E}$ is uncertainty of C/E; n is the number of models.

Results & Discussion

Calculated results are as follows.



	Library	Ave_Δk1/pcm	Std_Δk1/pcm	χ ²
Uranium models	ENDF/B-VIII.0	208.0	615.4	3.099
	CENDL-3.2	153.5	631.5	3.250
Plutonium models	ENDF/B-VIII.0	346.7	967.6	15.11
	CENDL-3.2	146.6	952.4	13.26

Note: 1-21 are highly enriched uranium models; 22-29 are plutonium mental models.

Two results can be obtained from three charts.

- $\Delta k1$ and $\Delta k2$ of CENDL-3.2 is lower than ENDF/B-VIII.0 by not more than 400pcm or $2\sigma_{C/E}$ for most models. Only four highly enriched uranium models are different. This indicates that these models, especially for uranium models, have inherent differences which have different responses from changes of Fe-56 nuclear data.
- The difference of $Std_ \Delta k1$ and χ^2 between two library is small. This corresponds with the slight changes of Fe-56 nuclear data and shows that CENDL-3.2 Fe-56 nuclear data may be more suitable for plutonium which have better agreement and it's just the opposite for uranium models. Moreover, $Ave_ \Delta k1$ have large discrepancies that caused by positive and negative $\Delta k1$ values of two libraries.

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