

IRSN

INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Faire avancer la sûreté nucléaire

New Results

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WPEC Sg. 33 Meeting
Issy-les-Moulineaux
November 29-30, 2012

Context

- Very preliminary results were presented in May 2012
- Sensitivity were computed with SCALE6.0/TSUNAMI-3D, -1D
- Discrepancies were observed in k_{eff} and sensitivity results for some configurations
- This presentation shows improvements to the results and
- New results of the adjustment

Computations

■ *SCALE6.1*

Nuclear data: CE & 238-group ENDF-B/VI.8 and ENDF-B/VII

Neutron transport: KENOvA and KENOVI

Sensitivities: TSUNAMI-3D, TSUNAMI-1D

■ ERANOS 2.2

Nuclear data: 33-group ENDF-B/VI.8

Neutron transport &

Sensitivities: BISTRO (Transport solver, RZ geometry)

Computations (cont'd)

Calculations used in the adjustment are shown in red

#	Configuration	Parameter	Parameter calculated with	Sensitivity calculated with
1	JEZEBEL	KEFF	KENOVa & ERANOS	TSUNAMI-3D & ERANOS
2	JEZEBEL	F28/F25	KENOVa & ERANOS	TSUNAMI-ID & ERANOS
3	JEZEBEL	F49/F25		
4	JEZEBEL	F37/F25		
5	JEZEBEL Pu240	KEFF	KENOVa & ERANOS	TSUNAMI-3D
6	FLATTOP-PU	KEFF	ERANOS	ERANOS
7	FLATTOP-PU	F28/F25		
8	FLATTOP-PU	F37/F25		
9	ZPR6-7	KEFF	KENOVa & KENOVI & ERANOS	TSUNAMI-3D & ERANOS
10	ZPR6-7	F28/F25	ERANOS	ERANOS
11	ZPR6-7	F49/F25		
12	ZPR6-7	C28/F25		
13	ZPR6-7 Pu240	KEFF	KENOVa & KENOVI & ERANOS	TSUNAMI-3D & ERANOS
14	ZPPR-9	KEFF		TSUNAMI-3D & ERANOS
15	ZPPR-9	F28/F25	ERANOS	ERANOS
16	ZPPR-9	F49/F25		
17	ZPPR-9	C28/F25		
18	ZPPR-9	NAVOID STEP3	KENOVa & KENOVI & ERANOS	TSUNAMI-3D & ERANOS
19	ZPPR-9	NAVOID STEP5		
20	JOYO MK-I	KEFF	KENOVa & KENOVI & ERANOS	TSUNAMI-3D & ERANOS

Code and Data Used for the Adjustment

BERING code (IRSN) by E. Ivanov

■ Data used for this exercise

Models: Simplified

C/E: SCALE/KENOVa 238 gr. & CE, ERANOS 33 gr.

Sensitivities: SCALE/TSUNAMI-3D 238 gr., ERANOS 33 gr.

Experimental correlations: by Makoto Ishikawa

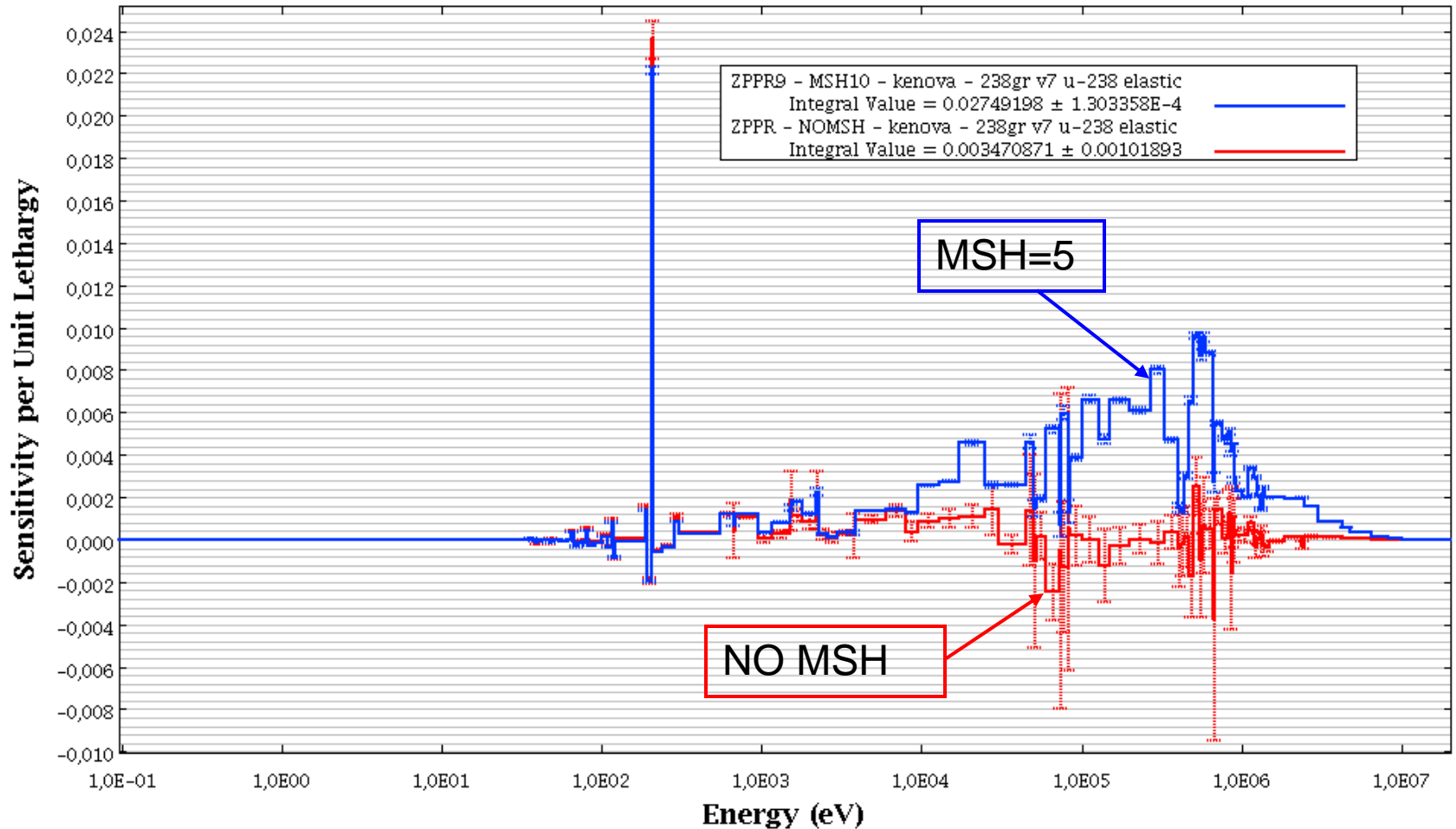
ND Covariances: COMMARA 2.0

■ Other data will be used for ND-2013 paper

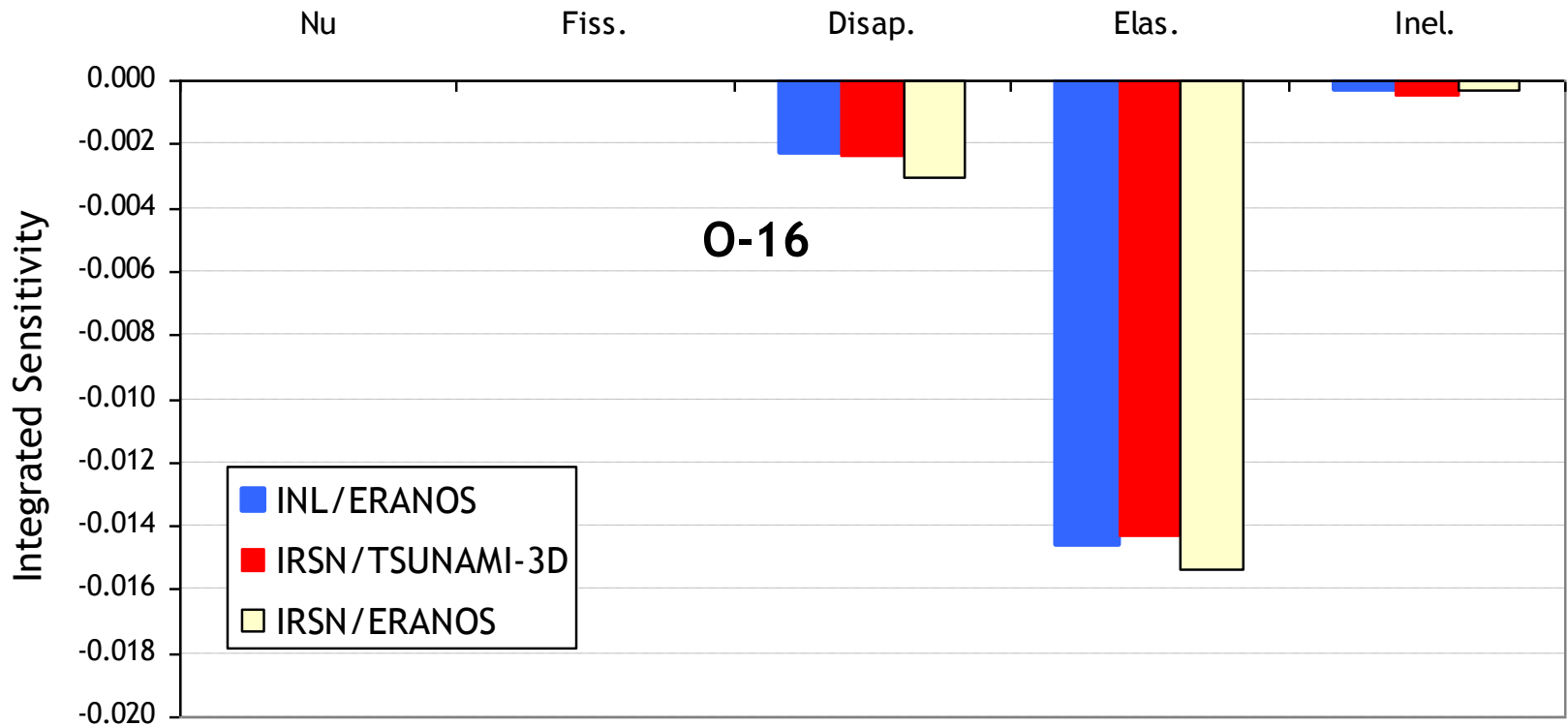
ND Covariances: SCALE, JENDL-4.0, TENDL and ENDF/B-VII.1

