Am Sphere Sensitivity-Uncertainty Analysis

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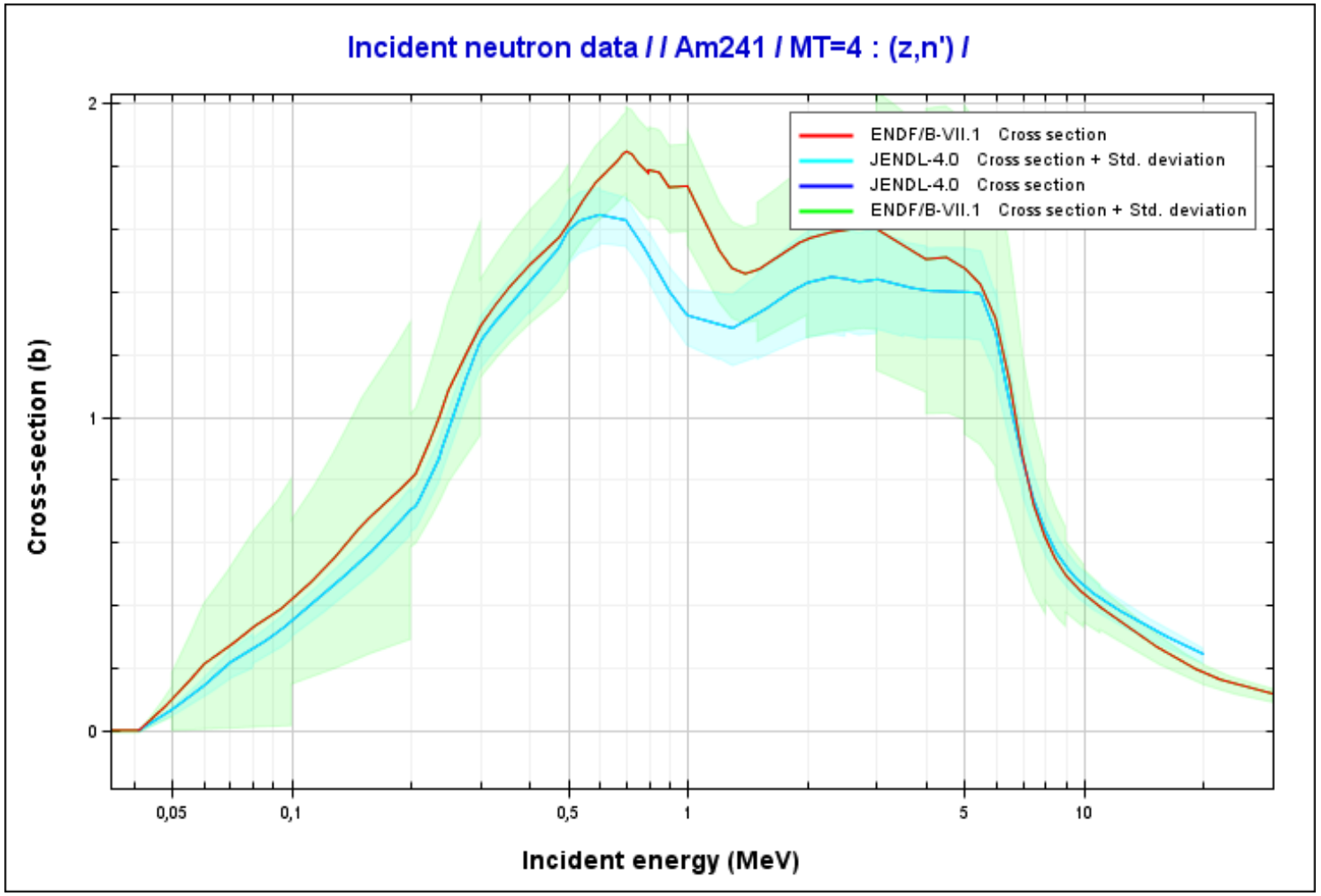
Am Sphere

- Case studied: Am-241 sphere (r=9.94 cm) with C reflector (r=30 cm)
- Transport code used: PARTISN, **S-48, P-5**
- Cross sections: **33 energy groups,**
- **ENDF/B-VII.0** processed by NJOY-99
- **JENDL-4.0** processed by NJOY-99 and NJOY-2012

k-eff	Direct	Adjoint
ENDF/B-VII.0	1.01696956	1.01696610
JENDL-4.0m	1.05187654	1.05187285

Am-241 Inelastic cross sections



SUSD3D sensitivity/uncertainty

Cross-section covariance matrices:

- **JENDL-4.0** (processed by NJOY): included reactions total, elastic, inelastic (MT4 and MT51 to MT91), fission, (n,2n), (n,3n), nu-bar and fission spectra
- **COMMARA-2**:
- **SCALE-6.0** (processed by ANGELO from ZZ-SCALE6.0/COVA-44G)

Cross-sections	^{241}Am sensitivity (%/%)					
	Elastic	Inelast.	(n,2n)	(n,f)	(n,γ)	ν
JENDL4.0m	0.03195	-0.1101	-2.33E-4	0.6897	-0.0226	1.0
ENDF/B-VII.0	0.02659	-0.1385	-2.99E-4	0.7050	-0.0261	1.0

Am-sphere: Uncertainty

Covariance data source	Uncertainty (%)	
	Transport XS used	
	JENDL-4.0m	**ENDF/B-VII.0**
JENDL-4.0m	1.7%* (mt4:1%) **2 % (using mt51-91)**** **5.1% (PFNS)***** **5.5% (total) ********	1.5 (mt4:0.9%, mt18:0.5%, ν:0.9%) **2.2 %**** **5.8% PFNS** **6.2% (total)**
COMMARA2	2.6%	**3%** (mt4:2.3%, mt18:0.9%)
SCALE6	6.1% (mt4: 5.4%)	**7.5%** (mt4: 6.8%)

* using JENDL4 total inelastic covariances (MT=4)
** using JENDL4 partial inelastic covariances (MT=51 to 91)
*** uncertainty due to prompt neutron fission spectrum (PFNS)
**** total uncertainty (due to transport XS + PFNS)

Conclusions

- **Difference in k_{eff} between ENDF/B-VII.0 and JENDL-4.0: ~ 3.5%**
- Sensitivities calculated using ENDF/B-VII.0 and JENDL-4.0 are in fair agreement;
- Large differences were observed between uncertainties based on different covariance matrix evaluations:
  - **COMMARA-2: ~3%**
  - **SCALE-6.0: ~ 7.5%**
  - **JENDL-4.0: ~ 5.5%**
- Only JENDL-4.0 includes PFNS covariances. However, these covariances are said to be obtained in the following (ad-hoc) way:

> Below 6 MeV, covariances of Pu239 fission spectra given in JENDL-3.3 were adopted after multiplying by a factor of 9. Above 6 MeV, estimated with CCONE and KALMAN codes.

The corresponding uncertainties should be taken with caution and are likely to be overestimated!