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Title: MCNP6 Release Notes: Pre-collision Next-Event Estimator

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Intended for: MCNP6 Release Notes



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Release Notes: Pre-collision Next-Event Estimator

Overview:

A pre-collision next-event estimator has been developed for MCNP6. This pre-collision estimator augments the post-collision next-event estimator that has historically been used for point flux estimation in MCNP. The pre-collision next-event estimator includes the contribution of all possible reactions before the collision isotope and resulting reaction are sampled. This has the advantage of providing an improved expected estimate per collision, but with a significant increase in computational costs per collision. This improved sampling technique removes the requirement to suppress coherent scattering for photon transport problems that include photon next-event estimators. The sampling of all possible scattering reactions generally provides an increase in the Figure of Merit (FOM) for most photon problems. This increase in the FOM can be significant when the contribution to a photon next-event estimator is primarily from forward scattering. For most neutron problems there is not typically a large increase in the FOM. However, for both photons and neutrons the pre-collision next-event estimator increases the convergence rate as measured by the time to pass MCNP's 10 statistical.

Input Modifications:

In order to enable this new feature a new alphabetic keyword identifier has been added to the FTn – Special Treatment for Tallies card. This new alphabetic keyword identifier is PDS – Point Detector Sampling. The PDS keyword takes a single integer as an option. The form is:

PDS c

The single parameter c specifies how the sampling of the collision is performed for the next-event estimator.

- c = -1 :: Next-event estimator sampling is performed post-collision, only a single reaction and isotope is sampled (historic MCNP4 and MCNP5 behavior)
- c = 0 :: default (Currently the same as c=-1, may change in future releases)
- c = 1 :: Next-event estimator sampling is performed using post-collision sampling of the collision isotope and pre-collision sampling of all reaction channels. (Recommended for photons)
- c = 2 :: Next-event estimator sampling is performed using pre-collision sampling of all collision isotopes and pre-collision sampling of all reaction channels.

Recommendations:

It is recommended that users performing photon next-event estimator tallies use either:

```
ftn pds 1
```

or:

```
ftn pds 2
```

Using either of these special treatments will allow the user to perform next-event estimator tallies with photon coherent scattering enabled.

For neutron next-event estimator tallies the user should perform a scoping calculations with PDS = -1, 1, and 2. The user should check the 10 statistical tests of the three runs to assess which parameter provides the best compromise between convergence and Figure of Merit (FOM). Using a pre-collision estimator for neutrons will typically reduce the computational time needed to pass the 10 statistical checks but result in a lower FOM.

Example:

In order to compare the pre-collision next-event estimator and the post-collision next-event estimator for a photon tally located at x=100.0 cm, y=50.0 cm, and z=25.0 cm the following can be used:

```
f5p 100.0 50.0 25.0 0.0 $ post-collision next-event estimator
ft5 pds -1                $ F5 tally is post-collision
c
f15p 100.0 50.0 25.0 0.0 $ pre-collision next-event estimator
ft15 pds 1                $ F15 tally is pre-collision
```