K_{eff} Sensitivity: ZPPR-9

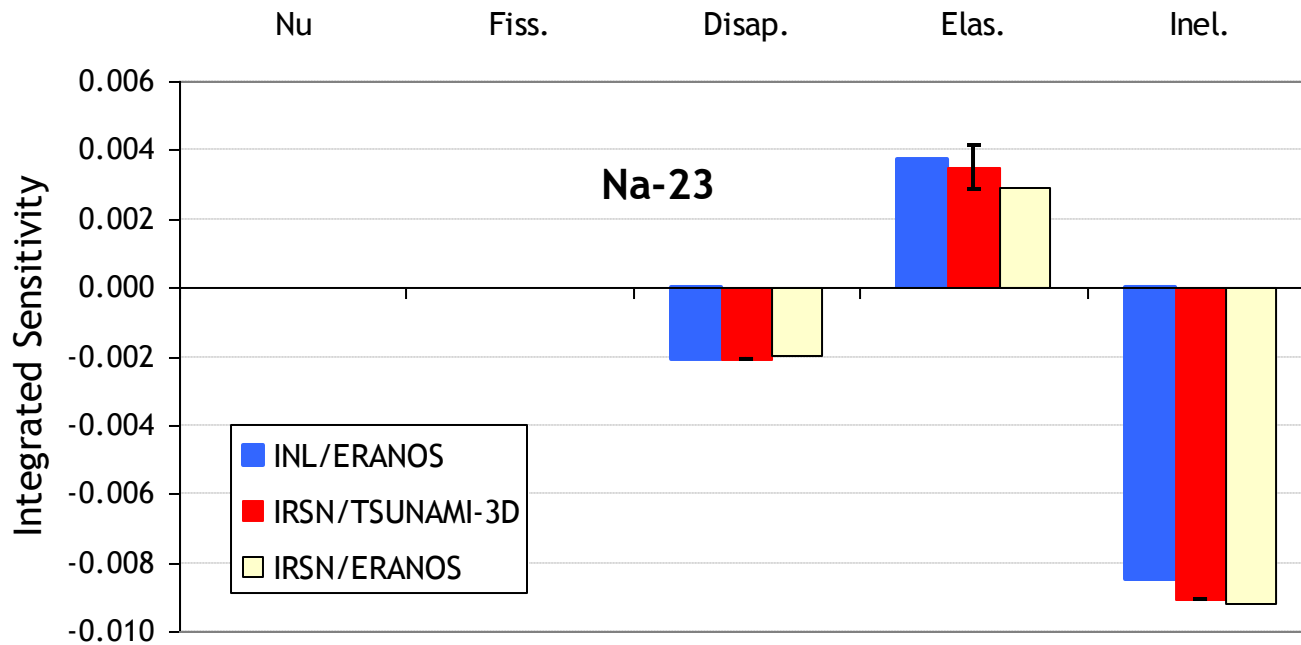
u-238 elastic



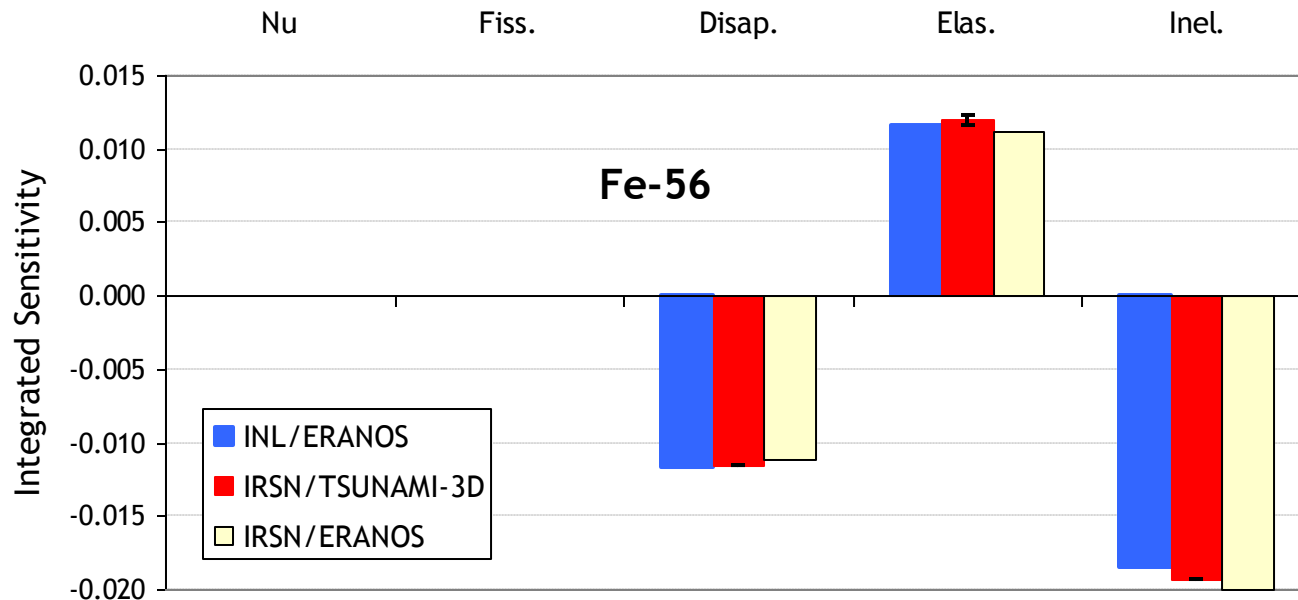
K_{eff} Sensitivity: ZPPR-9



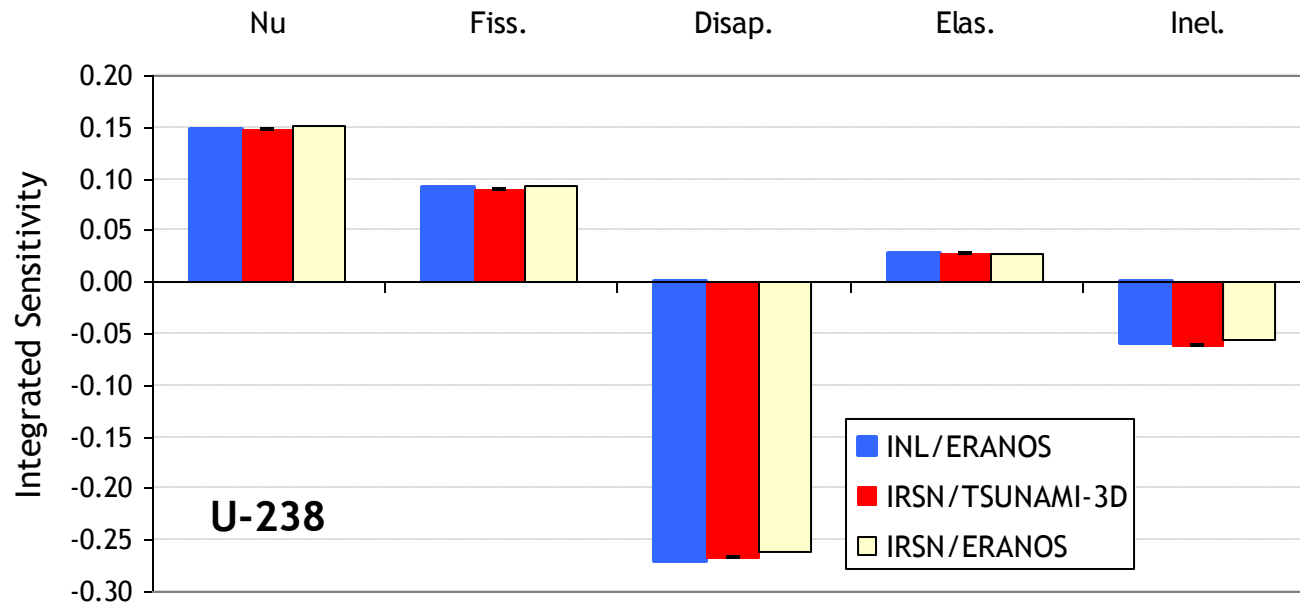
K_{eff} Sensitivity: ZPPR-9



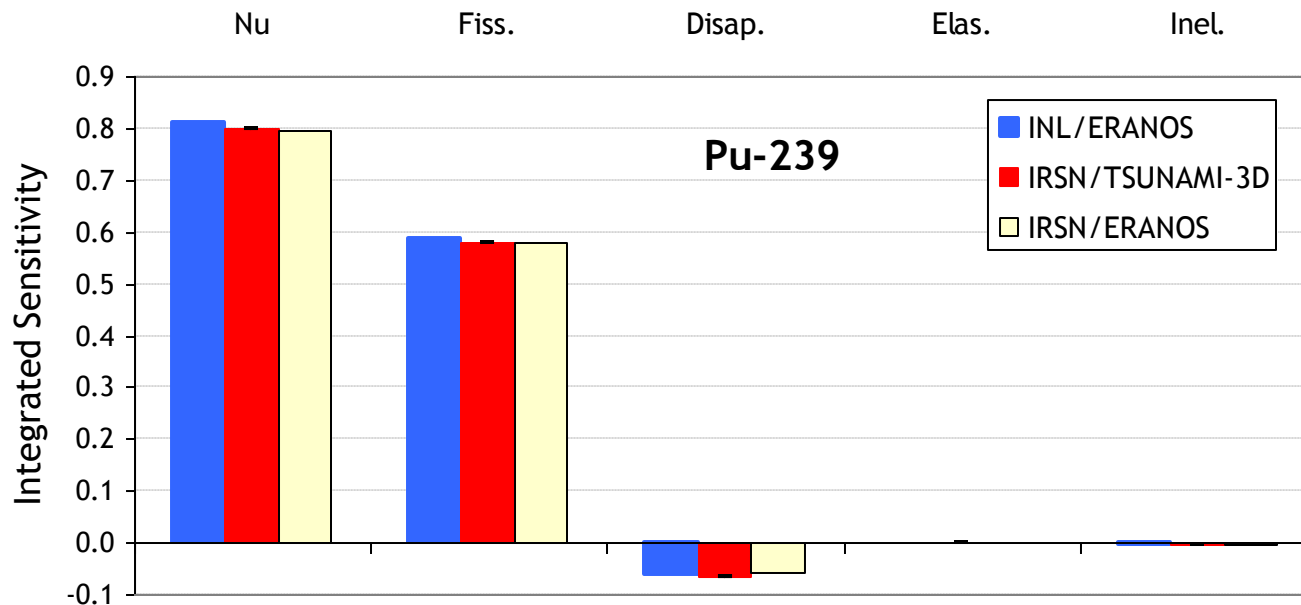
K_{eff} Sensitivity: ZPPR-9



