

Proposal for a LArTPC Overlay Workshop

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Motivation for ‘Overlays’

- Want to improve simulation of neutrino/interesting interactions with data-derived models of the detector and backgrounds:
 - Noise, dead channels, etc.
 - Cosmic interactions
 - Radiological backgrounds
 - Other beam and non-beam, related backgrounds
- Overlay sample
 - Simple idea: take data from detector and ‘overlay’ neutrino interactions from simulation on top of it
 - Naturally includes noise, detector conditions, and background interactions from data
 - But...many interesting physical and technical issues related to ‘how to combine simulation and data properly’

Overlay Sample

Event Display



Overlay Sample

Event Display



Why have a workshop

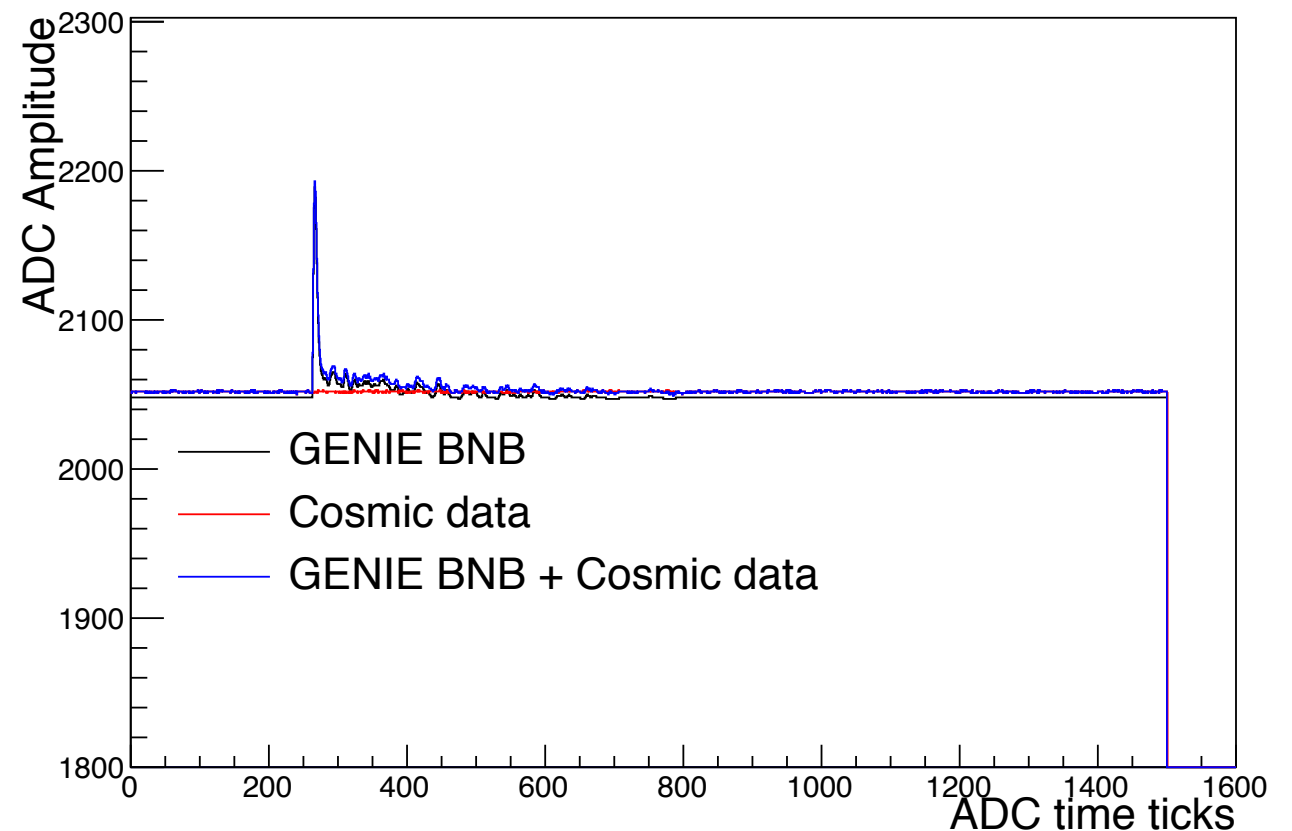
- MicroBooNE has developed an end-to-end overlay sample production chain that will become the default in our next production release
 - While much of the code is in ‘uboonecode’ (and affiliated), much of it was written with more general LArSoft in mind
 - The methods are at a mature enough state to think about more general application
 - *Our ignorance: we’re not aware of development from other efforts in other experiments, so please let us know!*
- Propose having a workshop for the LArSoft community to discuss issues of overlay samples and develop a roadmap for common tools within LArSoft

Ideas for topics

- Overview of method and its strengths/limitations
- ‘How to add’ signals together
- ‘How to calibrate’ simulation to match data
- ‘How to time in’ simulation and data
- ‘How to produce’ overlay samples
- <your ideas here!>

‘How to add’

- Considerations for how to add signals together for each sub-detector
 - TPC raw waveforms
 - PMT (discriminated!) waveforms
 - Cosmic-ray-tagger signals



- Considerations for other modes of readout and kinds of data
 - E.g. zero-suppressed TPC waveforms?

