“Joint Institute for Power and Nuclear Research - Sosny”

Upper boundary lattice cell assessment in terms of weight windows

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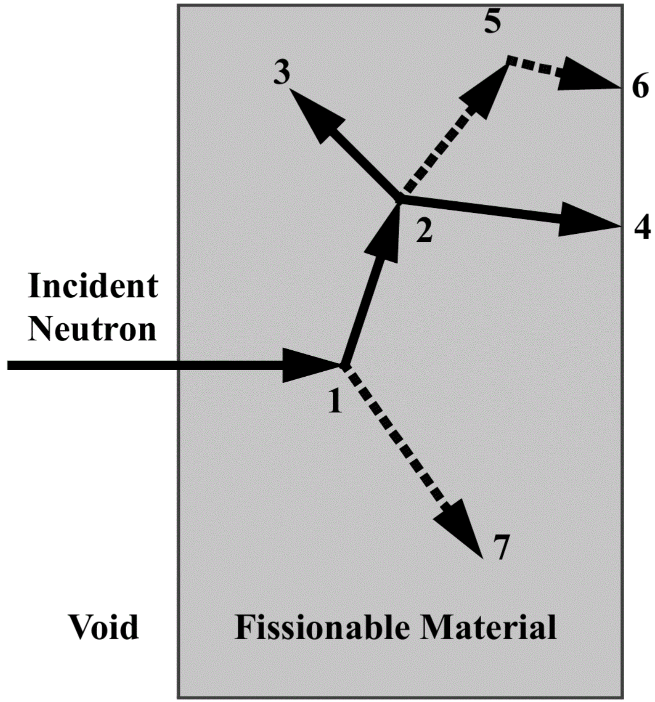
Behavior

Event Log

1. Neutron scatter, photon production
2. Fission, photon production
3. Neutron capture
4. Neutron leakage
5. Photon scatter
6. Photon leakage
7. Photon capture



Thermalization

Energy decrementation – thermalization:

$$E_{th} = E_0 e^{u}, \quad (1)$$

Where u — lethargy

$$E=(1-\frac{1}{2}a)\ E_0,\ a=\frac{4A}{(1+A)^2} \quad (2)$$

Thus average collisions rate for thermalization from 2 MeV to 0.625 eV

$$\bar{n} = \frac{u}{a} \approx 18 \quad (3)$$

To calculate Fermi neutron Age and other media characteristics use average logarithmic energy decrement on nuclei with mass number A:

$$\xi = 1 + \frac{a}{1-a},\ a = (\frac{1-A}{1+A})^2 \quad (4)$$

1. M. Ragheb, "Lecture Notes on Fission Reactors Design Theory," FSL-33, University of Illinois, 1982.

2. J. R. Lamarsh, "Introduction to Nuclear Engineering," Addison-Wesley Publishing Company, 1983.

Thermalization(cont.)

$$\tau_{th}(E) = \frac{ln(\frac{E_0}{E})}{3\xi\Sigma_{tr}\Sigma_s} \quad (5)$$

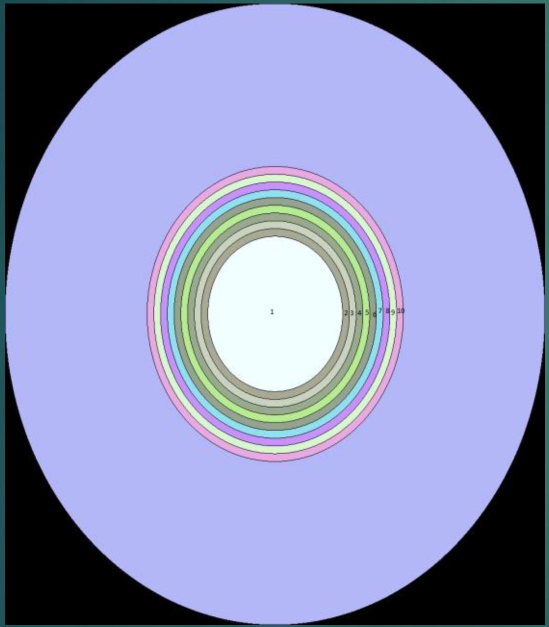
Diffusion comes after thermalization:

$$\tau_{df}(E) = \frac{1}{3\xi\Sigma_{tr}\Sigma_s} \quad (6)$$

For water from 2 MeV to 0.625 eV:

τ_{th}= 5.71 cm, τ_{df} = 2.72 cm;

Model

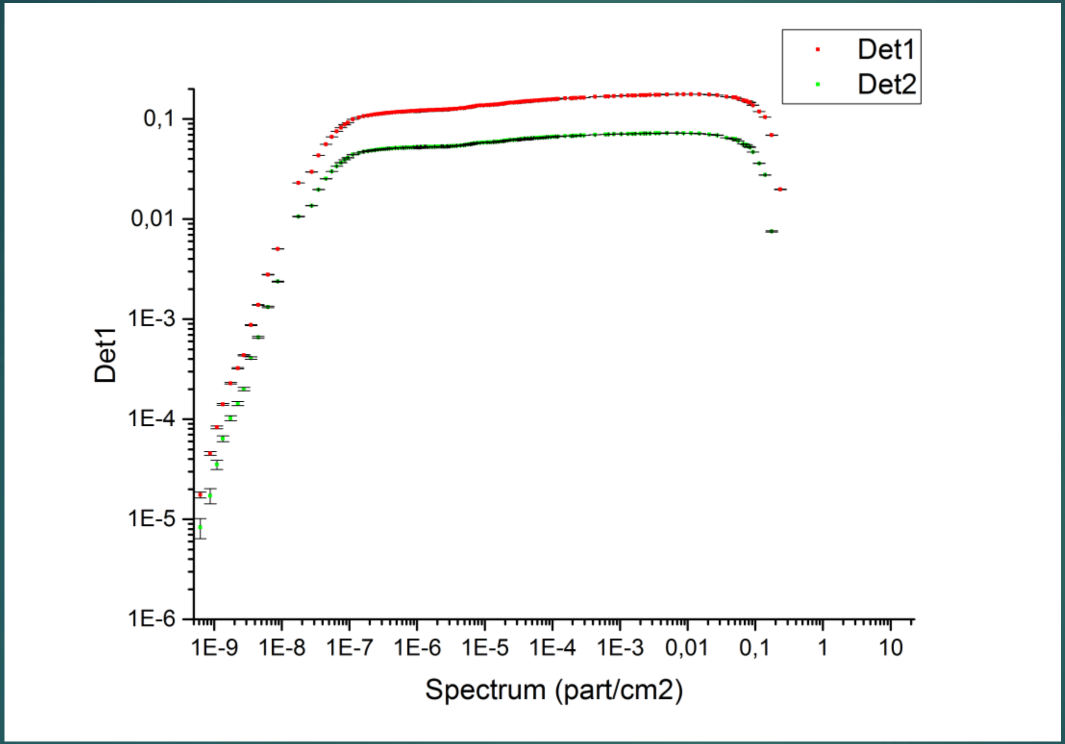


- 10 cm cylinder of 1,3% Uranium
- Ten coaxial cylinders with 1 cm difference in radius
- Use of Serpent code and MCNP for calculations[3][4]

1.Leppänen, J. "*Performance of Woodcock delta-tracking in lattice physics applications using the Serpent Monte Carlo reactor physics burnup calculation code.*" Ann. Nucl. Energy **37** (2010) 715–722

2. J. K. Shultis , R. E. Faw "An MCNP Primer", Dept. of Mechanical and Nuclear Engineering, Kansas State University,Manhattan, 2011, P.1-45

Results



Det1
Det2
0,1
0,01
1E-3
1E-4
1E-5
1E-6
Det1
1E-9
1E-8
1E-7
1E-6
1E-5
1E-4
1E-3
0,01
0,1
1
10
Spectrum (part/cm2)

Conclusions

- One should consider media influence using any kind of variance reduction methods
- Lower bound of cell only is up to available computer resources
- Though weight windows can be used without of this, results bound to be biased in case of weight windows and importance method way of accelerating calculations

Спасибо за внимание!