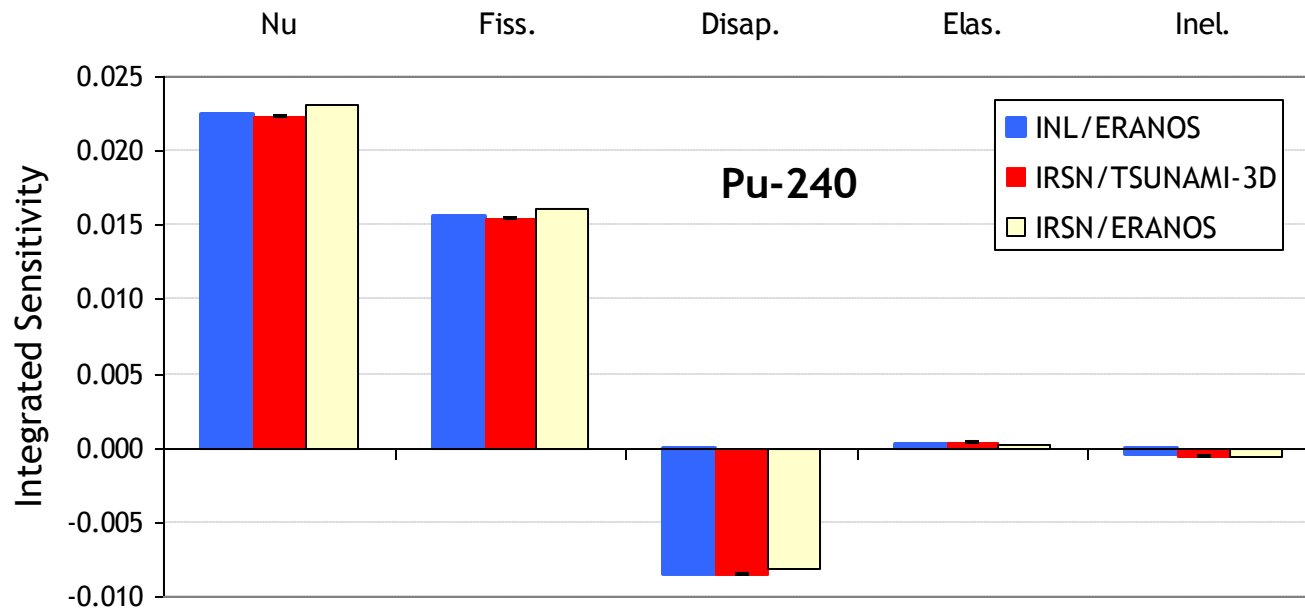
K_{eff} Sensitivity: ZPPR-9



K_{eff} Sensitivity: ZPPR-9

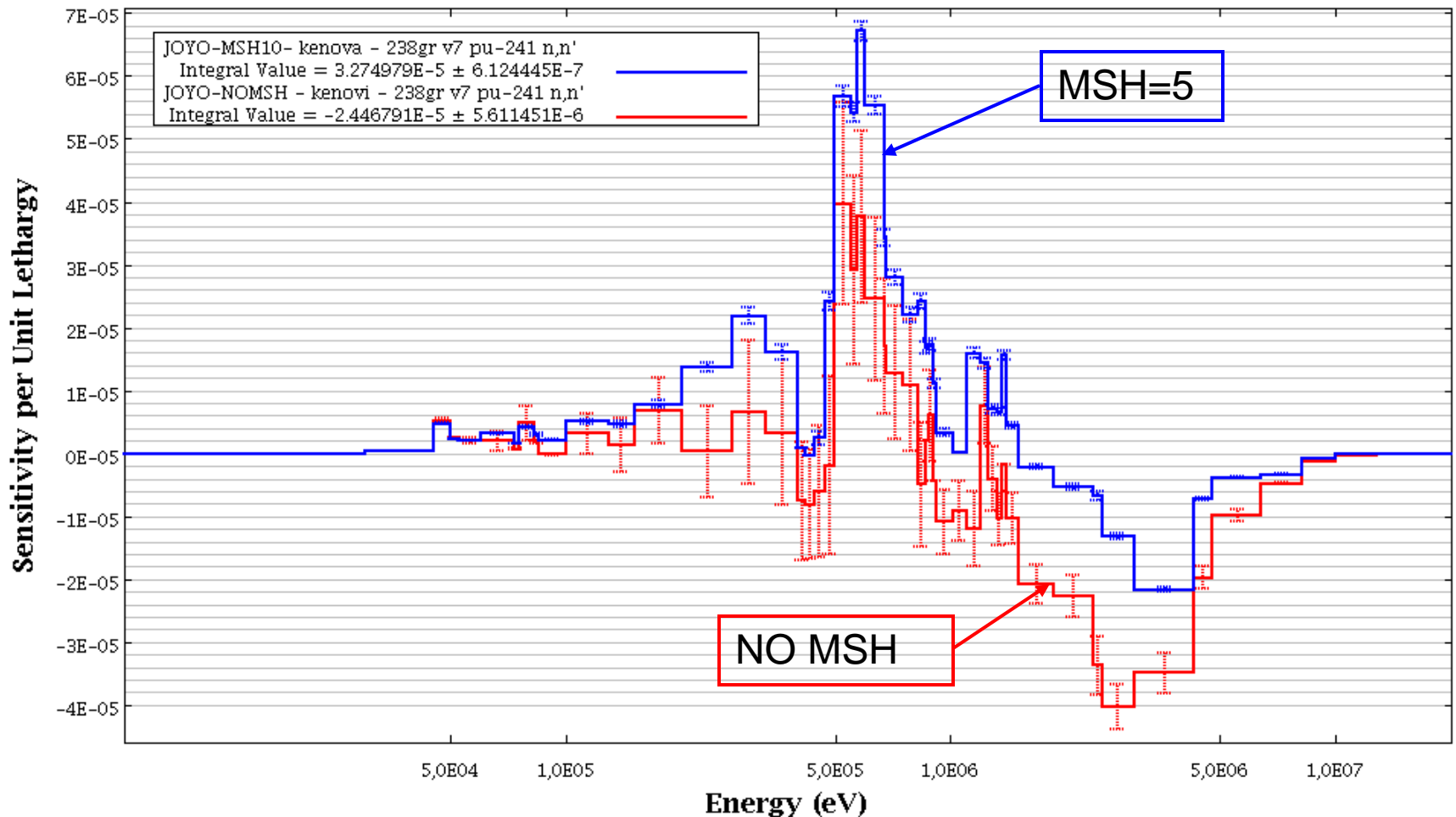


K_{eff} Sensitivity: ZPPR-9

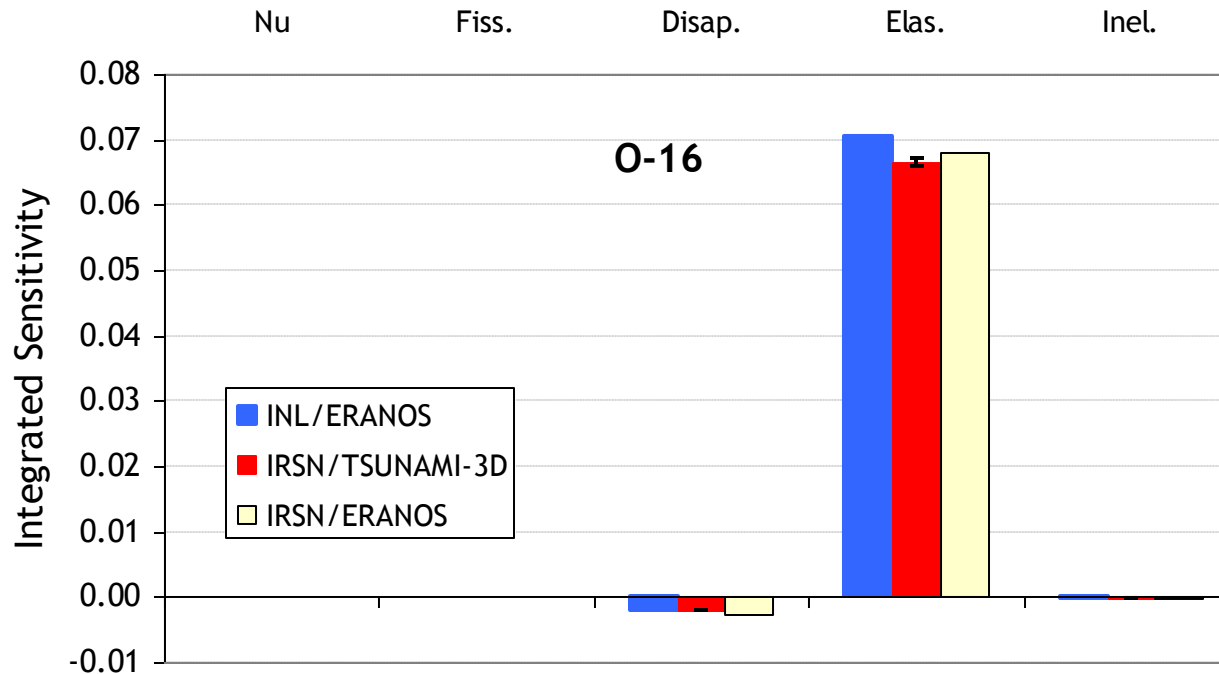


K_{eff} Sensitivity: JOYO

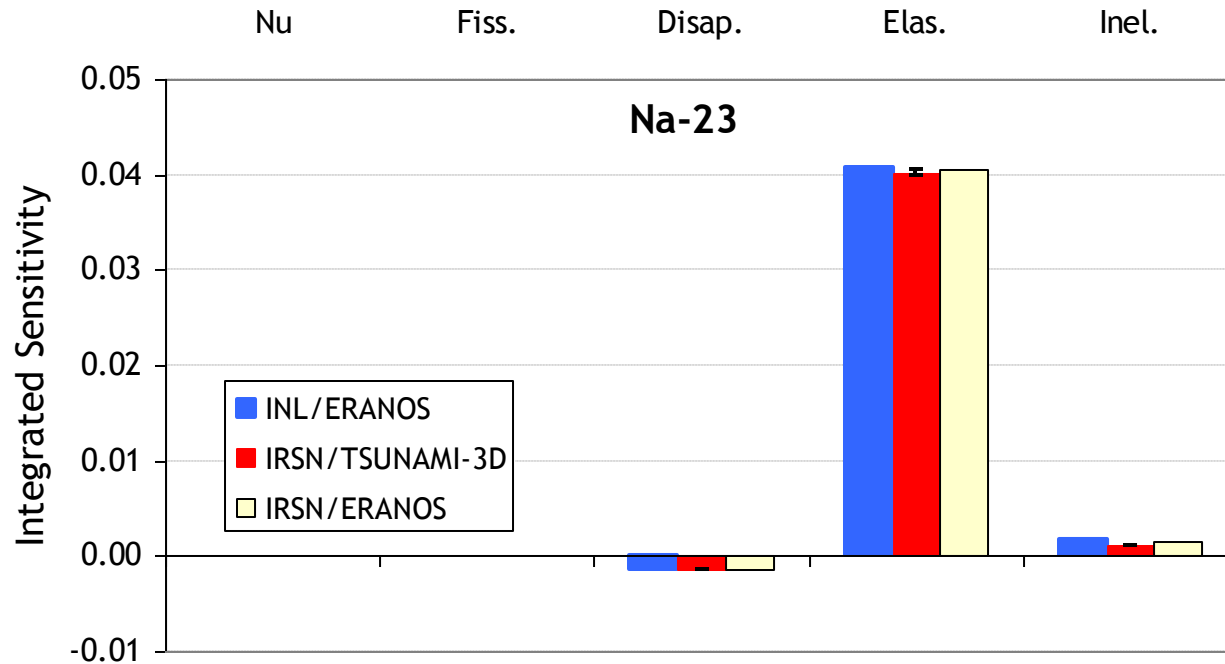
pu-241 n,n'