‘How to calibrate’

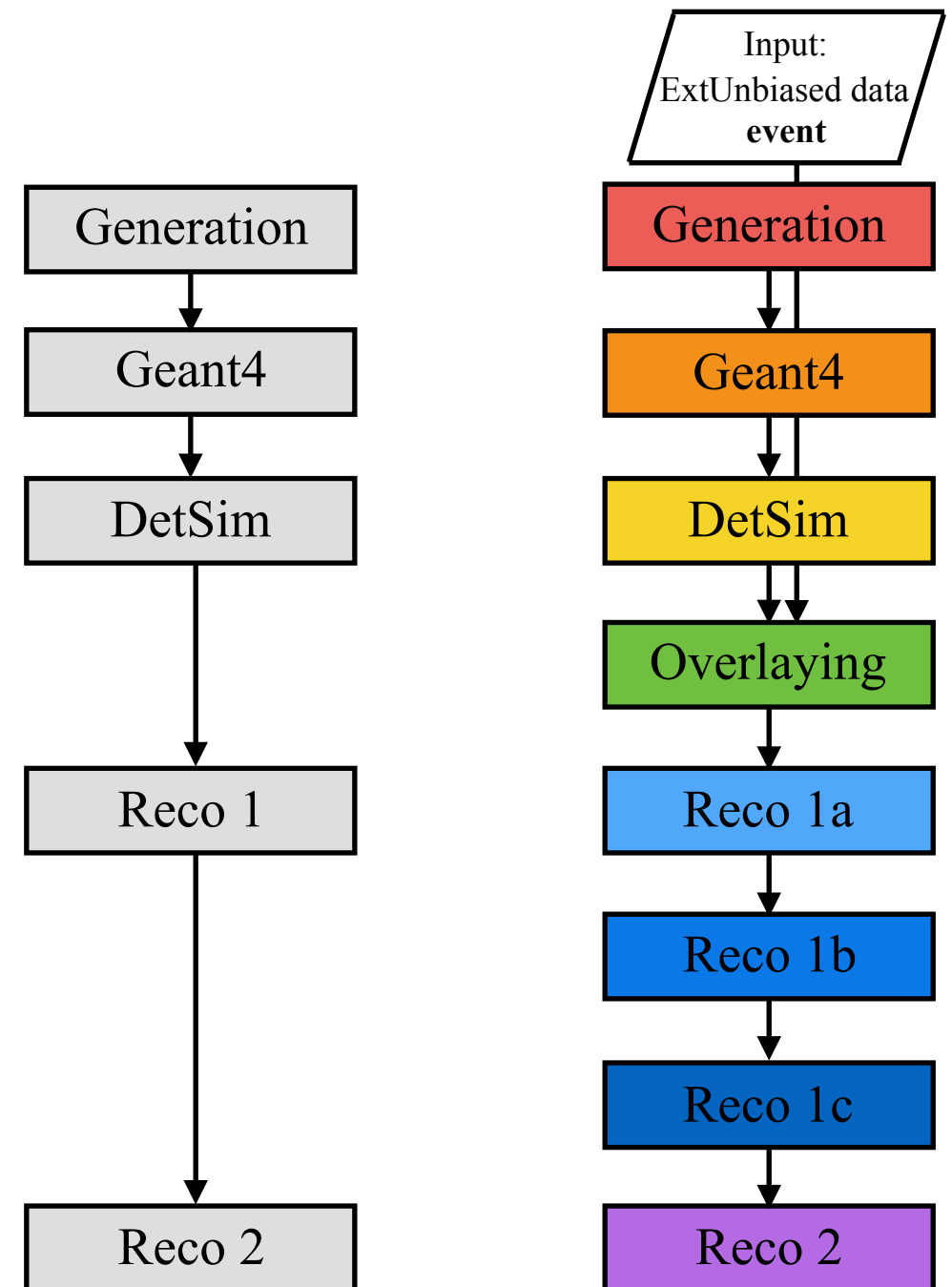
- Data-derived background/detector models are great!
- Adding data and simulation together requires understanding both well!
 - E.g. important to match signal amplitudes in data and simulation
- Overview and discussion of calibration strategies and workflows
 - Channel-by-channel calibration and dead-time checks
 - Simulation of detector effects
 - End-of-reconstruction calibration strategies
 - Etc.

‘How to time in’

- Overlay sample lives in two different worlds
 - Simulation, where (typically) times are consistent and set to defaults
 - Data, where time is generally actual time
- This has complications and implications for
 - Time-dependent calibrations
 - Setting trigger times and trigger simulation properly
 - ‘Backtracking’ reconstructed objects to truth
- Outline current strategies for assigning coherent timing in overlay samples, and discuss future developments/improvements

‘How to produce’

- Overlay production chains ‘mix’ simulation and data production chains
 - Need to draw data from two sources: simulation and data
 - Intermediate/additional steps that combine data and simulation concerns
- Discuss possible production chains, their advantages/disadvantages, and general complications



Workshop plans

- Let us know if you think this is interesting and would participate!
 - And what ideas/other topics should be covered!
- If so...
 - Thinking a ~day-long workshop with lots of time for discussion
 - Topics technical in nature, aimed at overall needs and coordinating future developments
 - Discussing with Erica a good date: currently aiming for late February/early March
 - Please let us know who should attend and participate!