Biasing in Geant4 Hadronic Models

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Outline

- Radioactive Decay Biasing
- Leading Particle Biasing
- Cross section biasing

Biasing in Radioactive Decay

- Increased sampling rate within a given time window
  - user can set probability distribution function to increase occurrence of rare isotopes
- Nuclear splitting
  - user sets the original number of parent nuclei to be decayed
- Branching ratio biasing
  - user can choose option to make all B.R.s have equal value, thereby enhancing rare decays
- Options are chosen at run time within user interface
- More biasing options requested from Technical Forum

Leading Particle Biasing (1)

- Keeps only the most important particles in a scattering event in order to reduce multiplicity
  - the particle with the highest energy
  - one baryon (p or n)
  - one pi0
  - one charged pion or one kaon
  - assign weights based on original multiplicity
  - energy conserved on average
- Not a separate model
  - works parasitically on any hadronic process
- User chooses this option by setting environment variable SwitchLeadBiasOn

Leading Particle Biasing (2)

- Somewhat crude, but quite general and useful
  - some tuning may be required to improve energy and charge conservation
  - no known validation of this, yet
  - could easily add other biasing options (biasing for strange particles, for example)

Cross Section Biasing (1)

- User can apply a factor to interaction cross section
  - primary continues after interaction, weighted by its true disappearance probability
  - secondaries weighted by:
    - (bias production prob/unbiased production prob) * unbiased survival probability of primary
- Currently used only for small cross sections processes
  - gamma- and electro-nuclear
  - maximum bias factor is 100
- User sets factor at compile time with a G4HadronicProcess method

Cross Section Biasing (2)

- Could be extended to incident hadrons as well, but this is dangerous
  - hadronic cross sections are relatively large, so non-linearities could be introduced in weights
  - scale factor limited to 100 (137?) for EM processes probably for that reason