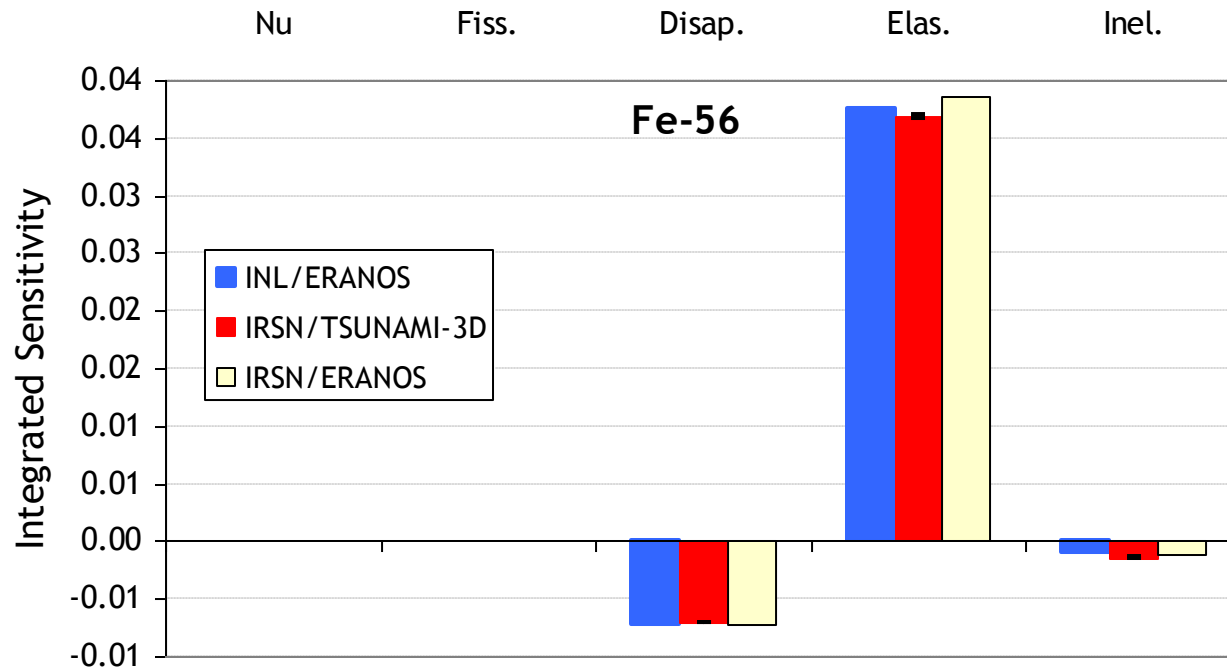
K_{eff} Sensitivity: JOYO



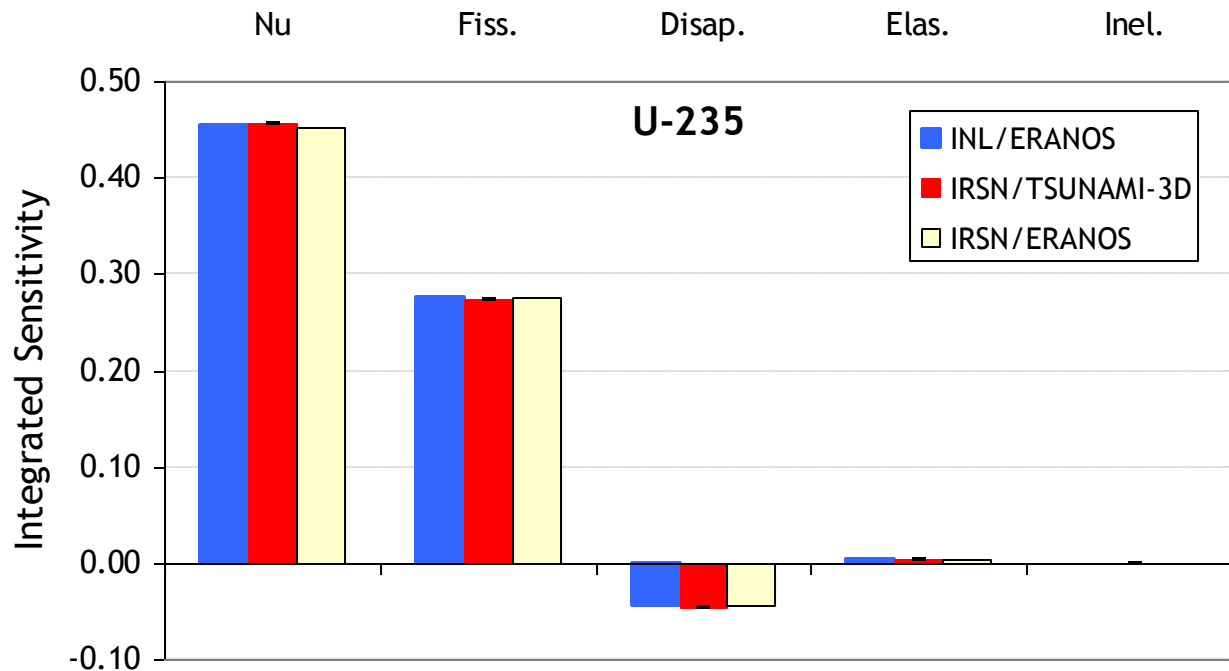
K_{eff} Sensitivity: JOYO



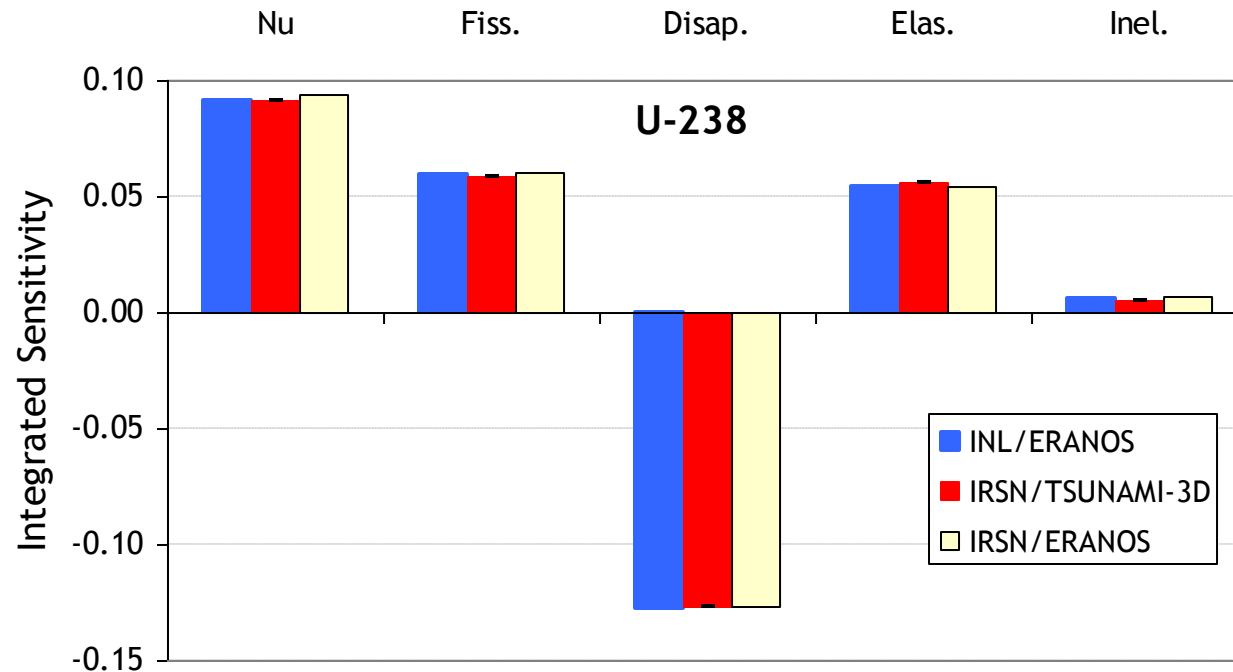
K_{eff} Sensitivity: JOYO



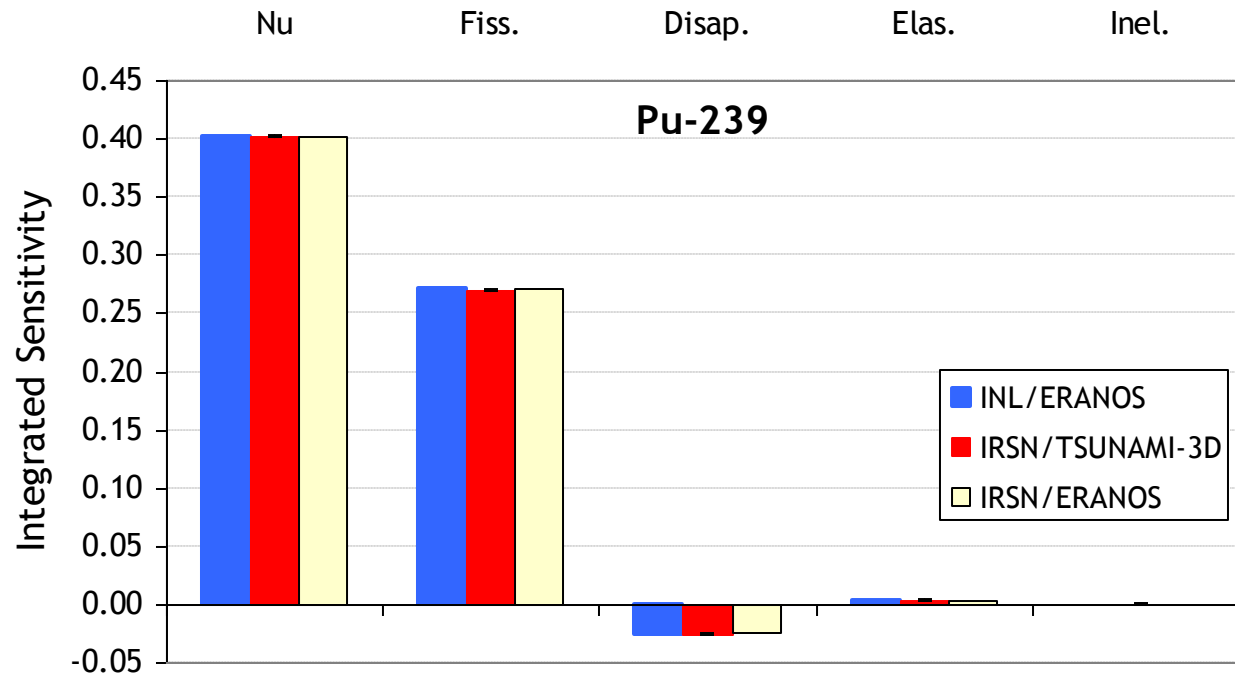
K_{eff} Sensitivity: JOYO



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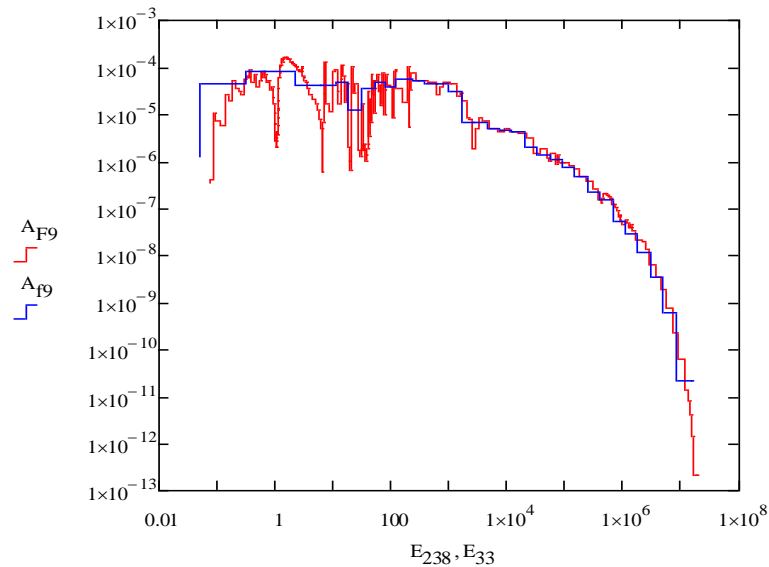


Data for Adjustment: k_{eff} Sensitivities

