

# Philosophy, Principle, and Method for the CombLayer: Day Four

Stuart Ansell

European Spallation Source, Lund, Sweden.

December 11, 2015



CombLayer has a number of variance reduction methods :

**Nothing here is more than undocumented bolt on actions to solve specific problems**

**Many depend on MCNP modifications**

- DXTRAN spheres
- EXT cards
- WWN modifiers
- PD modifiers



There is a full neutron Monte-Carlo transport code within CombLayer – source/transport/scattering/detectors.

Simulated a whole experiment [D4C]

Variance reduction is best thought of as minimizing the variance of the variance of the tally.

- 1 The number of initial source particles is unlikely to be important
  - The source distribution needs to be sampled no better than  $\sqrt{2}$  better than the tally distribution
  - A volume distribution need to be sampled no better than  $\sqrt{2}$  better than the tally distribution
  - A volume unit need to vary less than  $\sqrt{2}$  better than the tally distribution

- 2 The workings/not-workings of forward-bias methods are debated to stupidity.
  - Point tallies/dxtrans are forward bias techniques
  - They approximate beyond the model threshold
  - The model threshold is 1GeV for TENDL and 200MeV for ENDF-VII.
  - If you **cannot** run a quick  $>100\text{MeV}$  solution without forward biasing **Game over**

The EXT can biases the direction of the particles in the same way as a weight window

Set in a two part process

- Scaling needs cells to apply to
- Direction to ally to / point to track to

```
1 |  
2 | ./myBox -r -wExt Object TubeObj scaleVec 0.5 'Vec3D(3,4,5)' AA
```

If cell based variance reduction is required (normally is):

- It is applied as a set of modifications to a default
- Large level of source code only documentation

```
4 |
5 | ./ess -r
6 |     -w \
7 |     --weightType high \
8 |     --weightSource 'Vec3D(600,0,14)' \
9 |     --weightTally 'Vec3D(1600,0,14)' \
10 |     --weightObject ABunker:Sector4 1.0 0.1 1e-5 \
11 |     --weightRebase object ABunker:Sector4 0 1.0 \
12 |     AA
```

- -w card is mandatory (if a number given then changes the distance  $\times 1/r^2$ )
- weightType controls the energy ranges
- Source/Tally pair do a pseudo simulation from A  $\rightarrow$  B



Forward biasing –

**REALLY REALLY** think about changing MCNP to support non-spherical DXTRAN.

```
13  
14 ./ess -r  
15     -w \  
16     -wDXT free 'Vec3D(3,4,5)' 50 \  
17     -wDD -0.01 30 \  
18     AA
```

- DD card is BOTH diagnostics AND control!!

The equivalent to DD card for point tally is the PD card.

```
19  
20 ./ess -r  
21     -w \      Required  
22     -T point object Mybox back 4.0  \  
23     -TW AA
```

- There are pitifully few options to this card
- MCNP only allows one value [not an energy range value]
- I overcome this by coding up ranged point tally into MCNP