Simulations---What's Needed

Detector acceptances can differ through:

1. Number of proton targets
2. Gd loading fraction
3. Scintillator response (photons/MeV), including aging effects
4. Optical Response, including attenuation lengths of media (5 for 3 zone, 3 for 2 zone), angular and wavelength response of PMT's, Rayleigh scattering, specular and diffuse reflection from all surfaces
5. Number of working PMT's, as well as individual gain and efficiencies
6. Number of working electronics channels, including individual efficiencies

And we need to do this for all positions, times,…

Some basic calibration questions:

- How many zones will we have?
- How much self-calibration can be done?
- What are `baseline' optical properties?
- How finely do we need to sample positions?
- How well do we need to know sampling positions?
- How often will we need to calibrate?

- Can neutron tail change independently of mean?
- How important are local effects (dead PMT's, etc.)
- Can there be differential non-linearities? (MPE, xtalk, ?)
- Can spallation nuclei give us restrictions on above?

Current Status

ReactorFsim is primarily a `parametric' model

This is OK if you have a reasonable idea of the response function and its uncertainties

But right now the response function and its uncertainties are what we need the simulation to tell us.

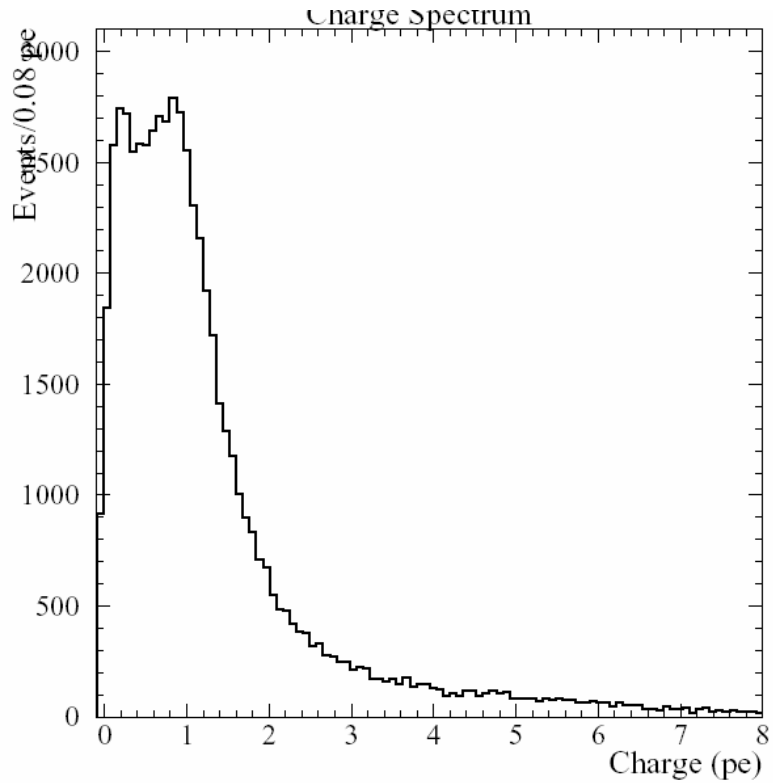
Response Function Example

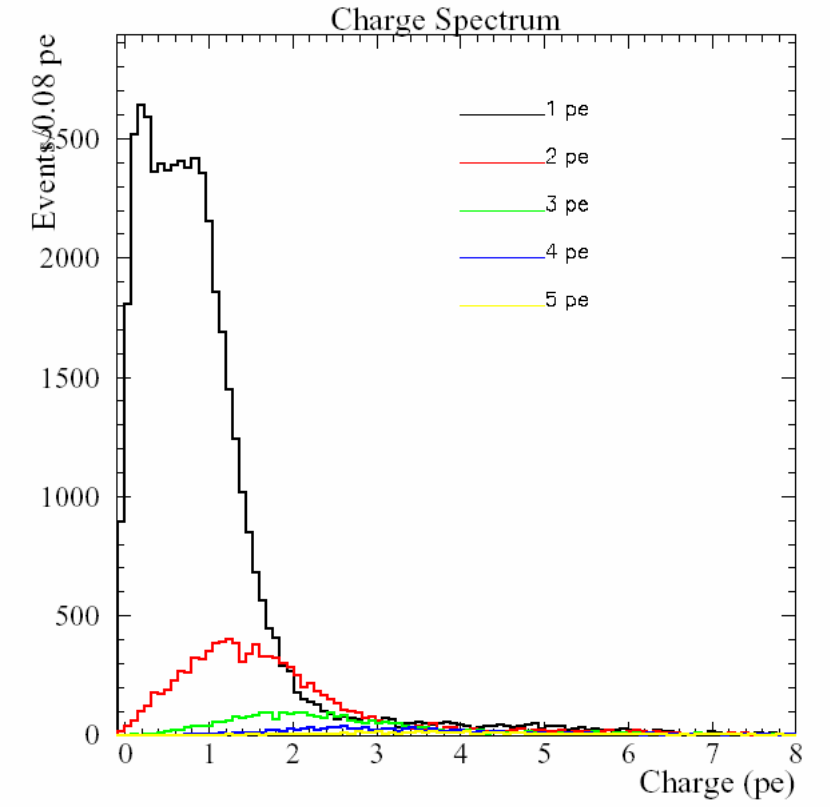
ReactorFsim predicted energy and reconstruction response using:

- Perfect PMT response (in photoelectrons)
- Knowledge of `true' vertex positions
- Complete knowledge of detector optics
- Exact knowledge of scintillator photon production

Response Function Example

Added in realistic PMT charge spectrum:

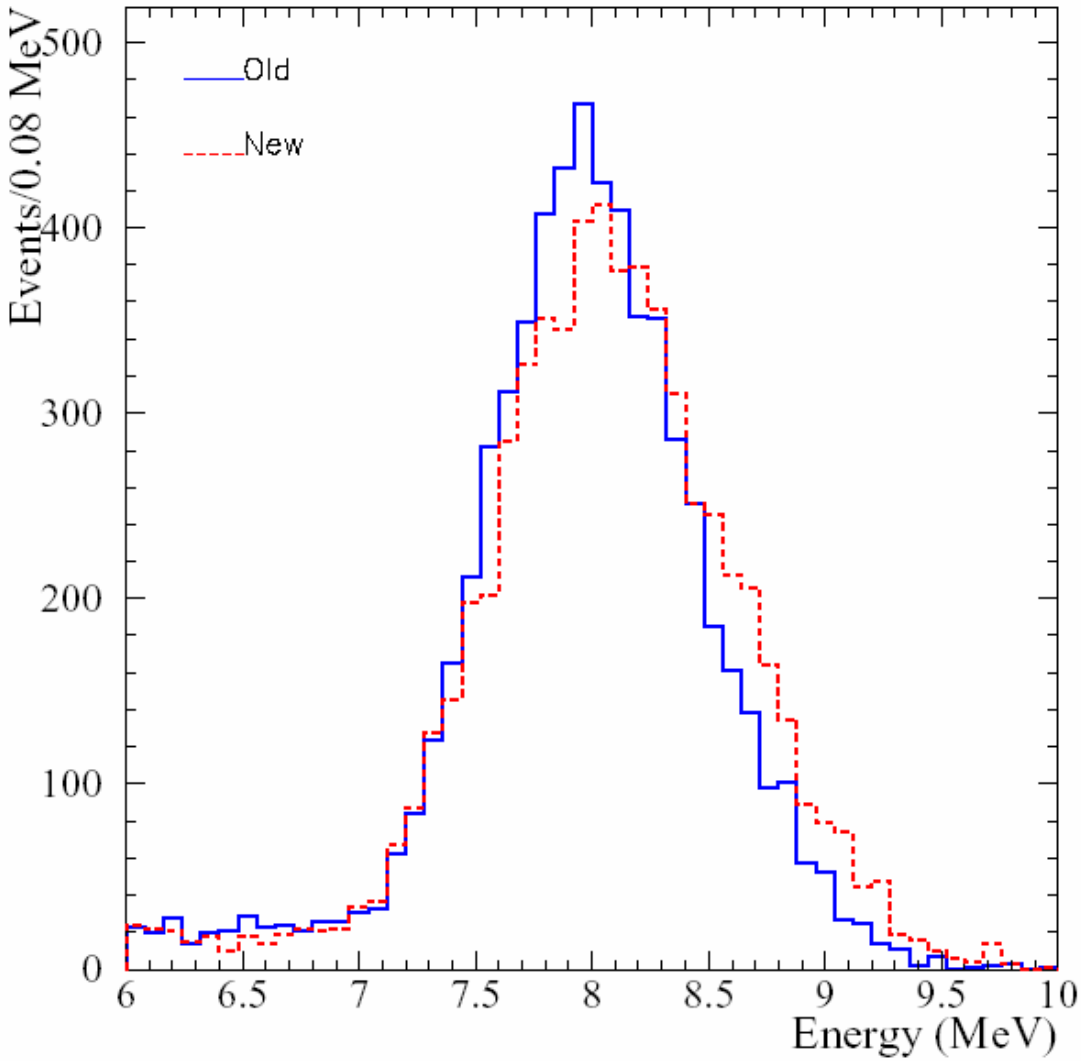




And used reconstructed position for energy, smeared number of photons

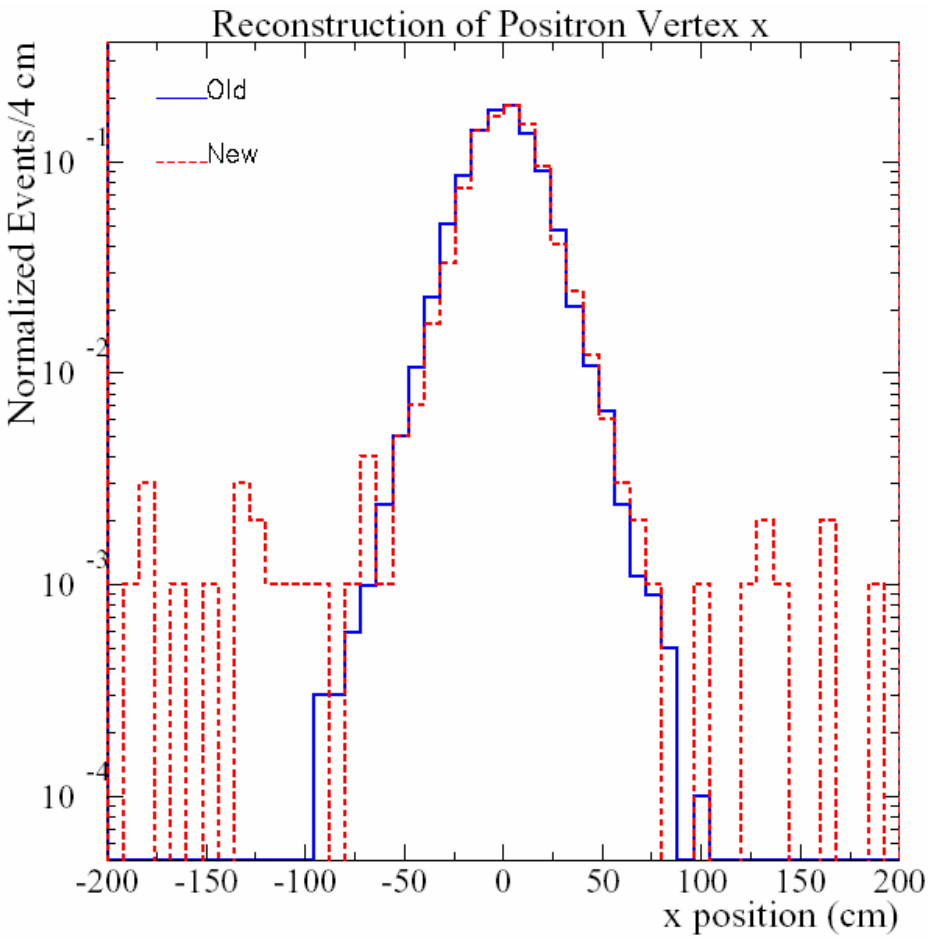
Response Function Example

Energy response now needs an input `scale' which depends on PMT gain



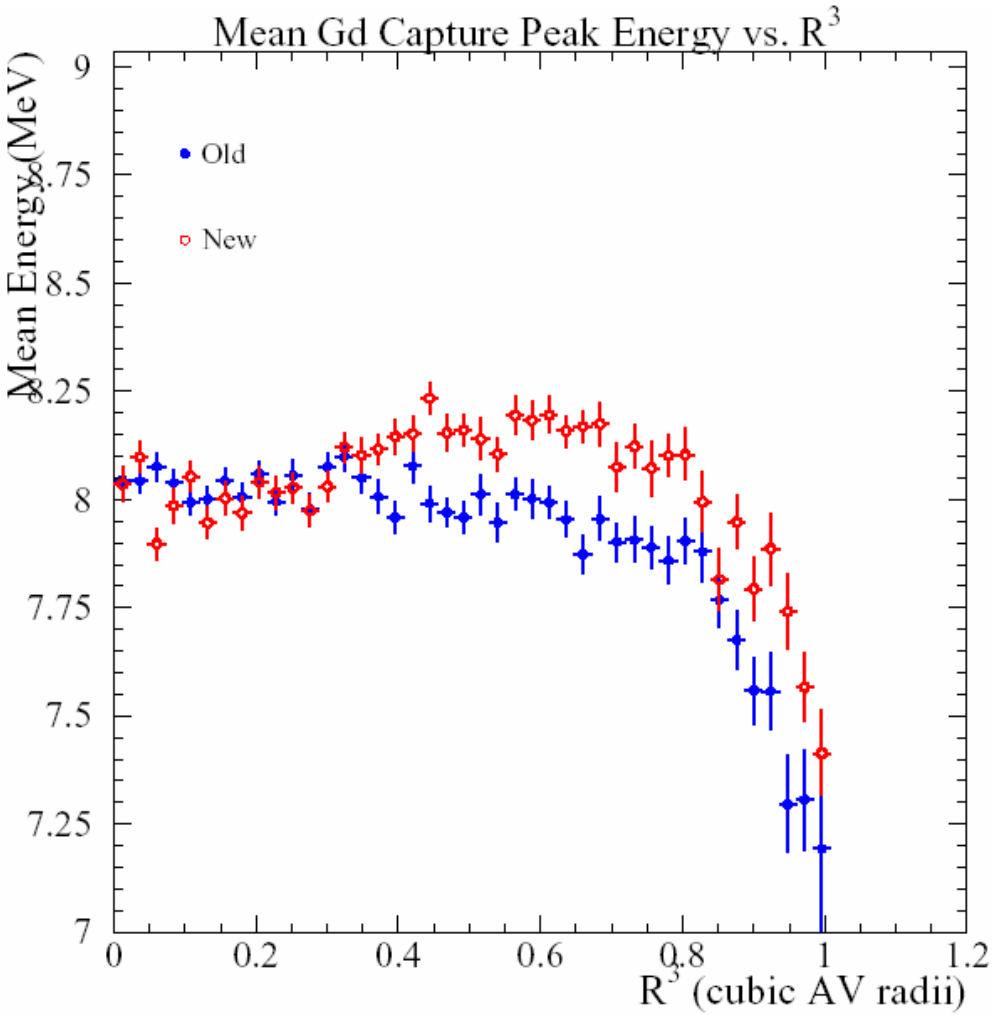
Response Function Example

Reconstruction noticeably worse:



Response Function Example

And response now also stronger function of position:



What We Still Need

- Extinction lengths for all media (2 zone and 3 zone)
- Scattering lengths for all media (2 zone and 3 zone)
- Scintillator and PMT timing distributions
- Reflection coefficients for all media (+ability to alter)
- Wavelength and angular response of PMTs
- Wavelength and number distribution of scintillation photons
- Cerenkov photon production
- DAQ sim (Channel thresholds and/or trigger)
- Checks/comparisons!!!!

Some Questions We Need to Answer Soon

- Do we need to track photons?
- How well do we need to model energy loss?
- How well do we need to model scintillation photon production?
- Is DAQ/digitization simulation at all important?

Some Suggestions

- We need a more global structure to simulation
- We should work with a tree structure and include root support
- We should start to move away (now) from parametric approach
- Eventually use GEANT4 for:
  - passage of particles through matter
  - generation of secondaries
  - geometry?
- But not:
  - optics
  - PMT response and efficiency
  - scintillation and Cerenkov photon generation