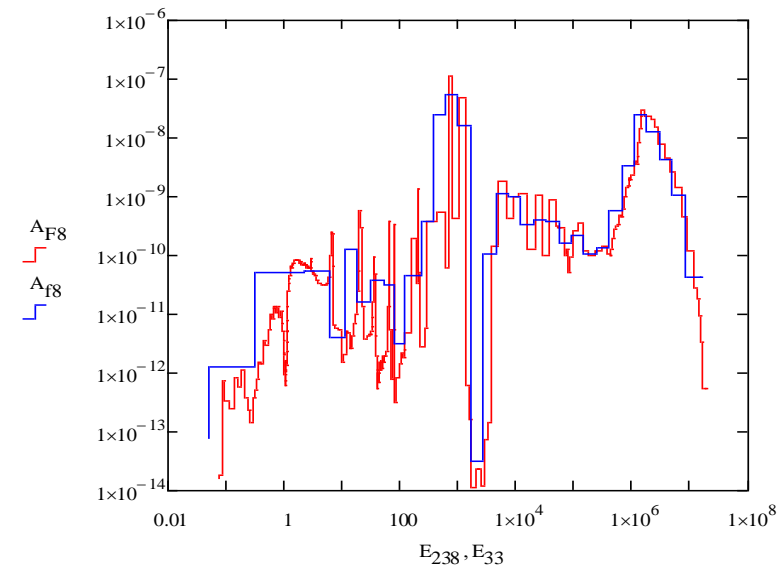
Verification of data transfer from 238 groups to 33 groups

$$S_k(E_g)/\Delta E_g$$

^{238}U fission for ABR



^{239}Pu fission for ABR

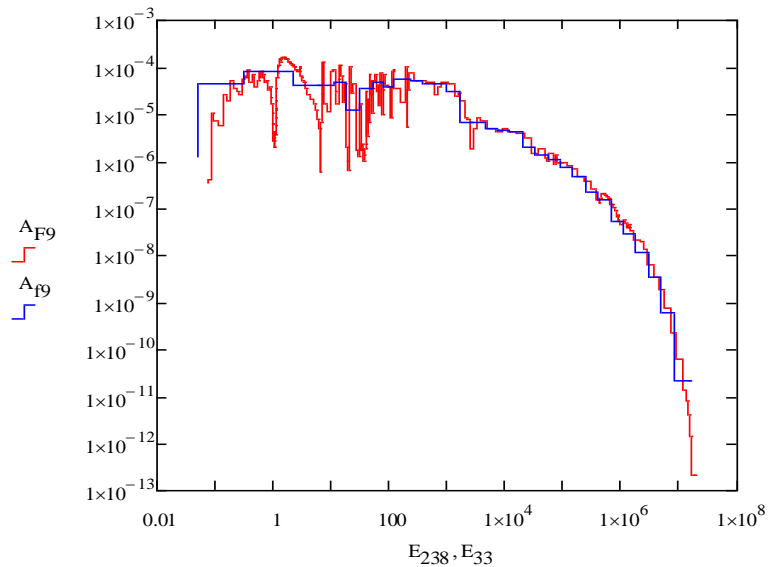


k_{eff} Sensitivities

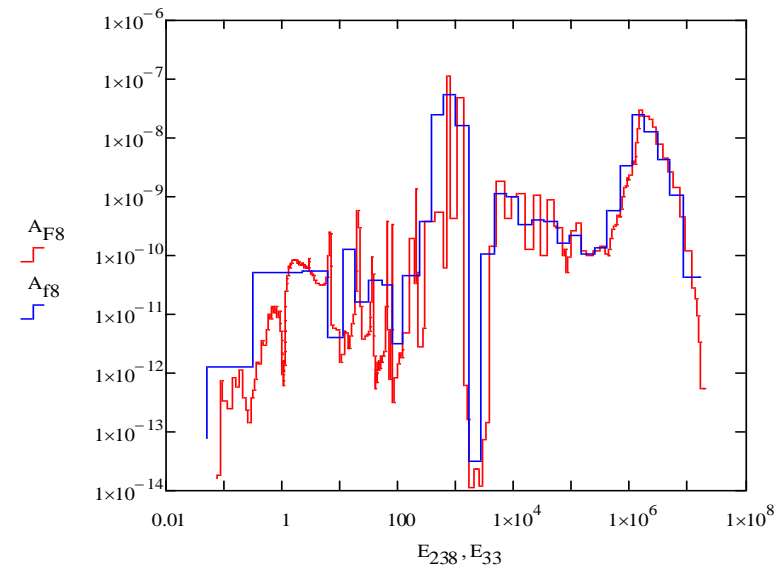
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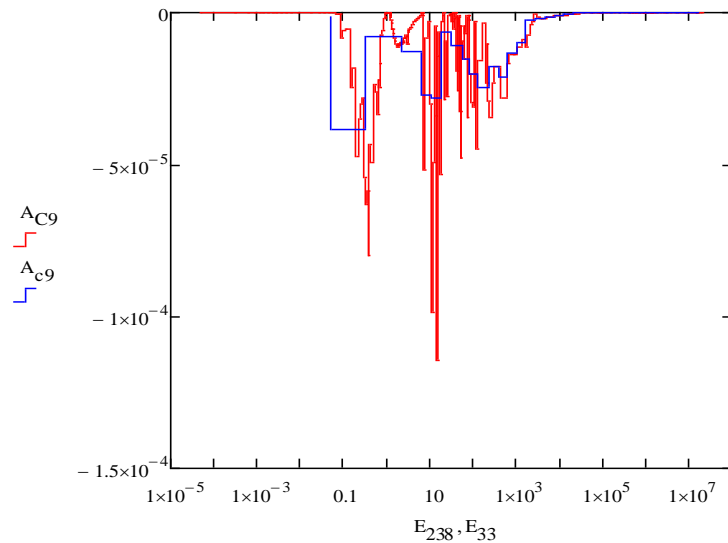


