Beyond GRETINA: Where to go with signal decomposition? Signal generation?

Signal Decomposition

- Limitations of current algorithm
  - poor determination of # of interaction points
  - Strong dependence of timing (t_0) and reported interaction points; t_0 distribution is broader than CFD algorithm
- Determination and impact of t_0 selection – when 'messed up' generates spurious interactions and crappy positions
  - Take a longer time window to avoid cutting off t_0 – more robust results but at speed/memory cost? "Low(-ish) hanging fruit"
- Confirm that position resolution would improve with very good start time (t_0)
  - External fast detector to determine t_0 (or RF accelerator signal)
  - Determine the 'true time' from all Ge? Problematic, you need events built *before* the signal decomposition
  - Try multiple guesses for t_0 – more computation but may be OK
  - Change time interpolation method (more than just piece-wise linear)
- Improvements from Majorana field generation could be included
  - Adaptive grid, identify undepleted voxels, allow capacitance calculation
  - Capacitance – needs also measurements to compare with – pulse the core, which would need hardware modification
- Calculate fields and weighting potentials using open libraries – FEniCS (implemented, but could be explored much more)
- Can we model finite charge cloud size rather than point charges to calculate the pristine basis signals – harder to do than in Majorana
  - Important to note – we don't include any cloud, so any approximation to compare to point charge signals would be extremely valuable
- Segment boundary gaps? Not currently captured at all – for signal generation and superpulse fitting steps in preparing a basis
- Fitting electronics responses to make a realistic basis – currently fits an average
  - Check robustness of "superpulse" method – fit more than just a flood field measurement
  - Expand on the electronics response model (preamplifier impulse response function) – adds parameters (of order 70) – may need to be added in the frequency domain (Fourier transforms!)
- Penalty factors in signal decomposition for number of interactions
  - Just a magic # -- can be studied in much more depth
  - Consider a likelihood approach? At least to help guide penalty factors? Based on simulations?
- Adaptive grid search – could be adaptable to GPU
- In post-processing of signal decomposition, is coalescence having undesired impacts?
- Is there an advantage to performing signal decomposition in the frequency domain?
- Measurements – γ beams?
- Correlated noise 😕
  - Subtract based on signals that don't have induced charges etc.
  - Filter out in frequency space
  - Fix the source…