

# Scoring updates regarding with event biasing

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# Perspective

- The several primitive scorers had been introduced in geant4.9.0 for the purpose of migrating the biasing scorers to the primitive scorers.
- The other scorers should be introduced in order to provide similar functionality as MCNPX.
  - Residual Nuclei
  - Reaction rate by process counter
  - DPA (Displacement per atom)
- 1D/2D counter plot should be provided for visualizing the result of a scorer.  
=> Cooperative work with M.Asai, A.Kimura, T.Aso.  
This will be presented by Makoto.

# New scorers - prototype -

- Reaction rate: Number of Hadronic inelastic interactions
  - Counts number of steps by a particular process
    - G4PSNofCollision and a process filter will be applied.
    - (Created) SD-filter by process name/type and particle name.  
G4SDProcessFilter/G4SDProcessTypeFilter.
- Termination: Number of killed tracks by a particular process
  - This may be useful in the other MC for evaluating the energy threshold for tracking, while it may be less important in G4 because G4 transports a track down to zero energy.
    - G4PSTermination and a process filter will be applied.
    - (Created) G4PSTermination scores only at a last step.
    - (Created) SD-filter by process name/type and particle.
- Residual: Number of recoil nuclei/produced nuclei
  - Counts number of nuclei.
    - G4NofSecondary will be applied with specifying the secondary particle
    - (Modified) G4NofSecondary for a particular secondary particle.
    - (Created) SD-filter by creator process name/type and parent particle.  
G4SDCreatorProcessFilter
- DPA: Displacement per atom (Pending)
  - Under investigation

# Status of development

- Several primitive scorers and filters have been introduced.
- However, “physics process” filters can not be implemented, because “digits\_hits” category does not have dependency to “physics process” category.
- (This was not a problem when the scoring code was written by users.)
- Need to find the solution.

# Another problem

- Radioactive Decay with biasing option
  - User forum: Hits, Digit. and Pileup
    - 170. use G4PSDoseDeposit class together with variance deduction techniques
      - Dear geant4 experts, I met a strange problem. I use sensitive detector to record dose. At the same time, I try to get dose by user-defined function in UserSteppingAction class. Two results are same if without variance deduction. **But if I use interactive commands, /grdm/analogueMC false,/grdm/splitNuclei 10 two results become different. The result from G4PSDoseDeposit becomes much larger than the result from UserSteppingAction.** The latter seems more reasonable, approximately equals to the results by Analogue method. I once thought it may be the weight factor has been forgotten in G4PSDoseDeposit. But actually G4PSDoseDeposit has taken into account the weight correction. So there must be other reasons. Any idea would be appreciated. Thanks in advance.

- I checked the particle weight in “SteppingAction” and “G4PSDoseDeposit” using RE02 example with the following input.
  - Carbon 11 with zero energy decays in water

```
/grdm/analogueMC 0  
/grdm/splitNuclei 10  
/gun/particle ion  
/gun/ion 6 11  
/gun/energy 0. MeV  
/gun/position 0 0 0 cm
```

Particle weight is extremely large.  
I am not sure that I am using this biasing  
option correctly. This is a bug of biasing?

At G4PSDoseDeposit:

edep keV 586.78009 volume cm3 16000 dens g/cm3 1 dose Gy 1.7585052e-07 Gy  
**weight 29928000**

At SteppingAction:

SteppingAction edep 0.58678009 **weight 29928000** time 9.9177263e+09

# Summary

- The scorers are prepared in order to provide similar functionality with the other Monte Carlo code.
- Currently, the process dependent scorers are not supported because of the dependency policy of categories.