Data for Adjustment: keff Sensitivities

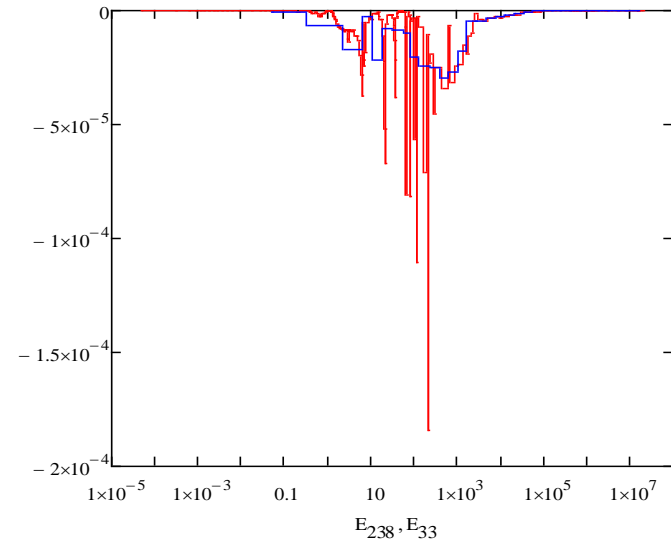
Verification of data transfer from 238 groups to 33 groups

$$S_k(E_g)/\Delta E_g$$

^{238}U capture for ABR



^{239}Pu capture for ABR

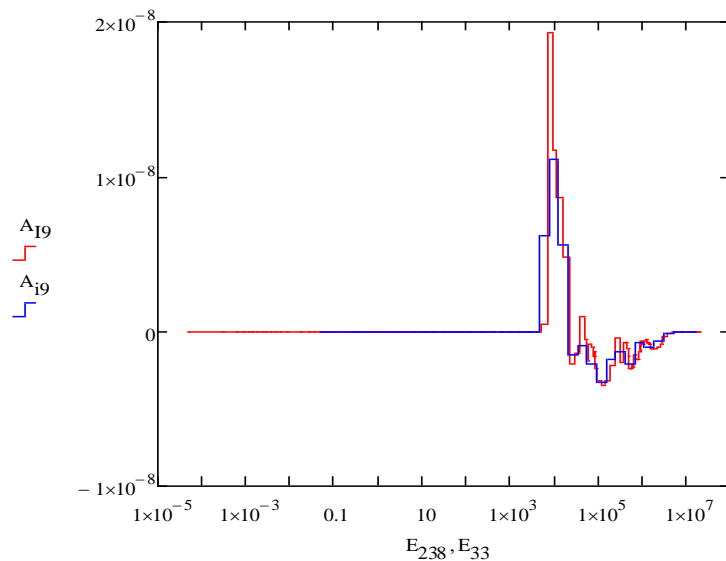


Data for Adjustment: keff Sensitivities

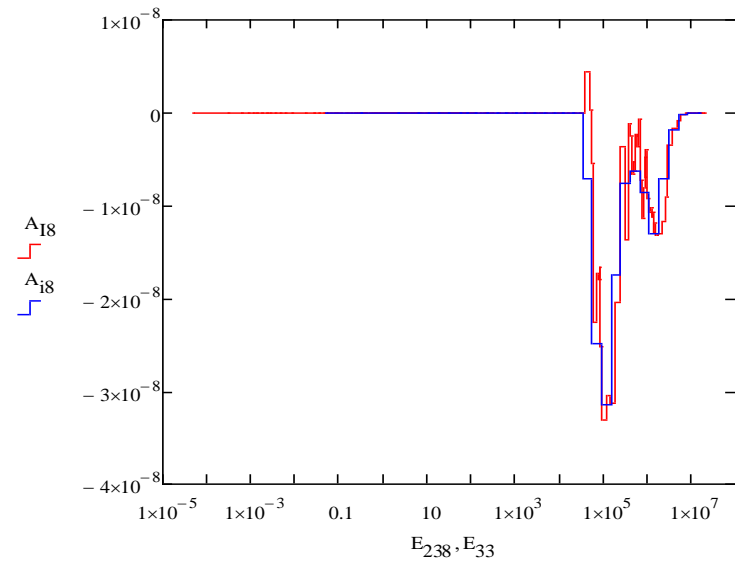
Verification of data transfer from 238 groups to 33 groups

$$S_k(E_g)/\Delta E_g$$

^{238}U inelastic for ABR



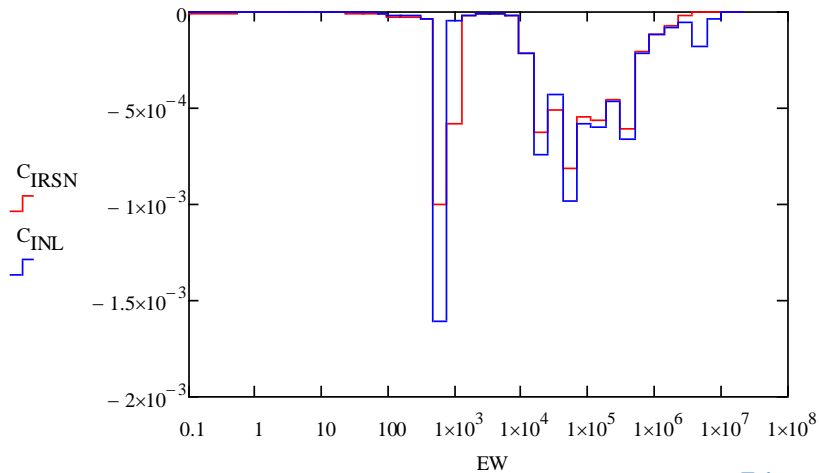
^{239}Pu inelastic for ABR



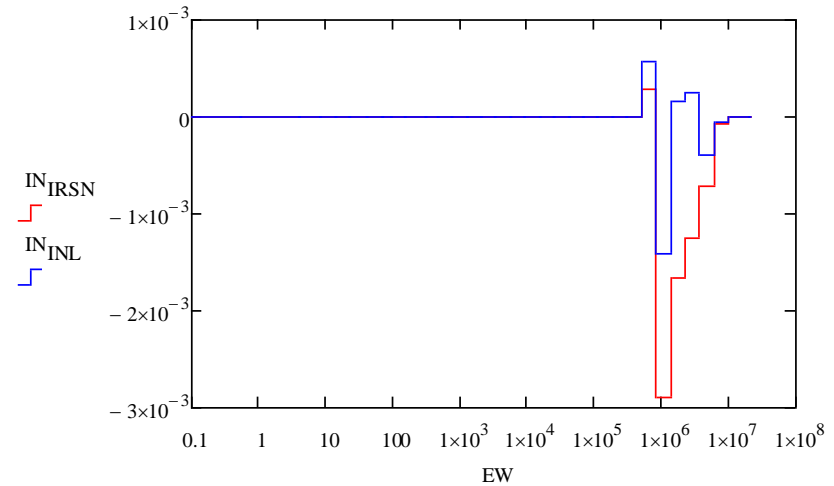
Data for Adjustment: keff Sensitivities

Verification of data transfer from 238 groups to 33 groups

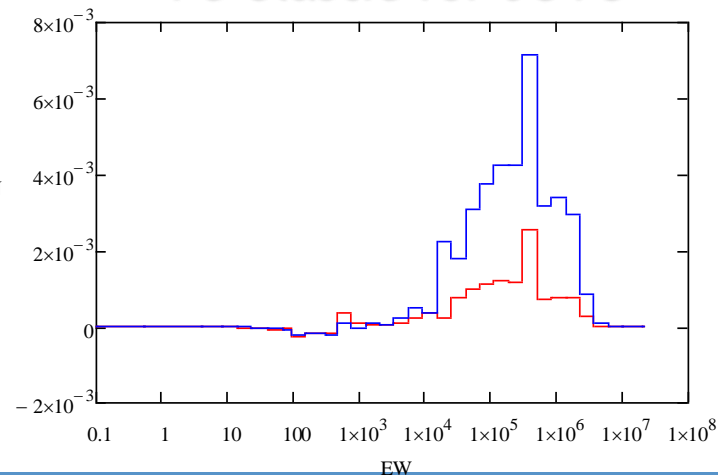
^{56}Fe capture for JOYO



^{56}Fe inelastic for JOYO



^{56}Fe elastic for JOYO



Verification of BERING Code

Many thanks to Pino for providing us with ALL the INL input data!

