Summary of Uncertainty Quantification Discussion (Leading-Order + “standard” $0\nu\beta\beta$ only)

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The problem

- We want to compute a matrix element $\mathbf{y}(\theta)^T O(\eta)\ \mathbf{x}(\theta)$
- (Here O is the matrix representation of the long-range light Majorana exchange plus contact operators.)
- Three sources of uncertainty:
  - Uncertainty in input Hamiltonian (θ)
  - Uncertainty in parameter of DBD operator (η)
  - Uncertainty in many-body method used to compute matrix element

Some things are less uncertain?

- Hamiltonians are already calibrated to a "basket of nuclei": some knowledge of region in which θ lies
- η can be determined ('calibrated') within some uncertainty using synthetic data on $nn \rightarrow ppe^{-}e^{-}$
- And results then computed using a variety of many-body methods, which we will label 1, 2, 3, 4, 5
- But which many-body method result should we trust?

Observables of Use?

In the DBD candidates ^{48}Ca, ^{76}Ge, ^{130}Te, ^{136}Xe:

- Single β-decay rates in nearby nuclei, e.g., intermediate nucleus in decay, $z^T B x$
- β- strength distribution from initial nucleus $z^T B x(E)$
- β+ distribution from final nucleus $y^T B^* w(E)$
- 2νββ matrix elements $y^T B B x$
- Muon capture $z^T B' x$
- Magnetic moments and M1's in three nuclei involved in decay $y^T C y$, $x^T C x$
- E2 to lowest 2+ state in initial and final nuclei $y^T D y$, $x^T D x$
- Energies of lowest few excited states *Eigenvalues associated with H for which x and y are eigenvectors*
- Charge radii $y^T D' y$, $x^T D' x$

But which are most reliable predictors of performance for neutrinoless double-beta decay?

Proposal

- Draw a small (< 100) number of samples from θ distribution
- Compute as many observables on that list as you can in many-body method N
- Compute Neutrinoless DBD matrix element in same MB method at each value of θ
- Examine correlation
- Also examine what happens when η is moved (possibly enhancing error on synthetic data to simulate growth of error in matrix element with A)

Correlators for 0νββ

- Assessment of "correlation" between observables <B>, <C>, <D>, etc. and observable <O>
- Do this for each many-body method

	1	2	3	4	5
B					
B*					
C					
D					

Correlations with data in D + performance wrt data-set D→modified evidence formula

$$\mathrm{pr}(O\,|\,D) = \sum_M w_M \mathrm{pr}(O\,|\,M, D)$$

- Where the weights w_M are determined not just by the ability of the many-body method M to describe data D, but also by the extent to which each piece of data in D is correlated with O in that model
- We can also examine correlations across different DBD candidate nuclei, and see if uncertainties are reduced through those correlations