Notes and Tasks from Radioactive Decay Meeting

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Floating Levels

- Establish convention for handling floating to non-floating and non-floating to floating transitions (not yet assigned)
- Check for consistency how level information is read in (float or double) and how particle gun is used (Laurent, Vladimir, Dennis)
- When using gun/ion UI command, do not use +X, +Y, etc. ; proper form is /gun/ion Z A E X not /gun/ion Z A E +X
- Similar command in GPS not yet migrated to floating levels (Andrea)

Consistency of Lifetime Thresholds

- There are different lifetime threshold values throughout the radioactive decay and photon evaporation code. Are they consistent or necessary?
- In ENSDFSTATE there is no threshold. If a lifetime is zero, nuclide does not appear in table

- In G4PhotonEvaporation all levels are listed, even if lifetime is zero. If lifetime > Max_Life, nuclide is released as trackable particle. Set this to false (not DBL_MAX) (Vladimir)

- It looks like halflifeThreshold in G4RadioactiveDecay can be removed. It is not used in analogue mode. Check if needed in biased mode (Laurent)

Databases

- Implement checks (system test, user test example) for consistency between RDM, photon evaporation and ENSDFSTATE (Laurent, Dennis)
- Study possibility of making versioned master file from which all other DBs are derived (Laurent)
- Explore the removal of RDM dependence on ENSDFSTATE (Tatsumi, Andrea)
- Fix broken assignment of user-defined files (unassigned)

Biasing (1)

- Develop un-biased only version of RDM (Dennis)

- Check with Fan Lei, Andrea Dotti which biased RDM methods can be removed without breaking Generalized Particle Source (Dennis)
  - e.g. SFBeta() currently does nothing
- Check to see if GPS methods handle all our RDM use cases (Laurent)
  - activation, collecting activities, observation, dosimetry

- Check how volume assignment is done in Cerenkov (Makoto, Vladimir)
- Implement RDM by region (Makoto, Vladimir)

Biasing (2)

- Develop method or class that solves Bateman equations by at least two methods: (Laurent)
  - matrix method
  - current method
- Implement command line entry of time histogram (general facility consistent with GPS?) (Andrea)
- Does biased RDM work when ion is moving at significant velocity?
- Refactor biased RDM code to perform all current functions using un-biased RDM process
  - stacking action will not work (for tracks only)
  - pre-assigned decay won't either (fixed chain)
  - make biased RDM a derived class of un-biased RDM
  - move analysis functions into GPS

Multithreading

- Michel expressed concern that the strong-initialization required by multithreaded mode inhibits interactivity
  - is there a way to alleviate this?

- How to take more advantage of multithreading in RDM?
  - use more C+11 features (Dennis)
  - for decay table map use hash map instead of std::map now used (Dennis)

Beta-delayed Particle Emission

- Transition to discrete levels is already OK
  - handled by already existing beta emission and neutron/proton emission
- Transition to continuum
  - make new model G4Beta(Plus or Minus)Continuum (Pico) with corresponding acronym for database entry (Laurent)
  - use hadronic de-excitation code to sample from continuum level density

Atomic De-excitation

- Better atomic de-excitation code desired
  - Kibedi model (written in F90) (Michael will contact)
  - defer due to lack of manpower (Susanna Guatelli, request for funds, Dennis will contact)

Correlated Gamma Emission

- Refactor RDM code to instantiate only one G4PhotonEvaporation (Dennis)
- Also see if G4ITDecay can be instantiated just once (Dennis)
- Store G4NuclearPolarization for subsequent transition
- Compare to polarization from working code of Jason, Ian
- Validation/examples (Ian, Jason, Dennis, Vladimir)
- Set correlations flag in G4PhotonEvaporation to on by default (Vladimir)
- Do we want UI commands?
- Shall we add multipolarity mixing data?

Examples

- New example to be added: extended/radioactive_decay/activation (Michel)
  - with reference files

- Need example for correlated gammas (Laurent, Ian)
  - will have ^{60}Co, ^{133}Ba and ^{208}Th
  - and two-detector geometry

- H*10 dose example (Laurent)

Charge Conservation

- Charge/energy/momentum non-conservation has been observed in cases where electron emission is involved (internal conversion, etc.)
  - Bertini with G4Precompound fails dues to energy non-conservation for conversion e- emission
  - add flag to denote this in hadronic final state (integer)

Reproducibility

- Look at consistency in use of float and double (Vladimir, Dennis)
- look for cases in which ordering of decay branches is different for same nuclide (Dennis)
- Check G4VDecayChannel (Andrea)
- Re-activate MT in RDM only after sequential reproducibility is solved
- Light ion incident with FTFP in interference with RDM produces slightly different states with sub-eV KE (Alberto, Vladimir, Dennis)

Radioactive Decay Paper

- Make Latex template (Dennis)
  - Introduction/history (Dennis)
  - description of use cases (Alex)
  - design, philosophy and UI (Dennis, Vladimir)
  - databases (Laurent)
  - biasing (Laurent, Dennis)
  - validation (Pico, Laurent, Dennis, Ian)
    - plots vs data: 1 each of beta+, beta-, alpha, gamma, correlated gamma (spectra), all the electrons (IC) , n, p emission, beta delayed
    - mention x-rays, Auger (references)
- Authors: Pete, Fan, Laurent, Pico, Makoto, Vladimir, Dennis, Ian, Jason, Michel, Alex, Luciano, Andrea, Alberto, Tatsumi, Giovanni, Marc

Validation

- Large amount of validation needed
  - many tests already exist, but need to be updated
  - also plots need to added to validation repository
  - check with Hans and Julia about how to submit to repository

- Infrastructure to do validation (Andrea)

- Start with a representative subset of validations
  - alpha decay (Laurent)
  - beta decay (Dennis)
  - IT/IC