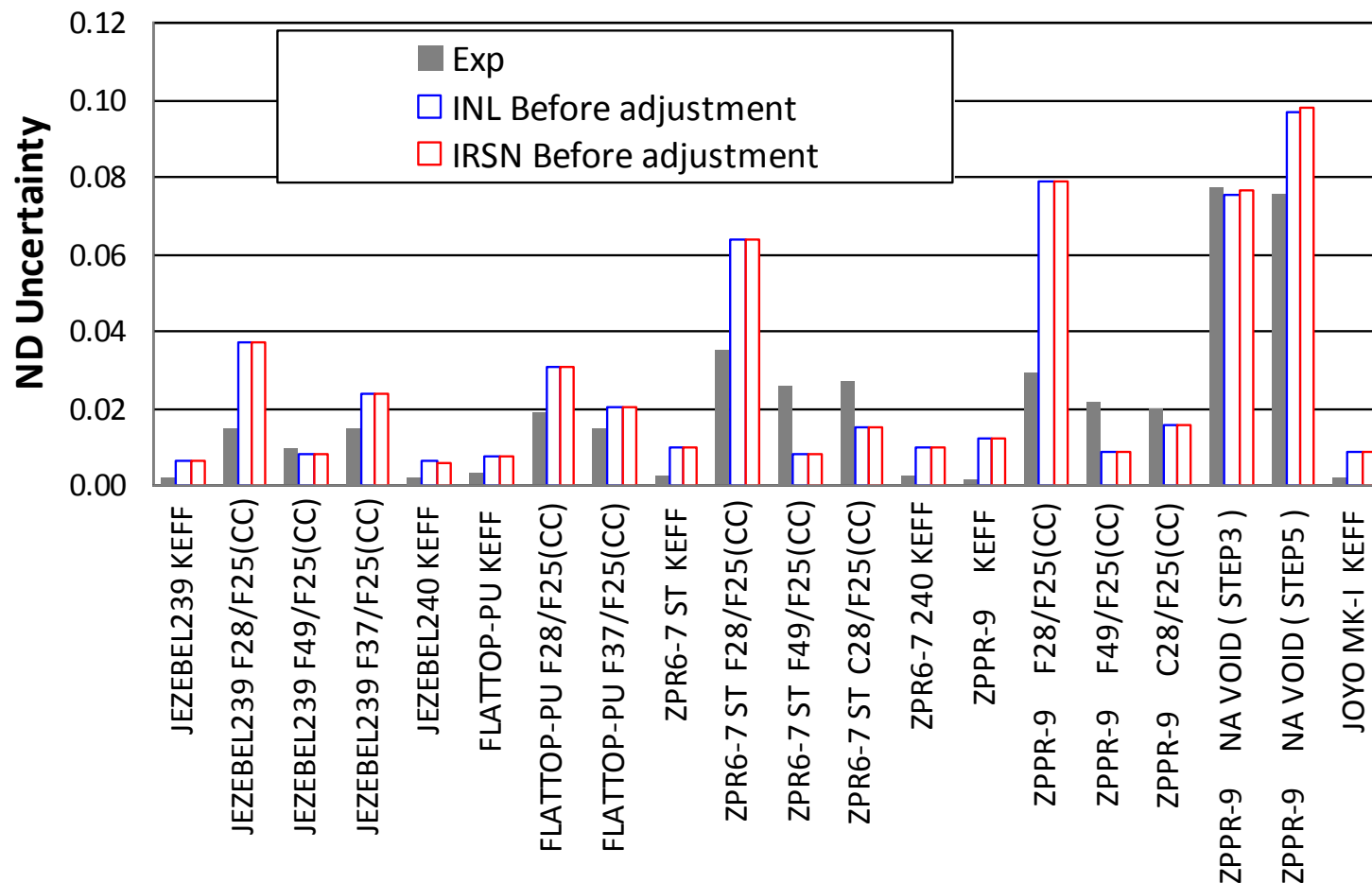
- The INL input data were used for adjustment with BERING code
- Good agreement in output results (see next slides)
- This adjustment exercise facilitated BERING verification



Grazie

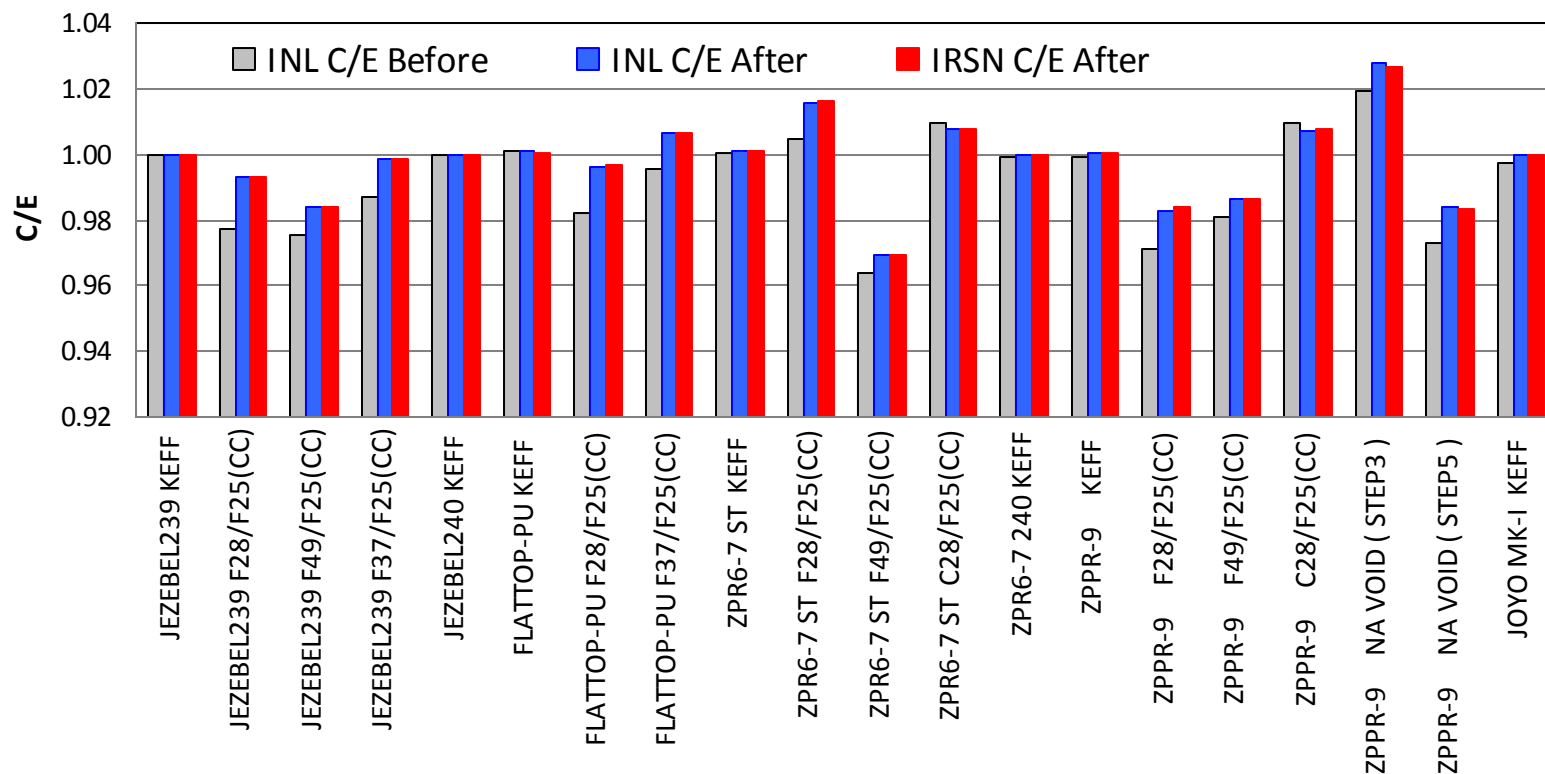
Verification of BERING Code

Uncertainty due to ND



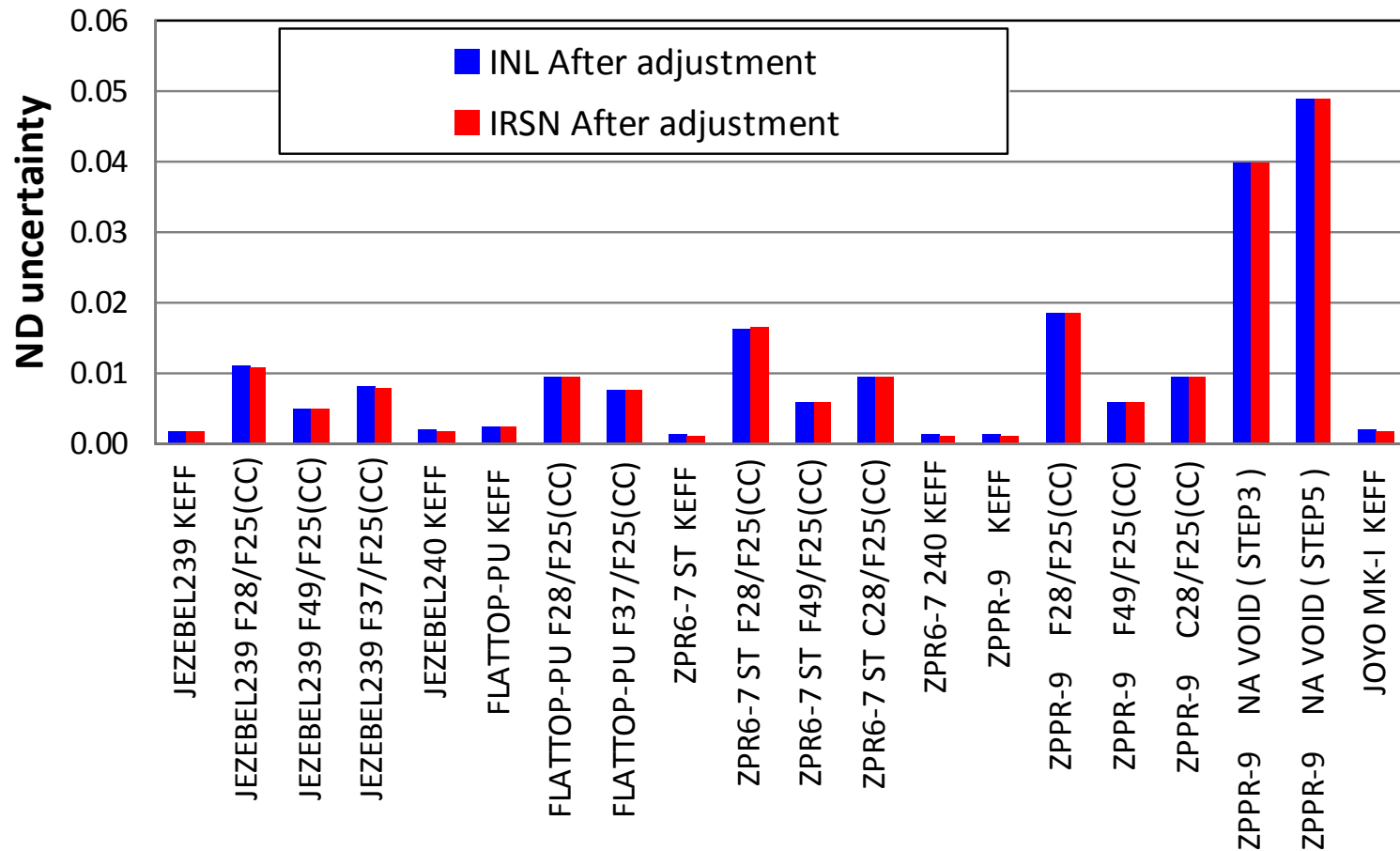
Verification of BERING Code (cont'd)

