Sensitivity analysis of FLATTOP-Pu using SUSD3D/PARTISN, SUSD3D/ANISN with different methods and P_N orders

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Cross Section Sensitivity Coefficients Forward / Adjoint Flux Approach



Loss term (absorption, scattering)

(scattering, fission, nu-bar)

Direct term

(detector response function)

SUSD3D : sensitivity and uncertainty code system



SUSD3D uses

- **flux moment files** produced by **SN codes**: DORT-TORT, ONE-, TWO-, THREEDANT and **PARTISN**

- angular flux files from ANISN and DOT-III

FLATTOP-Pu calculations

- ENDF/B-VII.0, 33 groups, P1 and P5
- PARTISN: flux moments passed to SUSD3D
- ANISN: angular fluxes converted in SUSD3D to moments; in principle P_{N} order in transport can be different from P_{N} in sensitivity calculation as well as different for GAIN and LOSS term.

Comparison with:

TSUNAMI-1D from SCALE 6.1 and SCALE-6, P1 and P5 in 238-groups and ERANOS/PSI (ongoing).

SUSD3D/ PARTISN/ ANISN		Code	Transport	Sensitivity	
				loss	gain
		PARTISN	P5	P5	P5
			P1-BGS	P1	P1
		ANISN	P5	P5	P5
				P1	P1
			P1-BGS	P1	P1
Code/options	k _{eff} (dir)			P5	P5
PARTISN / P5	1.000302			P5	P1
	0.000022		P1	P1	P1
PARTISN/P1-BHS	0.999023			P5	P5
ANISN / P5	1.00337			P5	P1
ANISN / P1-BHS	1.00208				
ANISN / P1	0.984632	BGS=Bell-Hansen-Sadmeister			

transport correction

FLATTOP-Pu (P₁) ²³⁸U

	Sensitivity (%/%)		∆k _{eff} (%)	
Code/options	²³⁸ U el	²³⁸ U inel	²³⁸ U(el+inel)	Total
PARTISN / P5	0.140	0.065	0.41%	1.20%
PARTISN P1 (BHS)	0.172	0.097	0.68%	1.32%
ANISN-P5/ SUSD3D-P5	0.140	0.063	0.39%	1.19%
ANISN-P5/ SUSD3D-P1	0.171	0.095	0.65%	1.30%
ANISN P1- BHS / SUSD3D-P1	0.171	0.096	0.66%	1.31%
ANISN P1-BHS/ SUSD3D-P5	0.141	0.065	0.40%	1.19%
ANISN P1-BHS / SUSD3D-P1_gain	0.118	0.065	0.63%	1.29%
ANISN-P1/ SUSD3D-P1	0.176	0.100	0.70%	1.33%
ANISN-P1 / SUSD3D-P5	0.149	0.074	0.49%	1.23%
ANISN-P1 / SUSD3D- P1_gain	0.130	0.074	0.68%	1.32%



FLATTOP-Pu (P₅)

ORNL-Tsunami (FLATTOP-PU, KEFF) Pu-239 Disap. MF3/MT100 — Susd3d-1dant_p3 FLATTOP-PU keff 239Pu Elas. MF3/MT2

Susd3d-1dant_p3 FLATTOP-PU keff 239Pu Inel. MF3/MT4 — Susd3d-1dant_p3 FLATTOP-PU keff 239Pu Disap. MF3/MT101 — ANISN-p5 nelas pu239 — ANISN-p5 ninel pu239

ANISN-p5 ng pu239

itivity

Ser

CONCLUSIONS

- large impact of P_{N} orders on FLATTOP-Pu transport, sensitivity and uncertainty analysis,
- surprisingly, using both angular flux (gain sensitivity term) and moments (loss), although in principle "correct" only slightly improves the sensitivity calculations.
- in spite of large differences in k_{eff} between the BHS corrected and uncorrected cross section computations (more than 1700 pcm) are the corresponding sensitivities not too different;
- Although not demonstrated it is expected that applying the BGS correction to the cross-sections used in the SUSD3D sensitivity calculations would resolve the relatively large differences between the sensitivities based on P5 and P1-BHS transport calculations.
- P5: excellent agreement between SUSD3D/PARTISN, SUSD3D/ANISN and TSUNAMI results;
- <u>P1:</u> consistent results using SUSD3D/PARTISN and SCALE-6;
- <u>P1:</u> consistent results using SUSD3D/ANISN P1_{transp}-P5_{loss}-P1_{gain} and SCALE-6.1 & ERANOS P1.