Hadronic Physics Requirements from Low Background Experiments

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Low Background Experiments

- SuperCDMS, EDELWEISS-II, EXO, Gran Sasso, ZEPLIN-II, etc.

- Physics required:
  - Muon-induced showers, muon capture
  - Background radioactivity
  - Nuclear recoil from neutrons and ions

Improved Neutron Production in μ-induced showers

- μ + A -> μ ' + B + n + ...
- model recently added (G4 9.5 beta): EM interaction produces virtual γ, virtual γ interacts as hadron in nucleus using Bertini cascade
- currently Bertini changes γ to π before interacting
- need to interact γ directly in future
- validate against other codes (FLUKA, etc.)
- validation of neutron production from μ capture on nuclei

Radioactivity Development and Validation

- For recent developments, see talk by Laurent deSorgher, parallel session 2A
  - gamma emission, forbidden decays
- Future development
  - delayed emission
  - correlated decays
  - database update
- Validation of radioactive decay (α, β, γ)
  - neglected for the past n? years
  - need to re-evaluate and expand existing test code

Better (α,n) Reactions at Low Energies

- Below 10 MeV the cross section for these reactions is small, but process is important
  - neutron-induced nuclear recoil could masquerade as a WIMP
- Geant4 models currently return 0
- Options:
  - extend cascade models to do this
  - use a data-driven model similar to NeutronHP
    - this option currently being pursued by P. Arce (see talk in parallel session 2A)

Population of Meta-stable States by Neutrons

- Geant4 currently supports only population of ground state
- Want: $n + A \rightarrow n' A^{m}$, $n + A \rightarrow (A+1)^{m}$
- What do we need?
  - meta-stable states in G4Ion
  - What does NeutronHP do?
  - specific cases desired ^{129m}Xe, ^{131m}Xe, ^{71m}Ge, ^{75m}Ge
  - decay of some meta-stable states supported by radioactive decay code and database

Nuclear Recoil from Neutrons and Ions

- Have been several bug fixes over the years relating to this
- Make sure that final state nucleus is created and recoiled correctly in all low background processes
- Do we need to check, validate this further?
  - each model may handle this differently