Bias

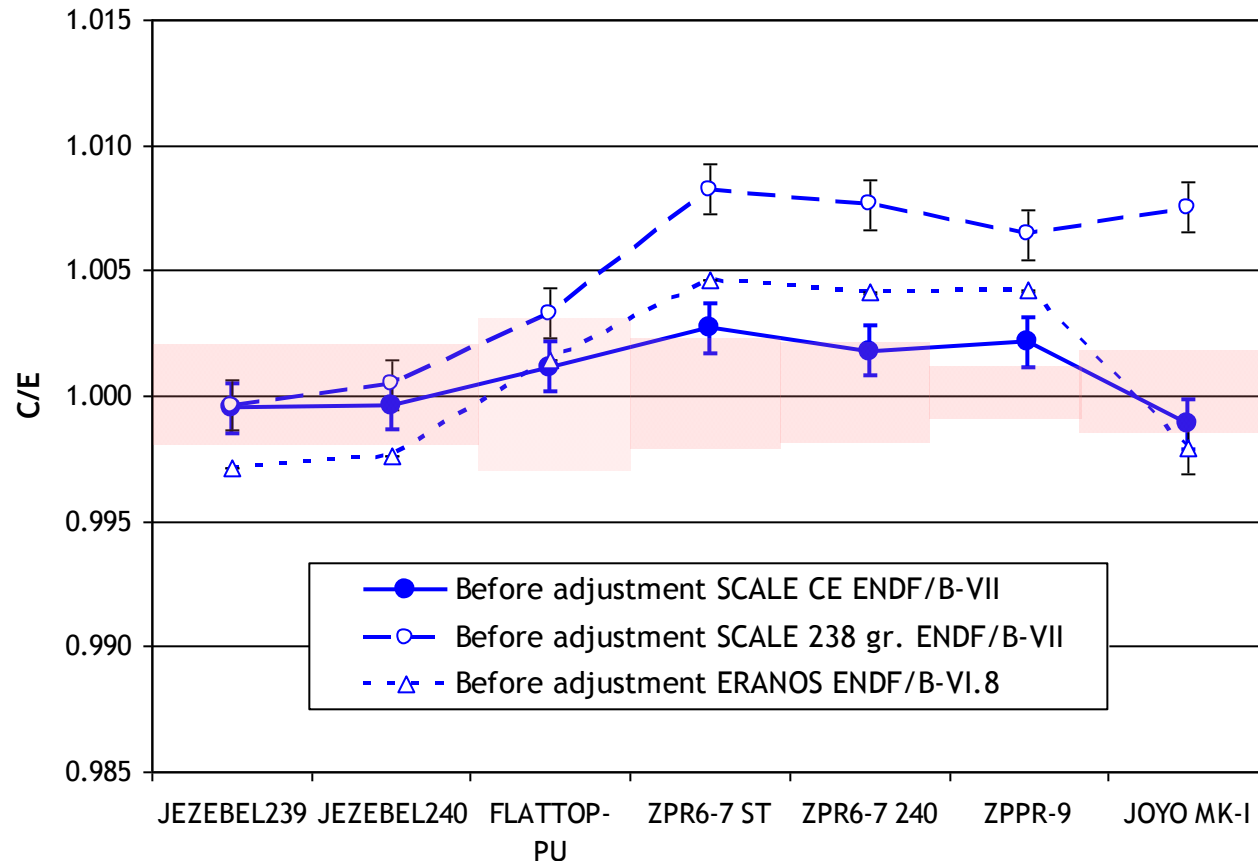


Verification of BERING Code (cont'd)

Bias Uncertainty



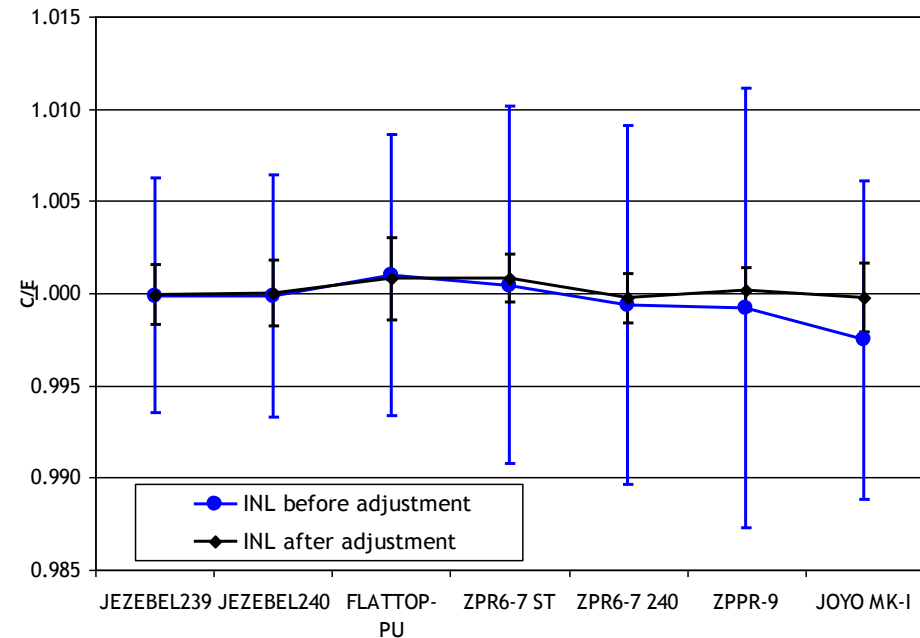
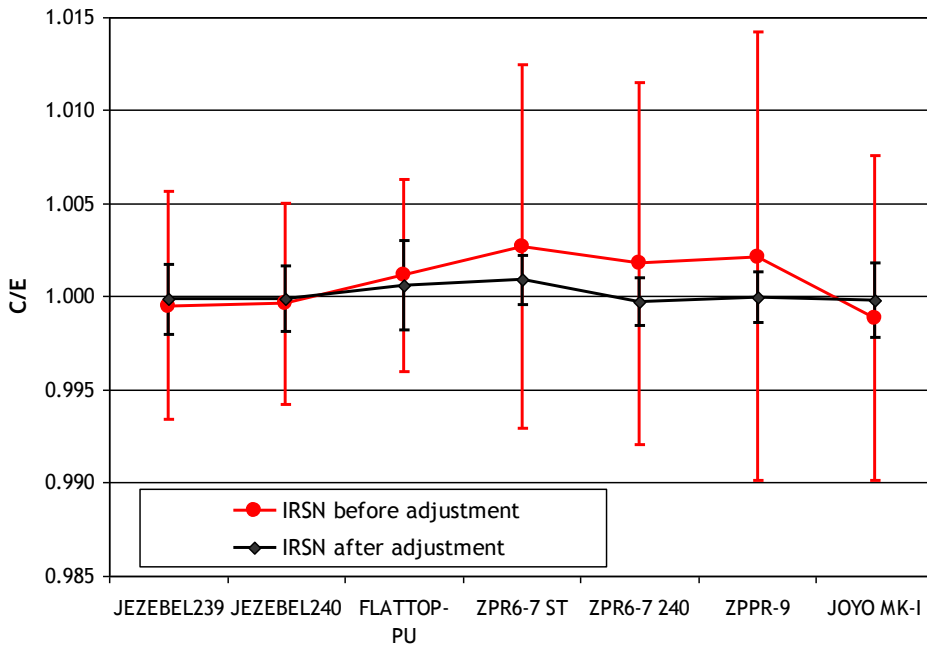
C/E Comparison Before Adjustment



SCALE/KENO_{Va} 238 gr. x Monte Carlo Corrective factor Sg. 33 = SCALE/KENO_{Va} CE
 ERANOS x Deterministic Corrective factor Sg. 33 ≠ SCALE/KENO_{Va} CE

Comparison of Adjusted Data

Only k-eff values



Concluding Remarks

- Work done since the last meeting
 - Major efforts - on initial data verification: Sensitivities and C/E
 - BERING verification
- Further work (hopefully, by ND-2013)
 - Understand C/E discrepancies in ERANOS and SCALE/KENOVa 238 gr. results
 - Calculate corrective factors based on comparison of SCALE/KENO CE & 238 gr (detailed, if possible and simplified) and ERANOS
 - Include R/R and SV into adjustment
 - Include ERANOS results into adjustment
 - Include SCALE, TENDL, JENDL4.0, and ENDF/B-VII.1 covariances into adjustment
 - Use SCALE/TSURFER code for adjustment