Beyond GRETINA: Where to go with tracking? Simulations?

Simulations (from Lew)

- Addback & Tracking
  - Determine packing resolution empirically (hit multiplicity)?
  - How to handle coincidences with background events?
- Efficiencies
  - > 2.5 MeV?
  - Segment efficiencies
  - Variation among crystal types, individual crystals?
  - Dead layers (pencil-beam measurements)
- Reactions
  - Additional reaction models
  - Nuclear alignment (i.e. input alignment tensor) -> 'real' γ-ray angular distributions
  - Polarimetry
  - 'Real' backgrounds
- Dead material (low-energy backscattering)
  - GRETA mounting shell, beam pipe, chambers
  - Auxiliary detectors, targets, chambers

Tracking

FYI – defining 'better' as improved P/T vs. efficiency

- Pair production – none of the codes include this fully (dominates over ~9MeV)
  - May be a good problem to attempt machine learning
- Exploring other figure of merits (FOM) – have as an option in the tracking code which to use
  - Examples from AGATA codes, D. Weisshaar (based on cos(theta))
  - Compound FOM? Average, weighted average, or compare multiple values? Supervisory logic?
  - FOM with weighting (how to formulate?) according to energy depositions under the assumption that larger depositions have less position uncertainty
  - Sensitivity study to explore which FOM is appropriate in different scenarios?
- Explore spectrum properties with different FOM cuts for different interaction point #
- Explore TANGO tracking to (possibly) recover events with two interaction points, but not full energy
  - How to evaluate when this is applicable? Uncertainty in energy?
- Penalty for unphysical range of scattering (i.e. beyond attenuation lengths?)
  - Couple with simulation in some way for probabilistic analysis with not just HPGe, but surrounding materials
- Can tracking be made robust against signal decomposition (position) errors?
  - Throw away low energy interactions for poor FOM events?
  - Make even more specific by throwing away low energy near segment boundaries
- If given multiple signal decomposition results, can tracking effectively pick which is 'best'?
- Including fully the Compton profile – most important for low energy scatters
- Implement penalty based on Klein-Nishina (scattering cross-sections/probabilities as a function of energy and angle)? i.e. scattering angles that aren't probable
- Long-range scatterings? How to go beyond the clustering cone, or capture events that don't stay in the cone (small # of events)